TORRANCE WIND FARM EXTENSION II

TECHNICAL APPENDIX 10.4: FISH HABITAT SURVEY

DECEMBER 2022

Prepared By:

Mhor Environmental Ltd

73 Bellshill Road
Motherwell
North Lanarkshire
ML1 3SJ

T +44 (0)1698 526 317 l **E** info@mhorenvironmental.co.uk
W www.mhorenvironmental.co.uk

Registered in Scotland No. SC623684

On Behalf of:

Arcus Consultancy Services

7th Floor
144 West George Street
Glasgow
G2 2HG

T +44 (0)141 221 9997 l **E** info@arcusconsulting.co.uk
w www.arcusconsulting.co.uk

Registered in England & Wales No. 5644976

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

This Technical Appendix (TA) presents the methods and results of a Fish Habitat Survey (FHS) undertaken to provide baseline ecological information for the proposed Torrance Wind Farm Extension II, hereafter referred to as the 'Proposed Development'. Mhor Environmental Ltd was commissioned by Arcus (an ERM Group Company) on behalf of Infinergy (the 'Client') to undertake the FHS.

The following terminology is used throughout this TA:

- **The Proposed Development**: the whole physical process involved in the development of land at Torrance Wind Farm Extension II, including wind farm construction, operation and decommissioning (not a piece of land or an area);
- **The site**: the proposed area of land, provided by the Client, within which all development works for the wind farm will take place (shown as the red-line boundary on Figure 10.4.1, Annex A,).

1.2 Site Description

The site lies to the north of the M8 motorway, approximately 1.5 km north of Harthill, North Lanarkshire. There is one main watercourse within the site. The main watercourse, the How Burn, flows north then east along the edge of the southern site boundary into the River Almond.

In addition to the How burn and River Almond, there are numerous field drains which flow through and in close proximity to the site. These watercourses flow into the How Burn, which is a tributary of the River Almond. All watercourses included in this survey fall under the River Almond catchment.

The site is dominated by farmland with small areas of moorland. An area of woodland is present within the centre of the site. Large forestry plantations are present at the southern end of the site.

1.3 Objectives

The purpose of the FHS was to provide a detailed assessment of watercourse bankside and habitat quality along the How Burn, its various tributaries / field drains, and at the confluence of the River Almond, to obtain detailed information regarding the suitability of watercourses for sensitive fish species within and in close proximity to the site. Detailed information obtained from the FHS will provide an accurate and robust baseline on which to base the Environmental Impact Assessment (EIA). A desktop study of the known barriers downstream of the site will also provide information on passage for migratory fish.

The aims of the FHS were to:

- Assess salmonid (Atlantic Salmon *Salmo salar* and sea/brown trout *Salmo trutta*) Utilisation Potential and Habitat Quality of watercourses within the zone of influence of the Proposed Development, including an assessment and searches for lampreys (*Lampetra Sp.*) and eel (*Anguilla anguilla*) habitat;
- To determine the requirement for further surveys (including targeted electrofishing surveys); and
- Establish baseline information for future comparison studies, potentially required during the Proposed Development construction and post-construction phases.

1.4 Survey Limitations

At the time of writing this report, the layout of Development infrastructure within the site, including potential watercourse crossings, were not known. Land access was also denied to the east of the site, beyond Torrance Farm and Blackbog Wood, due to landowner objection. These limiting factors were not considered to present a significant constraint to the survey.

2 METHODS

2.1 Desktop Study

A detailed desktop study was undertaken to identify any statutory, non-statutory or designated/classified sites, relevant to the aquatic environment, within 2 km of the site.

The following web-based sources were utilised for this:

- NatureScot (formerly Scottish Natural Heritage) SiteLink website[1] - information provided covered the location of any designated sites, statutorily protected species or habitats;
- SEPA website[2] - information provided covered classified and designated waterbodies under the WFD and Freshwater Fish Directive (FFD);
- Marine Scotland MAPS NMPi website[3] – information provided on Atlantic salmon and Sea trout records. Information/ location of barriers to migratory species.
- National Biodiversity Network (NBN)[4] – information provided covered localised species records, and focused on legally protected and priority species; and
- Google Earth[5] – satellite imagery provided detailed maps used during fieldwork.

2.2 Fish Habitat Survey

The FHS was carried out by Leigh Kelly BA MRes MIFM of Mhor Environmental Ltd (Scottish Fisheries Co-Ordination Centre (SFCC) Qualified Electrofishing Team Lead and Salmonid Habitat Surveyor). The FHS was conducted on the 16th June 2021. Survey weather conditions were overcast and light rain throughout the day, with moderate to high water levels, and good water clarity.

During the field survey, a combination of methods developed by Hendry and Cragg-Hine[6], and those developed for the river/Fish Habitat surveying[7],[8] were adopted to record both Fish Habitat Quality (FHQ) and Fish Utilisation Potential (FUP).

FHQ is the quality of habitat features present as defined by Hendry and Cragg-Hine[6]. FHQ is assessed using the habitat characteristics observed and a score ranging from poor to good is given to each sampling location.

FUP is based on how extensively fish are likely to use a specific stretch of the watercourse and is assessed on other environmental factors including barriers to fish migration, water quality and connectivity to migratory routes. FUP is scored between low and high.

[1] https://sitelink.nature.scot/home (last accessed December 2022)

[2] www.sepa.org.uk (last accessed December 2022)

[3] https://marinescotland.atkinsgeospatial.com/nmpi/ (last accessed December 2022)

[4] https://nbn.org.uk/ (last accessed December 2022)

[5] https://earth.google.com/web/ (last accessed December 2022)

[6] Hendry K, Cragg-Hine D (1997) – A Guidance Manual. APEM Ltd, Fisheries Technical Manual 4, R & D Technical Report W44, Version 1.0/07-97. R & D Project 603.

