Appendix B5: Ecology Assessment -Bowland

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Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Supplementary Environmental Information

Appendix B5: Ecology Assessment - Bowland

February 2022

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

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Contents

1. Ecology Assessment of Bowland SEI

1.1 Introduction

1) United Utilities plc is seeking planning consent for the Haweswater Aqueduct Resilience Programme (HARP), which is a proposal to replace the underground tunnel sections of the existing 110 km Haweswater Aqueduct.

2) This is Appendix B5 Ecology Bowland and is a technical appendix of the Main Bowland Supplementary Environmental Information (SEI) report. Further SEI ecology information can be found in the following documents:

- SEI technical appendix B6, Ecology Ribble Crossing
- SEI technical appendix B7, Ecology Off-Site Highways Works
- Bowland HRA addendum
- Bowland SSSI addendum
- Bowland BNG On-Site Habitat Compensation revised report
- Bowland BNG Off-Site Habitat Compensation revised report.

3) This SEI technical appendix B5 provides information to be read in conjunction with the Environmental Statement (ES) and associated planning application for the Bowland Section of the Haweswater Aqueduct Resilience Programme (HARP), which were submitted to Lancaster City Council and Ribble Valley Borough Council in June 2021. Specifically technical appendix B5 relates to and should be read in conjunction with ES Volume 4 Proposed Bowland Section (Chapter 9A and 9B and supporting figures and appendices cover the terrestrial and aquatic ecology assessments). This SEI technical appendix B5 covers:

- Review of confirmed construction traffic access proposals
- Review of the amendment to the Newton-in-Bowland access track
- Review of the amendment to the planning application boundary north of the Newton-in-Bowland Compound
- Review of the proposed bridge spanning the BHS at the Newton-in-Bowland compound
- Additional Aquatic ecology survey data
- Review of updated AIA
- Response to consultee comments

1.2 Confirmed Construction Traffic Access

4) The June 2021 Environmental Statement (Volume 4 Appendix 3.1) made reference to two transport route options to serve the main construction compounds on the Proposed Bowland Section. It was confirmed in the June 2021 Environmental Statement that one of the two options would be selected prior to determination of the Proposed Bowland Section planning application. It is now possible to confirm that Route Option 2 (referred to in the June 2021 Environmental Statement as the Ribble Crossing) has been adopted in preference to Route Option 1, albeit with a need to use local roads for a short period of approximately nine months to enable construction of the temporary crossing.

5) Because the Ribble Crossing option was included and fully assessed in the June 2021 ES, the confirmation of this option being taking forward does not require any additional assessment.

1.3 Newton-in-Bowland Compound Access Track Amendment

6) The alignment of the Hodder Crossing access track, north of the River Hodder has been revised, which has resulted in an amendment to the planning application boundary at the Newton-in-Bowland

compound. This revision has the Hodder Crossing access track now coming slightly further south before it bends where it crosses a small watercourse and then heads southeast towards the River Hodder. The new redline boundary and access track route are displayed on Phase 1 and NVC habitats plans provided at Annex 1 of this report (Appendix B5 Annex 1).

7) The re-routed access track now avoids the majority of an area of GWDTE habitats that were previously affected. The access track is now routed to the south (downstream) of these habitats, instead routing through an area of grazed poor semi-improved grassland and only crossing a small area of marshy grassland and requiring only one watercourse crossing. Furthermore, this alteration takes the access track even further down slope (south) from a section of shallow tufa-rich stream.

8) Although the overall planning application boundary has been extended, and now includes an additional area of semi improved grassland, this amendment will result in a small reduction of impacts on sensitive habitats, instead affecting habitat of lower ecological value (poor semi-improved grassland). There are no additional trees which will be affected by the access track amendment and there will therefore be no impacts of this amendment on bats. This amendment would slightly reduce the ecological impacts of the scheme, reported within the June 2021 ES.

1.4 Newton-in-Bowland Compound Planning Application Boundary Amendment

9) There is a revision to the planning application boundary submitted with the June 2021 Environmental Statement which includes a widening of the below-ground tunnel construction easement to enable greater construction flexibility below ground level in response to potential development at the surface and protection of water quality in the new aqueduct. The tunnel bore diameter remains the same irrespective of where within the planning application boundary the tunnel is ultimately constructed.

10) No above ground impacts on ecology were previously predicted and no GWDTE habitats fall within the influence of this widened below-ground tunnel construction easement. There are no changes to the ecology assessment within theJune 2021 Environmental Statement.

1.5 Additional Information Relating to Gamble Hole Farm Pastures BHS

Gamble Hole Farm Pastures BHS

11) Gamble Hole Farm Pastures Biological Heritage Site (BHS Site Ref: 65SE09) is a Local Wildlife Site (LWS) partly located within the Newton-in-Bowland Compound. This site comprises habitats of principal importance (NERC Act, 2006) as well as irreplaceable habitats. Potential impacts on this BHS and associated fen habitat include habitat loss and degradation, habitat fragmentation, hydrological impacts, compaction, disturbance, pollution and sedimentation. There were some uncertainties over mitigation options at the time of the June 2021 ES and therefore a reasonable worst case scenario was taken and significant adverse residual effects were predicted for this site.

Proposed Temporary Gamble Hole Farm Pasture BHS Crossing

12) Impacts were in a large part due a temporary road required for construction traffic to cross the BHS to reach the tunnel portal. The June 2021 ES stated that assessments were ongoing to determine the feasibility of further reducing impacts on this BHS, including bridging the access road over sensitive habitats, avoiding the need for excavation and reducing direct impacts on sensitive habitats.

13) Site meetings were held with representatives of the Lancashire Wildlife Trust and it can now be confirmed that the bridge option is feasible and is being taken forward as an update to the proposals for the access road to the Newton-in-Bowland compound. Further information on the bridge is provided in the main SEI document. The bridge will cross the BHS at the point where the valuable habitats are narrowest. It will bridge the watercourse that flows along the southern boundary and over sail the adjacent M23/M26 habitat. The road runs up to the bridge foundations and the bridge section is c40 m long between the foundations. The southern foundations are outside the BHS boundary within poor semi-improved grassland. The northern foundations are within the BHS boundary but within poor semi-improved grassland, the road north of the bridge runs through the BHS for c30 m but remains within poor semi-improved grassland.

14) The new BHS crossing design will avoid ground works within valuable habitats in the Gamble Hole Farm Pastures BHS and will therefore greatly reduce any direct loss of habitats associated with this designation and reduce the risk of severing habitats and interrupting water flows. The bridge would have some degree of shadowing effect on the habitats it crosses, but the route avoids tufa springs and if any valued plants are identified as at risk from shadowing effects, these would be relocated within the BHS.

15) The bridge will require excavations to form foundations in the vicinity of GWDTE habitats associated with the BHS designation and there is potential for impacts on groundwater conditions to arise as a result of these temporary works, however, it is considered these would be lower than effects arising from the alternative road option through the BHS. Additional information would be submitted with the contractor's final design as part of the conditions relating to compound layout and this would further inform the proposed monitoring and adaptive management of the BHS habitats (detailed below).

16) The previous design comprised the access track bisecting the BHS, the GWDTE assessment identified direct and significant impacts, with a total loss of part of the GWDTE. The temporary bridge now proposed would avoid the need for excavation within the GWDTE habitats and would reduce potential direct impacts as much as practically possible to highly sensitive habitats. The new design would, however, likely require excavations deeper than 2 m maximum depth for the foundations either side of the bridge span. Where these are adjacent to the edges of the GWDTE, the water table could be at, or close to, the ground surface during construction of the bridge. As such, dewatering effects could have localised impacts to groundwater flows supporting the GWDTE. Although potential for effects on retained BHS habitats are not ruled out by the bridge, the effects are certainly reduced by the new proposed crossing.

Monitoring and Future Management

17) A bespoke botanical survey method has been produced in consultation with Lancashire Wildlife Trust to establish a detailed baseline status that can be repeated throughout the lifetime of the construction period and beyond. The method is provided at Annex 3 of this report (Appendix B5 Annex 3) and year one of survey will be undertaken this year (2022). The monitoring will allow identification of changes to site conditions (i.e. location of springs, individual notable plants and spread of habitats) and will inform adaptive management of the BHS.

18) A further uncertainty at the time of the June 2021 submission was whether United Utilities would have possession of the BHS land within the redline boundary beyond the construction period. The default position being they would not and all compensation would be delivered through offsetting. It can now also be confirmed that United Utilities are buying Gamble Hole Farm Pastures BHS and the field it is situated within. They will establish a 30 year management plan to ensure this site is optimally managed to support the features and interest it is designated for. This will result in improvements to this BHS site which has reduced in value over recent years. The management plan will be designed in consultation with Lancashire Wildlife Trust and will be informed by the 2022 baseline monitoring described above and is expected would be a condition of the planning permission.

19) This positive management is deliverable and guaranteed and will mitigate or compensate for any adverse effects associated with changes in ground water conditions as a result of the proposed development.

Changes to Assessment

20) A range of mitigation measures detailed above have now been secured to reduce impacts on the Gamble Hole Farm Pastures BHS. These have been designed with representatives from Lancashire Wildlife Trust. The following table confirms whether these changes to proposed mitigation for Gamble Hole Farm Pastures BHS result in any changes to the conclusions of the June 2021 ES.

Table 1: Review of June 2021 ES Enabling Works and Construction Works Assessment of Effects on Gamble Hole Farm Pastures BHS

Feature	June 2021 Significance of Effect Pre-Mitigation	June 2021 Significance of Effect Post-Mitigation	January 2022 Assessment
Enabling Phase			
Gamble Hole Farm Pasture BHS including HPI which solely comprises BHS: Fen	Significant Adverse County	Significant Adverse Local	Although there is still some land take within the BHS boundaries, this is limited to poor semi-improved grazed grassland. There could be some impact on M23/M26 habitat due to shadowing of the bridge and there may be some localised changes to groundwater conditions adjacent to the bridge foundations. However, this is unlikely to result in total loss. Important plants can be translocated prior to construction, on completion habitats can be reinstated using retained BHS plants. Once the works are complete and the bridge and road removed, the purchase of the land means there will now be >20yrs left of a 30yr management plan to ensure active management of these impacted areas (in addition to the full 30yrs of positive management of the majority of the BHS which is not affected. This will result in a **significant adverse impact at the Less than Local level in the medium to long term** while the bridge is in position. However, once the bridge is removed and given the land will be managed under a 30 year Management Plan to restore the habitat within the BHS to better than its current condition the impact will reduce to **Not significant in the long term.**
Construction Phase			
Gamble Hole Farm Pasture BHS including HPI which solely comprises BHS: Fen	**Impact:** Degradation: decline in quality or function as a result of vehicles using temporary construction access route across fen habitat. Significant Adverse County	Not significant	Pre-emptive measures will still be employed to intercept and divert any potential pollution from the road or uphill of the BHS to prevent these effects from occurring. The monitoring strategy will ensure that there are no significant detrimental impacts to the BHS during construction works. Therefore, the assessed impact remains the same. **No change to the June 2021 assessment.**
	Impact: Degradation as a result of ground compaction. Significant Adverse County	Significant Adverse Local	A bridge will now be used to take the access road over the important habitats within the BHS. There will therefore no longer be any ground compaction of these habitats although poor semi-improved grassland within the BHS will still be impacted by foundations and a section of road on the north side. In addition, the monitoring strategy and the 30 year Management Plan will ensure that the habitats

Feature	June 2021 Significance of Effect Pre-Mitigation	June 2021 Significance of Effect Post-Mitigation	January 2022 Assessment
			within the BHS improve over the current state in the long term. This will result in a **significant adverse impact at the Less than Local level in the medium to long term** while the road is in position, reducing to **Not significant in the long term** as the road is removed and the positive management of the BHS shows results.
	Impact: Decline in quality or function of retained fen habitats through disruption of ground or surface water paths as a consequence of drawdown associated with construction activities. Significant Adverse County	Not significant	The mitigation measures to limit drawdown in the 2021 ES still apply and the bridged section of the access road will further reduce this impact, although some effects from bridge foundations adjacent to BHS habitats may arise. The monitoring strategy and the 30 year Management Plan will ensure that the habitats within the BHS improve over the current state in the long term. **No change to the June 2021 assessment.**

21) Gamble Hole Farm Pastures BHS is 2.5 ha in size, the citation states the site comprises an area of wet, semi-natural, neutral grassland with springs and flushes, supporting a rich variety of plants characteristic of unimproved ancient grassland and flush systems. Lowland hay meadow (which includes species-rich neutral grassland) and swamp and fen are priority habitats. The area with ground disturbing works within the BHS boundaries is < 0.1 ha and does not include any of the habitats for which the site is designated nor any priority habitats. Due to additional mitigation to reduce impacts on Gamble Hole Farm Pastures BHS which has been devised and agreed with representatives of Lancashire Wildlife Trust and due to the greater level of confidence of managing any impacts due to United Utilities purchasing the BHS site, the original level of significance of impacts on this ecological feature have been reduced since the June 2021 ES assessment. This includes reducing all impacts to either not significant or to significant adverse at the less than local level in medium to long term, decreasing to not significant in the long term.

