Bhlaraidh Wind Farm Extension Section 36C Variation

Technical Appendix 3.6f: Private Water Supply Risk

Scottish Government - Energy Consents Unit - Application Details

Bhlariadh Wind Farm Extension

Private Water Supply Risk Assessment

SSE Renewables

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Document history

Author	E McCallum	22/05/2024
Checked	E Bryder	10/06/2024
Approved	Paul McSorley	13/06/2024

Client Details	
Contact	Isla Davidson
Client Name	SSE Renewables
Address	Inveralmond House, 200 Dunkeld Road, Perth, PH1 3AQ

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Local Office:

Ochil House
Springkerse Business Park
Stirling
FK7 7XE
SCOTLAND
UK
Tel: +44 (0) 1786 542 300

Reg No: SC177881

Registered Office:

The Natural Power Consultants Limited
The Green House
Forrest Estate, Dalry
Castle Douglas, Kirkcudbrightshire
DG7 3XS

VAT No: GB 243 6926 48

Contents

1. Introduction

Natural Power Consultants Ltd (Natural Power) has been commissioned by SSE Renewables (the Client) to prepare a Private Water Supply Risk Assessment (PWSRA) for supplies that may be affected during the construction and operation of the consented Bhlaraidh Wind Farm Extension (the Development).

The Development is situated adjacent to SSE Renewables operational Bhlaraidh Wind Farm, located on the Glenmoriston Estate, northwest of Invermoriston in the Great Glen. The Development will comprise the construction and operation of 15 wind turbines with a maximum tip height of up to 180 m.

1.1. Background

This report has been requested by the Client to provide reassurances to Private Water Supply (PWS) users within the vicinity of the Development as a result of concerns raised by the local Community Liaison Group (CLG). The CLG was established in order to provide local residents with a communication forum between themselves and the Client during the enabling works for the Development.

A PWSRA has already been produced by ITPEnergised as part of the Environmental Impact Assessment Report[1] (EIAR). However, residents have raised uncertainties around the information provided by the Highland Council (THC) private water supply register. Furthermore, in recent email correspondence (November 2023), THC Environmental Health department has indicated the requirement of "a private water supply monitoring scheme, including monitoring prior to construction in order to have a baseline for comparison" and which will facilitate the discharge of planning condition (PC) 13 (part 2d) relating to the Construction Environmental Management Plan (CEMP), as follows:

"*a drainage management plan, demonstrating how all groundwater, surface water and waste water arising during and after development is to be managed and prevented from polluting any watercourses, water abstractions and private water supplies if relevant, including details of the separation of clean and dirty water drains, and location of settlement lagoons for silt laden water. Any temporary drainage during construction*"

This report is considered a risk assessment and the scheme for monitoring is outlined in an update to the Water Quality and Fish Monitoring Plan (WQFMP)[2] and should be read in conjunction with the CEMP[3] associated with the Development.

1.2. Purpose of this report

The aim of this report is to provide details regarding the identification and potential risk of the Development on the quality, quantity and continuity of private water supplies (PWSs) within 5 kilometres (km) of the Development Site (the study area) and, where appropriate, to provide recommendations for potential mitigation measures. The assessment will adopt a phased approach evaluating risk through the formulation of a Source-Pathway-Receptor conceptual model.

In order to ensure completeness of PWSs information and to provide reassurance to residents, consultation has been undertaken with THC and local residents. Furthermore, PWSs will be identified for monitoring that can be included in the updated WQFMP which is required to discharge PC 29.

[1] ITPEnergised (2021) Bhlaraidh Wind Farm Extension EIAR Chapter 9: Hydrology and Hydrogeology.

[2] Natural Power (2022) Bhlaraidh Wind Farm Extension Water Quality and Fish Monitoring Plan.

[3] SSE Renewables (2023) Bhlaraidh Wind Farm Extension Construction Environmental Management Plan (CEMP)

1.3. Policy and Guidance Context

The Drinking Water Inspectorate (DWI) states that drinking water must be 'wholesome'. This is defined in law by water standards covering a wide range of substances, organisms and properties. The standards are set to be protective of public health and the definition of wholesome reflects the importance of ensuring that water quality is acceptable to consumers. The legal standards in the UK transpose the European Council (EC) Drinking Water Directive 1998 (98/83/EC).

In Scotland, PWSs which supply 50 or more people, or more than 10 m^3 of water a day (Type A), are governed by the Water Intended for Human Consumption (Private Supplies) (Scotland) Regulations 2017. Regulation 16 of the 2017 Regulations says that "a person must not take action which has the effect of allowing deterioration of the quality of the water". Such powers are also enshrined and built upon in the revised EC Drinking Water Directive 2020 (2020/2184), which has been transposed into Scottish law under the Public Water Supplies (Scotland) Amendment Regulations 2022, with the aim to minimise the risk of harmful impact of pollution on human health and water resources by way of a preventative risk-based approach reducing pollution at source.

The Private Water Supplies (Scotland) Regulations 2006 continue to apply to all other, smaller supplies (Type B). The Prescribed Concentration or Value (PCV) limits are legal thresholds for acceptable levels of contamination in drinking waters. These are set out against EC Directive (98/83/EC) and applied against the 2006 Regulations.

The local authority, in this case THC, has a responsibility to ensure consumers have a water supply that complies with the aforementioned regulations, with the Drinking Water Quality Regulator for Scotland (DWQR) overseeing and providing guidance and clarification to them.

In addition to the above regulatory drivers, a key guidance document is the Scottish Environment Protection Agency (SEPA) Land Use Planning System Guidance Note 31 (LUPS-GU31) which provides guidelines when assessing the impacts of wind farms on groundwater and associated receptors. This guidance recommends that all groundwater abstractions within the following distances of development need to be identified in order to assess potential risk:

- within 100m radius of all excavations less than 1m in depth; and
- within 250m of all excavations deeper than 1m.

Furthermore, LUPS-GU31 suggests that the following information is gathered in relation to PWSs:

- source location (including National Grid Reference, NGR);
- source type e.g. spring, borehole etc; does it receive part of its flow from surface run-off / field drains?
- use e.g. domestic water supply for house, water troughs for livestock, supply to industrial / commercial premises;
- abstraction rate (this could be estimated from, for example, the number of people / animals using the supply); and
- nature and integrity of the construction e.g. is there the potential for contaminants to enter the supply via overland flow.

1.4. Structure of this report

This report presents the results of Natural Power's site walkover and targeted PWSRA. The report structure is outlined below:

- To provide some environmental context to the assessment Section 2 presents a summary description of the environmental setting of the site; more detailed information can be found in the EIAR;
- In Section 3 and 4 the PWSs in the area are identified and 'screened' with reference to consultations undertaken with THC and PWS users to obtain sufficient information to enable the formulation of a conceptual model for each 'screened in' PWS;

- Section 5 presents a risk assessment for the remaining PWSs. PWS indicative catchments (or Zones of Contribution, (ZoCs); occasionally otherwise referred to as Zones of Influence (ZoIs)) are defined and risk ratings assigned based on the extent of the interaction of these ZoCs with the proposed development, and ZoCs and risk ratings refined based on catchment area analysis where necessary;
- Section 6 presents standard good practice measures to be implemented during construction, emergency contingency measures in case of a pollution event and monitoring recommendations in order to protect PWSs identified as having risk rating of low or above; and
- A monitoring plan and summary is then presented in Section 6 and Section 7.

1.5. Disclaimer

This document should be considered live and, as such, it will be updated should new information come to light. The information presented in this document is based on data provided by the THC, the Client, consultation with Ordnance Survey (OS) mapping and, from information provided by residents. Based on corroboration of these sources, the data is considered accurate.