[7] Environment Agency (2003) – River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual: Environment Agency, Bristol.

[8] SFCC. (2007) - Fisheries Management SVQ – Habitat Surveys Training Course Manual. Scottish Fisheries Coordination Centre.

Both FHQ and FUP were determined based on expert opinion following identification and classification of suitable habitat features and other environmental factors within the catchment.

During the field survey the watercourse and the surrounding habitats were characterised and assessed according to the following criteria (These characteristics were used to help determine the FHQ and FUP scores):

- Predominant channel substrate and flow-types;
- Habitat features;
- Modifications to the channel and banks;
- Channel vegetation types;
- Vegetation structure of the banks and banktop; and
- Land-use.

The habitat was then defined as described in Table 1.

Table 1: Fish Habitat Classification

Habitat Type*	Classification
Spawning habitat	Stable gravel up to 30 cm deep that is not compacted or contains excessive silt. Substrate size with a diameter of 1.3 to 10.2 cm.
Salmon Fry (0+) habitat	Shallow (<20 cm) and fast flowing water indicative of riffles and runs with a substrate dominated by gravel and cobbles.
Salmon Parr (1+) habitat	Riffle-run habitat that is generally faster and deeper than fry habitat (20-40 cm). Substrate consists of boulder, cobbles and gravels.
Trout Fry (0+) habitat	Slow to medium flowing shallow water with a substrate dominated by pebbles and smaller cobbles, often concentrated at stream margins.
Trout Parr (1+) habitat	Variety of substrate sizes; undercut banks, tree roots, big rocks; deeper, slower water.
Lamprey spawning habitat	Stable gravel up to 30 cm deep that is not compacted or contains excessive silt (but may contain some sand). Substrate size varies from gravels to pebbles.
Juvenile lamprey habitat	Optimal: Stable fine sediment or sand ≥15 cm deep with low water velocity and the presence of organic detritus/plant material. Sub-optimal: Shallow sediment (<15 cm deep), often patchy and interspersed among coarser substrate.
Eel Habitat	Variety of habitats including streams, rivers, and muddy or silt-bottomed lakes during their freshwater stage.
Glides	Smooth laminar flow with little surface turbulence and generally greater than 30 cm deep.
Pool	No perceptible flow. Shallow pool ≤0.3 m – Deep pool >0.3 m
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth.
Obstructions to migration	Impassable falls, weirs, bridge sills etc. shallow braided river sections preventing upstream migration during low flows.

** If significant amounts of different habitat types were found to co-exist in the same section, these habitat classifications were adequately described. For example, in the case of salmonids, fry and parr habitat is classified as juvenile habitat. Where parr habitat is mentioned, this refers to habitat that has principally been identified as habitat more suited to parr than fry, however, habitually contains a lower quantity of fry habitat and habitat which is suited to both fry and parr. Salmonid definitions in Table 2 are adapted from SFCC Habitat Manual (2007i) and Hendry & Cragg Hine (1997), and lamprey from Maitland (2003).l (2000).*

2.3 Habitat Requirements

2.3.1 Salmonids

The physical habitat requirements of juvenile salmonids have been subject to a considerable amount of detailed study[6,9,10,11]. Trout and salmon spawn in late autumn and early winter, depositing their eggs in redds which they excavate in gravel and pebble substrates. Spawning depth can range from 5 cm to 90 cm[12], but it is likely that habitat is selected on the basis of suitable substrate and flow rather than depth.

Eggs are often deposited in areas of accelerating flow, such as the tails of pools and glides, upstream from riffles. However, in upland streams eggs may be deposited in any areas of gravel that can be physically moved. A good supply of oxygen is essential for eggs to develop, and this is facilitated by a flow of water through the gravel. Clogging with fine sediment such as silt and fine sand reduces water flow resulting in egg mortality due to lack of oxygen. Egg survival is also affected by redd 'washouts' during winter spates – the direct, physical, scouring out of eggs from the gravel. Substrate stability, the dynamics of water flow and the weather all determine the extent of siltation and washouts. After hatching the young fry remain in the gravel as alevins, absorbing nutrient from the remaining yolk sac.

On emergence, usually between March and early May, the young fry disperse from the redds and set up territories that they defend aggressively. Salmon fry prefer fast flows (>30 cm/s) and favour areas with surface turbulence (riffle habitat). They require a rough bed of pebble, cobble and gravel. Trout fry prefer areas of relatively lower velocity water near the streambed and often inhabit slower flows than salmon fry. Cover from stones, plants or debris is required and good cover is essential for maintaining high fry densities.

Salmon that have survived their first winter (parr) prefer deeper water than fry (typically 15-40 cm) and a coarser substrate often consisting of pebbles, cobbles and boulders. Trout parr generally favour areas of relatively low current speed where cover is available. Juvenile trout are often to be found in cover alongside the banks, in undercuts, among tree roots or in marginal vegetation. Cover remains important for adult trout and salmon particularly in smaller streams. In larger rivers and lochs this may be less important, as deep water provides refuge.