1.6 Additional Aquatic Ecology Information

22) Aquatic habitat walkover surveys were undertaken post submission and are reported within Annex 2 of this SEI Appendix (Appendix B5 Annex 2). The surveys covered Unnamed watercourse 386 (W463) and 391 (W470), both associated with Newton-in-Bowland Compound access track. The survey findings have not led to any changes to the assigned importance of aquatic receptors within the watercourse and therefore no change to the June 2021 assessment or mitigation proposals is required.

1.7 Lower Houses and Newton-in-Bowland Compounds Updated AIA

23) Following submission of the June 2021 Environmental Statement some additional survey work was undertaken at the Lower Houses Compound and further work has also been undertaken to minimise the impacts on arboricultural features within the Lower Houses and Newton-in-Bowland Compounds through embedded mitigation. In addition, there has been a change to the redline planning boundary and the haul road associated with the Newton-in Bowland Compound. Overall, this has reduced the

number of trees adversely affected when compared with the June 2021 Environmental Statement. The update to the Tree Constraints and Assessment Plan is included in the SEI submission (LCC_RVBC-BO-FIG-006-005) and a summary of the changes is provided in the main SEI report. Notably these confirm that:

- At the Lower Houses Compound, only one feature (T66) would be removed and only one feature (short hedge, H2b) is at risk of removal and neither have bat roost suitability
- Eight trees or tree groups have changed from Amber (at risk of removal) to Green (retained with protection measures) and this includes T71 (BT24) which has Low roost suitability
- At the Newton-in Bowland Compound, of the trees now assumed lost (Red or Amber categories) those with bat roost suitability comprise only six with low suitability (T78/BT103, G129/BT115, G129/BT135, G129/BT118, G129/BT120, G112/BG35) and only three with moderate suitability (G103/BT113, G129/BT121, T94BT142)
- At the Newton-in Bowland Compound fifty-three features have changed from Red or Amber (removed, partially removed or at risk of removal) to Green (retain or retained with protection measures) and these now retained trees include a number of trees/tree groups with low bat roost suitability (BT106/G95, BT107/G95, BT108/T100, BT112/T109, BT116/G128, BT122/G128, BT123/G132, BT138/G115, BT139/T123, BT140/G115, BT141/G115, BG25/H82) and moderate bat roost suitability (BT117/G128, BT119/G128, BT124/G132, BT125/G132, BT126/G132, BT127/G132, BT128/T139, BG28/G137)

24) The following table confirms whether these changes to tree impacts result in any changes to the conclusions of the June 2021 ES.

Table 2: Review of June 2021 ES Enabling Works Assessment of Effects on Features Linked to Trees

Feature	June 2021 Significance of Effect Pre-Mitigation	June 2021 Significance of Effect Post-Mitigation	January 2022 Assessment
Semi-natural broadleaved woodland	Significant Adverse Local	Not significant	None of the changes affect this habitat type. **No change to the June 2021 assessment.**
Broadleaved and mixed plantation woodlands	Significant Adverse Less than local	Not significant	None of the changes affect this habitat type. **No change to the June 2021 assessment.**
Scattered broadleaved trees (veteran)	Not Significant	N/A	None of the changes affect this habitat type. **No change to the June 2021 assessment.**
Scattered broadleaved trees (non-veteran)	Significant Adverse Local	Not significant	A reasonable worst-case scenario previously assumed a loss of 75 no. trees or groups of trees at Newton-in-Bowland and a loss of 10 no. trees or groups of trees at Lower Houses. This now reduced to 22 no. and 2 no. **This is a large improvement on the previous proposals reducing the pre mitigation significance of effect from Significant Adverse at the Local level to the Significant Adverse at the Less than local level. However, as the post-mitigation effect**

Feature	June 2021 Significance of Effect Pre-Mitigation	June 2021 Significance of Effect Post-Mitigation	January 2022 Assessment
			reported in the June 2021 assessment was Not significant, this remains unchanged.
Bats: roosts	Significant Adverse Less than local (Newton-in-Bowland compound only)	Not significant	A reasonable worst-case scenario previously assumed loss of 19 no. trees or groups of trees with low bat roost suitability 10 no. trees with moderate suitability. This is now reduced to 5no. trees or tree groups with low suitability and 3 no. trees with moderate suitability. **This is an improvement on the previous proposals but does not change the significance stated in the June 2021 assessment.**
Bats: flyways and foraging	Not significant	N/A	53 no. arb features at Newton-in Bowland and 8 no. features at Lower Houses have moved from assumed lost (Red and Amber categories) to Green (retained or retained with protection measures). Of the new arb features surveyed at Lower Houses, only one (H2b) is assumed lost (Amber at risk) and this is a very short section of isolated hedge. **This is an improvement on the previous proposals but does not change the significance stated in the June 2021 assessment.**

25) Table 2 confirms no change to the June 2021 assessment except for scattered broadleaved trees, for which the pre-mitigation effect is reduced from Significant Adverse at the Local level to Significant Adverse at the Less than local level (post-mitigation effects remain Not Significant).

1.8 Responses to Consultee Comments

26) A response to all consultee comments is provided within SEI Appendix A1, a few issues are also covered below and in the other ecology SEI Appendices (B6 and B7).

Great Crested Newt

27) Consultee comments queried the assessment relating to great crested newts:

ES Vol 4, Chapter 9A, Table 9A.7 states that no ponds within 500m of the Newton-in-Bowland compound were confirmed to support great crested newts. However, Chapter 9A, Appendix 9A.7 (Amphibians) indicates positive great crested newt eDNA in TR3 Pond 2. No results from Pond 92 (66m from Newton-in-Bowland Compound) seem to be given within the report. Results are inconclusive for ponds 12, 24, and 57f.

28) Pond 2 was the only positive result but is 1.6 km northwest of the Lower Houses Compound and therefore not within 500 m. Pond 92 was missing from the eDNA results table presented in the table, but we can confirm this was surveyed and was negative. It is correct that results were inconclusive for ponds 12, 24 and 57f but these ponds are respectively 7 km and 8 km south of the Lower Houses Compound and 2.3 km north of the Newton-in-Bowland Compound. It is therefore confirmed that the assessment relating to great crested newts is accurate and no licence from Natural England is required.

Otter

29) Consultee comments were received regarding the known presence of otter in the vicinity of the Hodder Crossing, stating that it must be demonstrated that licensable impacts on otter will be avoided or that licensing tests are met. They went onto state that consideration should be given not only to risk of killing. injury and disturbance, but also to potential effects from pollution or sedimentation.

30) The potential otter holt was located over 0.87 km (1.37 km via the River Hodder) from the proposed crossing point and approximately 0.26 km (0.29 km via the River Hodder) from the closest section of the red line boundary (the existing outfall). The location of the potential otter holt relative to the red line boundary is shown in Figure 9B.2 Otter Baseline (figure reference: LCC_RVBC-BO-FIG-009-02-02) page 5 of 5. There will be no direct impacts to the potential holt and taking into account the proposed mitigation there is limited potential for disturbance of otters using the potential holt identified. The crossing design will maintain connectivity with the upstream habitats and the identified mitigation relating to the water environment should ensure minimal impacts to the supporting habitats. Therefore, based on the current baseline information no licensable activities have been identified for the proposed Hodder crossing.

31) Otters are highly mobile and utilise a range of resting places and holts across their home range. Due to this behaviour and the changing nature of riverbank features it is possible that otter use of individual shelter features could change during the period between baseline surveys and works commencing. As identified in the ES Chapter 9, Section 9.7.4 paragraph 161: Pre enabling works checks for otter resting places are specified as part of the CCoP. If otter resting places are confirmed in any areas requiring vegetation removal/disturbance of riverbanks removal, mitigation under licence from Natural England would be implemented as appropriate to the location and status resting place.

32) The potential for adverse effects on otter populations from habitat degradation through, potential changes to habitat connectivity, pollution including sedimentation of watercourses, and the potential for a reduction in prey availability have been considered in the assessments for each of the phases of the Proposed Scheme. The assessments of each of these potential impacts from the proposed activities at each phase of the scheme are outlined in Sections 9.6.1 (enabling Works Phase), 9.6.2 (Construction Phase), 9.6.3, (commissioning Phase), 9.6.4 (Operational Phase), and 9.6.5 (Decommissioning Phase).

Water Vole

33) Consultee comments were received regarding the timing of water vole surveys and whether (in addition to the 2019-2020 Bowland Ecology surveys) the RSK 2020-2021 surveys were taken into account in the Environmental Statement. The comments refer to water vole being found during the RSK Biosensus surveys and the likely need for a licence from Natural England.

34) The results of surveys on watercourses relevant to the activities assessed as part of the main chapter (Volume 4) have been included in the ES Chapter 9B, the additional surveys of watercourses associated with road widening or passing places were used to inform the assessment of the Offsite Highways Improvement works (Volume 5 Part II).

35) The potential water vole evidence identified in the Appendix 9B.3 and RSK Biocensus TR3 otter and water vole survey report appendix, as identified in the report, is not considered to be evidence of water voles but are highly likely to be attributable to bank vole or brown rat based on the size and of burrows, feeding remains, and droppings identified and absence of definitive evidence of water vole at all surveyed watercourses within the relevant catchments.

36) The watercourses identified in the ES aquatic ecology chapters as having activities which would require works in channel or bank side vegetation clearance and hence could impact water voles if present were generally unsuitable or had low suitability. This in combination with the lack of evidence of water voles at all watercourses surveyed in the wider catchments indicates than water voles are highly unlikely to be present and as such no licensable activities for water voles are associated with the Proposed Scheme. The timing of the initial surveys in 2019 was sub optimal but combined with overall lack of suitability of the watercourses and lack of evidence identified in the other surveys undertaken this is not considered to represent a significant constraint to the conclusions of the associated assessments.

Local Designations

37) Consultee comments included a request for clarification on impacts on local designations including consideration of alternatives and mitigation or compensation. There are no designations within the Lower Houses Compound. BHS 65SE05 (Roadside verge) along the Dunsop Road is not impinged upon by the Newton-in-Bowland Compound. Gamble Hole Farm Pastures BHS lies within the Newton-in Bowland Compound and has already been discussed in Section 1.5. The River Hodder BHS is crossed by the temporary haul road, this new crossing is required to access Newton-in-Bowland compound as it is not possible to get the construction traffic vehicles along the existing road through the village that is serviced by the current bridge. In addition to engineering requirements and other environmental topics, the location of the new temporary crossing has considered existing features to minimise impacts on ecology. Furthermore, the bridge design would not require any in-channel works, thus avoiding impacts on the BHS.

38) The potential for Off-Site Highways works to impact designations are clarified within in SEI technical appendix B7.

