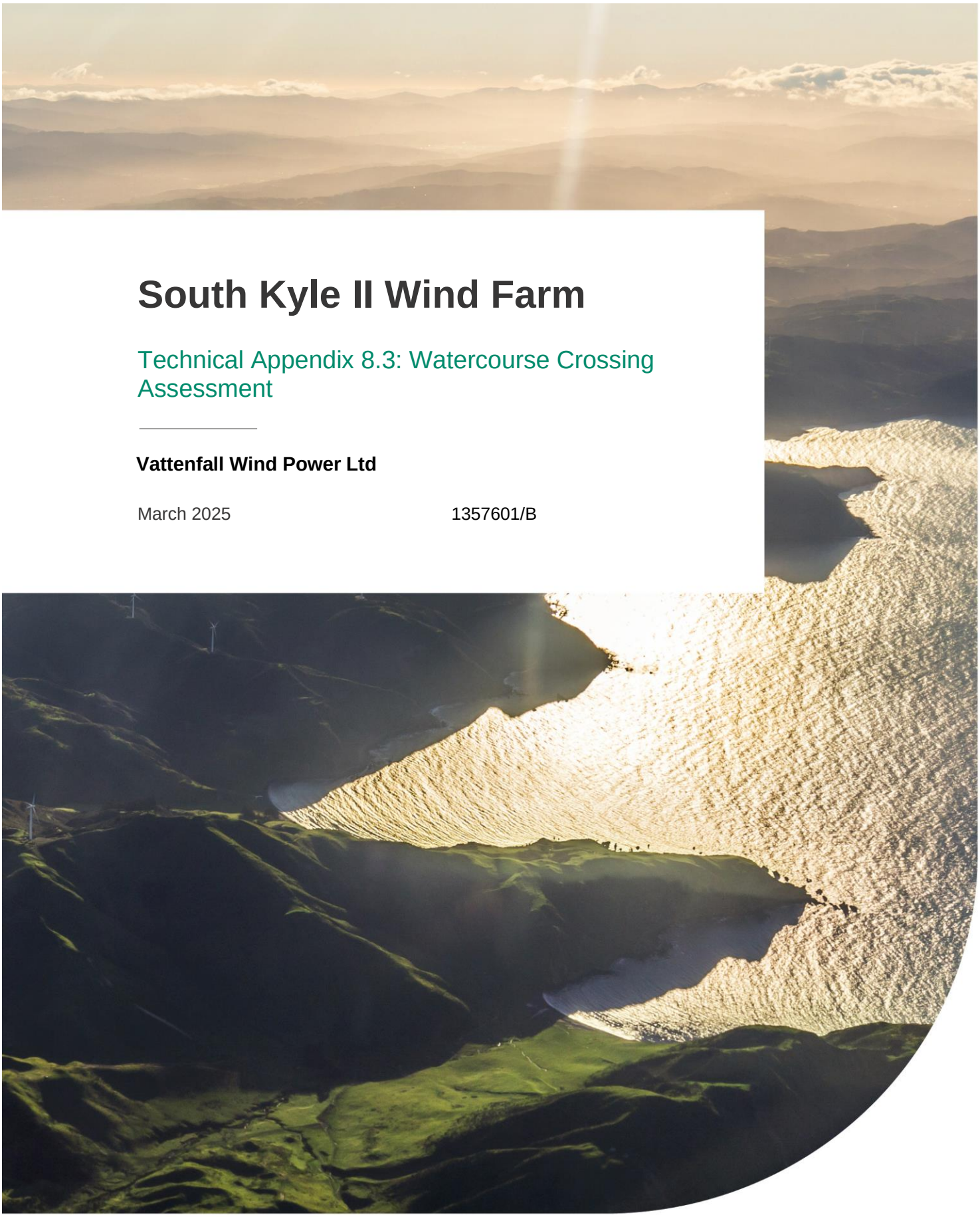

South Kyle II Wind Farm

Technical Appendix 8.3: Watercourse Crossing Assessment

Vattenfall Wind Power Ltd

March 2025 1357601/B

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Document history

Author	Christopher Laing	06/06/2024
Checked	Emma Bryder	13/06/2024
Approved	David Croke	10/10/2024

Client Details	
Contact	Simon Lejeune
Client Name	Vattenfall Wind Power Ltd
Address	St Andrew House Haugh Lane Hexham NE46 3QQ

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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

This technical appendix presents the following information in support of Chapter 8: Hydrology, Geology & Hydrogeology, of the Environmental Impact Assessment Report (EIAR) for South Kyle II Wind Farm (the Proposed Development).

The purpose of this report is to provide the relevant information associated with the watercourse crossings required as part of the Proposed Development, and to assist in the contractors detailed design of the crossings prior to construction.

It is recommended that all the watercourse crossings are designed to maintain hydrology, as well as allowing the free passage of mammals and aquatic species. Consideration should also be given on the upgrade of existing crossings for environmental betterment. The final design of each crossing solution should be agreed with Scottish Environment Protection Agency (SEPA) prior to construction and be determined as part of the detailed site design.

1.1. Legislation

The assessment will consider the requirements of the Water Framework Directive (2000/60/EC) (WFD). The requirements of various EU Directives such as the WFD (2000/60/EC), the European Liability Directive (2004/35/EEC) and the Groundwater Daughter Directive (2006/118/EEC) have been in domestic legislation following the United Kingdom leaving the EU by the Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019 (the 'Environment Regulations 2019'). The WFD, as retained in domestic legislation by the Environment Regulations 2019, and supporting domestic legislation establish a legal framework for the protection, improvement and sustainable use of surface waters, transitional waters, coastal waters and groundwater resources. The WFD aims to protect and enhance the quality of surface freshwater (including lakes, rivers and streams), groundwater, groundwater dependant terrestrial ecosystems, estuaries and coastal waters. The key objectives of the WFD relevant to the assessment are:

- To prevent deterioration and enhance aquatic ecosystems; and
- To establish a framework for the protection of surface freshwater and groundwater.

The WFD resulted in The Water Environment and Water Services (Scotland) (WEWS) Act 2003, which gave Scottish Ministers powers to introduce regulatory controls (Section 20 of WEWS) over water activities in order to protect, improve and promote sustainable use of Scotland's water environment. These regulatory controls, in the form of The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) have made it an offence to undertake certain activities (as listed in Schedule 2) without a CAR authorisation.

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).

The three levels cover activities with increasing levels of potential impact upon the hydrological environment. GBR represent a set of mandatory rules which cover low risk activities. Activities complying with GBR do not require an application to be made to the Scottish Environment Protection Agency (SEPA), as compliance with a GBR is considered to be compliance under an authorisation.

SEPA will be required to provide authorisation for watercourse crossing shown on the 1:50,000 scale Ordnance Survey (OS) maps. All watercourses major or minor are regulated under CAR if works include culverting for land gain, realignment or diversion of watercourse and in these instances, authorisation are always required. Where appropriate, likely authorisations required for the surveyed crossings are described in this report.

It is also acknowledged that the more recent Water Environment (Miscellaneous) (Scotland) Regulations 2017 brought about significant changes to CAR, with sites exceeding certain thresholds now requiring a site construction licence. Individual regulated activities, such as watercourse crossings, can either be considered as part of the construction runoff licence or be individually authorised under the existing CAR requirements. Confirmation of this will be discussed and agreed with SEPA prior to construction taking place. This document is associated with identifying the licensing requirements for engineering works within the water environment only.

Advice and best practice guidance is available within the water engineering section of SEPA's website[1]. Guidance on the design of water crossings can be found in the Construction of River Crossings Good Practice Guide[2]. Reference should also be made to SEPA's Standing Advice on flood risk[3] which recommends that watercourse crossing should be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures.