Owing to the inherent complexity of the subsurface, it is rarely possible to determine the mechanics of a hydrogeological system with absolute certainty. In this regard, investigations as part of this assessment will determine the circumstance of each supply based on the evidence available to support this assessment. As the assessment is of relative risk, a detailed quantitative risk assessment has therefore not been completed.

Should additional information come to light, it is recommended that a revised risk assessment is carried out, if deemed necessary.

2. Environmental Setting

By way of context, this section presents an overview of the soils and geology, hydrogeology and hydrology within the study area.

Land use within the Development is mainly upland moorland. Some areas of commercial forestry are located adjacent to the access route from Invermoriston in the south.

2.1. Soils and Geology

The National Soil Map of Scotland[4] indicates that majority of the site is underlain by peaty gleys with dystropic semi-confined peat. The northwestern section of the site along topographic highs is underlain by blanket peat (subalpine podzols with dystrophic blanket peat). Adjacent to the A887 to the south of the Development, the site is underlain by peaty gleys, podzols and humus iron podzols.

British Geological Society (BGS) online mapping[5] tool (Superficial geology: 1:50,000 scale) indicates that the majority of the site does not have any superficial deposits. There are small pockets of peat present, mostly concentrated in the northern reaches of the site. Diamicton Till and Devensian Glacial Deposits are found in localised areas to the south of the site, but are confined to the area underlying the existing access track.

The BGS online mapping tool (Bedrock geology: 1:50,000 scale) indicates that the bedrock geology to the west of the site comprises psammite of the Tarvie Psammite Formation. This rock unit predominantly comprises fine-

[4]Scotland's Environment (2023) *National Soil Map of Scotland.* [Online] Available from - https://soils.environment.gov.scot/maps/soil-maps/national-soil-map-of-scotland. [Accessed: 22/05/2024]

[5] British Geological Survey (2023) *Geoindex Onshore* [Online] Available from - https://www.bgs.ac.uk/map-viewers/geoindex-onshore/. (Accessed: 22/05/2024)

grained, thin-bedded, siliceous to micaceous psammite with localised thin beds of semipelite that are muscovite-rich and locally migmatitic. The east of the site comprises psammite and semipelite of the Achnaconeran Striped Formation. This rock unit consists of muscovite rich inter-banded psammite and semipelite, which is locally migmatitic

The BGS online mapping tool (Linear features: 1:50,000 scale) shows four faults of unknown displacement, mostly striking southwest – northeast. There is one fault that strikes northwest – southeast, running from Loch a Chrathaich towards Carn a Mheallain Odhair.

2.2. Hydrogeology

The BGS online mapping tool (Hydrogeology 1:625,000 scale) indicates that the Development is underlain by low productivity aquifers with small amounts of ground water in the near surface weathered zone and secondary fractures.

Low yields from these deposits are confirmed by the borehole log and testing data (presented in Appendix B) drilled for the existing Bhlariadh Wind Farm (NGR NH 36889 20317). The log indicates that water strikes were observed at 15 metres below ground level (mbgl), 24 mbgl, 36 mbgl and 48 mbgl in the fractured gritty psammite bedrock. The resting water level was recorded at 2 mbgl. A yield test returned results of 1300 litres per hour (0.36 litres per second).

The BGS Hydrogeological Map of Scotland[6] indicates that the Precambrian bedrock beneath the Development is generally impermeable and without groundwater except at a shallow depth. The crystalline bedrock offers little potential for groundwater storage and transport other than in cracks and joints which may be associated with tectonic features or near surface weathering. Groundwaters emanating from springs are generally weakly mineralised, although bicarbonate concentrations may attain 120 mg/l.

The Tarvie and Striped Achnaconeran Formation forms part of the Northern Highlands (ID: 150701) Water Framework Directive (WFD) groundwater body which was classified by SEPA in 2022 as having a Good overall status.

2.3. Hydrology

The majority of the site drainage is anticipated to flow to Allt Saigh, either directly or via the Allt Carn Choire Rainich or other smaller unnamed watercourses. The watercourses within this catchment also flow through multiple named and unnamed lochans such as Lach nam Brathain, Loch Coire na Rainich. A dam is located across the Allt Saigh, at NH 41358 19952 which is approximately 200 m east of where the Allt Saigh leaves the site boundary. The dam is used for hydroelectricity generation and presents a physical barrier across the river.

The west of the Development is part of the the Allt Bhlàraidh catchment. The Development area extends into the River Moriston catchment in the south, although only a small portion of the Development area is assessed as being in hydraulic connectivity with the River Moriston. The River Moriston is designated as a Special Area of Conservation (SAC)[7].

In 2021 SEPA designated the Allt Saigh (ID: 20278) as having a WFD overall status of Good and the Allt Bhlariadh (ID: 20282) as having a WFD overall status of Bad. Both watercourses are heavily modified on account of physical alterations that cannot be addressed without a significant impact on water storage for hydroelectricity generation.

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[6] British Geological Survey (1988) Hydrological Map of Scotland [Online]. Available from - British Geological Survey (BGS) | large image viewer | IIPMooViewer 2.0 [Accessed 22/05/2024]

[7] NatureScot (2018) River Moriston SAC [Online]. Available from - https://sitelink.nature.scot/site/8361 [Accessed-: 22/05/2024]

3. PWS Identification and Screening

This section identifies the PWSs present within the study area and those PWSs that require further consideration with respect to potential impacts from the Development.

3.1. PWS Identification

Upon request, THC provided Natural Power with details of PWSs within the study area. In addition, the Client provided details of further PWSs (outlined in Table 4.1) to be included in this assessment. This additional information was established by the Client following discussions with members of the CLG. The refined combined list of PWS properties and, where identified, sources in the study area is presented in Table 4.1, with the PWS locations mapped on Figure 1 in Appendix A.

4. PWS screening

The PWSs located within the study area are presented in Table 4.1 below and in Figure 1 (Appendix A). All PWSs lie outside of the development site, except for Bhlaraidh Wind Farm PWS (ID: 1). Table 4.2 presents the results of a screening exercise whereby each PWS was either 'screened in' or 'screened out' of the later PWS risk assessment, with a rationale for each decision provided.

Table 4.1: Potential PWSs located within study area

PWS Source	PWS Property	ID	PWS Type	NGR for property	NGR for source
Bhlaraidh Sub Station	Bhlaraidh Substation	1	Groundwater - Borehole	NH 36889 20317	NH 36889 20317
Old Farm	Glenmoriston Lodge Estate	2	Groundwater - Borehole	NH 42911 16257	Unconfirmed
The Lochside Hostel	The Lochside Hostel	3	Groundwater - Borehole	NH 45717 18999	Unconfirmed
Levishie Power Station	Levishie Power Station	4	Surface water – Loch	NH 35320 15964	Unconfirmed
Briarbank Mains	Briarbank	5	Mains Water Supply[1]	NH 45578 18960	N/A
Briarbank	No2 Aultsaigh	6a	Surface Water - Watercourse	NH 45681 19091	NH 45574 19178
	No.1 Aultsaigh	6b		NH 45681 19091	
	Aultsaigh Cottage	6c		NH 45744 19171	
Dundreggan Power Station	Dundreggan Power Station	7	Surface Water - Watercourse	NH 35756 15611	Unconfirmed
Glenmoriston Power Station	Glenmoriston Power Station	8	Surface Water - Watercourse	NH 35739 15617	Unconfirmed
Point Claire House	Point Claire House	9	Surface Water - Watercourse	NH 41823 13630	Unconfirmed
Inver Coille	Port Clair	10a	Surface Water - Watercourse	NH 41651 14076	Unconfirmed
	Inver Coill	10b		NH 41786 14031	Unconfirmed