Irreplaceable / Very High Distinctiveness Habitats

39) Consultee comments were received regarding identification of all irreplaceable / very high distinctiveness (VHD) habitats that may be affected by the proposed works, demonstration that any losses are unavoidable and that a suitable compensation strategy exists.

40) There are no VHDs within the Lancaster City Council planning application boundaries. The VHDs within the Ribble Valley Borough Council planning application boundaries fall into the following categories:

- Veteran trees
- Fens upland and lowland
- Purple moor grass and rush pasture

41) One potential veteran tree is located between the River Hodder and Dunsop Road, this tree is identified as encroached but retained with protection measures. No additional veteran trees would be impacted by the Ribble Crossing or Offsite Highway Improvements associated with the Proposed Bowland Section.

42) Lowland fen habitat is present in two locations. The main area lies within the Newton-in-Bowland compound and is associated with Gamble Hole Farm Pastures BHS, this habitat incudes typha forming springs. As described in Section 1.5 of this report, no works will be undertaken within this habitat and a clear span bridge will be used to facilitate construction traffic crossing the habitat associated with the BHS designation. A smaller area of lowland fen is present along the temporary haul road between the River Hodder crossing and Dunsop Road. As described in Section 1.3 of this report, since the June 2021 submission, the red line boundary has been extended south to realign the haul road and allow avoidance of the valuable habitats at this location.

43) Purple moor grass and rush pasture is present along the offsite highways within Ribble Valley Borough Council at locations RW16, RW18 and RW20. Further information including alternatives, avoidance, mitigation and compensation is provided in SEI Appendix B7 Ecology Offsite Highways Improvements.

Biodiversity Net Gain

44) The June 2021 BNG reports have been updated (February 2022) and take account of the revised red line boundary along the Hodder access haul road to the Bowland compound and the offsite highways works. The Bowland BNG On-Site Habitat Compensation revised report (LCC-RVBC-BO-APP-008_01 Rev 2) confirms baseline conditions pre and post development and the Bowland BNG Off-Site Habitat Compensation revised report (LCC-RVBC-BO-APP-008_02 Rev 2) confirms how 10% gain will be delivered.

45) To clarify following a consultee query, in addition to any replacement planting ratio outlined in the landscape and arboriculture chapter, the BNG assessment for tree groups and individual trees has taken

the root protection area given within the AIA to determine the canopy area and this has been used in the DEFRA metric to establish baseline and calculate how 10% net gain would be delivered.

HRA and SSSI Assessments

46) The June 2021 Bowland HRA assessment and SSSI assessment have both been reviewed in light of the changes to design and additional information provided. Addendums to these documents have been produced and submitted with SEI that confirm no changes to the conclusions of those June 2021 assessments.

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section Supplementary Environmental Information

Appendix B5: Annex 1

Bowland – Phase 1 Habitat and NVC Survey Plans (updated red line boundary)

February 2022

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

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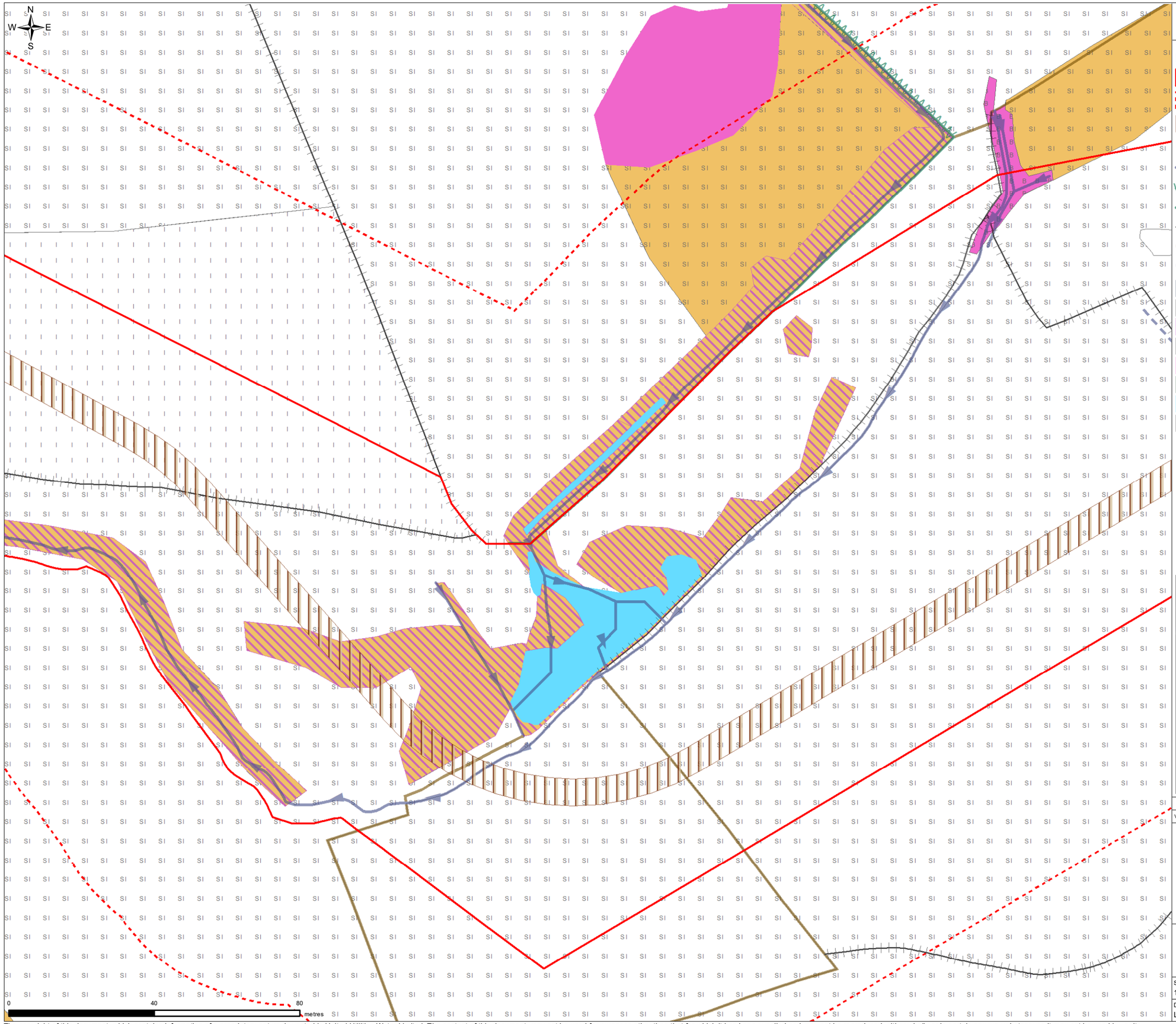
FIGURE 9A.21

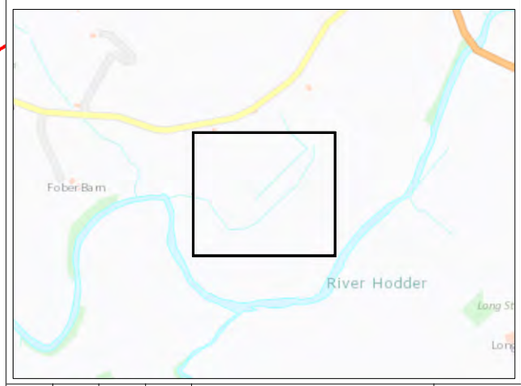


Legend

- Compound location
- Compound location - 50m buffer
- Proposed route alignment

Phase 1 Habitat Data

- Running water
- Native species-rich intact hedge
- Species-poor intact hedge
- Fence
- Wall
- Dry ditch
- Semi-improved neutral grassland
- Improved grassland
- Marsh/marshy grassland
- Poor semi-improved grassland
- Acid/neutral flush
- Basic flush
- Swamp
- Other habitat



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0	MK	MW	LS	Initial Issue	04/02/2022

United Utilities
Water for the North West

UNITED UTILITIES WATER LIMITED
HAWESWATER AQUEDUCT RESILIENCE PROGRAMME
PHASE 1 HABITAT SURVEY
NEWTON-IN-BOWLAND COMPOUND

SCALE	SHEET SIZE
1:999	A3
DRAWING NUMBER	REVISION
LCC_RVBC-BO-FIG-009-01-21	0

FIGURE 9A.7

Legend

- Compound location
- Compound location - 50m buffer
- Proposed route alignment

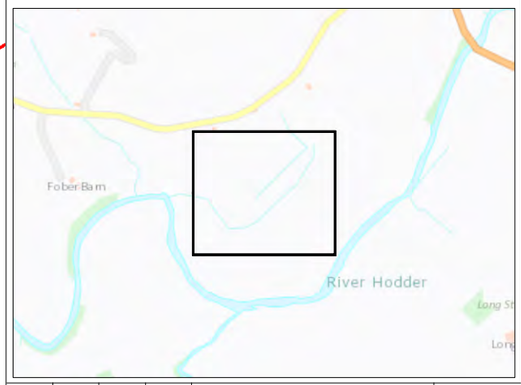
NVC Habitats 2020

- M23/M27
- M23b
- M27
- MG10
- MG13
- MG9
- MG9a
- S19
- S22a
- S7

Boundary Lines

- Running water
- Native species-rich intact hedge
- Species-poor intact hedge
- Fence
- Wall
- Dry ditch

No quadrat locations provided.



VERSION	AUTH	CHKD	REVD	REASON FOR ISSUE	DATE
A	MK	CW	LS	Route alignment added.	04/02/2022

United Utilities
Water for the North West

UNITED UTILITIES WATER LIMITED
HAWESWATER AQUEDUCT RESILIENCE PROGRAMME
NATIONAL VEGETATION CLASSIFICATION PLAN
BOWLAND SECTION
PAGE 4 of 4

SCALE	SHEET SIZE
1:1,000	A3
DRAWING NUMBER	REVISION
LCC_RVBC-BO-FIG-009-01-07A	0

0 40 80 metres

Creating a world fit for the future

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section Supplementary Environmental Information

Appendix B5: Annex 2

Bowland – Post Submission Aquatic Ecology Surveys

February 2022

United Utilities

Water for the North West

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Project No:	B27070CT
Document Title:	Proposed Bowland Section Supplementary Environmental Information (SEI) Appendix B5 Annex 2: Bowland – Post Submission Aquatic Ecology Surveys
Document ID:	LCC_RVBC-BO_SEI-Appendix B5 Annex 2
Revision:	0
Date:	February 2022
Client Name:	United Utilities
Author:	Ricardo

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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved

Post Submission Aquatic Ecology Surveys - Review of Implications for Impact Assessment

A number of aquatic ecology surveys were undertaken in September 2021 and November 2021 in order to complete the baseline surveys required for the Haweswater Aqueduct Resilience Programme. These surveys were not able to be completed prior to the submission of the planning application due to seasonal constraints. The survey report is provided in **Appendix A** (Aquatic Walkover Results) and **Appendix B** (Lower Houses Highway Aquatic Surveys) Surveys).

The following table presents a review by Ricardo Energy and Environment of the potential implications on the conclusions within Chapter 9B Aquatic Ecology of the Haweswater Aqueduct Resilience Programme – Proposed Bowland Section Environmental Statement, which was submitted in June 2021.

In summary, no changes to the submitted assessment have been identified.