1.2. Disclaimer

This report should be considered live and as such changes will be made 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 mapping or were not encountered during the site visit will be identified within the Proposed Development area. Should the construction process identify additional crossings, then these should be surveyed immediately, and due consideration should be given to the legislation above to ensure compliance.

2. Methodology

This section describes the methodology undertaken to carry out the watercourse crossing survey.

2.1. Desk Study

The desk study consisted of a review of the information regarding the Proposed Development. This principally involved an examination of the track 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.

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.

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[1] SEPA (2024), Engineering guidance. At: https://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/ [accessed 11/10/24]

[2] SEPA and Scottish Government (2010), Engineering in the water environment: good practice guide. River Crossings. At: https://www.sepa.org.uk/media/151036/wat-sg-25.pdf [accessed 11/10/24]

[3] SEPA (2024), Flood Risk Standing Advice for Planning Authorities. At: flood-risk-standing-advice.docx (live.com) [accessed 11/10/24]

Site surveys, including watercourse crossing assessments, were carried out by Natural Power on 3 April to 5 April, and 4 June 2024, with weather conditions recorded as variable, with heavy rainfall to dry conditions.

A plan indicating the site boundary and survey points is illustrated in Figure 8.1: Hydrological Overview.

2.3. Watercourse Crossing Selection

Information collected during the site visit has been used to inform crossing selection. Construction of the Proposed Development will include laying access roads, which will require the crossing of natural watercourses and other features such as flush zones (waterlogged land near river sources). Historically, the usual approach to cross minor watercourses was to place one or more circular culverts in the stream bed and build the track on an embankments above the culvert. However, although this approach has been employed for many years and wind farm developments are often located in similar terrain to forestry, the acceptable design for watercourse crossings has changed. It is now ecological status, rather than purely river volume and the conveyance of flows that is of importance when choosing and designing watercourse crossings. An illustration of typical watercourse crossing designs are shown in Appendix A. 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 600 mm) and flood risk is not compromised elsewhere.

Since April 2006, in Scotland, the majority of watercourse crossing proposals have had to be submitted to SEPA for appraisal and depending on the scale of the work and/or the sensitivity of the watercourse, may require authorisation under CAR. The main driver behind this change is the WFD. Reference should still also be made to the UK Forestry Standard Guidelines[4], the CIRIA Culvert Design and Operation Guide[5] which focuses mainly on engineering features, the SEPA 2010 guidance document[6] on the construction of watercourse crossings and the NatureScot Good Practice During Wind Farm Construction, guidance document[7].

3. Watercourse Crossing Assessment Results

The current layout of the Proposed Development will require up to nineteen watercourse crossings for the construction or upgrade of access tracks as part of the Proposed Development. Fifteen are existing watercourse crossings which will likely not require any upgrade or changes prior to use. Four are new watercourse crossings that will likely be required. Table 3.1 provides a summary of the surveyed natural watercourses, including proposed crossing type and anticipated CAR authorisation. The field notes and details of the watercourse crossing locations can be found in Appendix B.

[4] Forestry Commission (2023), The UK Forestry Standard. The governments' approach to sustainable forest management (Fifth edition). At: https://assets.publishing.service.gov.uk/media/651670336a423b0014f4c5c0/Revised_UK_Forestry_Standard_-_effective_October_2024.pdf [accessed 13/06/2024]

[5] CIRIA (2010), Culvert Design and Operation Guide

[6] SEPA (2010), Engineering in the Water Environment, Good Practice Guide – River Crossings, 2nd Edition, November 2010.

[7] NatureScot, Scottish Renewables, SEPA, FCS, Historic Environment Scotland, Marine Scotland Science and AECoW (2019), Good Practice During Wind Farm Construction, Version July 2024

Table 3.1: Summary of Watercourse Crossings

ID	Easting	Northing	Type	Existing Crossing Type	Recommended Crossing Type	Anticipated CAR Authorisation
WX1	252179	607841	Existing	Circular Culvert	-	-
WX2	252846	607065	Existing	Circular Culvert	-	-
WX3	252888	606660	Existing	Circular Culvert	-	-
WX4	251954	606639	New		Bottomless Culvert	Registration
WX5	252783	606196	New		Bottomless Culvert	Registration
WX6	253577	605824	New		Bottomless Culvert	Registration
WX7	253924	605409	New		Bottomless Culvert	Registration
WX8+	255076	606228	Existing	Circular Culvert	-	-
WX9	254729	606500	Existing	Circular Culvert	-	-
WX10	254547	606804	Existing	Circular Culvert	-	-
WX11	254218	607359	Existing	Circular Culvert	-	-
WX12	253935	607440	Existing	Circular Culvert	-	-
WX13	253463	607065	Existing	Circular Culvert	-	-
WX14	252272	608081	Existing	Circular Culvert	-	-
WX15*	252243	608131	Existing	Circular Culvert	-	-
Watercourse Crossing Identified During the Survey						
WX16	254478	606927	Existing	Circular Culvert	-	-
WX17	254391	607172	Existing	Circular Culvert	-	-
WX18	253852	607414	Existing	Circular Culvert	-	-
WX19	253672	607259	Existing	Circular Culvert	-	-

+ Watercourse has been surveyed and presented for information only however it is associated with South Kyle 1 Wind Farm and it is not envisaged that access will be required to it based on current layout and it has been included on a precautionary basis.

ID	Easting	Northing	Type	Existing Crossing Type	Recommended Crossing Type	Anticipated CAR Authorisation
** Watercourse crossing identified during desk study, however site visit confirmed that no watercourse crossing present and it has been included on a precautionary basis.*						
- No proposed change or upgrade requirements to existing crossing.						

Source: Natural Power (2024)

4. Discussion

Key points from the survey include:

- Of the nineteen watercourse crossings identified, four require a new crossing (WX4, 5, 6 and 7);
- The predominant crossing type encountered across the Proposed Development was a circular culvert. This was identified at fifteen watercourse crossings (WX1, 2, 3, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19);
- Four watercourse crossings were recorded during the site visit that were not previously identified during the desk study due the watercourses not being present on the mapping resources (WX16, 17, 18 and 19);
- The flow conditions encountered during the site visits were typically moderate;
- The flowing water width for the surveyed watercourses were ≤ 1.3 m, with WX3 featuring the greatest flowing water width;
- The circular culverts were recorded as being plastic and in good condition, however upgrade requirements can be confirmed if necessary; and
- WX15 did not feature as an observable watercourse during the time of survey, however a small pipe was encountered which may act as a pathway during periods of higher rainfall.

The location of the watercourse crossings in relation to the proposed infrastructure is shown in Figure 8.1 provided in Volume 1 of Chapter 8: Hydrology, Hydrogeology and Geology for South Kyle II Wind Farm. More detailed information on the watercourse crossings is provided in Appendix B, which includes the preceding information, includes photographs and hydromorphological information associated with each crossing.

5. Rationale and Design

The design of the proposed track layout has been optimised as far as possible to make use of existing track and existing watercourse crossings, reduce the total area of land-take and minimise the number of new/upgraded watercourse crossings whilst accommodating other environmental or engineering related constraints. An illustration of typical watercourse crossing designs are shown in Appendix A.

