Bloch Wind Farm

Technical Appendix 9.1: Schedule of Watercourse Crossings

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Renewable Energy Systems Limited

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Author	Emma Bryder	03/08/2022
Checked	Sam Wainwright	21/09/2022
Approved	Kelly Wyness	13/10/2022

Client Details	
Contact	James Cameron
Client Name	Renewable Energy Systems Limited
Address	Beaufort Court, Egg Farm Lane, Kings Langley, Hertfordshire WD4 8LR

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Local Office:

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

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

This document provides a Schedule of Watercourse Crossings at the Proposed Bloch Wind Farm (the proposed development) as part of Chapter 9:Hydrology, Hydrogeology, Geology and Soils of the Environmental Impact Assessment Report (EIA Report). The purpose of this document is to provide the relevant information associated with the watercourse crossings required as part of the proposed development and to assist in the identification of regulatory licensing requirements.

All the watercourse crossings are designed to maintain hydrology as well as, where necessary, allowing the free passage of mammals and aquatic species.

All new crossings will be able to convey 1 in 200 year flow volumes (plus an allowance for climate change) without constriction. Hydraulic modelling to demonstrate compliance would be undertaken prior to construction as part of the detailed drainage design.

1.1. Regulatory Legislation

The Water Framework Directive (2000/60/EC) (WFD) represents a significant piece of environmental legislation which has implications for the proposed development. The WFD has been transposed into Scottish legislation as the Water Environment and Water Services (Scotland) Act 2003 (or WEWS) and has given Scottish Ministers powers to introduce regulatory controls over activities in order to protect and improve Scotland's water environment. The water environment includes wetlands, rivers, lochs, transitional waters (estuaries), coastal waters and groundwater. These regulatory controls, known as The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) came into force on the 31st of March 2011.

With respect to watercourse crossings required for the proposed development, CAR requires that all 'engineering works in inland waters and wetlands' are subject to authorisation and allow for proportionate risk-based regulation. The authorisation process operates at three levels:

- General Binding Rules (GBR);
- Registration; and
- Licence (Simple or Complex).

GBR are a set of mandatory rules which cover low risk activities. Activities complying with the rules do not require an application to be made to the Scottish Environment Protection Agency (SEPA), however it is mandatory for activities that fall under GBR to comply with the standard rules.

The three authorisation process levels cover activities with increasing levels of potential impact upon the hydrological environment. SEPA will be required to provide authorisation for watercourse crossings shown on the 1:50,000 scale Ordnance Survey (OS) maps (Landranger series). All watercourses, minor or major, are regulated under CAR if works include culverting for land gain, realignment or diversion of watercourses and, in these instances, authorisations are always required. Where appropriate, likely authorisations required for the surveyed crossings are described in this report.

Following an update to CAR in 2018 and in 2021 all large construction projects, which exceed a certain aerial extent, also require a Construction Runoff Permit (CRP), formerly known as a Construction Site License, which must be obtained from SEPA prior to the initiation of construction. Whilst the design of watercourse crossings is in part related to the site's drainage and associated impacts (which is an integral element of the CRP), this document is associated with identifying the licensing requirement for engineering works within the water environment only.

1.2. Disclaimer

This report should be considered 'live' and as such changes may be needed should new information come to light. Natural Power has endeavoured to identify the watercourse crossings required as part of the construction associated with the proposed development. However, it is possible additional watercourse crossings, which do not feature on either the OS mapping or were not encountered during the site visit, will be identified within the site. Should the construction process identify additional crossings, then these should be surveyed, and due consideration given to the legislation above to ensure compliance.

The information presented in this document is only intended to act as a guide. The actual design, construction and/or improvements to the crossings during construction will be the responsibility of the appointed Principal Contractor.

2. Methodology

2.1. Desk Study

The desk study consisted of an examination of the infrastructure layout and the identification of watercourses which will require crossings, including those marked on the 1:10,000, 1:25,000 and 1:50,000 scale OS maps. Watercourse buffers are shown in related figures and were applied to those shown on a 1:25,000 scale OS map and were allocated a 50m buffer.