Watercourse	Relevant Scheme Component	Environmental Statement Baseline (Importance of Aquatic Receptors)	Additional Surveys Completed	Summary of Findings	Implications for Assessment/Mitigation
Unnamed watercourse 386 (W463)	Newton-in Bowland Compound access track	**Macrophytes** – Immediate site **Fish** - Immediate site **Macro-invertebrates** – Immediate site **White clawed crayfish** - Not applicable (not present) **Otter** – Immediate site **Water vole** – Not applicable (not present)	Aquatic habitat walkover	The majority of the surveyed reach of the watercourse was slow flowing or chocked with in-channel vegetation. A small section, above the confluence with Unnamed Watercourse 391 (W470), was dry with no flow during the survey. The substrate was predominantly silt but with areas of coarser material such as boulder, cobble, and gravel in areas with less vegetation. One potential obstacle to fish passage was identified in the surveyed reach reducing the suitability for migratory fish species. The in channel vegetation was predominantly emergent fine leaved vegetation with occasional small areas of emergent broadleaved vegetation.	None

Watercourse	Relevant Scheme Component	Environmental Statement Baseline (Importance of Aquatic Receptors)	Additional Surveys Completed	Summary of Findings	Implications for Assessment/Mitigation
				The survey findings have not led to any changes to the assigned importance of aquatic receptors within the watercourse.	
Unnamed watercourse 391 (W470)	Newton-in Bowland Compound access track	**Macrophytes** – Immediate site **Fish** - Not applicable (not present) **Macro-invertebrates** – Not applicable (not present) **White clawed crayfish** - Not applicable (not present) **Otter** – Immediate site **Water vole** – Not applicable (not present)	Aquatic habitat walkover	The two branches of Unnamed Watercourse 391 both had low flow with one section completely dry during the survey and one with 100% cover of emergent fine leaved vegetation. This indicates that the watercourse dries periodically and has limited potential to support aquatic communities, however the frequency of drying is unknown. The survey findings have not led to any changes to the assigned importance of aquatic receptors within the watercourse.	None
Eskew Beck (W2334)	Lower Houses Highways Updates – RW32	**Macrophytes** – Immediate site **Fish** – Immediate site) **Macro-invertebrates** –Immediate site **White clawed crayfish** – Immediate site (if present) **Otter** – Immediate site **Water vole** – Not applicable (likely absent)	Habitat suitability surveys for: - Otter - Water vole - White clawed crayfish - Migratory fish species	Eskew Beck is a tributary of the River Wenning. The beck is within a steep-cut broadleaved woodland valley at the north of the survey reach. The beck is crossed by a road overbridge (Eskew Lane/ Long Lane). At the southern end of the survey reach, the beck is shallow-sided and bordered by grazing pasture and broadleaved woodland. **Otter** The watercourse contains suitable habitats for foraging and commuting otters.	None

Watercourse	Relevant Scheme Component	Environmental Statement Baseline (Importance of Aquatic Receptors)	Additional Surveys Completed	Summary of Findings	Implications for Assessment/Mitigation
				The section of watercourse north of Eskew Lane/ Long Lane provided suitable opportunities for otter holts There were no identified opportunities for otter holts within the southern half of the survey reach. **White clawed crayfish** The Watercourse contains suitable habitat to support white clawed crayfish. **Water vole suitability** The beck is considered to be generally unsuitable for water voles. The watercourse is too shallow and over-shaded by adjacent trees and scrub to provide suitable refuge of food sources. **Migratory fish species** The watercourse contains suitable habitats to support juvenile salmonid species. Potential barrier to fish movement from steep section of bedrock.	
Clear Beck (W2305)	Lower Houses Highways Updates – RW37	**Macrophytes** – Immediate site **Fish** – Immediate site) **Macro-invertebrates** –Immediate site	Habitat suitability surveys for: - Otter	The beck is a tributary of the River Hindburn and flows roughly east to west through the survey reach. It flows	None

Watercourse	Relevant Scheme Component	Environmental Statement Baseline (Importance of Aquatic Receptors)	Additional Surveys Completed	Summary of Findings	Implications for Assessment/Mitigation
		White clawed crayfish – Immediate site (if present) **Otter** – Immediate site **Water vole** – Not applicable (likely absent)	- Water vole - White clawed crayfish Migratory fish species	adjacent to a private pond at the upstream (eastern end). The beck is bordered by grazing pasture along with scattered adjacent mature trees, scrub, hedgerows, and rushes. The beck is crossed by a road overbridge (Long Lane). **Otter** The watercourse contains suitable habitats for occasional use by foraging and commuting otters. No potential otter resting places were identified and there were limited suitable locations for otter resting places. **White clawed crayfish** The western part of the surveyed reach of the beck has suitable areas for crayfish refuge in the form of scattered boulders, cobbles and woody debris. The eastern survey reach is slower flowing and dominated finer substrates with limited refuges for crayfish. **Water vole suitability** The beck is considered to be generally unsuitable for water voles. Due to heavy shading or poaching by livestock throughout the surveyed reach.	

Watercourse	Relevant Scheme Component	Environmental Statement Baseline (Importance of Aquatic Receptors)	Additional Surveys Completed	Summary of Findings	Implications for Assessment/Mitigation
				Migratory fish species The watercourse contains suitable habitats to support juvenile salmonid species. No barriers to fish movement were identified.	

Appendix A : Watercourse walkover survey results

352500 355000 357500 360000 362500 365000 367500 370000 372500 375000

470000 467500 465000 462500 460000 457500 455000 452500 450000

RW6 RW5 RW6 RW5 RW7 RW7 RW8 RW8

Mears Beck Mears Beck

W478 W478

RW20 RW16 RW20 RW16 W206 W206 W207 W207

W1369 W1369

W461 W46 W470 W461 W463 W477 W470

Over Kellet Nether Kellet Gressingham Hornby Tatham Bentham Mill Houses Wray Farleton Aughton Claughton Whit Moor Brookhouse Caton Caton Moor Salter Goodber Common Thrushgill Lowgill Tatham Fells Burn Moor Burn Moor Fell Keasden Lawkland Clapham Newby High Bentham Crossgill Littledale Haylot Fell Blanch Fell Quernmore Botton Head Catlow Fell Clougha Mallowdale Fell White Hill Ward's Stone Wolfhole Crag Croasdale Fell Tarnbrook Fell Tarnbrook Brow Top Lower Green Bank Lee Abbeystead Marshaw Hawthornthwaite Fell Blaze Moss Whins Brow Sykes Dunsop Bridge Hareden Slaidburn Tosside Gisburn Forest Stocks Reservoir Easington Fell Bleasdale Moors Lancaster Services Street Ohinholme Conder River Wyre River Wenning River Hodder ROMAN ROAD ROMAN ROAD FOREST OF BOWLAND

A65 A683 B6480 10 11

Legend:

Walkover extents

- Start Point
- End Point
- TR3 Map Views

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter

Rev	Date	Description	Drn	Chk	App
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HARP Aquatics

Ricardo Energy & Environment

RSK biocensus EXPERTS IN ECOLOGY

TITLE: Figure 1:
Bowland TR3
Walkover Survey Overview

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Meters
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363400 363500 363600

465700

465600

W206 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 W215 19 20 22 25 26

Legend:

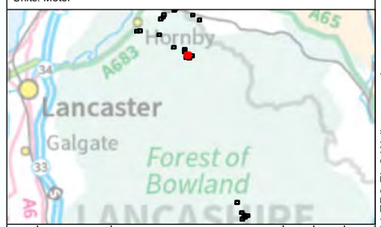
Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Choked with vegetation
- Dry
- No Channel
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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RSK biocensus EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 1 of 23

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Meters
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363200 363300 363400 363500

465500

465400

W206 W215 W215

16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

Legend:

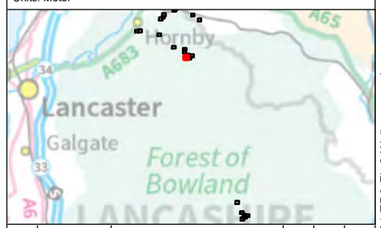
Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Choked with vegetation
- Dry
- No Channel
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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HARP Aquatics

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RSK biocensus EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 2 of 23

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SCALE: 1:1,000 @ A3

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465700
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W207
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35
36
37
38
39
40
41
42
43
Summer House Gill

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
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- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
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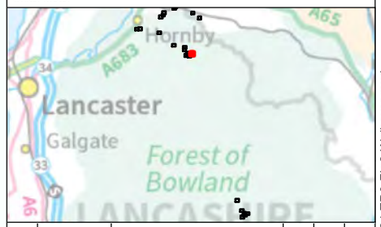
Units: Meter



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RSK biocensus EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 3 of 23

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SCALE: 1:1,000 @ A3

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465500 465400 465300

40 41 42 43 44 45 46 47 48 49 50 51 W207

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Choked with vegetation
- Dry
- No Channel
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
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TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 4 of 23

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368200
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451300
451200
W1369
W1369

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
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- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
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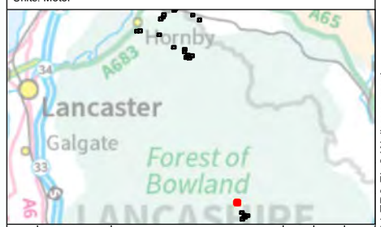

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TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 5 of 23

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58
59
60
61
62
63
64
65
66
Fober Farm

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
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- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
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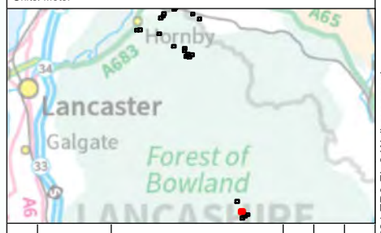
Units: Meter



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EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 6 of 23

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63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 W461 97 94 475 W463 93 99 96 95 98 101 100 102 92 91 103 104 105 106

Fober Barn

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
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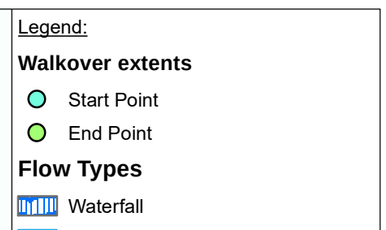

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RSK biocensus
EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 7 of 23

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449900 449800 449700

W461 W463 W477

82 83 94 97 99 96 95 93 475 98 101 100 102 92 474 103 104 105 91 473 106 108 107 90 89 109 88 86 87 110 111 85 112 84 114 113 115

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
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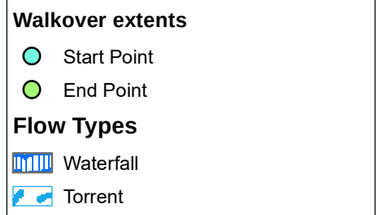

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HARP Aquatics

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RSK biocensus EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 8 of 23

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SCALE: 1:1,000 @ A3

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368700 368800 368900

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111 112 113 114 115 116 117 118 W477 119

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
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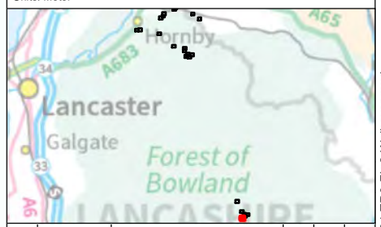

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HARP Aquatics

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 9 of 23

0 20 40
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469700 469600 469500

RW5
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137

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
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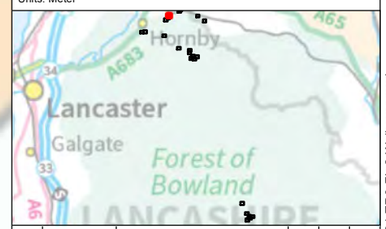

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HARP Aquatics

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 10 of 23

0 20 40
Meters
SCALE: 1:1,000 @ A3

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469500 469400 469300

129 130 131 132 133 137 134 136 135 138 140 141 139 142 143 144 145 147 146 148 151 149 150 152 153 154 155 156 157

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Choked with vegetation
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- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
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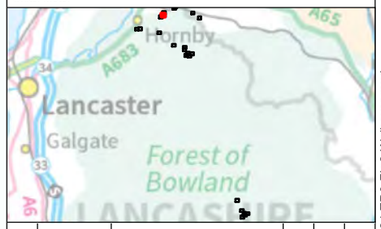
Units: Meter