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 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 contractor takes care to ensure that the construction does not pose a permanent obstruction to migrating species of fish, or riparian mammals;

- 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; 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:

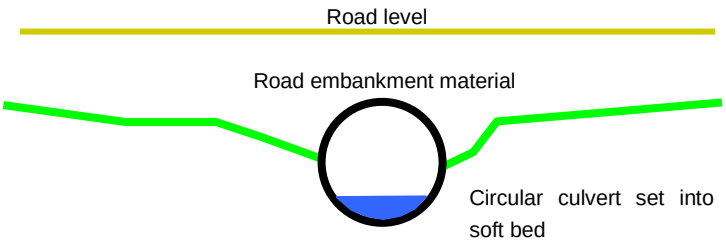
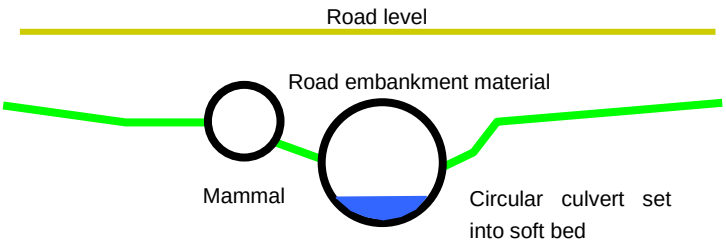
- Flow;
- Velocity;
- Channel bed material;
- Vegetation;
- The effects/consequences of erosion; and
- Types of erosion protection including:
  - Geotextile bank reinforcement;
  - Vegetation solution;
  - Dumped stone;
  - Laid stone (Rip-rap or equivalent); and
  - Concrete block systems.

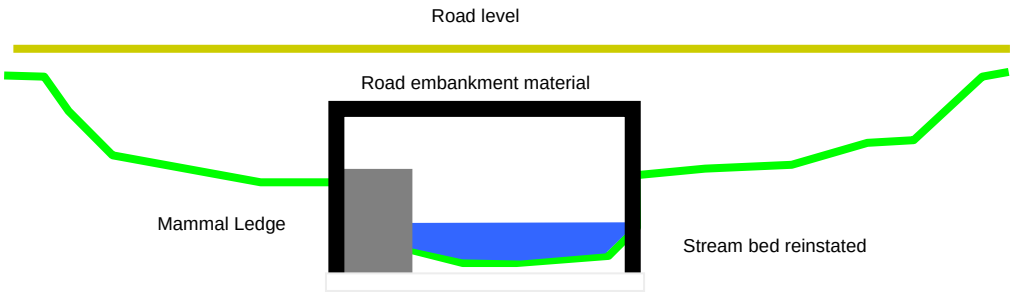
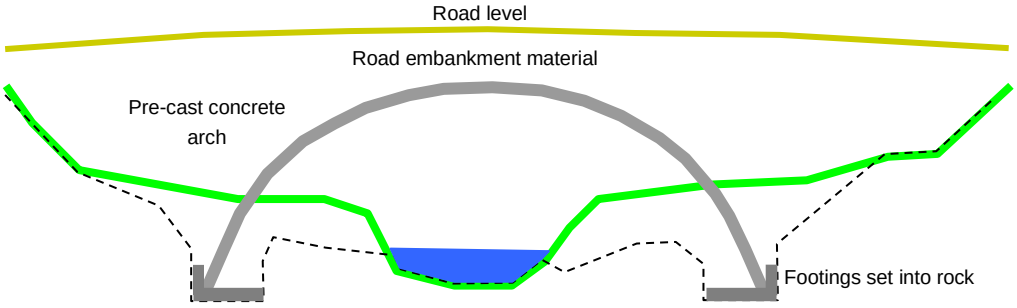
The appointed construction contractor will adhere to the following principles for culvert design and construction:

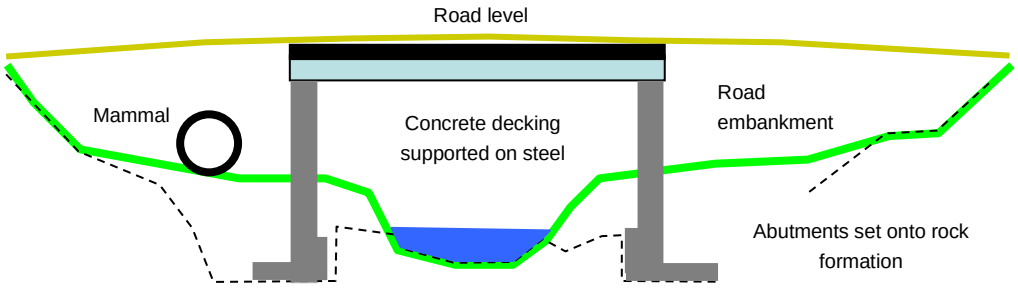
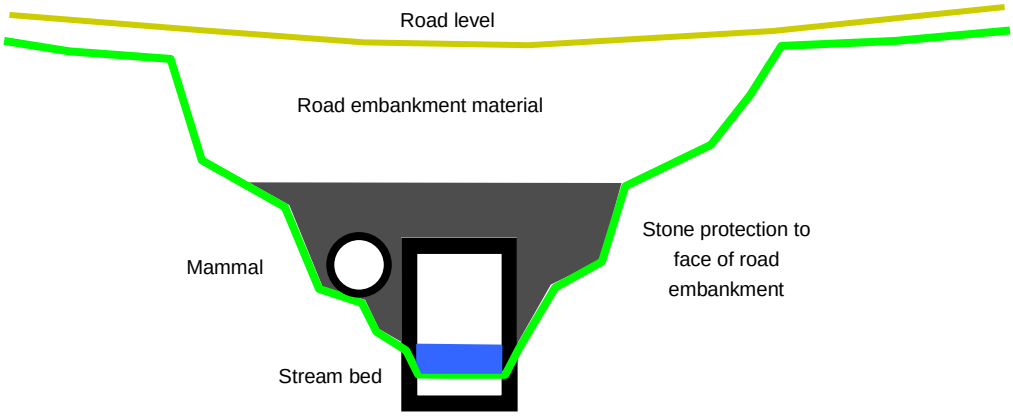
- Where appropriate, the natural low flow depths are maintained through culvert base;
- The culvert base should be buried below the natural bed level to allow for a naturalised culvert bed to be maintained during scour associated with high flow events;
- The culvert should be at least the same width 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, so that no restriction is related to established animal movement routes.

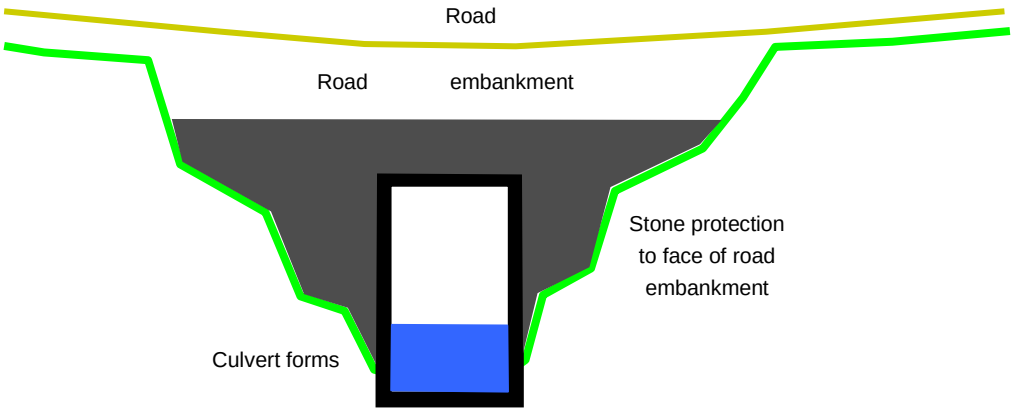
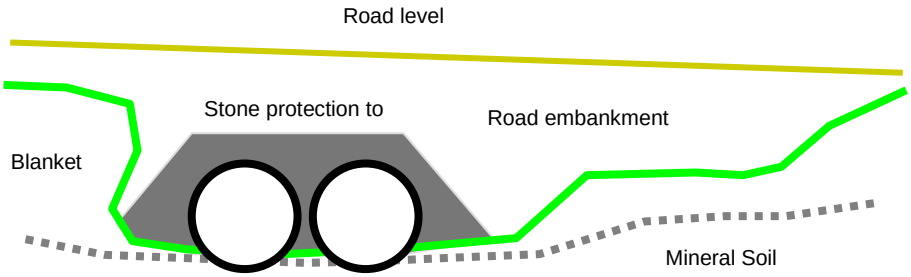
Appendices