As outlined in Chapter 9 of the EIA Report and in Technical Appendix 9.6: Watercourse Assessment, many of the minor watercourses encountered at the proposed development, including those shown only on the 1:10,000 scale OS map, and not on a 1:25,000 scale OS map or 1:50,000 scale OS map and were actually artificial ditches of anthropogenic origin.

Details of the hydrological regime and associated flood risk affecting the proposed development is presented in Chapter 9 of the EIA Report.

2.2. Site Visit

Following the desk study, a survey of the identified crossings was undertaken to obtain information specific to each watercourse. Photographs and detailed field notes were taken, reporting the dimensions of the watercourse channel and flood channel (where apparent), the type of substrate and the crossing type.

Watercourse surveys were undertaken in July 2022. The weather conditions during the survey were dry and sunny. A further site visit was undertaken in September 2022 as part of the production of the Watercourse Assessment Technical Appendix. Weather conditions during the survey were dry.

A plan indicating the site boundary and survey points is illustrated in Figure 9.1 of the EIA Report – Hydrological Overview. Figure 9.1 also demonstrates the locations of identified ditch networks.

2.3. Water Crossing Selection Criteria

The design process adopted for each watercourse crossing is complex, taking account of a range of design criteria and constraints to develop the most appropriate crossing for each watercourse. The primary technical standards driving the design of culverts are DMRB HA107/04 Design of Outfall and Culvert Details (2004)[1] and the CIRIA Culvert design and operation guide (C689) (2010)[2]. However, in addition to these technical standards, there are other site-specific drivers that influence the culvert design which include among others: flood risk; maintenance requirements; ecological considerations; and geomorphological considerations. Reference should be made to the UK Forestry Standard Guidelines[3] which focuses on engineering features, SEPA guidance documents[4] [5] for the construction considerations and Scottish Government guidance for best practice[6] and ecology[7].

The design process for each watercourse crossing is iterative, such that the final design meets the fundamental design standard; which is that the proposed development remains free from flooding during the design flood event whilst maintaining adequate freeboard (typically 600mm) and flood risk is not compromised elsewhere.

The Wauchope Water (Collin Burn catchment, Bigholm Sike catchment and Back Burn catchment) and Glenzier Burn (Limey Sike catchment and Bloch Burn catchment) have moderate status under SEPA's River Basin Management Plan (RBMP). For future objectives, water crossing that maintain natural flow, gradient and aid fish passage have been recommended.

Galloways Fisheries Trust highlighted that the Bigholms Burn, Wauchope Water, Collin Burn and Back Burn were important fish supporting waters. The Border Esk supports an important salmon and sea trout fishery. The river and its burns also support a range of protected fish species including Atlantic salmon, sea trout, European eels and Lamprey.

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1 The Highway Agency et al., (2004) *Design Manual for Roads and Bridges, Volume 4, Section 2, Part 7 HA 107/04*

2 Construction Industry Research and Information Association (CIRIA) (2010) *Culvert design and operation guide.*

3 Forestry Commission (2017) *The UK Forestry Standard, The governments' approach to sustainable forestry, 4th edition.*

4 Scottish Environment Protection Agency (SEPA) (2010) *Engineering in the water environment, Good Practice Guide – Construction of River Crossings, 2nd edition.*

5 SEPA (2015) *WAT-PS-06-02: Culverting of Watercourses - Position Statement and Supporting Guidance, 2nd edition.*

6 Scottish Government (2019) *Good Practice During Wind Farm Construction, 4th edition.*

7 Scottish Government (2012) *River Crossings and Migratory Fish: Design Guidance*.

3. Watercourse Crossing Assessment Summary

Four watercourse crossings were identified for the access tracks constructed as part of the proposed development and a summary of the proposed CAR authorisations is summarised in Table 3.1.

Table 3.1: Summary of Watercourse Crossings

CAR Authorisation	Number of Crossings
Registration	4
Total	**4**

Source: Natural Power

Table 3.2 provides a summary of the surveyed natural watercourses, including proposed crossing type and proposed CAR authorisation.