PWS Source	PWS Property	ID	PWS Type	NGR for property	NGR for source
Killiannan Mor	Killiannan Mor	11	Surface Water - Watercourse	NH 41392 13674	Unconfirmed
Loch Ness Country Lodge	Loch Ness Highland Cottage	12	Unknown	NH 41552 13598	Unconfirmed
Guisaichein	Giusaichean	13	Groundwater - Borehole	NH 42987 16570	Unconfirmed
Homewood	Homewood	14	Groundwater - Borehole	NH 43066 16587	Unconfirmed
Dalcattaig	Dalcattaig	15	Surface Water - Watercourse	NH 40671 17243	Unconfirmed
Loch View	Loch View	16	Surface Water - Watercourse	NH 42481 15815	Unconfirmed
Hill Cottage	Loch View Cottage	17	Unconfirmed	NH 42475 15810	Unconfirmed
Achnaconeran[1]	Achnaconeran	18a	Groundwater - Spring	NH 41247 17976	Unconfirmed
	May Cottage	18b		NH 41535 17926	Unconfirmed
	Mount View	18c		NH 41640 17981	Unconfirmed
Creag-Nan-Eun	Creag-Nan-Eun	19	Groundwater - Spring	NH 43187 16629	Unconfirmed
Pole Cottage	Pole Cottage	20	Groundwater - Spring	NH 43351 16780	Unconfirmed
Dundreggan	Dundreggan	21	Surface Water - Watercourse	NH 35254 15853	Unconfirmed
Tigh-Na-Roinn	Tigh-Na-Roinn	22	Surface Water - Watercourse	NH 41856 13980	Unconfirmed
Achlain[1]	3 x Holiday Chalets	23a	Mains Water Supply	Unconfirmed	N/A
	Bhlaraidh House	23b		NH 38085 16546	
	Burnside	23c		NH 37977 16666	
	Oaklea	23d		NH 38119 16614	
	Andorra	23e		Unconfirmed	
	No 1 Bhlaraidh	23f		NH 38065 16628	
	No 2 Bhlaraidh	23g		NH 38057 16633	
	Allt Darach	23h		NH 38036 16661	
	Moriston House	23i		Unconfirmed	
Levishie[1]	Levishie Cottage	24a	Groundwater – Type Unconfirmed	NH 40193 17693	Unconfirmed
	Levishie Burn	24b		NH 40101 17619	Unconfirmed
	Levishie House	24c		NH 40241 17661	Unconfirmed

[1] *Data source - SSE Renewables*

Source: THC / SSE Renewables

Table 4.2: PWS Screening Exercise

PWS Source	Ref	Rationale	PWS Screened In/Out
Bhlaraidh Substation	1	The Bhlaraidh PWS Substation PWS is located within the site boundary and approximately 105 m from the temporary construction compound. There is the potential for the PWS ZoC to extend onto Development infrastructure, and therefore the PWS requires further investigation.	In
Old Farm	2	The Old Farm PWS is located on the banks of the River Moriston at a significant distance from the Development (~3.5 km) and its ZoC will not extend onto the site. Furthermore, by nature of their design groundwater boreholes are offered a higher level of protection against changes in surface water quality. Given the distance from the Development and that the PWS is a borehole, the PWS is not considered to be at risk from the Development.	Out
The Lochside Hostel	3	The Lochside Hostel PWS is located on the banks of Loch Ness at a significant distance from the Development (~5.5 km) and its ZoC will not extend onto the site. Furthermore, by nature of their design groundwater boreholes are offered a higher level of protection against changes in surface water quality. Given the distance from the Development and that the PWS is a borehole, the PWS is not considered to be at risk from the proposed development.	Out
Levishie Power Station	4	The Levishie Power Station PWS is located approximately 2.7 km upstream of the Development therefore it is not considered to be in hydrological connection with the Development. The PWS is not considered to be at risk from the Development.	Out
Briarbank Mains	5	SSE Renewables reported that property 5a associated with Briarbank is now on a mains supply, therefore this property has been scoped out for further consideration.	Out
Briarbank	6	The Briarbank PWS is located at a significant distance from the Development (~5.5 km). However, the source is a surface water intake of the Allt Saigh watercourse which drains the majority of the Development. Surface water sources tend to be more vulnerable to changes in water quality compared to, for example a borehole. As the PWS ZoC has the potential to extend onto the Development this PWS requires further investigation.	In
Dundreggan Power Station	7	As the Dundreggan Power Station PWS is located approximately 2.5 km upstream of the Development it is not considered to be in hydrological connection with the Development. The PWS is not considered to be at risk from the Development.	Out

PWS Source	Ref	Rationale	PWS Screened In/Out
Glenmoriston Power Station	8	As the Glenmoriston Power Station PWS is located approximately 2.5 km upstream of the Development it is not considered to be in hydrological connection with the Development. The PWS is not considered to be at risk from the Development.	Out
Point Claire House	9	The Point Clare House PWS is located near the banks of Loch Ness at a significant distance from the Development (~3.8 km), However, it is possible that it sources its water from the Loch and, as it is technically located downstream of the Development. Nevertheless, with the significant distance combined with the effects of attenuation and dilution in both the River Moriston and Loch Ness, the PWS is not considered to be at risk from the Development.	Out
Inver Coille	10	The Inver Collie PWS is located near the banks of Loch Ness at a significant distance from the Development (~3.8 km) and it is likely to source water from the adjacent Innerack Burn which is located in a separate surface water catchment. The PWS is not considered to be in hydrological connectivity with the Development and therefore it is not considered to be at risk from the Development.	Out
Killiannan Mor	11	The Killiannan Mor PWS is located near the banks of Loch Ness at a significant distance from the Development (~3.8 km) and it is likely to source water from the adjacent Portclair Burn which is located in a separate surface water catchment. The PWS is not considered to be in hydrological connectivity with the Development and therefore it is not considered to be at risk from the Development.	Out
Loch Ness Country Lodge	12	The Loch Ness Country Lodge PWS is located near the banks of Loch Ness at a significant distance from the Development (~3.8 km) and it is likely to source water from the adjacent Portclair Burn which is located in a separate surface water catchment. The PWS is not considered to be in hydrological connectivity with the Development and therefore it is not considered to be at risk from the Development.	Out
Guisaichein	13	The Guisaichein PWS is located at a significant distance from the Development (~ 3.5 km). There is a topographic high located between the PWS and the Development. Furthermore, by nature of their design groundwater boreholes are offered a higher level of protection against changes in surface water quality. Therefore, the PWS is not considered to be in hydrological connectivity with the Development and the PWS is not considered to be at risk.	Out
Homewood	14	The Homewood PWS is located at a significant distance from the Development (~ 3.5 km). There is a topographic high located between the PWS and the Development. Furthermore, by nature of their design groundwater boreholes are offered a	Out

PWS Source	Ref	Rationale	PWS Screened In/Out
		higher level of protection against changes in surface water quality. Therefore, the PWS is not considered to be in hydrological connectivity with the Development and the PWS is not considered to be at risk.	
Dalcattaig	15	The Dalcattaig PWS is likely to source its water from an unnamed watercourse adjacent to the property, which issues from Creag Bhaig, to the south and out with the catchment of the proposed Development. Furthermore, it is located on the opposite side of the River Moriston to Development which therefore presents a hydrological divide. The PWS is not considered to be in hydrological connectivity with the Development and is therefore, not considered to be at risk from it.	Out
Loch View	16	The Loch View PWS is located near the banks of Loch Ness at a significant distance from the Development (~3.3 km), therefore it is not considered to be in hydrological connectivity with the Development. The PWS is not considered to be at risk from the Development.	Out
Hill Cottage	17	The Hill Cottage PWS is located near the banks of Loch Ness at a significant distance from the Development (~3.3 km), therefore it is not considered to be in hydrological connectivity with the Development. The PWS is not considered to be at risk from the Development.	Out
Achnaconeran	18	The Achnaconeran PWS is located approximately 1.9km from the Development. There is a topographic high located between the PWS and the Development. Part of the existing track and the temporary construction compound is located within the same catchment (the River Moriston catchment), however infrastructure is located downgradient of the PWS. Therefore, the PWS is not considered to be in hydrological connectivity with the Development and the PWS is not considered to be at risk.	Out
Creag-Nan-Eun	19	The Creag-Nan-Eun PWS is located at a significant distance from the Development (~ 3.5 km). There is a topographic high located between the PWS and the Development. Therefore, the PWS is not considered to be in hydrological connectivity with the Development and the PWS is not considered to be at risk.	Out
Pole Cottage	20	The Pole Cottage PWS is located at a significant distance from the Development (~ 3.5 km). There is a topographic high located between the PWS and the Development. Therefore, the PWS is not considered to be in hydrological connectivity with the Development and the PWS is not considered to be at risk.	Out
Dundreggan	21	As the Dundreggan PWS is located approximately 2.7 km upstream of the Development it is not considered to be in hydrological connection with it. The PWS is not considered to be at risk from the Development.	Out