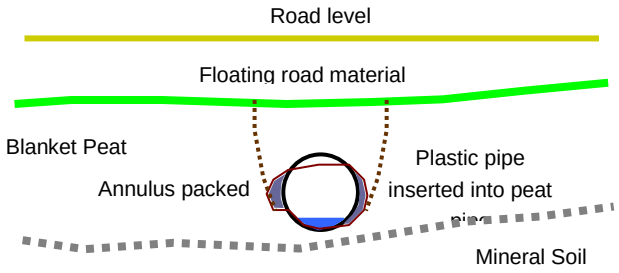
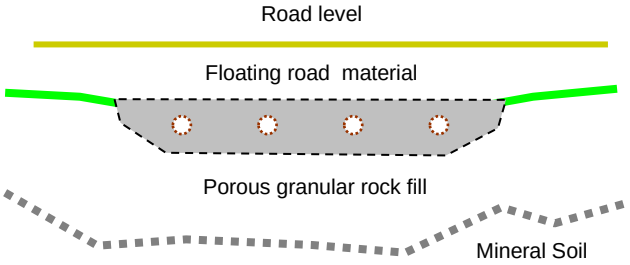
A. Illustration of Watercourse Crossing Types

Sketch of Channel Cross-Section / Longitudinal Section	
1	**Stream: Broad valley, Small channel, No Ecological provision**  Typical of small headwater burns on rolling topography, perhaps before slopes become steeper and streams gather volume and energy and are more incised. Altitude or downstream topographic features exclude the possibility of fish being present. A circular precast concrete or plastic pipe can be placed so that the invert is imbedded within the channel, allowing the natural bed to form. The pipe diameter is sized by inspection of stream morphology because calculations alone may only provide the illusion of precision.
2	**Stream: Broad valley, Small channel, Ecological provision**  Typical of small burns on rolling topography, similar to (1) above but where there is a requirement for mammals to pass along the watercourse. A circular precast concrete or plastic pipe can be placed so that the invert is imbedded within the channel, allowing the natural bed to form. The mammal passage should be at top of bank level and comply with minimum diameter requirements.

Sketch of Channel Cross-Section / Longitudinal Section	
3	**Stream: Broad valley, Medium channel, Ecological provision**  Typical of mid reach 'Highland' streams with granular and cobbled beds. The habitat is well suited to resident and migratory fish. Aquatic mammals are present. The Bottomless Box culvert structure contains a reinstated natural bed and the width allows for the provision of mammal ledges aligned with the banks. The freeboard provides passage for the design flood flows.
4	**Stream: Broad valley, Large channel, Ecological provision (or not)**  Typical of mid reach streams where superficial drift deposits are shallow. The stream has been cut into the rock and the bed consists of boulders and intact rock. Using a pre-cast concrete arch, avoids the need to pour concrete next to the watercourse. This also allows passage for mammals. The height of the arch will pass the design flood without surcharging.

Sketch of Channel Cross-Section / Longitudinal Section	
5	**Stream: Broad valley, Large channel, Ecological provision (or not)**  Typical of mid reach streams where superficial drift deposits are shallow. The stream has cut into the rock and the bed consists of boulders and intact rock. Placing Bottomless Box culvert(s) is an alternative to (4). These can be pre-cast and set on strip foundation to avoid concrete pouring adjacent to the watercourse. Passage for mammals where necessary. The height of the bridge soffit will pass the design flood without surcharging.
6	**Stream: Incised valley, Medium channel, Ecological provision**  Typically found on energetic streams which have cut into deep clay or glacial deposits. As flood flows cannot spread latterly, depth fluctuations may be considerable. The Box culvert structure contains a reinstated natural bed. As an alternative to mammal ledges a higher level circular pipe allows mammal passage. This would act as a high flow relief if required but be above the majority of minor floods.

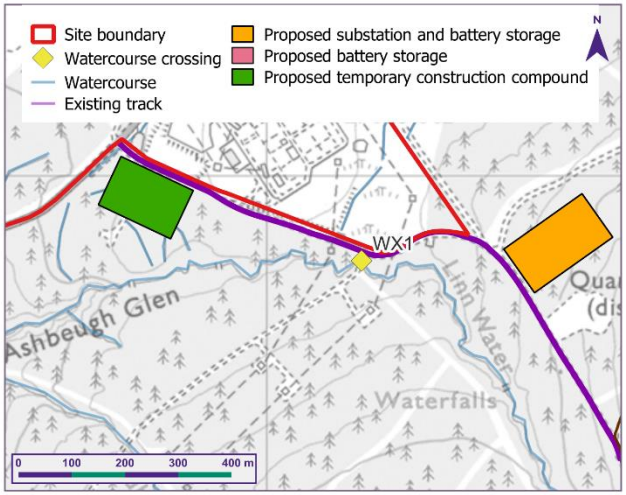
Sketch of Channel Cross-Section / Longitudinal Section	
7	**Stream: Incised valley, Large channel, No Ecological provision**  Typically found on energetic streams which have cut through superficial deposits and into the rock formation. Depth fluctuations may be considerable, as flood flows cannot spread laterally. The bedrock has been broken out to facilitate the placing of large Box culvert which will pass the design flow without surcharging.
8	**Peat Hagg: Broad, Large (deep) channel, No Ecological provision**  Typically found in deep blanket peat where the gulley has bottomed out at the mineral soil / rock interface. Normally flows are small arising from seepage out of the peat, with intermittent large storm flows which may carry blocky peat fragments. The soil / bedrock has been excavated to allow for bedding and twin circular culverts set at a level which will avoid upstream ponding. The pipe diameter is sized by inspection of the gully morphology because calculations alone may only provide the illusion of precision.

Sketch of Channel Cross-Section / Longitudinal Section	
9	**Peat Pipe: Buried, Large size**  These are encountered at random in blanket peat (and some may go un-noticed). Ensuring continuity of the bog hydrology is important. The section of peat pipe which will be below the road should be excavated and a 'best fit' plastic pipe should be inserted into the irregular ends. The space between the drainage pipe and the peat pipe requires to be sealed with natural material such as clay. The trench should be refilled with the excavated peat.
10	**Flushes: Various widths**  Within the area of the flush there is no clearly defined channel, other than perhaps a broad concave area. Flow is predominantly by sub-surface interflow and it is important to ensure this continuity and avoid compaction of the flush by the road. A drainage blanket wrapped in geotextile placed below the road construction will provide flow continuity without concentrating the discharges into a narrow channel.

B. Summary of Watercourse Details

WX1 (252179, 607841)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Artificial drainage channel, artificially modified watercourse
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Rounded pebbles
- **Riparian corridor:** Commercial Forestry, Moorland
- **Flow condition:** Fast
- **Culvert Dimensions (m)**: 1.5
- **Water width (m):** 1.0
- **Water depth (m):** 0.2
- **Bankfull width (m):** 1.2
- **Bankfull height (m):** 0.4
- **Banktop height (m):** 0.6
- **Flooded Bankfull width (m):** 1.2
- **Flooded Bankfull height:** 0.6

Note: None

Crossing Photographs

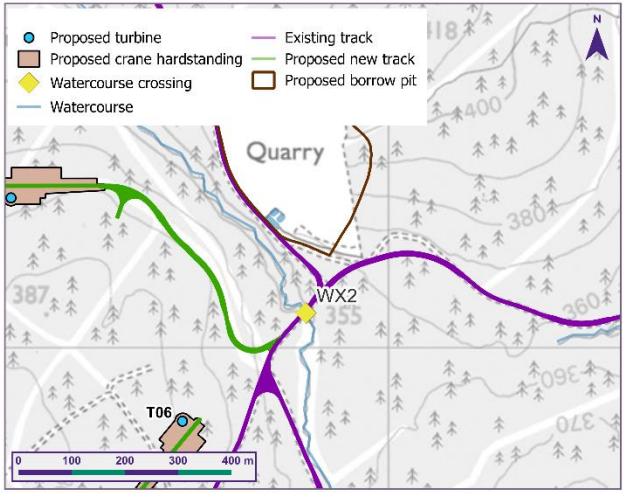
Upstream

Across

Downstream

WX2 (252846, 607065)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Artificial drainage channel
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Bedrock
- **Riparian corridor:** Commercial Forestry, Moorland
- **Flow condition:** Moderate
- **Culvert Dimensions (m)**: 0.5
- **Water width (m):** 1.0
- **Water depth (m):** 0.30
- **Bankfull width (m):** 1.3
- **Bankfull height (m):** 0.70
- **Banktop height (m):** 1.0
- **Flooded Bankfull width (m):** 1.5
- **Flooded Bankfull height:** 1.0

Note: Crossed by hardstanding track in good state, it creates a pool on the other side of the track and there returns to the same width see (picture 2).