Table 3.2: Summary of Watercourse Crossing Types

ID	Easting	Northing	Type	CAR Authorisation
WX1	330962	580234	New	Registration
WX2	331046	579670	New	Registration
WX3	333054	579953	New	Registration
WX4	333791	581198	New	Registration

Note: CAR Authorisations classified as a "registration" are identified as a watercourse or water body on an Ordnance Survey Landranger 1:50,000 scale series.

Source: Natural Power

The location of the watercourse crossings in relation to the proposed infrastructure is provided in Figure 9.1 Hydrological Overview. More detailed information on the watercourse crossings is provided in Section 3.2 and takes into account the preceding information, as well as photographs and hydromorphological information associated with each crossing.

In addition to the watercourse presented in this schedule, additional crossings may be required on unmapped, minor artificial ditches. Some of these ditches may be blocked as part of habitat enhancement proposals and in other culverts or other cross drainage structures would be utilised. Good practice mitigation regarding pollution prevention is outlined in Chapter 9 as well as Technical Appendix 2.3: Outline Pollution Prevention Plan. Further details on the identification of artificial ditches and their corresponding management is presented in Technical Appendix 9.6: Watercourse Assessment and Technical Appendix 7.6: Outline Habitat Management Plan.

In addition to the CAR authorisations summarised in Table 3.1, the proposed development will also require a Construction Runoff Permit (CRP) to meet SEPA's permitting principles and must be obtained prior to construction.

3.1. Rationale and Design

The design of the proposed development has been optimised as far as possible to reduce the total area of land-take and minimise the number of watercourse crossings whilst accommodating other environmental or engineering related constraints. At each watercourse crossing location, consideration has been given to the nature and size of the crossing, fluvial scour and environmental requirements.

In designing the watercourse crossings, industry good practice will be applied, ensuring that various conditions will be considered during the works, and which are summarised below:

- All watercourses, over which the access tracks cross, will be routed through circular culverts, bottomless arch culverts or under bridges appropriately sized and designed not to impede the flow of water;
- Safe passage for wildlife, such as fish, water voles, otters etc. will also be considered in the design through increased capacity of culvert or separate mammal crossing (pipe);
- When constructing culverts, the appointed Principal Contractor takes care to ensure that the construction does not pose a permanent obstruction to migrating species of fish, or riparian mammals;
- If instream works are planned in a watercourse supporting trout/salmon then such works should avoid taking place between October – May to protect spawning redds. Also, a fish rescue by electrofishing should take place prior to instream works in fish supporting watercourses. Final arrangements would be clarified with the Galloway Fisheries Trust;
- Culvert design will be engineered to ensure that the invert can be sunk into the bed of the watercourse allowing riverine substrate to stabilise on the floor of the culvert;
- Designed to convey a minimum of 1 in 200 year plus climate change return period flood events, and individually sized and designed to suit the specific requirements and constraints of its location. For larger crossings such as single span structures, a minimum freeboard of 0.6m above the 1 in 200 flow must also be incorporated; and
- All watercourse crossings to include splash boards and run-off diversion measures to prevent any direct siltation of watercourses.

Erosion protection will be implemented at the outfall of all culverts. Where required, the type of erosion protection would depend on a number of factors including:

- Flow;
- Velocity;
- Channel bed material;
- Vegetation;
- The effects/consequences of erosion; and
- Types of erosion protection including:
  - Geotextile bank reinforcement;
  - Vegetation;
  - Dumped stone;
  - Laid stone (Rip-rap or equivalent); and
  - Concrete block systems.

The appointed Principal Contractor will adhere to the following principles for culvert design and construction:

- Where appropriate, the natural low flow depths are maintained through culvert base;
- The culvert base should be buried below the natural bed level to allow for a naturalised culvert bed to be maintained during scour associated with high flow events;

- The culvert should be at least the same width as the natural active channel width, with consideration to low flows and channel migration;
- Culvert alignment should match alignment of the watercourse i.e. in a parallel direction to flow;
- The slope of the culvert base should be similar to that of the bed of the watercourse;
- The culvert must not present a barrier by creating a step or hydraulic drop at the culvert inlet or outlet;
- The culvert must be designed not to exacerbate or create flooding;
- A natural stone headwall should be provided upstream and downstream to protect the road embankment where necessary;
- Culverts should not be constructed under high flow conditions; and
- A mammal tunnel should be provided where considered appropriate by the Environmental Clerk of Works (ECoW), so that no restriction is related to established animal movement routes.