PWS Source	Ref	Rationale	PWS Screened In/Out
Tigh-Na-Roinn	22	The Tigh-Na-Roinn PWS is located near the banks of Loch Ness at a significant distance from the Development (~3.8 km) and it is likely to source water from the adjacent Innerack Burn which is located in a separate surface water catchment., The PWS is not considered to be in hydrological connectivity with the Development and is therefore not considered to be at risk from it.	Out
Achlain	23	SSE Renewables reported that the properties associated with Achlain PWS are now on a mains supply, therefore Achlain has been scoped out of further assessment.	Out
Levishie	24	The Levishe PWS is located at approximately 650 m from the Development. The source of the supply is likely to be the OS mapped well at NH 40193 17740. There is a topographic high located between the PWS and the Development. Part of the existing track and the temporary construction compound is located within the same catchment (the River Moriston catchment), however infrastructure is located downgradient of the PWS. Therefore, the PWS is not considered to be in hydrological connectivity with the Development and the PWS is not considered to be at risk.	Out

To summarise, the Bhlaraidh Wind Farm substation (ID: 1) and the Briarbank (ID: 6) PWSs have been scoped in for further assessment.

4.1. Consultation with owners / site reconnaissance

Following the screening exercise, those PWSs that remained 'screened in' were subject to further investigation prior to the risk assessment stage. As part of this exercise a letter was sent to the three properties associated with Briarbank (ID: 6) PWS explaining the nature of the Development and the purpose of the assessment. This communication included a questionnaire for the supply owner to complete to provide details of the supply such as the location of the supply, usage details, installation details etc. A map was also included for the owners to mark up the PWS infrastructure locations e.g. source location, header tanks etc. Responses were received from one PWS resident at Briarbank (ID:6a).

Further information was also sought from SSE Renewables regarding the Bhlaraidh Wind Farm PWS (ID: 1). This communication included a questionnaire for the Operations Supervisor at Bhlaraidh Wind farm to complete to provide details of the supply such as the location, usage details, installation details etc. A borehole log (presented in Appendix B) and installation details were also provided by the PWS installer, High Water Private Water Supplies.

In addition to this communication, a site visit was carried out on 23 May 2024 to the Briarbank PWS. This visit included consultation with one of the three users of the Briarbank PWS.

The outcome from this consultation exercise is presented below in the form of a conceptual model for each PWS.

Bhlaraidh Wind Farm PWS (ID: 1)

Bhlaraidh Wind Farm PWS is a groundwater borehole located at NGR NH 36890 20326 which was installed in 2016 and supplies the operational wind farm welfare and substation with drinking water. The Operations Supervisor reports no known issues with the quality or quantity of the supply.

The borehole log (see Appendix B) indicates that the borehole was drilled to a depth of 60 m below ground level (bgl). Made ground was encountered from ground level to 0.75 mbgl, followed by sand and gravel to 1 mbgl. From 1 mbgl to 60 mbgl psammite is encountered, with fracture zones observed. Water strikes were recorded at 15 mbgl, 24 mbgl, 36 mbgl and between 48 and 54 mbgl. A resting water level of 2 mbgl was recorded with a reported yield of 1300 l/hour (31.1 m^3/day).

Permanent steel casing is installed to a depth of 2.7 mbgl. The borehole is installed with plain pipe to 42 mbgl, with slotted screen from 42-48 mbgl. A concrete pad is installed at ground level. No bentonite seal or gravel pack was installed within the borehole annulus.

The borehole is located within a heated, insulated plant room, which also houses the borehole pump control equipment and the associated water treatment systems. The treatment systems include two sediment filters, a manganese reduction filter and an ultraviolet steriliser. The water is stored in a 1,100 litre storage tank with a low flow warning system in place when the tank is at less than 50% capacity.

Briarbank PWS (ID:6)

Briarbank PWS is a surface water abstraction supplied by the Allt Sigh watercourse (see Figure 4.1). The abstraction point is located within the watercourse at NGR NH 45574 19178. Water collects behind a concrete dam within the watercourse, which is fed by an open pipe into a capture tank which is also located within the watercourse. The water is then pumped through a plastic pipe, upgradient to a header tank at NGR NH 45591 19178 (see Figure 4.2). From the header tank the water is then gravity fed through a pipe network to the three properties listed in Table 4.1.

The capture tank is a concrete structure with a steel manhole cover and is comprised of two internal chambers. Organic matter (leaves and pine needles) was observed within the tank during the survey. The first internal chamber, into which the water initially flows from the river, is a settling tank. The water then discharges from the first internal chamber into the second through five small pipes at the bottom of the chamber. From here, the water is then pumped to the header tank.

The header tank is constructed of fiberglass material and is located within an uninsulated shed, upslope of the river. The pumping system from the tank is automated and is controlled by a ballcock inside the fibreglass tank, which initiates the pump when water levels drop below a certain level.

The water is gravity fed from the header tank to the properties. The PWS feeds three domestic properties, including two outside taps. There is no filtration or treatment of the water for any of the properties.

The supply is understood to have been installed in the 1950s and was initially used by the forestry commission. The supply has never been known to dry up, however the header tank often freezes in the winter. The resident defrosts the supply manually using hot water. The colour of the water is variable and tends to be influenced by rainfall patterns, with heavy rain resulting in higher colour issues. The resident, who returned the questionnaire and accompanied for the survey, reports changes in quality of supply as a result of works within the catchment e.g. forestry works.

Source: Natural Power (May 2024)

Figure 4.1: Surface water inlet in the Allt Sigh watercourse showing dam feeding the capture tank via an open pipe.

Source: Natural Power (May 2024)

Figure 4.2: Fibreglass header tank located within uninsulated shed.

5. PWS risk assessment

This section presents a risk assessment for the ‘screened in’ PWSs. Indicative PWS ZoCs are defined, and theoretical risk ratings formulated based on the extent of the interaction of these ZoCs with the Development, with the risk further investigated via catchment area analysis where necessary.

5.1. Methodology

The risk assessment first requires the indicative ZoCs of all the 'screened in' PWSs in the area to be considered with respect to the extent of the Development to derive risk ratings.

The indicative ZoCs for surface water catchments have been derived using a precautionary approach, based on the topography. The indicative PWS ZoCs are further constrained by hydrological boundaries such as watercourses or topographic high points / catchment divides. These indicative ZoCs represent the maximum area from which water could reach the PWSs.

The indicative ZoCs for groundwater abstractions (boreholes) have been derived using LUPS GU31 (250/100m buffers. From the abstraction point a 250 m buffer is applied to indicate the ZoC for deeper excavations (>1m) associated with the development infrastructure, and a 100 m buffer is applied to indicate the ZoC for shallow excavations (<1m) associated with the Development infrastructure. These indicative ZoCs represent the likely area from which water could reach the groundwater abstraction.