Crossing Photographs

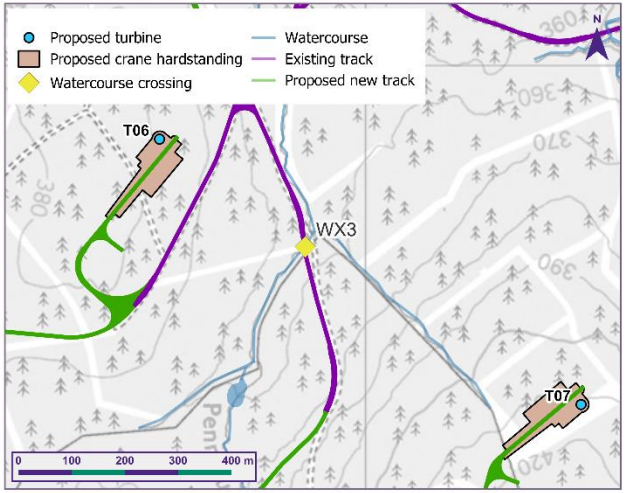
Upstream

Across

Downstream

WX3 (252888, 606660)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Artificially modified watercourse
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Bedrock, Vegetation
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Moderate
- **Culvert Dimensions (m)**: 0.5
- **Water width (m):** 1.3
- **Water depth (m):** 0.4
- **Bankfull width (m):** 1.3
- **Bankfull height (m):** 0.5
- **Banktop height (m):** 1.5
- **Flooded Bankfull width (m):** 1.5
- **Flooded Bankfull height:** 1.5

Note: Hardstanding track crosses this watercourse , in good condition, upstream (see picture 2 for other side of the stream), believe it is an artificially modified stream.

Crossing Photographs

Upstream

Across

Downstream

WX4 (251954, 606639)

Crossing Location

Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Incised
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Vegetation
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Slow
- **Water width (m):** 0.2
- **Water depth (m):** 0.25
- **Bankfull width (m):** 0.3
- **Bankfull height (m):** 0.5
- **Banktop height (m):** 0.6
- **Flooded Bankfull width (m):** 0.5
- **Flooded Bankfull height:** 0.6

Note: None

Crossing Photographs

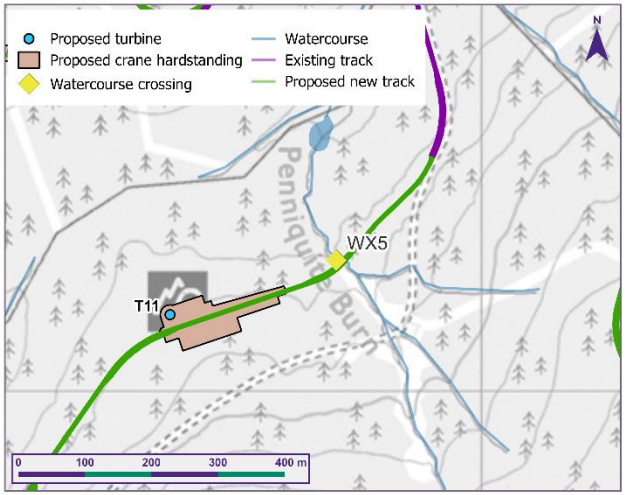
Upstream

Across

Downstream

WX5 (252783, 606196)

Crossing Location



Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Meandering
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Rounded pebbles
- **Riparian corridor:** Moorland, Commercial Forestry
- **Flow condition:** Fast
- **Water width (m):** 0.5
- **Water depth (m):** 0.1
- **Bankfull width (m):** 0.7
- **Bankfull height (m):** 0.5
- **Banktop height (m):** 0.7
- **Flooded Bankfull width (m):** 0.7
- **Flooded Bankfull height:** 0.7

Note: None

Crossing Photographs

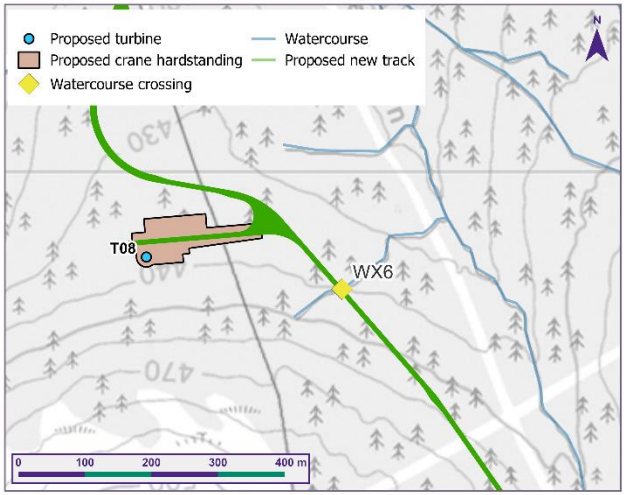
Upstream

Across

Downstream

WX6 (253577, 605824)

Crossing Location



Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Incised
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Vegetation, Soil
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Moderate

- **Water width (m):** 0.3
- **Water depth (m):** 0.5
- **Bankfull width (m):** 0.4
- **Bankfull height (m):** 0.6
- **Banktop height (m):** 0.9
- **Flooded Bankfull width (m):** 1.1
- **Flooded Bankfull height:** 1.0

Note: None

Crossing Photographs

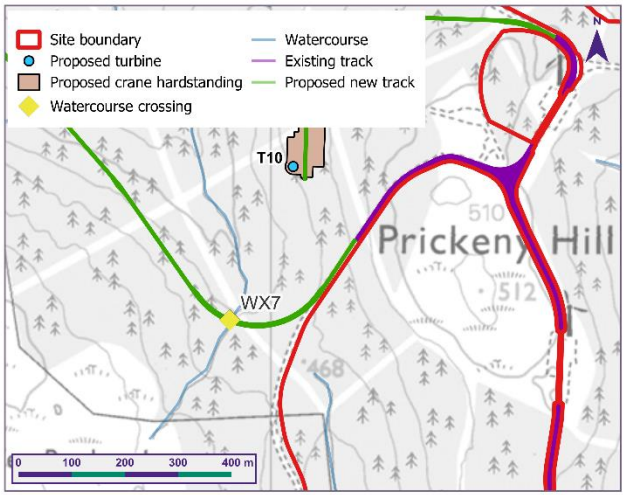
Upstream

Across

Downstream

WX7 (253924, 605409)

Crossing Location



Crossing Description

- **Existing Crossing:** No
- **Channel Type:** Incised
- **Gradient:** Gentle
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Vegetation, Soil
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Moderate
- **Water width (m):** 0.4
- **Water depth (m):** 0.4
- **Bankfull width (m):** 0.7
- **Bankfull height (m):** 1.0
- **Banktop height (m):** 1.5
- **Flooded Bankfull width (m):** 0.8
- **Flooded Bankfull height:** 1.5