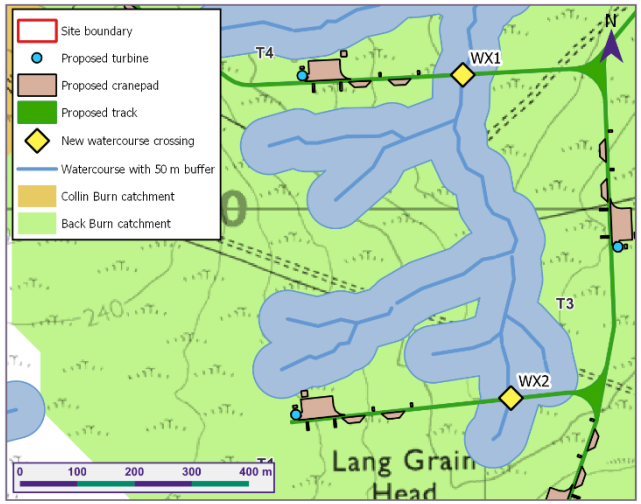
Following the completion of detailed site investigation and micro-siting, **a revised version of this assessment should be produced** to estimate peak flows in the watercourses for which flows need to be accommodated to ensure that any potential risk to flooding is minimised. Due to the small size of the catchments, and it being unlikely that local flow data will exist, in line with SEPA guidance, a number of techniques should be presented in the estimation of peak flows. These estimated peak flows will help inform the detailed design considerations required for each of the identified crossing locations. An indication of the required sizing for crossing dimensions would also be provided.

3.2. Detailed Crossing Assessment

Information on the new watercourse crossings outlined in Table 3.2 are provided below.

WX1

Crossing Location



Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Incised, Meandering
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Fine sand/silt, Coarse gravel, Boulders
- **Riparian corridor:** Moorland
- **Flow condition:** Moderate
- **Water width (m):** 0.80
- **Water depth (m):** 0.10
- **Bankfull width (m):** 1.50
- **Bankfull height (m):** 0.20
- **Flooded Bankfull width (m):** 2.0-2.5
- **Flooded Bankfull height (m):** 0.50

Note: Shown on 1:25,000 scale OS Map.

CAR Auth Level: Registration

Proposed Crossing Type: To accommodate flow and aid fish passage oversized culverts which contain natural bed material or similar is recommended.

Crossing Photographs

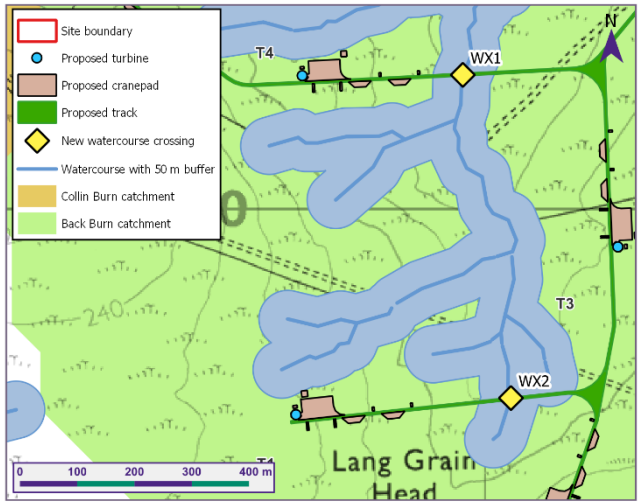
Upstream

Across

Downstream

WX2

Crossing Location



Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Incised, Meandering
- **Gradient:** Moderate
- **Valley form:** Shallow vee, Deep vee
- **Bank condition:** Stable
- **Bed material:** Coarse gravel, Rounded pebbles, Boulders
- **Riparian corridor:** Moorland
- **Flow condition:** Slow
- **Water width (m):** 0.30
- **Water depth (m):** 0.05
- **Bankfull width (m):** 0.50
- **Bankfull height (m):** 0.40
- **Flooded Bankfull width (m):** 1.0
- **Flooded Bankfull height:** 0.8

Note: Shown on 1:25,000 scale OS Map.