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TITLE: Figure 2:
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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Choked with vegetation
- Dry
- No Channel
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
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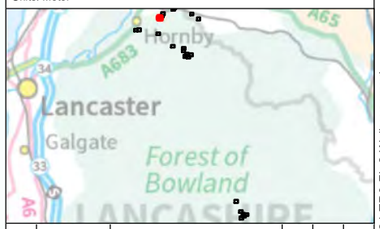

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
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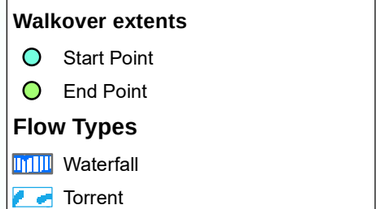

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
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- Overhanging Vegetation
- Coarse Woody Debris

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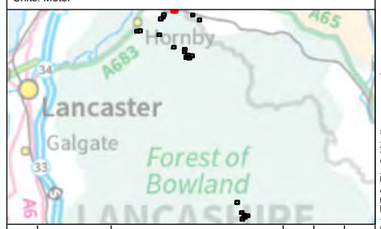

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
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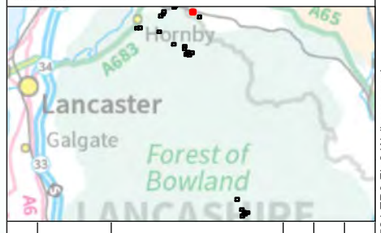
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
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Coordinate System: British National Grid
Projection: Transverse Mercator
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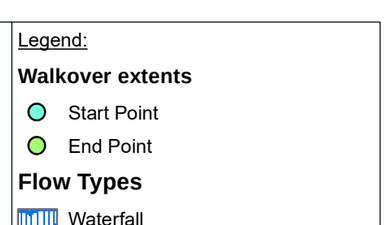
Units: Meter



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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
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- Pool
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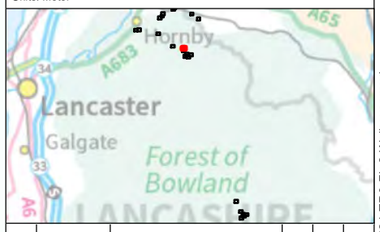
Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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TITLE: Figure 2:
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Walkover Survey
Map 17 of 23

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
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Coordinate System: British National Grid
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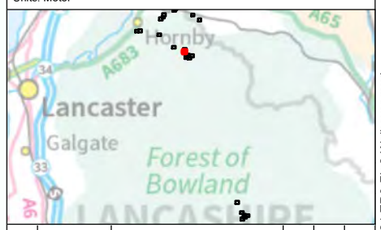

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
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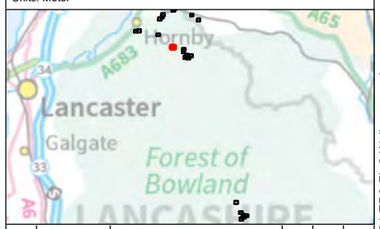

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
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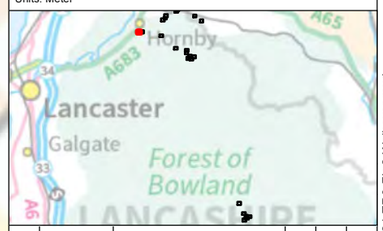
Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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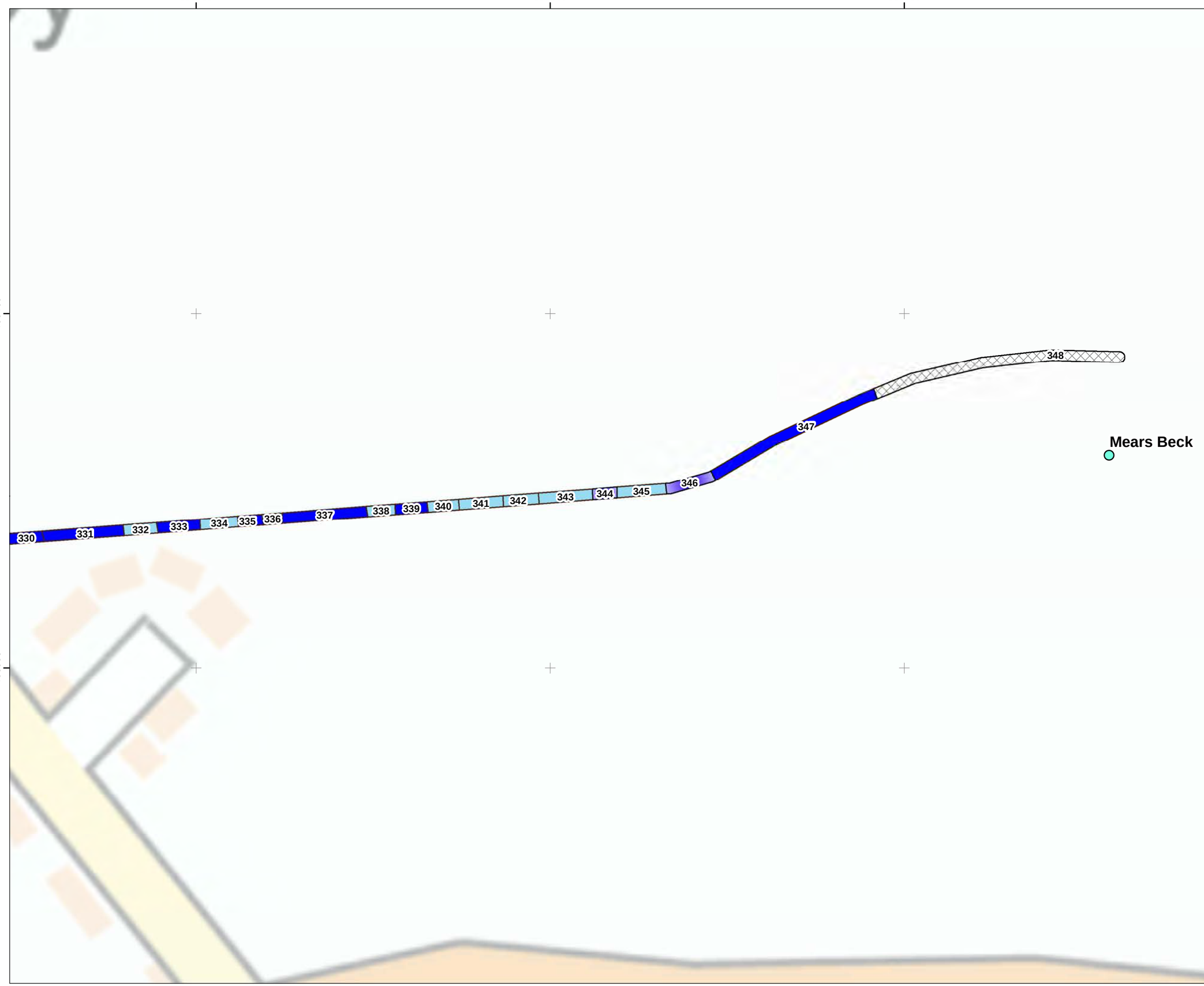

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
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- Dry
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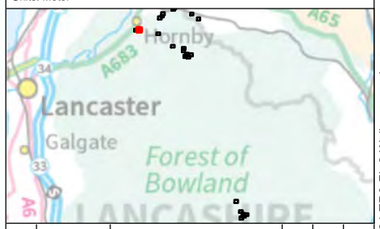
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
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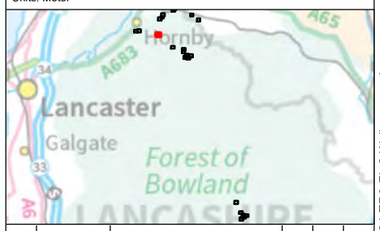
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
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Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter

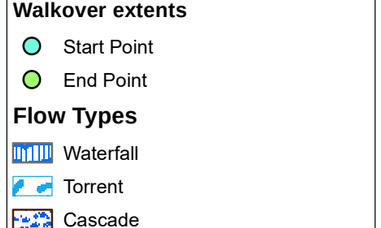

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Table 1: Habitat classifications and abbreviations

	Flow Type		Depth		Velocity		Substrate		Notable/species specific habitat		Macrophyte (% cover)		Other features
GL	Glide	A	0.05 - 0.1 m	0	0.01 - 0.05 m/s	BE	Bedrock	Pr	Salmonid parr habitat	SFL	Submerged fine-leaved	Obstruction	Potential obstacle/obstruction to fish passage
R	Run	B	0.1 - 0.2 m	1	0.05 - 0.15 m/s	BO	Boulder (> 256 mm)	Fr	Salmonid fry habitat	SLL	Submerged linear-leaved		
RI	Riffle	C	0.2 - 0.4 m	2	0.15 - 0.3 m/s	CO	Cobble (64 - 256 mm)	Pr/Fr	Mixed juvenile salmonid habitat	SBL	Submerged broad-leaved		
P	Pool	D	0.4 - 1.0 m	3	0.3 - 0.5 m/s	GR	Gravel (2 - 64 mm)	SPO	Optimal salmonid spawning habitat	ELL	Emergent linear-leaved		
CAS	Cascade	E	> 1.0 m	4	0.5 - 0.7 m/s	SA	Sand (< 2 mm)	SPSO	Sub optimal salmonid spawning habitat	EBL	Emergent broad-leaved		
ED	Eddy			5	> 0.7 m/s	SI	Silt	LO	Optimal juvenile lamprey habitat	FL	Filamentous algae		
TOR	Torrent					CL	Clay	LSO	Sub optimal juvenile lamprey habitat	FLO	Floating		
NP	No perceptible flow					AR	Artificial			FLR	Floating-leaved rooted		
DRY	Dry					NV	Not visible			CHOKED	Channel choked (veg)		

Table 2: HARP Bowland (TR3) walkover data

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
1	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
2	No perceptible flow	A	0	BO/CO/GR		
3	Glide	A	1	BE		
4	Run	A	1	CO/BO/BE		
5	No perceptible flow	A	0	BE		
6	Run	A	1	CO/BO/BE		
7	No perceptible flow	A	0	BE		
8	No perceptible flow	A	0	BO/BE/GR		
9	No perceptible flow	A	0	BO		
10	No perceptible flow	A	0	BO/BE/GR		
11	Pool	D	1	BO/CO/GR		
12	Waterfall	A	1	BO		
13	Cascade	A	1	BE		
14	No perceptible flow	B	0	BO/CO/GR		
15	Pool	B	1	BE/CO/GR		
16	No perceptible flow	A	0	BE		
17	Pool	B	1	BE/GR		
18	Pool	C	1	BE/BO/GR		
19	No perceptible flow	A	0	BO/GR/SI		
20	No perceptible flow	A	0	BO/GR/SI		
21	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
22	No perceptible flow	B	0	BO/GR/CL		
23	No perceptible flow	A	0	BO/CL		
24	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
25	No perceptible flow	B	0	BE		
26	No perceptible flow	B	0	BE/BO		
27	Pool	B	1	BE/CL		
28	No perceptible flow	B	0	BE/CL		
29	Pool	B	1	BO/CL		
30	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
31	Pool	B	0	BO/GR/CL		
32	No perceptible flow	A	0	BE/CL		
33	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
34	Run	A	2	GR/BO/SI		
35	Glide	A	1	GR/BO/SI		
36	Riffle	A	2	GR/BO/SI		
37	Pool	C	1	GR/BO/SI		
38	Glide	B	1	BE/SI/GR		
39	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
40	Run	A	2	BE/SI/GR		
41	Pool	C	1	BO/GR/SI		
42	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
43	Run	A	1	BO/GR/SI		
44	Run	A	1	BO/GR/SI		
45	No perceptible flow	A	0	BO/GR/SI		
46	Pool	C	1	SI/BE/GR		
47	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
48	No perceptible flow	A	0	BO/GR/SI	FL 5% EBL 50%	
49	No perceptible flow	A	0	BO/GR/SI		
50	No perceptible flow	A	0	BO/GR/SI	EFL 50%	
51	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
52	Run	A	2	SA/GR/CO	ELL 10%	
53	Run	B	2	GR/BO/SI	ELL 10%	
54	Run	A	2	GR/BO/SI	ELL 10%	
55	Glide	C	2	CO/BO/GR		
56	Run	A	2	SI/SA/CO	ELL 20%	
57	No perceptible flow	A	0	SI	ELL 50%	
58	Run	A	2	BO/CO/SA	EBL 10%	
59	Riffle	A	2	BO/CO/SA		
60	Run	A	2	SI/CO/GR	ELL 80% EBL 20%	
61	Riffle	A	2	BO/CO/GR		
62	Run	A	2	SI/CO	EBL 5% ELL 10%	
63	Run	A	2	SI/CO/BO		
64	Run	A	2	SI/CO/GR	EBL 40% ELL 40%	
65	Riffle	A	2	CO/GR/SI	EBL 5%	
66	No perceptible flow	A	0	SI	EBL 40% ELL 45%	
67	Glide	B	1	SI/GR/CO		
68	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
69	Pool	C	1	BO/CO		
70	Riffle	A	2	BO/CO/GR		
71	Pool	C	1	BO/CO/SI		
72	Riffle	A	2	SA/GR/SI		
73	Run	A	2	GR/SI/SA		
74	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
75	Riffle	A	2	BO/CO/SI		
76	Run	A	2	AR	FL 30%	
77	Run	A	2	CO/GR/SA		
78	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
79	Glide	B	1	AR		
80	Run	A	2	SI/CO/SA		