2.3.2 Lampreys

A review of lamprey ecology is provided by Maitland (2003)[13]. Adult lampreys aggregate to spawn and extrude their eggs into 'nests' excavated in the riverbed. Suitable spawning substrate varies between species. Brook lampreys spawn in areas of coarse sand and gravel while the larger species select areas of gravel, pebble and cobble. After hatching the young lamprey larvae, known as ammocoetes, drift downstream with the current. They settle in nursery habitat consisting of fine, soft substrate in well oxygenated, slow flowing water.

The ammocoetes are blind and feed on fine particulate matter such as diatoms, algae and bacteria. Ammocoetes spend several years in this muddy nursery habitat before metamorphosing (or transforming) from larval to adult form. The larvae of river and brook

[9] Crisp, D.T. 1993. The environmental requirements of salmon and trout in fresh water. Freshwater Forum, 3(3): 176-201.

[10] Klemetsen, A., Amundsen, P-A, Dempson, J.B., Jonsson, B., Jonsson, N., O'Connell, M.F. and Mortensen, E. 2003. Atlantic salmon Salmo salar L., brown trout Salmo trutta L. and Arctic charr Salvelinus alpinus (L.): a review of aspects of their life histories. Ecology of Freshwater Fish, 12, 1-19.

[11] Youngson, A & Hay, D. 1996 The Lives of Atlantic Salmon. An illustrated account of the life-history of Atlantic salmon. Swan Hill Press, Shrewsbury

[12] Neary, J.P. 2006. Use of Physical Habitat Structure to Assess Stream Suitability for Brown Trout: A Case Study of Three Upland Scottish Streams. Ph.D. Thesis, University of Stirling, October 2006.

[13] Maitland, P.S. 2003. Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

lamprey are indistinguishable from one another. Following transformation, it becomes possible to distinguish between them on the basis of morphology and colouration[14].

Upstream migrating lampreys may be prevented from reaching spawning grounds by both natural and man-made barriers. They are weak jumpers, so can be prevented from moving upstream by relatively low vertical barriers.

2.3.3 Eel

Eel habitat requirements have received less attention than those of salmonid fish. Tesch (1977)[15] suggests that so long as temperature and oxygen requirements are met, there are few stretches of water that are not suitable for eels. The main requirement for eels is cover, as they are averse to light and require suitable refuges during daylight hours. Eels of different size show different substrate preferences. Larger eels require large hollows, crevices or weed beds whereas small eels are sometimes abundant in cobble substrates, where they can burrow between the stones. Tree stumps, roots and other large structures provide ideal cover for eels. Eel diet is diverse, but the majority of diet consists of benthic species[16]. Migratory pathways can be severely impacted by barriers, both man-made and natural[17].

2.4 Sampling Locations

A total of 12 sampling locations were assessed for their potential to support habitat for salmonids, lamprey and eel; as summarised in Table 2 and shown on Figure 1, Annex A. Photographs of each sampling locations are included in Annex B.

Table 2: FHS Sampling Locations

Sampling Location Code*	Watercourse	Downstream Location	Upstream Location
HH1	How Burn	NS 88174 64236	NS 88079 64215
HH2	How Burn	NS 88897 64567	NS 88823 64527
HH3	How Burn	NS 89048 64635	NS 88985 64601
HH4	Tributary of the How Burn (field drain)	NS 89105 64660	NS 89179 64527
HH5	How Burn	NS 89111 64611	NS 89104 64658
HH6	How Burn	NS 89313 64520	NS 89276 64577
HH7	How Burn	NS 90065 64633	NS 90038 64612
HH8	Tributary of the How Burn (field drain)	NS 89928 65220	NS 89852 65165
HH9	Tributary of the How Burn (field drain)	NS 90465 65567	NS 90377 65522

[14] Gardiner R (2003). Identifying Lamprey. A Field Key for Sea, River and Brook Lamprey. Conserving Natura 2000 Rivers Conservation Techniques Series No. 4. English Nature, Peterborough.

[15] Tesch, F. W. 1977. The Eel, Biology and Management of Anguillid Eels. John Wiley and Sons, New York.

[16] Moriarty, C.M. 1978. Eels: A Natural and Unnatural History. David & Charles, Newton Abbot. 192pp

[17] Mouton, A.M., Huysecom, S., Buysse, D. et al. Optimisation of adjusted barrier management to improve glass eel migration at an estuarine barrier. J Coast Conservation 18, 111–120 (2014).

Sampling Location Code*	Watercourse	Downstream Location	Upstream Location
HH10	Tributary of the How Burn (field drain)	NS 90895 65770	NS 90802 65735
HH11	How Burn	NS 93385 65725	NS 93361 65734
HH12	River Almond	NS 93457 65562	NS 93423 65543

**HH annotates Harthill*

3 RESULTS

3.1 Desktop Study

3.1.1 *NatureScot SiteLink website*[18]

No statutory designated sites are present within a 2 km radius of the site. One non-statutory designated site is within 2 km of the site. Polkemmet Country Park is located 1.5 km to the southeast of the Proposed Development (Ordnance Survey National Grid Reference NS 92399 64983).

3.1.2 SEPA Water Classification Hub website[19]

Two watercourses within and in close proximity to the site are classified and designated under the Water Framework:

- **River Almond** (Source to Foulshiels Burn confluence) is a river (ID: 3003) in the River Almond catchment of the Scotland River basin district. The main stem is approximately 18.41 kilometres in length. The water body has been designated as not heavily modified, mid-altitude, small and calcareous in nature. The pressure associated with this water body are morphological alterations – impounding weir / dam (fish passage), point source pollution – sewage disposal, and diffuse source pollution – mining / quarry and road transport intensive use. Associated protected areas River Almond (Lothian) – Freshwater Fish (Existing). WFD classification data for the River Almond is presented in Table 3.
- **How Burn** is a river (ID: 3031) in the River Almond catchment of the Scotland River basin district. The main stem is approximately 7.98 kilometres in length. The water body has been designated as not heavily modified, lowland, small and calcareous in nature. The pressure associated with this water body are morphological alterations – impounding weir / dam (fish passage), point source pollution – sewage disposal, and diffuse source pollution – sewage disposal. Associated protected areas River Almond (Lothian) – Freshwater Fish (Existing). WFD classification data for the How Burn is presented in Table 3.