Also relevant to the assessment are the 100 m and 250 m 'buffers' around the Development infrastructure introduced in the SEPA (LUPS-GU31) guidance. Whilst LUPS-GU31 considers such buffers only with respect to groundwater abstractions (and groundwater dependent terrestrial ecosystems, GWDTEs), it is considered that such buffers also have a relevance with respect to surface waters and springs.

The Natural Power risk rating adopts a semi-qualitative approach with definitions and impact scenarios for each risk rating presented in Table 4.1. Both the receptors indicative ZoCs and the infrastructure buffers are used to derive a theoretical risk rating 'score'.

The ZoCs of those PWSs whose risk ratings are Medium or higher are then subject to a more detailed assessment, and, if required, a mitigation and residual risk assessment then undertaken.

The risks posed to the 'screened in' PWSs are described below, utilising the definitions set out in Table 5.1.

Table 5.1: Probability of Impacts

Probability	Definition	Impact Scenario
Very High	The receptor's indicative ZoC **does** extend onto the Development and **does** intercept site infrastructure, **and** the Development's LUPS-GU31 (250/100m) buffer (as appropriate, with allowance for micro-siting) **does** extend to the receptor.	Likely to be a marked impact on receptor without mitigation.
High	The receptor's indicative ZoC **does** extend onto the Development and **does** intercept site infrastructure, **or** the Development's LUPS-GU31 (250/100m) buffer (as appropriate, with allowance for micro-siting) **does** extend to the receptor.	Likely to be some impact on receptor without mitigation.
Medium	The receptor's indicative ZoC **does** extend onto the Development and **does** intercept the Development's LUPS-GU31 (250/100m) buffer (as appropriate) but **not** the site infrastructure, **and** the Development's LUPS-GU31 (250/100m) buffer (as appropriate, with allowance for micro-siting) **does not** extend to the receptor.	Likely to be limited impact on receptor without mitigation.
Low	The receptor's indicative ZoC **does** extend onto the Development but **does not** intercept the Development's LUPS-GU31 (250/100m) buffer (as appropriate, with	No measurable impact on receptor is predicted.

Probability	Definition	Impact Scenario
	allowance for micro-siting), **and** the Development's LUPS-GU31 (250/100m) buffer (as appropriate) **does not** extend to the receptor.	
None	The receptor's indicative ZoC **does not** extend onto the Development, **and** the Development's LUPS-GU31 (250/100m) buffer (as appropriate, with allowance for micro-siting) **does not** extend to the receptor.	No impact on receptor is anticipated

5.2. Theoretical risk assessment findings

Bhlaraidh Wind Farm PWS (ID: 1)

The indicative ZoC for the borehole has been derived and is presented in Figure 5.1. In addition, the 250/100m SEPA buffer has been applied to site infrastructure.

The borehole is located within the Development site boundary. The analysis indicates that the ZoC for shallow excavations (100 m buffer) is located approximately 5 m from the nearest Development infrastructure. It also shows that the ZoC for deep excavations (>1 m) has Development infrastructure located within it. The Development infrastructure located at approximately 105 m from the borehole is a temporary construction compound in which excavations would be <1 m, therefore the ZoC for shallow excavations apply and the infrastructure buffers do not intersect the receptor. The existing track prevents the construction compound from being microsited closer to the borehole.

It is also worth noting that the existing access track is located at 95 m from the borehole, therefore it is located within the 100 m LUPS buffer, however no upgrades are required for this track. Therefore, it will not be considered further as part of this risk assessment.

The assessed risk to the Bhlaraidh Wind Farm PWS from the Development is therefore rated as Medium and, as such, further detailed assessment is warranted for this PWS which is presented in Section 5.3.

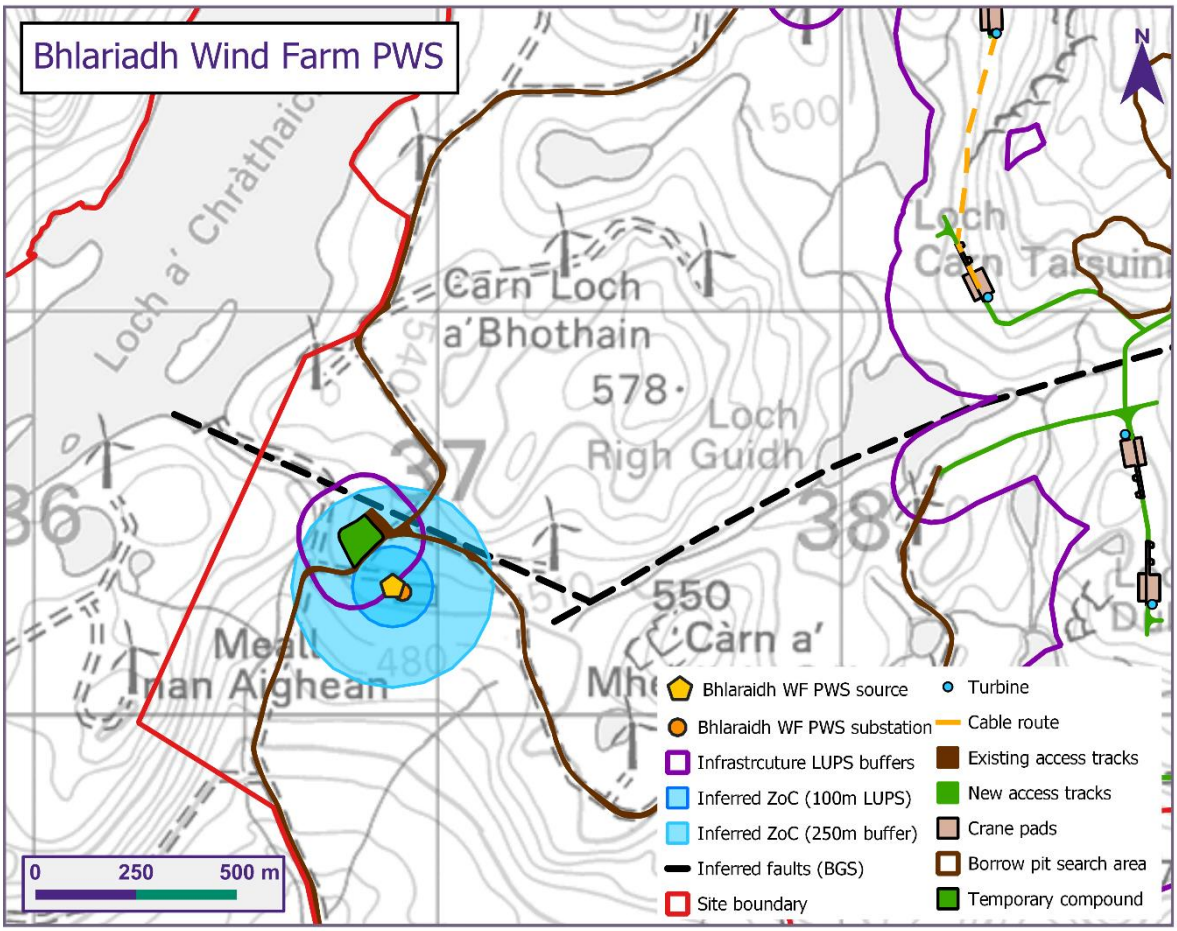


Figure 5.1: Bhlaraidh Wind Farm PWS (ID: 1)

Briarbank PWS (ID: 6)

The indicative ZoC for the surface water PWS has been derived and is presented in Figure 5.2. In addition, the 250/100m SEPA buffer has been applied to the site infrastructure.

The analysis indicates that the indicative PWS ZoC is within the Development site boundary. The nearest Development infrastructure is the cable route, located approximately 5.3 km west of the PWS abstraction point. The Development infrastructure area makes up approximately 30% of the catchment of the PWS source.