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
81	Glide	B	1	SA/GR/SI		
82	Riffle	A	2	CO/BO/SA		
83	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
84	Glide	C	2	BO/CO/GR		
85	Glide	B	2	BO/CO/GR		
86	Run	B	3	BO/CO/GR		
87	Run	B	2	BO/CO/GR		
88	Run	A	2	BO/CO/GR		
89	Salmonid habitat	C	3	BO/CO/GR		Fry
90	Salmonid habitat	C	3	BO/CO/GR		Parr/Fry
91	Glide	D	2	BO/CO/GR		
92	Glide	B	2	BO/CO/GR	FL 60%	
93	Pool	C	1	BO/CO/GR	FL 60%	
94	Glide	C	3	BO/CO/GR		
95	Run	B	3	BO/CO/GR	FL 40%	
96	Run	C	4	BO/CO/GR	FL20%	
97	Run	B	3	BO/CO/GR	FL 40%	
98	Glide	B	2	BO/CO/GR	FL 70%	
99	Pool	E	1	BO/CO/GR	FL 30%	
100	Run	B	2	BO/CO/GR	FL 50%	
101	Riffle	B	3	BO/CO/GR	FL 80%	
102	Run	C	3	BO/CO/GR	FL 50%	
103	Glide	C	2	BO/CO/GR		
104	Salmonid habitat	C	4	BO/CO/GR		Parr
105	Run	C	3	BO/CO/GR	FL 40%	
106	Run	C	3	BO/CO/GR	FL 70%	
107	Run	D	4	BO/CO/GR	FL 20%	
108	Run	A	2	BO/CO/GR	FL 80%	
109	Run	D	3	BO/CO/GR	FL 30%	
110	Glide	E	2	BO/CO/GR	FL80%	
111	Run	C	3	BO/CO/GR	FL 30%	
112	Salmonid habitat	C	3	BO/CO/GR	FL 10%	Parr
113	Juvenile lamprey habitat	B	1	SI/SA/GR		Sub optimal
114	Glide	C	3	BO/CO/PE	FL 90%	
115	Glide	B	1	BO/CO/GR	FL 80%	
116	Glide	C	3	BO/CO/GR	FL 90%	
117	Glide	E	2	BO/CO/GR	FL 10%	
118	Glide	B	2	SI		
119	Pool	D	1	BO/CO/GR		
120	Glide	B	2	BO/GR/SA		
121	Salmonid	B	4	CO/GR/SA		Fry

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
122	Salmonid	C	4	BO/CO/GR		Parr
123	Run	B	2	BO/CO/SA		
124	Run	C	3	BO/GR/SA		
125	Salmonid	C	3	BO/GR/SA		Sub optimal spawning
126	Lamprey	B	2	GR/SA/SI		Sub Optimal
127	Run	B	3	BO/GR/SA		
128	Salmonid	B	4	BO/GR/SA		Fry
129	Salmonid	C	4	BO/GR/SA		Fry
130	Lamprey	B	2	GR/SA/SI		Sub Optimal
131	Lamprey	B	1	GR/SA/SI		Sub Optimal
132	Glide	B	1	BO/SA/SI		
133	Run	C	3	BO/CO/SA		
134	Glide	B	2	BO/SA/SI		
135	Lamprey	B	2	GR/SA/SI		Sub Optimal
136	Run	C	2	BO/CO/SA		
137	Run	B	2	BO/CO/SA		
138	Riffle	B	2	BO/CO/SA		
139	Glide	B	1	BO/CO/SA		
140	Glide	C	2	BO/CO/SA		
141	Eddy	D	0	BO/CO/SI		
142	Glide	D	2	BO/CO/SA		
143	Glide	B	2	CO/SA		
144	Run	C	3	BO/CO/SA		
145	Glide	B	2	CO/SA		
146	Run	C	2	BO/CO/GR		
147	Salmonid	C	3	BO/CO/GR		Sub optimal spawning
148	Glide	B	2	BO/SA/GR		
149	Glide	C	2	BO/SA/GR		
150	Glide	B	2	BO/SA/GR		
151	Lamprey	B	2	GR/SA/SI		Sub optimal
152	Run	B	3	BO/GR/SA		
153	Run	B	3	BO/GR/CO		
154	Torrent	C	5	BO		
155	Potential obstacle/obstruction to fish passage					
156	Run	C	3	BO/SA/GR		
157	Run	B	3	BO/SA/GR		
158	Run	B	3	BO/SA/GR		
159	Salmonid	C	4	BO/CO/GR		Parr
160	Glide	B	2	BO/GR/SA		
161	Glide	B	1	BO/CO/GR		
162	Glide	D	2	BO/CO/SA		

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
163	Glide	D	3	BO/GR/SA		
164	Glide	B	2	BO/GR/SA		
165	Salmonid	B	3	BO/GR/SA		Sub optimal spawning
166	Salmonid	B	4	BO/CO/SA		Parr/Fry
167	Riffle	B	3	BO/GR/SA		
168	Lamprey	B	1	SA/SI		Optimal
169	Run	C	3	BO/CO/GR		
170	Run	E	3	BO/CO/GR		
171	Glide	B	3	BO/CO/GR		
172	Glide	D	3	BO/CO/GR		
173	Glide	B	3	BO/CO/GR		
174	Glide	A	1	BO/SA/GR		
175	Riffle	A	2	BO/CO/GR		
176	Glide	B	1	BO/SA/SI		
177	Pool	B	1	BO/SA/SI		
178	Run	A	2	CO/GR/SA		
179	Potential obstacle/obstruction to fish passage					
180	Pool	B	1	BO/CO/GR		
181	Run	A	2	CO/GR/SA		
182	Riffle	A	2	BO/CO/SA		
183	Run	A	2	CO/GR/SA		
184	Potential obstacle/obstruction to fish passage					
185	Pool	B	1	SA/SI/CO		
186	Run	A	2	CO/GR/SA		
187	Run	A	2	CO/GR/SA		
188	Potential obstacle/obstruction to fish passage					
189	Riffle	B	2	BO/SA/CO		
190	Run	A	2	SA		
191	Run	B	2	BO/CO/SA		
192	Run	C	3	BO/CO/GR		
193	Run	B	2	BO/CO/SA		
194	Lamprey	B	1	GR/SA/SI		Sub optimal
195	Salmonid	B	4	BO/CO/GR		Parr/Fry
196	Eddy	C	0	BO/SI		
197	Run	B	2	BE/BO/SA		
198	Run	C	3	BO/CO/GR		
199	Lamprey	B	1	SA/SI		Optimal
200	Glide	B	1	BO/CO/SA		
201	Run	C	2	BO/CO/SA		
202	Lamprey	B	1	SA/SI		Optimal
203	Pool	B	1	BO/SI/SA		

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
204	Run	B	2	BO/CO/SI		
205	Potential obstacle/obstruction to fish passage					
206	No perceptible flow	B	0	SA/SI	SFL-100	
207	Glide	B	2	SA/SI	SFL-60 EBL-40	
208	Glide	A	1	SA/SI	EBL-70	
209	Glide	A	1	SA/SI	SFL-40 EBL-40	
210	Glide	B	1	BO/CO/SA	EFL-20 EBL-10	
211	Potential obstacle/obstruction to fish passage					
212	Potential obstacle/obstruction to fish passage					
213	Run	C	3	BO/CO/SA	BO/CO/SA	
214	Glide	D	2	BO/SA/BE		
215	Eddy	D	0	BO/SA/BE		
216	Eddy	E	0	BO/SA/BE		
217	Glide	B	1	BO/GR/SA		
218	Salmonid	C	3	BO/GR/SA		Parr/Fry
219	Run	B	1	BE/SA		
220	Eddy	C	0	BO/SA/BE		
221	Run	B	2	BO/CO/SA		
222	Run	C	3	BO/CO/BE		
223	Riffle	C	4	BE		
224	Run	A	2	BO/CO/GR		
225	Riffle	A	3	BO/CO/GR		
226	Run	A	3	BO/CO/GR		
227	Potential obstacle/obstruction to fish passage					
228	Riffle	A	3	BO/CO/GR		
229	Run	A	3	BO/CO/GR		
230	Riffle	A	3	BO/CO/GR		
231	Run	A	3	BO/CO/GR		
232	Riffle	A	3	BO/CO/GR		
233	Glide	B	1	BO/CO/GR		
234	Potential obstacle/obstruction to fish passage					
235	Run	A	3	BO/CO/BE		
236	Riffle	A	2	BO/CO/SI		
237	Pool	B	1	SI/BO		
238	Riffle	A	2	BO/CO/SI		
239	Potential obstacle/obstruction to fish passage					
240	Run	A	3	GR/SI		
241	Pool	B	1	BO/SI		
242	Run	A	3	GR/SI		
243	Pool	C	1	SI		
244	Run	A	2	GR/SI	EFL-10 EBL-10	

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
245	Glide	B	1	SI	EFL-10 EBL-10	
246	Run	A	2	GR/SI	EFL-10 EBL-10	
247	Run	A	2	BO/CO/GR		
248	Riffle	A	3	BO/CO/GR		
249	Run	A	2	BO/CO/GR		
250	Riffle	A	3	BO/CO/GR		
251	Cascade	A	3	BO/CO		
252	Pool	C	1	BO/CO		
253	Potential obstacle/obstruction to fish passage					
254	Run	A	3	BO/CO/SI		
255	Glide	A	1	SI/SA		
256	Pool	B	1	BO/SI		
257	Potential obstacle/obstruction to fish passage					
258	Glide	A	1	SI/SA	EFL-5	
259	Run	A	2	SI/SA/GR	EBL-10	
260	Glide	A	2	SI/SA/GR	EBL-10	
261	Run	A	2	SI/SA/GR	EBL-10	
262	Potential obstacle/obstruction to fish passage					
263	Run	A	2	SI/GR	EBL-30	
264	Run	A	2	BO/CO/SA		
265	Potential obstacle/obstruction to fish passage					
266	Glide	B	1	SA/SI		
267	Glide	A	1	SA/SI/CL		
268	Run	A	2	SA/SI/CO		
269	Glide	A	1	SA/SI/CL		
270	Potential obstacle/obstruction to fish passage					
271	Glide	A	1	SA/SI/CL		
272	Glide	B	1	GR/SA/SI		
273	Run	A	2	SA/SI/CL		
274	Run	B	2	BO/SA/SI		
275	Potential obstacle/obstruction to fish passage					
276	Potential obstacle/obstruction to fish passage					
277	Run	B	2	BO/CO/SA		
278	Glide	B	1	BO/SA/SI		
279	Run	B	2	BO/SI/CL		
280	Riffle	A	2	BO		
281	Run	B	2	BO/SI/CL		
282	Potential obstacle/obstruction to fish passage					
283	Glide	B	1	BO/CO/SI		
284	Riffle	A	2	BO/CO/GR		
285	Potential obstacle/obstruction to fish passage					