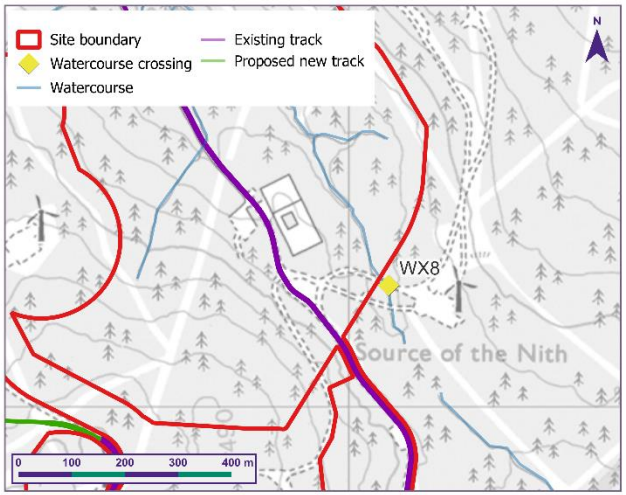
Note: None

Crossing Photographs

Upstream	Across	Downstream
		

WX8 (255076, 606228)

Crossing Location



Crossing Description

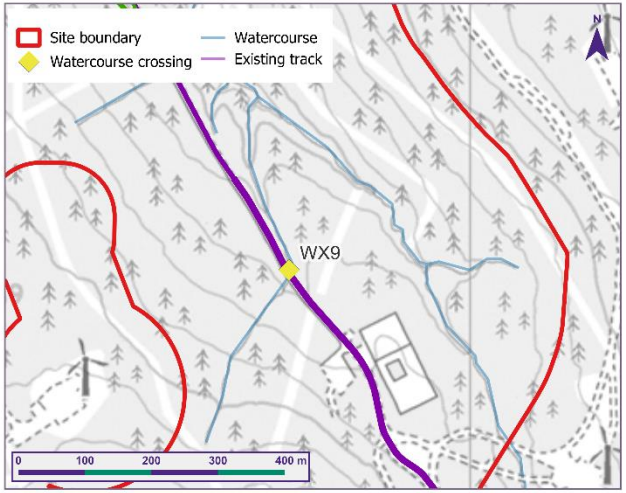
- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Poorly defined, Incised
- **Gradient:** Gentle
- **Valley form:** No obvious valley sides, Shallow vee
- **Bank condition:** Stable
- **Bed material:** Coarse gravel, Boulders, Rounded pebbles
- **Riparian corridor:** Moorland
- **Flow condition:** Moderate
- **Culvert Dimensions (m)**: 0.8
- **Water width (m):** 0.5
- **Water depth (m):** 0.10
- **Bankfull width (m):** 0.7
- **Bankfull height (m):** 0.5
- **Flooded Bankfull width (m):** 1.5
- **Flooded Bankfull height:** 0.6-0.7

Note: Kept in for consideration given proximity to existing track and at source of Nith location. This is a different culvert system, it has a landscaped feature of two pools and artificial channel above the upstream culvert, which is approximately 20m from the road and steep sided slope. It also has two watercourses entering the culvert, the other looks like a drainage ditch. The culvert doesn't cross the road perpendicularly but at an angle of 45 degrees, emerging on the downstream side approx. 50m from the upstream culvert. The downstream watercourse is more natural and dimensions and descriptions are from the downstream watercourse.

WX8 (255076, 606228)		
Crossing Photographs		
Upstream	Across	Downstream
		
Culvert view (upstream of crossing)		Culvert view (downstream of crossing)
		

WX9 (254729, 606500)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Poorly defined
- **Gradient:** Moderate
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Rounded pebbles, Coarse gravel, Boulders
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Moderate
- **Culvert Dimensions (m)**: 1.1
- **Water width (m):** 0.4
- **Water depth (m):** 0.1
- **Bankfull width (m):** 0.6
- **Bankfull height (m):** 0.7
- **Flooded Bankfull width (m):** 1.5
- **Flooded Bankfull height:** 0.8-1.0

Note: The upstream culvert has another 'culvert pipe' diverting the roadside drainage ditch water flow over this culvert and continues draining on the other side of the culvert (see photo).

Crossing Photographs

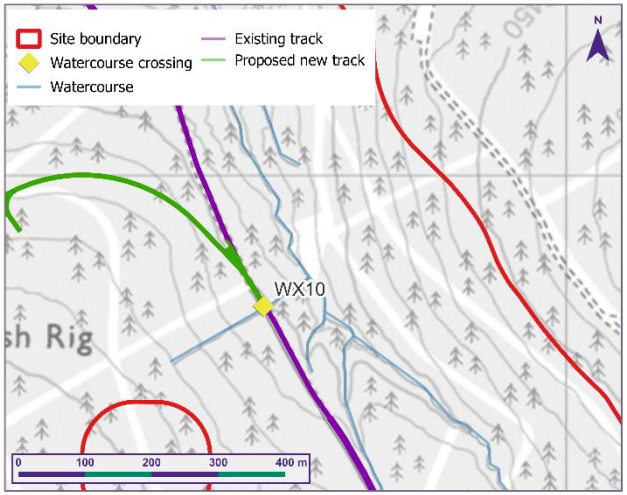
Upstream view of Culvert

Across

Downstream

WX10 (254547, 606804)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Incised
- **Gradient:** Moderate
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Coarse gravel, Boulders
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Moderate
- **Culvert Dimensions (m)**: 1.2
- **Water width (m):** 0.3
- **Water depth (m):** 0.1
- **Bankfull width (m):** 0.5
- **Bankfull height (m):** 0.35
- **Flooded Bankfull width (m):** 1.5-2.0
- **Flooded Bankfull height:** 0.8

Note: Upstream gradient steeper than downstream. Downstream has incised valley.

Crossing Photographs

Upstream

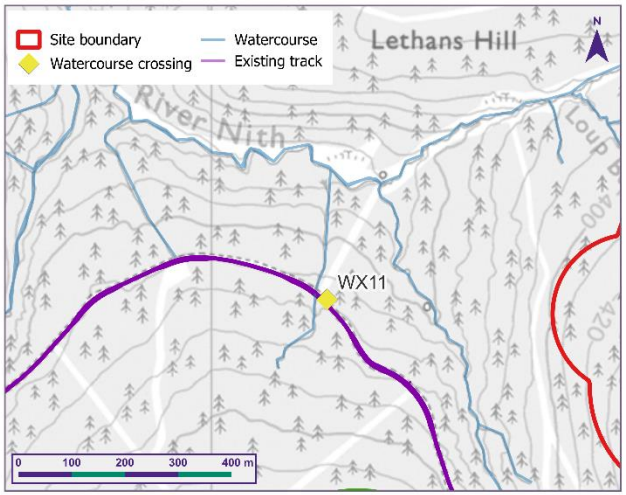
Across

Downstream

WX10 (254547, 606804)	
Culvert view (upstream of crossing)	Culvert view (downstream of crossing)
	

WX11 (254218, 607359)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**:
- **Channel Type:** Incised
- **Gradient:** Moderate
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Fine sand/silt, Rounded pebbles, Coarse gravel, Boulders
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Moderate
- **Culvert Dimensions (m)**: 1.0
- **Water width (m):** 0.3
- **Water depth (m):** 0.15
- **Bankfull width (m):** 0.4
- **Bankfull height (m):** 0.35
- **Flooded Bankfull width (m):** 0.5-0.7
- **Flooded Bankfull height:** 0.6

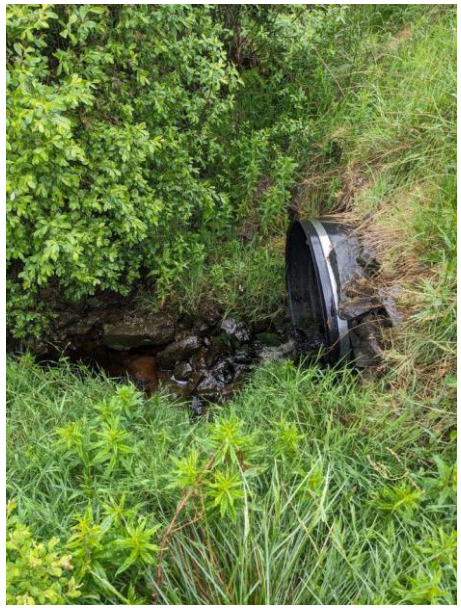
Note: None.