Table 3: Water Classification Data

2014 Parameters	How Burn	River Almond (Source to Foulshiels Burn confluence)
Overall status	Poor	Poor
Access for fish migration	Poor	Poor
Water flows and levels	High	High
Physical condition	Moderate	Good

[18] https://sitelink.nature.scot/map (accessed online 06/08/2021)

[19] https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (accessed online 06/08/2021)

Freedom from invasive species	High	High
Water Quality	Moderate	Moderate

3.1.3 Marine Scotland MAPS NMPi (*National Marine Plan interactive)*[3] website

3.1.3.1 Barriers to Fish Migration

Various records detailing barriers to fish migration are available on the Marine Scotland National Marine Plan Interactive Map[3]. Cramond Angling Club produced a report in 2010 identifying 40 potential obstructions within the catchment which may present barriers to migratory fish and therefore warrant further investigation[20].

The Rivers and Fisheries Trusts of Scotland (RAFTS) in partnership with the Scottish Environment Protection Agency Water Environment Fund (SEPA WEF) and various other stakeholders including City of Edinburgh Council and West Lothian Council, through the River Almond Barriers Project[21], are looking to deliver improvements to the River Almond at a catchment scale. The work consists of in-channel and new channel changes to the river and structures within the river to improve the status of the reaches to 'good' under EU Water Framework Directive (WFD) categorisation as well as improving the setting, access and interpretation of the River Almond. The work is likely to deliver significant benefits in terms of fish migration.

The following barriers to fish migration have been removed or improved through the River Almond Barriers Project:

- Livingston Rugby Club Weir;
- Old Inveralmond Bridge Weir, Howden; and
- Kirkton Weir.

West Lothian Council commissioned works to commence on the Mid Calder Weir in September 2021[22]. Once complete, the improvement works will 'unlock' upstream migration within the River Almond as four weirs upstream were previously eased as part of the project.

Dowies Weir downstream of the site remains a barrier to fish migration. However, Forth Rivers Trust, through the RiverLife project[23], are in partnership with the City of Edinburgh Council forming plans to adapt the remaining weir structure to better allow all species of fish to move up and down the river.

3.1.3.2 Salmon and Sea Trout – Scottish Salmon Rivers data

Both Atlantic salmon and sea trout have been recorded downstream of the site on the River Salmon[24]. The closest record to Site was approximately 4 km downstream of the Mid Calder weir near Livingston. This would indicate that salmon and sea trout are likely to continue establishing populations further upstream after the removal of the Mid Calder weir.

3.1.4 National Biodiversity Network (NBN)

No records are available for Atlantic salmon, sea trout, eel or freshwater pearl mussel within the watercourses surveyed during this survey. However, records are present for salmon,

[20] BARRIERS TO FISH MIGRATION IN UPPER RIVER ALMOND, LOTHIANS REGION, 12 MARCH 2008 (fishalmond.co.uk) (accessed online 20/09/2021)
[21] RiverLife: Almond & Avon | Forth Rivers Trust (accessed online 20/09/2021)
[22] New fish pass to boost ecology of River Almond | Media | Scottish Environment Protection Agency (SEPA) (accessed online 20/09/2021)
[23] https://www.friendsoftheriveralmondwalkway.org.uk/2021/03/07 (accessed online 20/09/2021)
[24]

sea trout, lamprey and eel downstream of the site. The barriers to migration within the catchment are considered to stop migratory species from reaching the sampling locations.

3.2 Fish Habitat Survey

Table 4 presents a summary of the prominent habitat characteristics recorded during the FHS (June 2021).

Table 4: FHS Results

Sampling Location Code Name	Fish Utilisation Potential	Fisheries Habitat Quality	Site Characteristics
HH1	Low/Moderate	Poor	Watercourse flows through Site into the River Almond. Poor juvenile salmonid habitat – if present considered likely to be low population density. Flow type predominantly shallow glide with pools. Average wet width 0.5 m. Depth ranging from <10-20 cm. Silt accumulation, with gravel / pebble and limited cobble/boulder substrate. Poor/moderate instream cover. Land use is grazing and road. Impassable culvert at watercourse crossing point upstream (as shown on Plate 1, Annex B). Areas of lamprey and eel habitat present.
HH2	Low/Moderate	Poor/Moderate	Watercourse flows through Site into the River Almond. Poor juvenile salmonid habitat – if present considered likely to be low population density. Flow type predominantly run / riffle with a large stagnant pool at the downstream section. Heavily poached in places. Average wet width 1 m. Depth ranging from <10-30 cm. Silt accumulation, with gravel / pebble and increased cobble substrate. Poor/moderate instream cover. Land use is grazing. Culvert at watercourse crossing point upstream. Visual signs of farm effluent entering watercourse. Areas of lamprey and eel habitat present.
HH3	Low/Moderate	Poor/Moderate	Watercourse flows through the middle of the site into the River Almond. Moderate (poor in places) salmonid habitat. Flow type predominantly riffle with shallow glide. Average wet width 2.2 m. Depth ranging from <10-20 cm. Mainly pebble substrate with limited cobble/boulder and accumulations of gravel/silt in margins. Undercut bank in high flows. Poor instream cover. Land use is grazing and single section of riparian woodland (beech trees). Areas of lamprey and eel habitat present.
HH4	Low	Poor	Confluence with How Burn - field drain. Poor salmonid habitat. Flow type predominantly glide / run although channel is obscured in places due to vegetation and narrowing of bank. Narrow channel with dense vegetation throughout. Average wet width <0.5 m. Depth ranging from <10 cm. Silt/gravel substrate. Poor instream cover. Land use is grazing. Not considered suitable for salmonid populations, however if present, considered likely to be low population density. Very limited lamprey and eel habitat present.