CAR Auth Level: Registration

Proposed Crossing Type: To accommodate flow and aid fish passage oversized culverts which contain natural bed material or similar is recommended.

Crossing Photographs

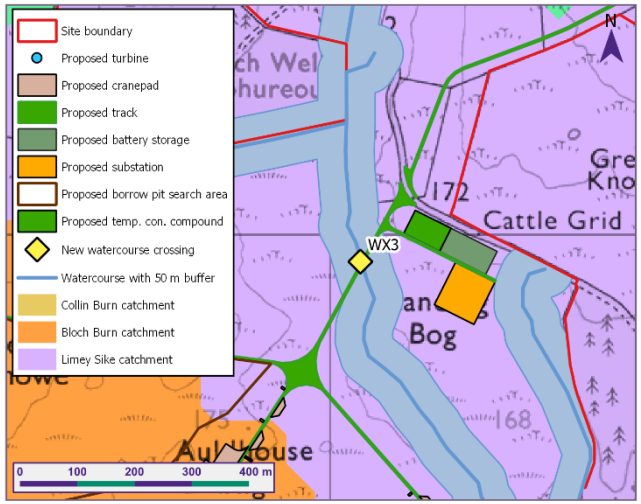
Upstream

Across

Downstream

WX3

Crossing Location



Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Poorly defined
- **Gradient:** Gentle
- **Valley form:** No obvious valley sides, Shallow vee
- **Bank condition:** Stable
- **Bed material:** Rounded pebbles, Boulders, Coarse gravel, Vegetation
- **Riparian corridor:** Moorland
- **Flow condition:** Slow

- **Water width (m):** 0.20
- **Water depth (m):** 0.10
- **Bankfull width (m):** 0.40
- **Bankfull height (m):** 0.30
- **Flooded Bankfull width (m):** 1.5-2.0
- **Flooded Bankfull height (m):** 0.5-0.7

Note: Shown on 1:25,000 scale OS Map.

CAR Auth Level: Registration

Proposed Crossing Type: To accommodate flow and aid fish passage oversized culverts which contain natural bed material or similar is recommended.

Crossing Photographs

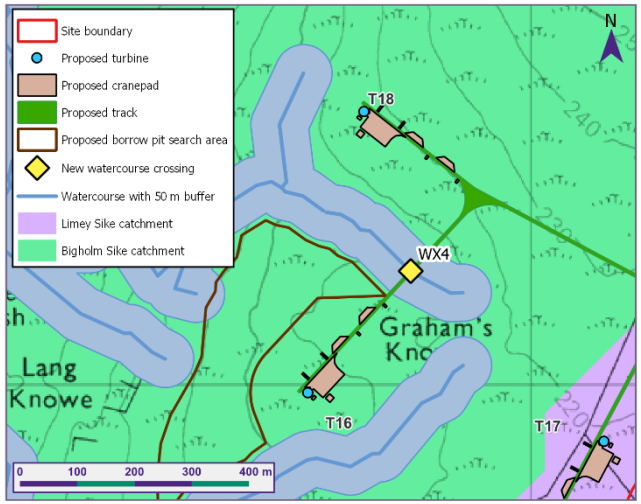
Upstream

Across

Downstream

WX4

Crossing Location



Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Poorly defined
- **Gradient:** Gentle
- **Valley form:** No obvious valley sides, Shallow vee
- **Bank condition:** Stable
- **Bed material:** Vegetation
- **Riparian corridor:** Moorland
- **Flow condition:** Dry
- **Water width (m):** 0.20
- **Water depth (m):** Dry
- **Bankfull width (m):** 0.50
- **Bankfull height (m):** 0.20
- **Banktop height (m):** 0.30
- **Flooded Bankfull width (m):** 1.50
- **Flooded Bankfull height (m):** 0.50

Note: Shown on 1:25,000 scale OS Map. Watercourse dry during survey.

CAR Auth Level: Registration

Proposed Crossing Type: To accommodate flow and aid fish passage oversized culverts which contain natural bed material or similar is recommended.

Crossing Photographs

Upstream

Across

Downstream

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