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
286	Pool	C	1	BO/SI/CL		
287	Potential obstacle/obstruction to fish passage					
288	Potential obstacle/obstruction to fish passage					
289	Pool	D	1	BO/SA/SI		
290	Riffle	B	3	BO		
291	Pool	D	1	BO/SA/SI		
292	Potential obstacle/obstruction to fish passage					
293	Run	B	3	BE/SI		
294	Pool	D	1	BE/BO/SI		
295	Riffle	B	3	BE/BO/SI		
296	Lamprey	B	2	GR/SA/SI		Sub optimal
297	Glide	C	1	BE/BO/SI		
298	Riffle	A	3	BO/SA/CO		
299	Run	A	3	BO/GR/SI		
300	Riffle	A	3	BO/SI		
301	Potential obstacle/obstruction to fish passage					
302	Run	A	3	BO/GR/SI		
303	Riffle	A	3	BO/SI		
304	Glide	B	2	BO/SI		
305	Run	B	2	BO/SI		
306	Run	B	3	BO/SI		
307	Potential obstacle/obstruction to fish passage					
308	Run	B	3	BO/SI		
309	Run	C	3	BO/SA/SI		
310	Glide	C	2	BO/SI		
311	Run	B	4	BO/SA/SI		
312	Glide	C	2	BO/SA/SI		
313	Run	B	2	BO/SA/SI		
314	Glide	B	2	BO/SA/SI		
315	Run	B	3	BO/SA/SI		
316	Glide	C	1	BO/SI		
317	Glide	B	2	BO/SI		
318	Run	B	4	BO/SA/SI		
319	Run	B	3	BO/SA/SI		
320	Glide	B	2	SA/SI		
321	Riffle	A	3	BO/SI		
322	Run	B	3	BO/SI		
323	Potential obstacle/obstruction to fish passage					
324	Run	B	2	BO/SA/SI		
325	Potential obstacle/obstruction to fish passage					
326	Glide	C	1	BO/SI		

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
327	Run	B	2	BO/SI		
328	Glide	C	2	BO/SI		
329	Run	C	3	BO/SI		
330	Glide	C	1	SA/SI		
331	Glide	B	2	SI		
332	Run	C	3	BO/SI		
333	Glide	C	2	BO/SI		
334	Run	C	3	BO/SA/SI		
335	Glide	C	1	BO/SA/SI		
336	Run	B	3	SA/SI		
337	Glide	B	2	BO/SI		
338	Run	B	3	BO/SA/SI		
339	Glide	B	2	SI		
340	Run	B	2	SA/SI		
341	Run	A	2	BO/SA/SI		
342	Run	B	2	BO/SA/SI		
343	Run	B	3	SA/SI		
344	Pool	C	1	SA/SI		
345	Run	A	3	GR/SI		
346	Pool	C	1	GR/SI		
347	Glide	B	2	GR/SI		
348	Potential obstacle/obstruction to fish passage					
349	Glide	D	2	BO/BE/SA		
350	Lamprey	C	1	SA/SI		Optimal
351	Eddy	C	0	GR/SA/SI		
352	Run	C	3	BO/BE/CO		
353	Glide	D	2	BO/SA/CO		
354	Pool	E	1	BO/CO/SI		
355	Lamprey	C	1	SA/SI		Optimal
356	Glide	E	2	BO/SA/CO		
357	Salmonid	C	4	BO/CO		Parr
358	Salmonid	B	4	BO/CO		Parr/Fry
359	Run	B	2	BO/CO/SA		
360	Riffle	A	2	BO/CO/GR		
361	Lamprey	C	1	SA/SI		Optimal
362	Glide	D	1	BO/CO/SA		
363	Lamprey	B	1	SA/SI		Optimal
364	Run	C	2	BO/CO/SA		
365	Riffle	B	3	BO/CO/SA		
366	Glide	C	2	BO/CO/SA		
367	Lamprey	B	1	SA/SI		Optimal

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
368	Salmonid	C	3	BO/CO/GR		Sub optimal spawning
369	Lamprey	B	2	GR/SA/SI		Sub optimal
370	Salmonid	B	4	BO/CO/GR		Parr/Fry
371	Run	B	3	BO/CO/SA		
372	Run	C	3	BO/CO/SA		
373	Lamprey	B	2	GR/SA/SI		Sub optimal
374	Glide	B	1	SA/SI		
375	Lamprey	B	2	GR/SA/SI		Sub optimal
376	Lamprey	B	1	GR/SA/SI		Sub optimal
377	Run	B	3	BO/CO/SA		
378	Run	B	3	BO/CO/SA		
379	Riffle	B	2	BO/CO/GR		
380	Run	B	2	BO/CO/GR		
381	Riffle	B	2	BO/CO/GR		
382	Run	C	2	BO/CO/GR		
383	Potential obstacle/obstruction to fish passage					
384	Salmonid habitat	B	4	BO/CO/GR		Parr/Fry
385	Run	B	2	BO/CO/GR		
386	Glide	C	2	BO/CO/GR		
387	Run	B	2	BO/CO/GR		
388	Glide	C	2	BO/CO/GR		
389	Salmonid habitat	B	3	BO/CO/GR		Fry
390	Run	B	3	BO/CO/GR		
391	Salmonid habitat	B	3	BO/CO/GR		Fry
392	Run	D	2	BO/CO/GR		
393	Potential obstacle/obstruction to fish passage					
394	Run	C	2	BO/CO/GR		
395	Run	B	2	BO/CO/GR		
396	Salmonid habitat	B	3	BO/CO/GR		Fry
397	Run	C	3	BO/CO/GR		
398	Run	B	2	BO/CO/GR		
399	Potential obstacle/obstruction to fish passage					
400	Glide	B	1	BO/CO/GR		
401	Run	C	2	BO/CO/GR		
402	Riffle	B	2	BO/CO/GR		
403	Run	B	2	BO/CO/GR		
404	Glide	C	2	AR/BO		
405	Potential obstacle/obstruction to fish passage					
406	Pool	C	2	BO/CO/GR		
407	Run	B	2	BO/CO/GR		
408	Salmonid habitat	B	3	BO/CO/GR		Fry

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
409	Run	B	3	BO/CO/GR		
410	Salmonid habitat	B	3	BO/CO/GR		Fry
411	Run	B	3	BO/CO/GR		
412	Salmonid habitat	B	4	BO/CO/GR		Parr/Fry
413	Run	C	2	BO/CO/GR		
414	Salmonid habitat	B	3	BO/CO/GR		Fry
415	Salmonid habitat	B	4	BO/CO/GR		Parr/Fry
416	Pool	C	2	BO/CO/GR		
417	Salmonid habitat	B	3	BO/CO/GR		Fry
418	Run	B	2	BO/CO/GR		
419	Potential obstacle/obstruction to fish passage					
420	Riffle	B	2	BO/CO/GR		
421	Pool	D	2	BO/CO/GR		
422	Run	C	2	BO/CO/GR		
423	Run	B	2	BO/CO/GR		
424	Run	C	2	BO/CO/SA		
425	Run	D	4	BO/CO/GR		
426	Run	C	3	BO/CO/GR		
427	Torrent	D	5	BO/CO/GR		
428	Salmonid habitat	C	4	BO/CO/GR		Parr
429	Pool	D	2	BO/CO/GR		
430	Run	D	4	BO/CO/GR		
431	Salmonid habitat	C	4	BO/CO/GR		Parr
432	Lamprey	C	1	SI/SA		Optimal
433	Run	B	2	BO/CO/GR		
434	Salmonid habitat	C	4	BO/CO/GR		
435	Run	B	3	BO/CO/GR		
436	Run	B	3	BO/CO/GR		
437	Salmonid habitat	B	4	BO/CO/GR		Parr/Fry
438	Torrent	D	5	BO/CO/GR		
439	Run	C	3	BO/CO/GR		
440	Run	E	4	BO/CO/BE		
441	Run	C	3	BO/CO/GR		
442	Eddy	D	0	BO/CO/GR		
443	Eddy	D	0	BO/CO/GR		
444	Run	B	2	BO/CO/GR		
445	Run	E	5	BO/CO/GR		
446	Run	D	4	BO/CO/GR		
447	Torrent	E	5	BO/CO/GR		
448	Run	C	4	BO/CO/GR		
449	Lamprey	C	0	SI/SA		Optimal

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
450	Salmonid habitat	C	4	BO/CO/GR		Parr
451	Torrent	C	5	BO/CO/GR		
452	Run	B	2	BO/CO/GR		
453	Run	C	3	BO/CO/GR		
454	Run	C	4	BO/CO/GR		
455	Salmonid habitat	B	3	BO/CO/GR		Parr/Fry
456	Salmonid habitat	C	4	BO/CO/GR		Parr
457	Run	B	3	BO/CO/GR		
458	Run	C	3	BO/CO/GR		
459	Run	C	4	BO/CO/GR		
460	Run	D	3	BO/CO/GR		
461	Run	D	3	BO/CO/GR		
462	Run	C	3	BO/CO/GR		
463	Dry	N/A	N/A	BO/CO/GR		
464	Run	A	2	BO/CO		
465	Run	A	2	SI	EFL-80	
466	Choked with vegetation	A	0	SI	EFL-100	
467	No perceptible flow	B	0	SI	EFL-20 EBL-5	
468	Choked with vegetation	A	0	SI	EFL-100	
469	No perceptible flow	C	0	SI	EFL-20 EBL-5	
470	Choked with vegetation	A	0	SI	EFL-100	
471	Potential obstruction to fish passage					
472	Run	A	2	BO/CO/GR/SA		
473	Choked with vegetation	A	0	SI	EFL-100	
474	Glide	A	1	SA/SI/GR	EFL-40 EBL-20	
475	Run	A	2	SI/SA/CO	EFL-40 EBL-20	
476	Dry	N/A	N/A	BO/CO/GR		
477	Choked with vegetation	N/A	0	SI	EFL-100	

Appendix B : Lower Houses Highway Updates – Aquatic survey results

Creating a world fit for the future

RICARDO

Haweswater Aqueduct Resilience Programme

TR3 Bowland - Lowerhouses Highways

Watercourse Walkover and Protected Species Survey Report

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Customer:

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Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001

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1 Introduction

1.1 Purpose of this report

Ricardo was commissioned by United Utilities to undertake walkover and protected species surveys of two watercourses in relation to the Haweswater Aqueduct Resilience Programme (HARP) Proposed Bowland Section.

Otter *Lutra lutra*, water vole *Arvicola amphibius*, white-clawed crayfish *Austropotamobius pallipes* and fish and lamprey habitat suitability surveys are required to inform the conclusions and recommendation identified in Chapter 9B of the Environmental Statement for the Proposed Bowland Section (Volume 6 Proposed Bowland Section Chapter 9B: Aquatic Ecology Document Ref.: LCC_RVBC-BO-ES-009-02).

This report details surveys undertaken on watercourses which may be impacted by the proposed Lowerhouses compound highways works.

1.2 Site information

The maps in **Appendix 1** show the location of the survey reaches and the survey extents for each watercourse. The watercourse details are shown in **Table 1.1** below.

Table 1.1: Watercourse information

Watercourse name	Watercourse ID
Eskew Beck	W2334
Clear Beck	W2305

2 Methodology

2.1 Watercourse walkover surveys

The walk-over habitat survey methodology was based on the Environment Agency's 'Restoration of Riverine Salmon Habitats' guidance manual[1]. The 'Hendry & Cragg-Hine' method was developed to be used to inform habitat restoration, fish survey site selection, and fish population studies.