The assessed risk to the Briarbank PWS from the Development is Medium. Therefore, further detailed assessment for the Briarbank surface water abstraction is warranted and is presented in Section 5.3.

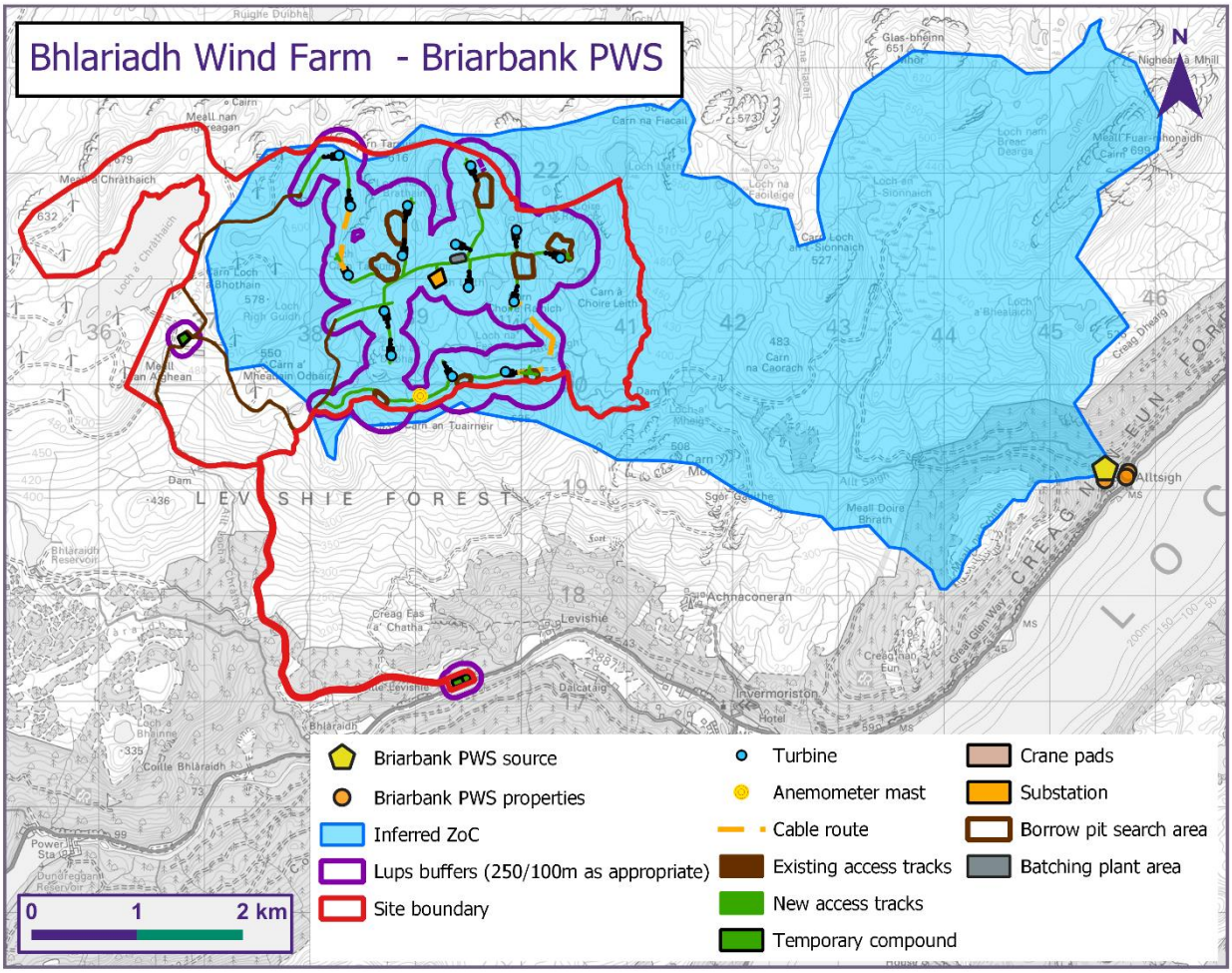


Figure 5.2: Briarbank PWS (ID: 6)

5.3. Detailed Assessment

As set out in Section 5.2, the risks posed to Bhlaraidh Wind Farm and Briarbank PWS is assessed as Medium therefore, more consideration is warranted and is provided in the following sections.

Bhlaraidh Wind Farm PWS (ID: 1)

The indicative ZoC for the borehole has been derived and is presented in Figure 5.1. In addition, the 250/100m SEPA buffer has been applied to site infrastructure.

The borehole is located within the Development area, but the ZoC 100m LUPS buffer does not intersect any Development infrastructure with shallow excavations (<1m), and the ZoC 250m LUPS buffer does not intersect any infrastructure requiring deep excavations (>1m). The closest infrastructure is the temporary construction compound located at 105m from the borehole. It is noted that, as the nearest infrastructure is the temporary construction compound, it is likely that welfare facilities, fuels and oils would be housed here. This means these is an increased risk of, for example, chemical and biological contamination to ground and subsequent leaching to the groundwater table.

The protection offered to the borehole from pollution is discussed below:

- Borehole sources, by nature of their design, are generally offered a higher level of protection compared to other PWSs such as surface water abstractions. However, it is noted that a sanitary seal (e.g. bentonite plug and gravel pack) has not been installed within the borehole annulus to prevent near-surface water ingress into the well. And, although steel casing has been installed through the unconsolidated deposits and approximately 2 m into competent rock, it has not been concreted into place through its full length. Therefore, it is possible that a pathway exists for surface water ingress into the borehole via seepage down the sides of the casing. The installation area is capped with a cement slab, which helps prevents against the ingress of surface and flood water in the immediate borehole surrounds;
- The borehole is located within a low productivity aquifer with only small amounts of groundwater in near surface weather zone and secondary fractures available. Furthermore, with a lack of overlying glacial superficial deposits e.g. till the aquifer is likely to be vulnerable to surface-derived pollution;
- There are also mapped faults within the vicinity of the borehole. There is an inferred fault (Fault 1) striking northwest-southeast approximately 180 m to the northeast of the borehole with an unconfirmed displacement. This intersects with an inferred fault (Fault 2) at NH 37378 20280 which strikes southwest - northeast and also has an unconfirmed displacement. Faults have the potential to provide a pathway for contamination to the borehole depending on their geometry; however Fault 1 does not intersect with any new infrastructure and Fault 2 only intersects with a new access track approximately 2 km from the borehole.
- The borehole is located up slope of the Development infrastructure, meaning overland and near surface groundwater flow is unlikely to be delivered by gravity towards the borehole location;
- It is reiterated that the borehole is located out with the SEPA LUPS buffer of 100m for shallow excavations (<1m). Therefore, the indicative ZoC for the borehole does not intersect with the infrastructure.

This assessment indicates that a pathway for contamination could exist from the surface to the borehole, however it is considered unlikely. This results in the risk becoming Low for the Bhlaraidh Wind Farm PWS.

Briarbank PWS (ID: 6)

The indicative ZoC for the surface water PWS has been derived and is presented in Figure 5.2. In addition, the 250/100m SEPA buffer has been applied to the Development infrastructure.

The analysis indicates that the indicative PWS ZoC is within the Development boundary however the nearest Development infrastructure is located at a very significant distance (approximately 5.3 km) from the PWS source. Furthermore, the catchment of the source is very large (2740 ha) and the development infrastructure area only makes up approximately 30% of the catchment. This means there will be a significant attenuation and dilution factor afforded to the PWS by overland flow and watercourses.

This results in the risk becoming Low for the Briarbank PWS.