Crossing Photographs

Upstream view of Culvert

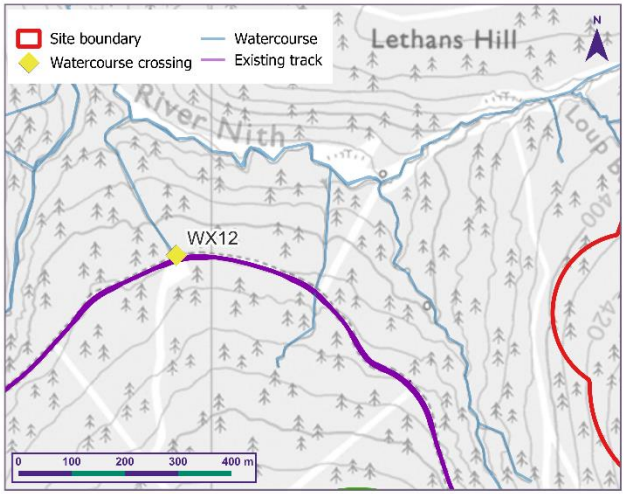
Across

Downstream

WX11 (254218, 607359)	
Culvert view (upstream of crossing)	**Culvert view (downstream of crossing**
	

WX12 (253935, 607440)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Incised, Artificial drainage channel, Artificially modified watercourse
- **Gradient:** Moderate
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Coarse gravel, Boulders
- **Riparian corridor:**
- **Flow condition:**
- **Water width (m):** 0.2
- **Water depth (m):** 0.1
- **Bankfull width (m):** 0.4
- **Bankfull height (m):** 0.3
- **Flooded Bankfull width (m):** 1.0
- **Flooded Bankfull height:** 0.5

Note: Water channel upstream was dry. Watercourse downstream was almost dry (must be water draining into from roadside), but it has signs of erosion, so water has been present.

Crossing Photographs

Upstream

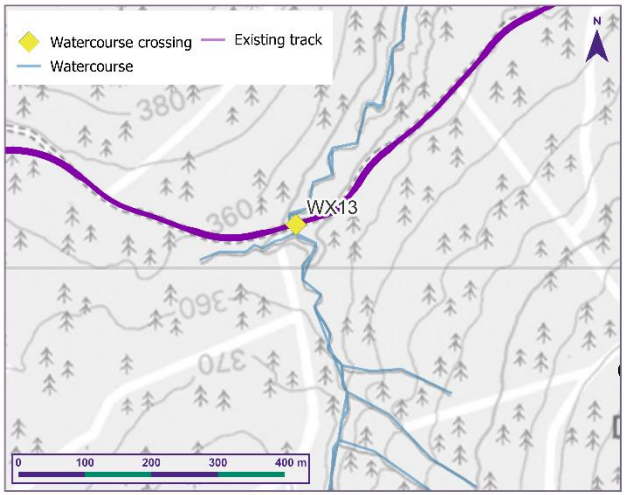
Across

Downstream

WX12 (253935, 607440)	
Culvert view (upstream of crossing)	Culvert view (downstream of crossing)
	

WX13 (253463, 607065)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Concrete
- **Crossing Condition (existing)**: Excellent
- **Channel Type:** Incised
- **Gradient:** Moderate
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Fine sand/silt, Rounded pebbles, Coarse gravel, Boulders
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Moderate
- **Culvert Dimensions (m)**: 2.2
- **Water width (m):** 1.0
- **Water depth (m):** 0.3
- **Bankfull width (m):** 1.5
- **Bankfull height (m):** 0.9
- **Flooded Bankfull width (m):** 1.5-2.0
- **Flooded Bankfull height:** 0.9-1.0

Note: None

Crossing Photographs

Upstream

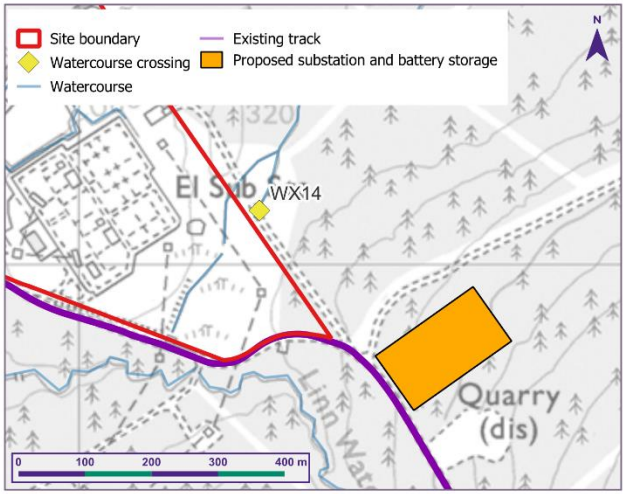
Across

Downstream

WX13 (253463, 607065)	
Culvert view (upstream of crossing)	Culvert view (downstream of crossing)
	

WX14 (252272, 608081)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Poorly defined
- **Gradient:** Gentle
- **Valley form:** No obvious valley sides
- **Bank condition:** Stable
- **Bed material:** Boulders, Coarse gravel, Vegetation
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Slow
- **Culvert Dimensions (m)**: 0.45
- **Water width (m):** 0.25
- **Water depth (m):** 0.05
- **Bankfull width (m):** 0.7
- **Bankfull height (m):** 0.3
- **Flooded Bankfull width (m):** 1.0
- **Flooded Bankfull height:** 0.5

Note: Very little water from upstream and some stagnant pools downstream.

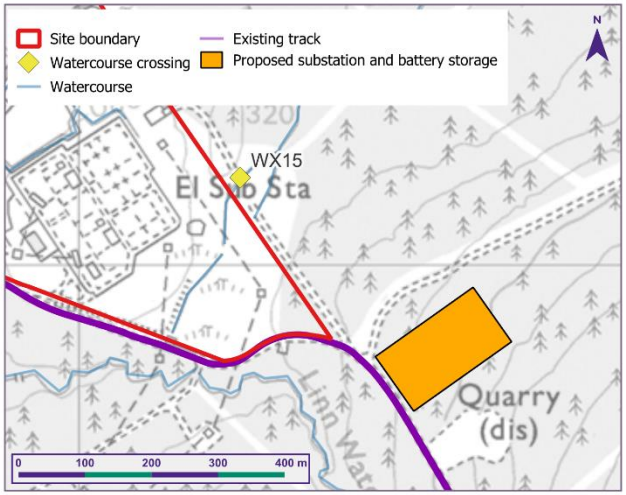
Crossing Photographs

Upstream

Across

Downstream

WX15 (252243, 608131)	
Crossing Location	**Crossing Description**



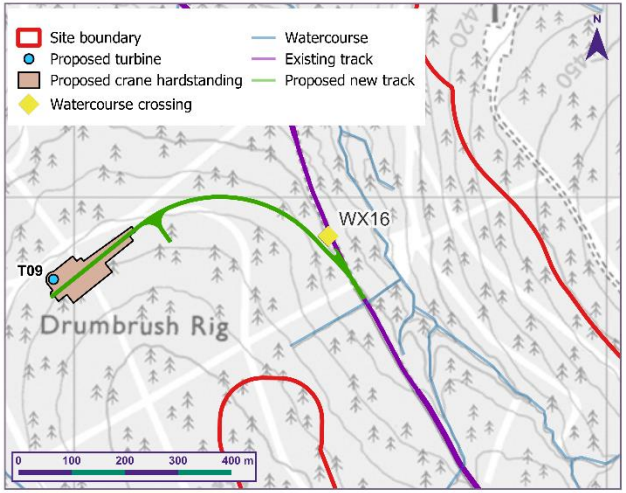
- **Existing Crossing:** No

Note: No WX here. The only thing I could find was the small pipe in the photo, but I couldn't find anything at the other side of the road.