Sampling Location Code Name	Fish Utilisation Potential	Fisheries Habitat Quality	Site Characteristics
HH5	Low/Moderate	Poor/Moderate	How Burn downstream of HH4. Poor/moderate salmonid habitat. Flow type predominantly deep glide with run downstream. Average wet width 1.5 m. Depth ranging from <20-50 cm. Substrate obscured by coloured water, cobble/gravel with accumulations of silt/gravel in places. Undercut left bank and poached area of recorded on both banks. Land use is grazing. Ford recorded at the downstream section. Areas of lamprey and eel habitat present.
HH6	Moderate	Moderate	Watercourse flows through Site, below the M8 motorway into the River Almond. Moderate (poor in places) salmonid habitat. Flow type predominantly riffle with glide/run sequences. Average wet width 2.4m. Depth ranging from <10-40 cm. Mainly cobble substrate with areas of pebble and limited boulder. Undercut left bank and area of unstable embankment recorded on right bank. Moderate instream cover. Land use is grazing. Areas of lamprey and eel habitat present.
HH7	Moderate	Moderate	Watercourse flows adjacent to Harthill services, south of the site, into the River Almond. Moderate salmonid habitat. Flow type predominantly glide/run sequences. Average wet width 2.5 m. Depth ranging from <10-30 cm. Cobble substrate with large sections of gravel/pebble/silt and limited boulder. Moderate/poor instream cover. Double culvert downstream, right channel considered impassable in low flow. Land use is riparian woodland and road. Areas of lamprey and eel habitat present.
HH8	Low	Poor	Field drain flowing into How Burn. Poor salmonid habitat. Depth <10 cm. Width <0.5 m. Substrate predominantly silt with boulder. Considered sub-optimal habitat for salmonid population, however if present, considered to be very low. Land use is grazing. Very limited lamprey and eel habitat present.
HH9	Low	Poor	Field drain flowing into How Burn. Poor salmonid habitat. Depth <10 cm. Width <0.5 m. Substrate predominantly silt with boulder. Considered sub-optimal habitat for salmonid population, however if present, considered to be very low. Land use is grazing. Very limited lamprey and eel habitat present.
HH10	Low	Poor	Field drain flowing into How Burn. Poor salmonid habitat. Depth <10 cm. Width <0.5 m. Substrate predominantly silt with boulder. Considered sub-optimal habitat for salmonid population, however if present, considered to be very low. Land use is grazing. Very limited lamprey and eel habitat present.
HH11	Low	Poor	Downstream section of How burn above confluence with River Almond. The sampling location is adjacent to works compound. 4+m wide and average depth of 50 cm. Deep silt throughout and considered poor salmonid habitat. Flow type was deep glide. Salmonid migration route only as not considered suitable for

Sampling Location Code Name	Fish Utilisation Potential	Fisheries Habitat Quality	Site Characteristics
			salmonid populations due to substrate. Heavily vegetated instream. Blue tinge observed from the water and considered to be potential pollution. Trade effluent from works compound visible. Abundant insect life recorded on surface of water. Land use is scrub and works compound left bank. Very limited lamprey and eel habitat present.
HH12	Moderate	Moderate	River Almond downstream of the site. Moderate salmonid habitat. Flow type predominantly deep glide with run downstream. Average wet width 3.6 m. Depth ranging from 10-60 cm. Cobble substrate with boulder and areas of pebble /gravel and significant silt accumulations in places. Large box culvert upstream considered impassable in low flow. Moderate instream cover. Land use is scrub with road and works compound upstream. Trade effluent from works compound visible. Areas of lamprey and eel habitat present.

4 EVALUATION OF RESULTS

The FHQ and FUP of the sampling locations ranged between poor and moderate and low to moderate, respectively, in terms of supporting salmonid populations. However, the connectivity between the watercourses throughout the catchment is significantly affected by barriers to fish migration located downstream of the site within the River Almond. Although the River Almond Barriers Project is actively working on easing or removing these barriers, the upper reaches of the catchment are likely to be inaccessible to migratory fish. It is likely that migratory fish species will be able to migrate upstream in the future due to the work currently being undertaken as part of the River Almond Barriers Project.

Habitat connectivity is integral to survival of migratory salmonids, successful migration upstream and downstream is required to support populations of migratory fish species[25] [26]. Therefore, it is considered that all watercourses within the sampling locations, where suitable habitat was recorded (HH1, HH2, HH3, HH5, HH6, HH7, HH8, HH9, HH10 HH11, and HH12), are likely to contain only resident brown trout if salmonids are present. However, this can only be determined by undertaking an electrofishing survey.