6. Risk Management

Risk management techniques involve managing one or more of the components in the Source-Pathway-Receptor chain. Where practical, actual or potential pollutant linkages should be broken to eliminate the risk of a hazard impacting the receptor and where a residual risk remains, management controls and contingency arrangements should be implemented to minimise risks to an acceptable level.

This section should be read in conjunction with the CEMP where further good practice measures are outlined.

6.1. Standard Good Practice Measures

Silt Laden Runoff

For site access, where required, the following good practice guidance shall be used:

- When working within PWS catchments, where required, silt mitigation measures should be installed prior to works commencing and ensure that these are maintained for the duration of the works;
- Trenching or excavation activities in open land should be restricted during periods of intense rainfall;
- Temporary bunding should be provided as required, to reduce the risk of sediment transport to the natural drainage system;
- Direct drainage into existing watercourses will be avoided to prevent sediment and runoff from disturbed ground being routed directly to the watercourses;
- Settlement/attenuation ponds, silt traps and silt fences will be provided adjacent to the track drains to avoid pollution and sedimentation of watercourses;
- Access track construction materials should be free draining, strong, durable and well-graded;
- The movement of construction traffic should be controlled to minimise soil compaction and disturbance;
- Clearly define permitted access routes;
- Water shall not be permitted to run down the length of the site access track; and
- Geotextile membranes should be laid underneath clean aggregate that is free from fines.

Fuels and Oils

The delivery, storage, transfer, handling and use of fuels and oils often presents one of the greatest hazards to PWS. Due to the proximity of the Bhlariadh Wind Farm borehole (ID: 1) to the temporary construction compound, all fuels and oils will be stored in bunded containers >100 m from the borehole.

In addition to the good practice guidance, there are documents such as:

- Construction Industry Research and Information Association (CIRIA), ‘Environmental Good Practice on Site Guide (C741)’ (2015); and
- CIRIA, ‘Control of Water Pollution from Construction Sites (C532)’ (2001).

It is recommended that good practice is considered in relation to fuel management in adherence to relevant Guidance for Pollution Prevention (GPP) including “Above ground oil storage” (GPP2) and “Safe storage and disposal of used oils” (GPP8) and the requirements under The Water Environment (Controlled Activities) (Scotland) Regulations 2011. In line with the measures above, measures for bulk delivery and transfer of oils and fuels should be carried out under supervision, and designated personnel must be trained in spill response measures.

Wastewater

Welfare facilities will either connect directly to the foul sewer, self-contained storage tanks or to a septic tank, subject to approval from Scottish Water and SEPA. If self-contained or septic tanks are to be used, these will be maintained

and emptied on a regular basis by a suitably licensed contractor. Welfare facilities will be audited on a daily basis and an overflow alarm system should be considered.

Surveillance and Site Audits

A programme of inspections and audits should be conducted on a regular and routine basis. As a minimum, the following elements will be included in this programme:

- Watercourses below working areas;
- Surface water and sedimentation run-off mitigation;
- Materials storage (fuels, oils, chemicals);
- Contingency controls;
- Waste management, including toilet facilities;
- Management controls;
- Emergency response and incidents; and
- Environmental issues (litter, dust etc.).

During the construction phase, regular visual inspections of all receiving watercourses should be carried out in conjunction with reviews of environmental mitigation controls.

6.2. Emergency Contingency Measures

If the quality of a PWS is suspected or shown to be negatively affected by the works the Contractor will cease works upstream of the supply until an alternative drinking water supply has been provided to the user(s) of the PWS and the cause of the PWS has been identified and remediated.

In the event of a pollution incident the Contractor notifies all potentially affected PWS users. Local residents will be kept informed of construction activities via the CLG.

Where supplies are affected or disrupted as a result of pollution arising from the construction works, the Contractor will arrange an alternative water source to be installed until such time as the existing supply is reinstated to an appropriate quality.

Where it is demonstrated that the disruption of a supply has been caused by construction works, the Contractor bears all the costs associated with additional sampling, monitoring and installation of temporary or alternative supplies.

Spill Response

Spill kits and response materials will be available within the identified high-risk vehicles and plant working within water supply catchments and at designated locations across the construction site where hazardous materials are stored. The locations of key spill kit supply stores should be marked on a site location plan included within key documentation, which should also include a specific spill response procedure.

Specialist Contractors

The Principal Contractor will have a contingency plan involving the procurement of specialist oil and fuel pollution contractors who can deal with major incidents and those incidents which site personnel are not able to deal with.

Hazards

Although the construction phase of the project is short term compared to the operational phase, the risk of pollution and damage to the water environment during this phase is significantly higher, without appropriate mitigation.

Runoff as a result of high rainfall increases the risk of pollution and damage to the surface and groundwater environment. Rainfall and associated surface water runoff during construction works can mobilise and transport pollutants such as sediment, oils, chemicals and other building materials into the surface and groundwater environment.

The key construction and operational activities associated with the Development that could introduce potential pollution to the water environment include:

- Excavation of borrow pits;
- Construction and operation of tracks and hardstand areas;
- Turbine excavation; and
- Creation of site compounds and laydown areas.

The completion of the construction elements listed above will require additional activities to be undertaken which may also lead to potential impacts, and these activities include:

- Surface water drainage and de-watering;
- Transport, storage and handling of fuels and oils;
- Use of machinery and plant;
- Wastewater management; and
- Concrete works.

6.3. PWS Monitoring Plan

Despite the results of the PWS risk assessment outlined in Section 5.3 indicating low risk, it is recommended that a PWS monitoring plan is implemented for Bhlariadh Wind Farm Substation and Brairbank PWSs to establish whether there are any effects on PWS water quality as a result of Development works that require further mitigation.

An update to the WQFMP is recommended to include monitoring of Bhlariadh Wind Farm and Brairbank PWSs which would also detail the proposed monitoring to be undertaken of the PWSs which were assessed to be at Low risk from Development activities.

A programme of water level and quality monitoring would be undertaken prior to the main construction phase of works, to establish the baseline setting, and during construction to assess if any impacts are arising as a result of the Development.