Crossing Photographs		
Upstream	**Across**	**Downstream**

WX16 (254478, 606927)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Average
- **Channel Type:** Poorly defined, Incised
- **Gradient:** Moderate
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Coarse gravel, Boulders
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Moderate
- **Culvert Dimensions (m)**: 0.45
- **Water width (m):** 0.2
- **Water depth (m):** 0.07
- **Bankfull width (m):** 0.5
- **Bankfull height (m):** 0.26
- **Flooded Bankfull width (m):** 1.0
- **Flooded Bankfull height:** 0.5

Note: None.

Crossing Photographs

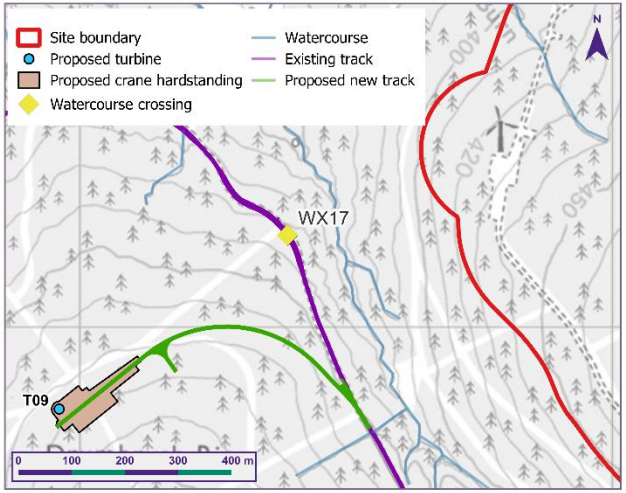
Upstream

Across

Downstream

WX17 (254391, 607172)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Average
- **Channel Type:** Poorly defined, Incised
- **Gradient:** Moderate
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Coarse gravel, Boulders
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Slow
- **Culvert Dimensions (m)**: 0.45
- **Water width (m):** 0.25
- **Water depth (m):** 0.07
- **Bankfull width (m):** 0.4
- **Bankfull height (m):** 0.25
- **Flooded Bankfull width (m):** 1.0
- **Flooded Bankfull height:** 0.4

Note: None

Crossing Photographs

Upstream

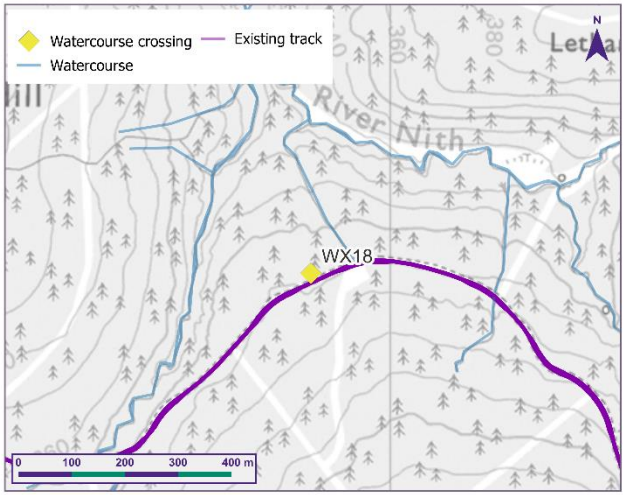
Across

Downstream

WX17 (254391, 607172)	
Culvert view (upstream of crossing)	Culvert view (downstream of crossing)
	

WX18 (253852, 607414)

Crossing Location



Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** None evident, Poorly defined
- **Gradient:** Gentle
- **Valley form:** No obvious valley sides
- **Bank condition:** Stable
- **Bed material:** Vegetation, Peat
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Slow
- **Culvert Dimensions (m)**: 0.5
- **Water width (m):** 0.2
- **Water depth (m):** 0.05
- **Bankfull width (m):** 0.5
- **Bankfull height (m):** 0.15
- **Flooded Bankfull width (m):** 1-3
- **Flooded Bankfull height:** 0.5

Note: Upstream from culvert is artificial drainage channel. Downstream the water is ponding with a small watercourse flowing from it.

Crossing Photographs

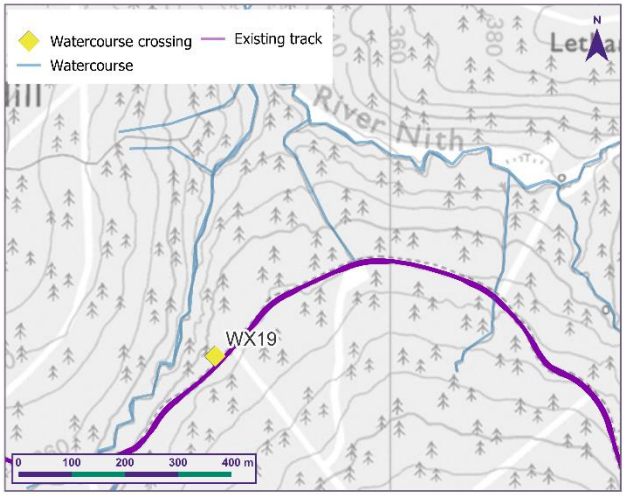
Upstream

Across

Downstream

WX19 (253672, 607259)

Crossing Location



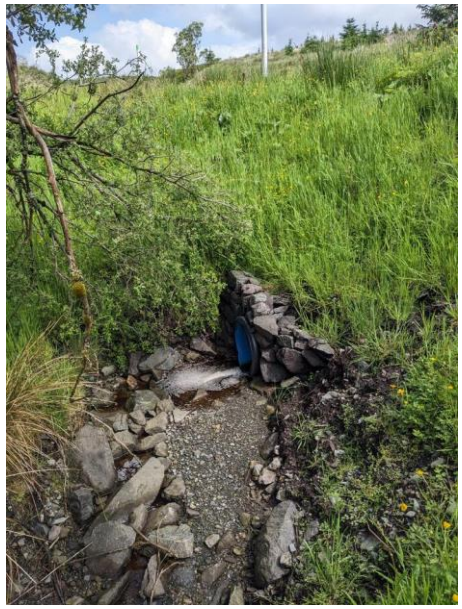
Crossing Description

- **Existing Crossing:** Yes
- **Crossing Type (existing)**: Circular Culvert
- **Crossing Material (existing)**: Plastic
- **Crossing Condition (existing)**: Good
- **Channel Type:** Incised
- **Gradient:** Moderate
- **Valley form:** Shallow vee
- **Bank condition:** Stable
- **Bed material:** Fine sand/silt, Rounded pebbles, Coarse gravel, Boulders, Peat
- **Riparian corridor:** Commercial Forestry
- **Flow condition:** Slow
- **Culvert Dimensions (m)**: 0.45
- **Water width (m):** 0.4
- **Water depth (m):** 0.06
- **Bankfull width (m):** 1.0
- **Bankfull height (m):** 0.35
- **Flooded Bankfull width (m):** 2.0
- **Flooded Bankfull height:** 0.5

Note: Upstream is a drainage channel from old forestry. Not much water.

Crossing Photographs

Upstream	Across	Downstream
		

WX19 (253672, 607259)	
Culvert view (upstream of crossing)	Culvert view (downstream of crossing)
	

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