All twelve sampling locations were located in the River Almond catchment. Location HH1 like forms the limit of upstream migration on the How Burn due to an impassable culvert. Seven locations on the How Burn (HH1, HH2, HH3, HH5, HH6, HH7 and HH12) had suitable combinations of flow types, depths and variable substrates providing poor to moderate habitat for juvenile salmonids, namely brown trout. Four locations (HH8, HH9, HH10 and HH11) had poor habitat for juvenile salmonids however these watercourses have the potential to support very low populations of brown trout. The field drain (HH4) was poorer in quality and considered not to be suitable for fish as the watercourse is not visible on the surface (as shown on Plate 7, Annex B).

[25] Hendry K & Cragg-Hine D (2003). Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No.7.English Nature, Peterborough.

[26] Willem B. Buddendorf, et al (2019). Integration of juvenile habitat quality and river connectivity models to understand and prioritise the management of barriers for Atlantic salmon populations across spatial scales. STOTEN 655, 557-566.

Although some habitat characteristics recorded withing the watercourses surveyed are considered suitable for both salmon and brown trout. It is highly unlikely that salmon are present due to the barriers to fish migration located downstream of the site. It is however likely that salmon could return to these watercourses if/when the barriers are removed. It is therefore considered likely that only low populations of resident brown trout will be present within the watercourses included in this survey.

Due to the current barriers to fish migration within the River Almond catchment it is considered unlikely that lamprey or eel are present within the sampling locations however if/when the barriers are removed it is considered likely that lamprey and eel could utilise the habitats within the site.

ANNEX A: FIGURES

Figure 1: Sampling Locations

INFINERGY Ltd
a BORALEX company

ARCUS

Site Boundary

Future Application Boundary

Fish Habitat Survey: Sampling Locations

Downstream Limit

Upstream Limit

1:19,500 Scale @ A3

0 0.4 0.8 km

NORTH

Produced By: LS	Ref: 3959-REP-009
Checked By: NW	Date: 2/16/2023

Fish Habitat Sampling Locations
Figure 10.4.1

Torrance Wind Farm Extension II
Technical Appendix 10.4: Fish

Y:\GIS\Ecology\Projects\3959 Harthill\3959 Harthill.aprx\3959-REP-009 Fig10.4.1 Fish Habitat Survey Sampling Locations

ANNEX B: PHOTOGRAPHS

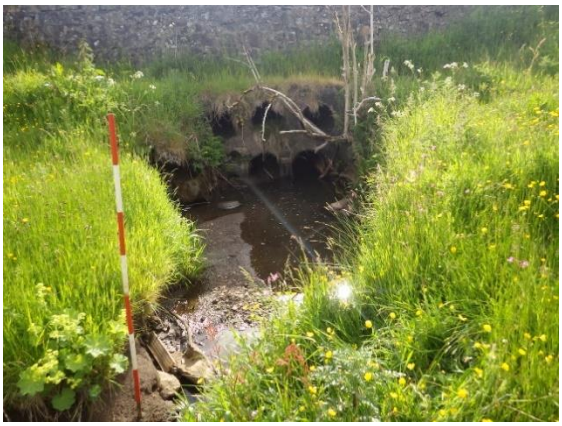
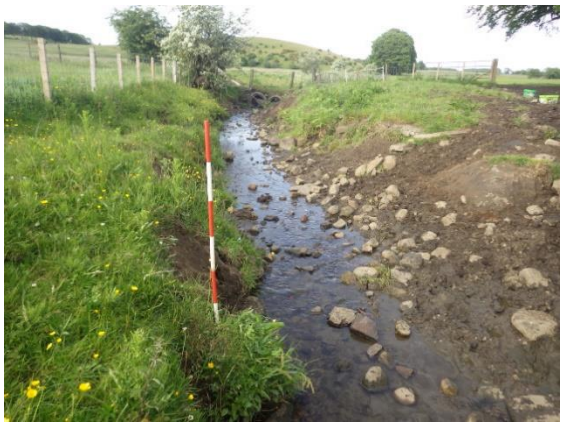


Plate 1 – HH1 (upstream)	**Plate 2 – HH1 (downstream)**
	
Plate 3 – HH2 (upstream)	**Plate 4 – HH2 (downstream)**

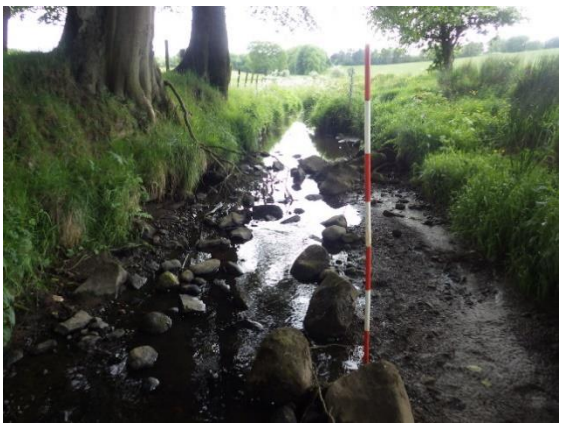
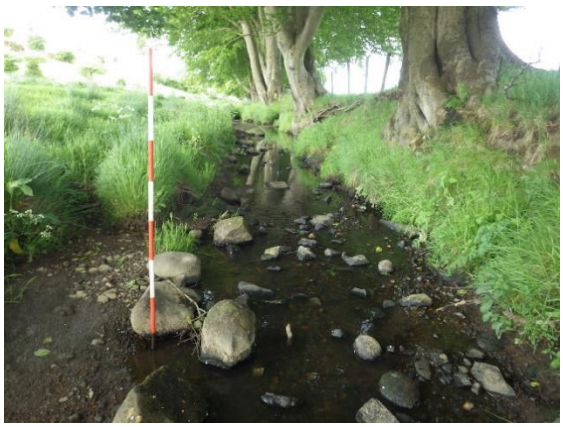
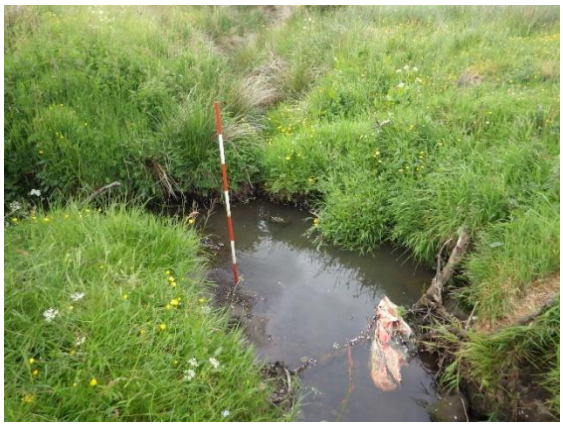