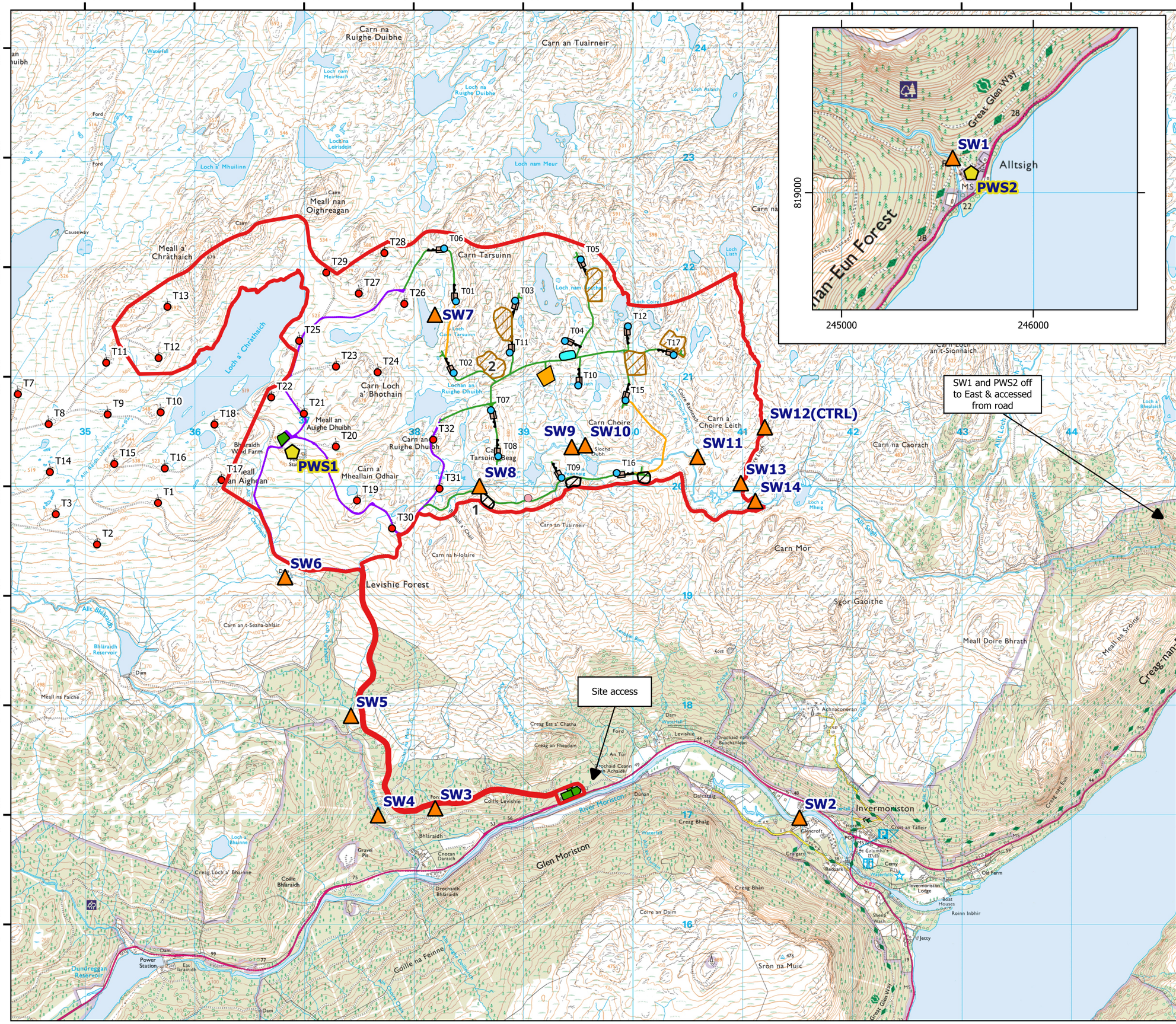
The WQFMP would include monitoring programme related to the Development, i.e. the sampling regime, frequency and analysis suite would be aligned closely with a surface water monitoring programme. The WQMFP would also include a pollution response plan and contingency measures that would detail, for example, the responsibilities and lines of communication that would be established between Construction Contractors, PWS users and other stakeholders. Contingency measures would include the provision of an alternative water supply, either temporary or permanent, as is necessary, in the event of an unforeseen impact on the existing PWS arising from the construction and operation of the Development.

7. Summary

Based on a consideration of the indicative ZoC areas with respect to the extent of the Development activities, the risk posed to the Bhlariadh Wind Farm PWS and to the Briarbank PWS is assessed as Low i.e. no measurable impact on receptor is predicted.

The risk to these PWSs can be effectively managed through the implantation of the risk management strategies outlined above in Section 6, which supplement the embedded mitigation measures set out in the CEMP. This includes effective silt management and stringent emergency contingency measures. The implementation of a PWS monitoring scheme would allow the effectiveness of the mitigation measures to be assessed and indicate where further contingency measures may be required to protect PWS.

A. PWS Overview Figure



Project:

Bhlaraidh Wind Farm Extension, Highland

Title:

Water Monitoring Location & Layout Plan

Key

- ▲ Surface water monitoring location
- ⬟ Private water supply monitoring location

Existing Wind Farm

- ● Phase 1 turbines
- 🟪 Existing access tracks

Consented Extension Wind Farm

- ▭ Extension development boundary
- ● Phase 2 consented turbines
- ● LiDAR station
- 🟩 Access track
- — Cross country cable route
- ■ Phase 2 crane pad
- 🟧 Substation
- ▨ Borrow pit search area
- ▨ Hydro borrow pit search area
- ■ Batching plant
- 🟩 Temp. construction compound

Scale @ A3: 1:35,000

Coordinate System: British National Grid

0 0.5 1 1.5 2 km

N

Date: 20-06-24	Prepared by: EM	Checked by: PM
Ref: GB204104_M_001_H	Layout: 080722_15t_A	

Drawing by:

The Natural Power Consultants Limited
The Green House
Forrest Estate, Dalry
Castle Douglas, DG7 3XS, UK
Tel: +44 (0)1644 430008
Fax: +44 (0)845 299 1236
Email: sayhello@naturalpower.com
www.naturalpower.com

natural power

B. Bhlaraidh Wind Farm Substation Borehole Log

HIGHWATER
private water supplies

DRILLING RECORD DR

Client Reference	**RJMcLeod - Bhlaraidh – 354.**		
BH Grid Reference	57°44'0N 4°41'6"W	**Static Water Level (mbgl)**	2 MBGL
Drilling Start Date	15/9/16	**Artesian Flow (l/min)**	–
Drilling Completion Date	16/9/16	**Overall Depth (m)**	60M
If Fail - Reason		**Steel Casing Diameter (mm)**	140MM
Well cap	Yes / No	**Steel Casing used (m)**	3M
Riser Pipe Fitted Size of Pipe (mm)	(Yes) / No	**Rock Bit Diameter (mm)**	115 TO 36M 95 TO 60
Photos Taken	Yes / (No)	**Well Screen Size**	3"
Yield Test (litre)	1300 l/hr.	**Well Screen (m)**	Slotted 12M / Plain 36M.
Well Screen Arrangement (e.g. 12m plain then 12m slotted)	6M SLOTTED AT BTM FOLLOWED BY PLAIN		

Comments/Observations
(Taste? Smell? Colour? Etc)
BOTTOM 24M OF HOLE WAS ~~DRAIN~~ DRILLED. IN 95MM SCREEN WOULD ONLY GO TO 48M

Quoted Value	£	**Quoted Value Reached**	mbgl

Has approval to drill beyond quoted value above been received from client?
Y/N (Circle applicable)

Received by (Email, Letter, Verbal):	**New Depth/Budget (mbgl/£):**

HIGHWATER
private water supplies

DRILLING RECORD

Depth (mbgl)	Depth (mbgl)	Geological Description	Water Strikes/Casing/Well Screen Info
0	0.75	MADE UP SUB BASE	
0.75	1.0	LOOSE SAND + GRAVEL	
1.0		FINE GRAINED	
		GREY SANDSTONE	
1.0	15	FINE GRAINED	
		GREY SANDSTONE	
	15	SOFT FRACTURED	SOME FREE
		LIGHT BROWN MEDIUM	WATER BUT
		GRAINED	SOON DISAPPEARS
15	24	BANDED GREY TO	
		LIGHT BROWN WEATHERED	
		MODERATELY HARD	
24		MORE SIGNIFICANT	FREE WATER
		FRACTURE WITH	AFTER 10M CHANGES
		LG LUMPS	
24	36	HARD DARKER GREY	
		TO BLACK ~~WITH~~ WITH	
		QUARTZ VEINING	
36	38.5	SOFT LIGHT TO	FREE WATER THROUGHOUT
		DARK BROWN GRITTY	RODS

HIGHWATER
private water supplies

Depth (mbgl)	Depth (mbgl)	Geological Description	Water Strikes/Casing/Well Screen Info
38·5	48	DARK GREY TO	
		BLACK V HARD	
		FINE GRAINED WITH	
		QUARTZ VEINING	
48	54	MULTIPLE SM	YIELD
		FRACTURED ZONES.	

HIGHWATER
private water supplies

Borehole Pump Test

Date		**Well Depth**	
Client		**Pump Depth**	
Location		**Pump Specification**	
		Dynamic Water Level (DWL)	

Time (HH:MM)	Meter Reading (Start)	Elapsed Time (mins)	Meter Reading (Finsh)	Volume (litres)	SWL (m)	Flow Rate (l/hr)	Remarks

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