	

Plate 5 – HH3 (upstream)	**Plate 6 – HH3 (downstream)**

	
Plate 7 – HH4 (downstream)	**Plate 8 – HH5 (upstream)**

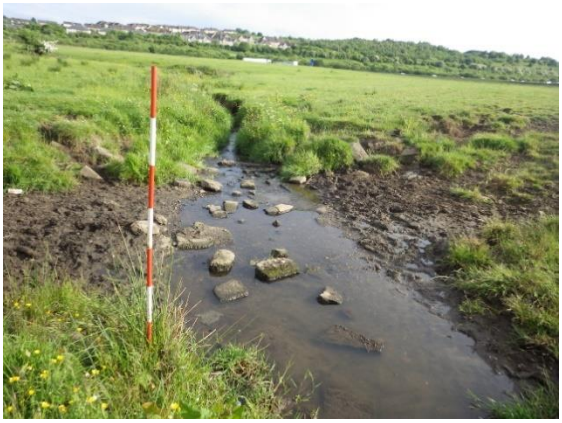
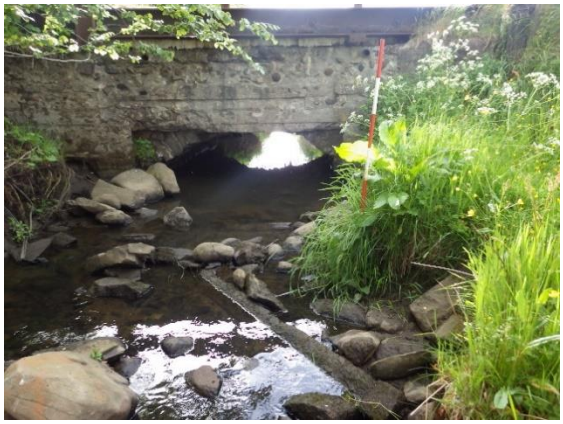

	

Plate 9 – HH5 (downstream at ford)	**Plate 10 – HH6 (upstream)**

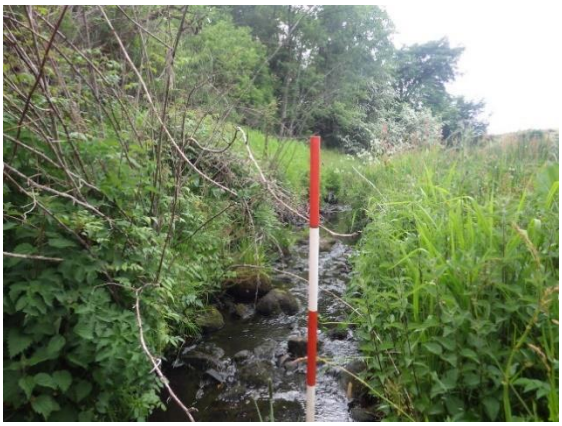
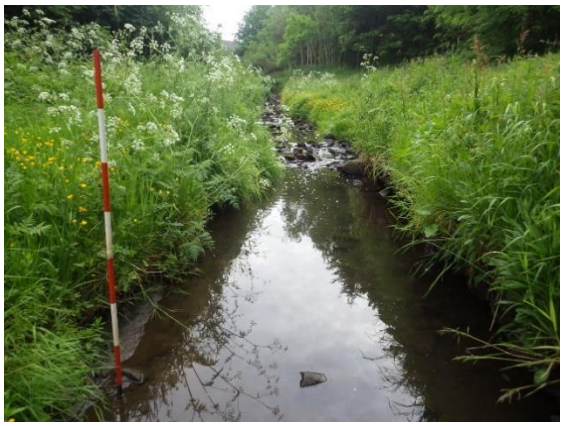

	

Plate 11 – HH6 (downstream)	**Plate 12 – HH7 (upstream)**

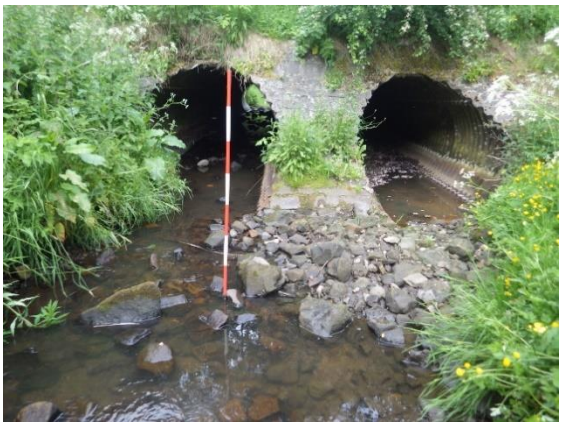


Plate 13 – HH7 (downstream)	**Plate 14 – HH8 (upstream)**

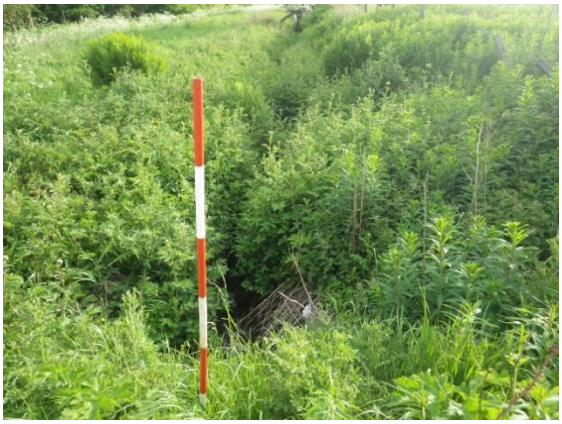
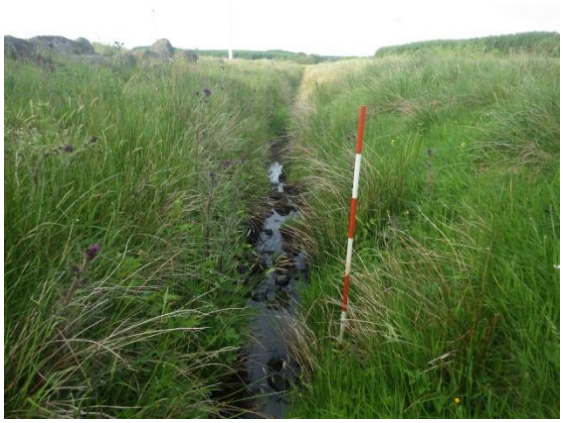

	

Plate 15 – HH9 (upstream)	**Plate 16 – HH10 (upstream)**

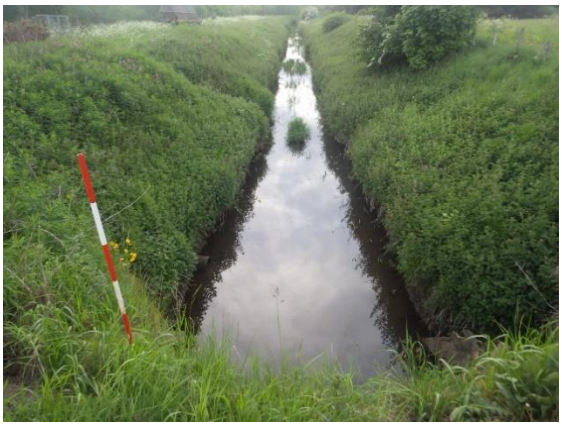
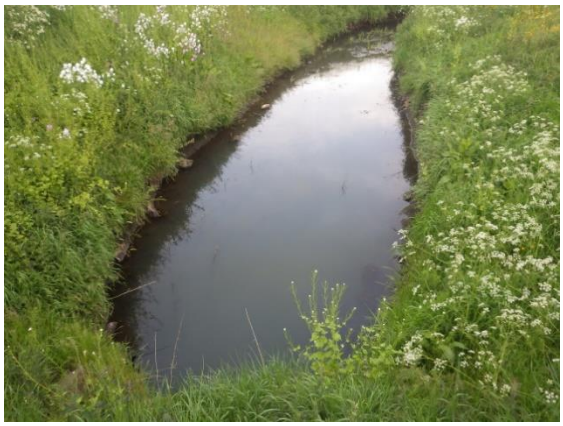

	

Plate 17 – HH11 (downstream)	**Plate 18 – HH11 (downstream)**

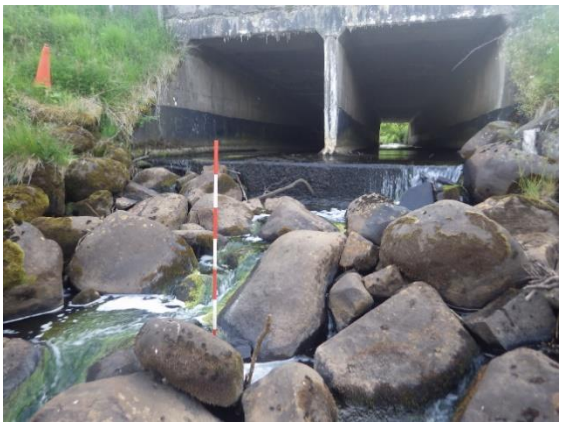
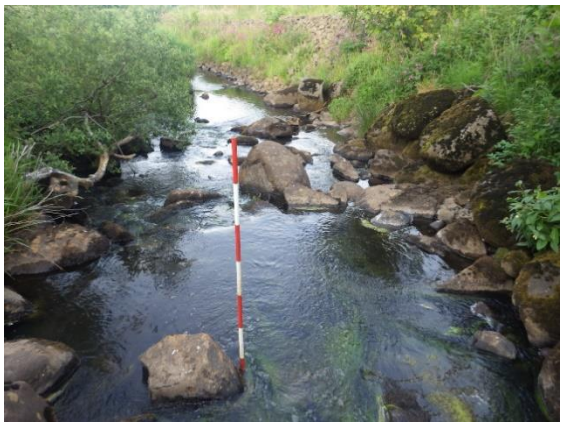
	

Plate 19 – HH12 (upstream)	**Plate 20 – HH12 (downstream)**