The main objective walk-over survey was to obtain a detailed representation of the location, extent, and condition of habitat features along and surrounding a watercourse. This was done by walking the riverbank of the selected survey stretch. The habitats and features recorded during the walk-over surveys included:

- Flow type
- Water depth
- Substrate composition
- Species specific habitats
- Obstructions
- Macrophytes – estimated percentage cover for:
    - submerged macrophytes
    - emergent macrophytes
    - filamentous algae
    - Macrophyte choked channel
- Other features:
    - Coarse woody material
    - Debris dam

[1] Hendry & Cragg-Hine (1997) http://www.apemltd.co.uk/wp-content/uploads/2016/08/Restoration-of-Riverine-Salmon-Habitats-A-Guidance-Manual.pdf

- Bankside roots (target note)
- Undercut bank (line along bank)
- Overhanging terrestrial vegetation
- Shading.

Incidental findings were also recorded during the walk-over surveys including Invasive Non-native Species (INNS), pollution sources, field boundaries, land use, and bank modifications.

2.2 Otter survey and habitat suitability assessment

The methodology for surveying otters broadly follows the guidance set out by Chanin (2003)[2] and includes an assessment of the (relative) suitability of the habitat for otters and a search for field signs indicating the presence, or possible presence.

Searches were undertaken for field signs as described by Chanin (2003). Surveys were carried out where possible during periods of low rainfall. The presence of Otter may be indicated by the following signs:

- Potential and actual holt locations
- Potential and actual couch locations
- Spraints (droppings)
- Footprints/ tracks
- Slides
- Evidence of feeding (fish carcasses)
- Direct observation of otter

Photographs were taken to document otter evidence as well as the habitats present on site.

2.3 Water vole survey and habitat suitability assessment

The methodology for surveying for water voles in relation to developments follows the guidance set out in the Water Vole Mitigation Handbook[3] and includes an assessment of the (relative) suitability of the habitat for water voles and a search for field signs indicating the presence, or possible presence, of water voles.

Searches were undertaken for field signs as described in the Water Vole Conservation Handbook[4] and Water Vole Mitigation Handbook. The presence of water vole may be indicated by the following signs:

- Burrows
- Faeces and/or latrines
- Feeding stations
- Other feeding signs (e.g. grazed ‘lawns’ outside burrow entrance)
- Above-ground nests
- Paths or runways
- Footprints (although rarely distinguishable from rat)
- Direct observation of water voles

The presence of any field signs that indicate the presence of key predators, such as American mink (*Mustella vison*) or water vole, were also searched for as well as evidence of other potential predators, such as cats and foxes were also noted, where identified.

[2] Chanin P. (2003) *Monitoring the Otter, Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series 10.
[3] Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series).
[4] Strachan, R., Moorhouse, T. and Gelling, M. (2011) Water Vole Conservation Handbook. Third Edition.

The optimum period for determining the presence of water vole is during the breeding season, during which latrines are regularly visited and marked. As per the Water Vole Mitigation Handbook (2016), two survey visits are required at each watercourse.

2.4 White-clawed crayfish habitat suitability assessment

In order to establish if white clawed crayfish could be present in waterbodies within the zone of influence, habitat assessment surveys were undertaken. These included recording habitat features as detailed in Peay (2002)[5] such as, but not limited to:

- Presence of suitable refuges, i.e. boulders, cobbles, woody debris, tree roots, other features suitable
- Size of stones within watercourse bed
- Microhabitats within the watercourse
- Presence of siltation and filamentous algae
- Substrate type, i.e. soft enough for burrowing
- Flow velocity and flow types
- Bank structure
- Potential input of nutrients or pollution
- The presence of potential barriers to crayfish movement e.g. weirs, waterfalls, areas of fast flow
- Direct observation of white-clawed crayfish or other crayfish species

2.5 Fish and lamprey habitat suitability assessment

The fish habitat assessment focussed on identifying habitat features considered to be important to Atlantic salmon *Salmo salar*, and river, brook and sea lamprey *Lampetra fluviatilis, Lampetra planeri* and *Petromyzon marinus* as detailed in Hendry & Cragg-Hine (2003)[6] and Maitland (2003)[7]. These included recording habitat features such as, but not limited to:

- Potential input of nutrients or pollution
- Presence of movement barriers e.g. waterfall, dam, weir or pollution barrier
- Flow velocity and flow types
- Sandy silt in fresh water at the edge of streams (lamprey)
- Substrate type
- Water depth
- Gradient of flow
- Cover by vegetation

2.6 Weather conditions and survey dates

The survey of both watercourses detailed in this report were undertaken on 11/11/2021 by experienced ecologists Eve Loxham and Oliver Parr. Weather conditions are detailed in **Table 2.1** below.

[5] Peay, S. (2002). *Guidance on Habitat for White-clawed crayfish and its Restoration*. Environment Agency Technical Report W1-067/TR. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290346/sw1-067-tr-e-e.pdf [online – accessed November 2021].
[6] Hendry, K & Cragg-Hine, D. (2003). *Ecology of the Atlantic Salmon.* Conserving Natura 2000 Rivers Ecology Series No 7. English Nature, Peterborough.
[7] Maitland, P. S. (2003). *Ecology of the River, Brook and Sea Lamprey*. Conserving Natura 2000 Rivers Ecology Series No 5. English Nature, Peterborough.

Table 2.1: Surveys dates and weather conditions for the 2019 water vole field sign surveys

Watercourse	Cloud cover	Wind speed (Beaufort scale) and direction	Temperature (°C)	Precipitation
Clear Beck	6/8	F2	11°C	No precipitation
Eskew Beck	6/8	F2	12°C	No precipitation

2.7 Limitations

The surveys were undertaken in November 2021 which is outside the optimal timing for undertaking water vole surveys, consequently only data on habitat suitability was recorded and any incidental evidence of water vole activity. Therefore, absence of field signs could not be relied upon as evidence of absence.

Surveyors were not able to access the full extent of Eskew Beck due to the presence of dense scrub and hedgerows, along with wire fencing on both sides of the beck. This is not considered to be a major constraint to the surveys since the watercourse could be clearly viewed from vantage points at the edges of the dense scrub.

3 Results

TR3: Eskew Beck W2334

Example watercourse northern survey reach:

Example substrate northern survey reach:

Bedrock-dominated section:

Eastings and Northings:

Upstream: X: 364449 Y: 469047

Downstream: X: 364528 Y: 468734

- **No evidence of otter, suitable otter holt identified and suitable couch habitat**
- **No evidence of water vole, no suitable habitat**
- **No evidence of crayfish, suitable habitat**
- **No evidence of fish or lamprey, suitable habitat**

General description

Eskew Beck is a tributary of the River Wenning. The beck is within a steep-cut broadleaved woodland valley at the north of the survey reach. The beck is crossed by a road overbridge (Eskew Lane/ Long Lane). At the southern end of the survey reach, the beck is shallow-sided and bordered by grazing pasture and broadleaved woodland. There were signs of livestock impacts to the beck in the southern survey reach in the form of poaching at the water edge along the embankments.

Much of the beck was unfenced aside from small sections adjacent to the overbridge.

Aquatic vegetation was limited and only a small section of brooklime *Veronica beccabunga* was noted within the beck at the bridge.

The width and depth of the beck varied and was between 2 - 6.5 m wide, and 0.1 - 0.7 m deep.

Flow types were variable and included extensive areas of smooth, unbroken standing waves, rippled, and chute flow with additional areas of free fall noted.

The channel bed was variable throughout the survey reach and included extensive areas of bedrock (northern survey reach), boulder, cobble, and gravel-pebble. Additional substrate types more rarely noted included sand, silt, clay and organic (leaves/ twigs). Embankments of the beck were earth (i.e. mixed substrate) dominated with cobbles and boulders.

Litter was rarely noted within the beck and surrounding habitats and included agricultural feed plastic waste and scattered other debris. There was evidence of a small fire adjacent to the beck in the southern survey reach.

The beck is within privately-owned woodland towards the north where disturbance is low. Within the southern survey reach, at the time of the survey, there was evidence of livestock poaching / trampling on one side of the embankment and occasionally within the mid-channel.

Otter

Within the northern half of the survey reach, mature tree roots at the water's edge provided suitable

Adjacent habitat northern survey reach:

Adjacent habitat southern survey reach:

Potential otter holt location:

opportunities for otter holts, e.g. at SD 64447 69043. Although the woodland understory vegetation is generally assessed to be sparse, there are opportunities for otter lay-up sites within areas of denser understory of the adjacent woodland and surrounding fallen mature trees which create refuge opportunities.

There were no identified opportunities for otter holts within the southern half of the survey reach.

Water vole suitability

The beck is considered too shallow and too over-shaded by adjacent trees and scrub for use by water vole. Sections of the beck considered deep enough for use by water vole were generally confined to small pools. The embankments within the northern survey reach were typically not soft enough for water vole burrowing (i.e., containing boulders and cobbles). Sections of the beck in the southern survey reach, and not over-shaded by trees were poached by livestock and there was a lack of bankside vegetation suitable for water vole foraging.

A small mammal hole was noted at the top of the embankment within the southern survey reach, close to an area of embankment collapse (SD 64498 68777). The hole size was approximately 3-4 cm in diameter and therefore too small for use by water vole. The hole is likely used by other small vole species or mice.

White-clawed crayfish suitability

The surveyed areas of the beck provide suitable crayfish refuges in the form of: boulders, cobbles and deadwood within the centre of the channel; undercut embankments; and boulders, cobbles and deadwood at the water edge. There are no weirs within the surveyed stretch, however the section of the beck dominated bedrock which was steep and fast flowing (SD 64434 68997) would prevent crayfish movement upstream.

Fish habitat suitability

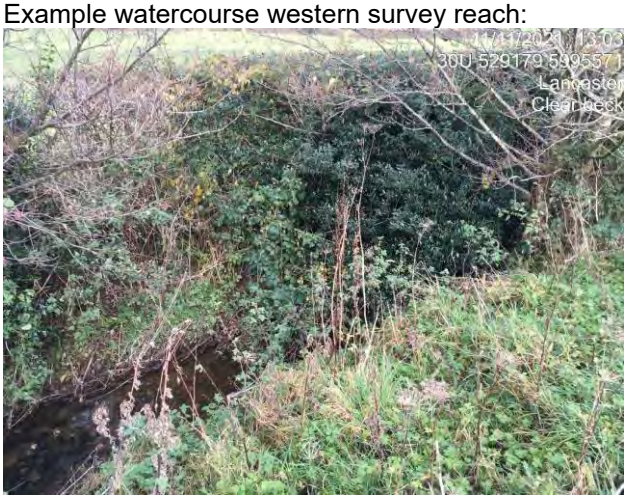
The beck substrate is variable and provides opportunities for salmonid species in the form of refuges amongst boulders, cobbles, and deadwood. The steep, bedrock-dominated section of the beck which is shallow and fast flowing (SD 64434 68997) may form a barrier to fish movement upstream.

Fine sediments suitable for lamprey juveniles were rarely noted along the water edge and were more commonly observed in the southern survey reach where the beck is bordered by grazing pasture. However poaching by livestock reduces the suitability for lamprey ammoceotes.

Identified mammal hole:

TR3: Clear Beck W2305

Example watercourse western survey reach:



Example watercourse eastern survey reach:

Eastings and Northings:

Upstream: X: 364028 Y: 467934

Downstream: X: 363628 Y: 468059

- **No evidence of otter, no suitable otter holt identified, and suitable couch habitat**
- **No evidence of water vole, no suitable habitat**
- **No evidence of crayfish, no suitable habitat**
- **No evidence of fish or lamprey, suitable habitat**

General description

The beck is a tributary of the River Hindburn and flows roughly east to west through the survey reach. It flows adjacent to a private pond at the upstream (eastern end).

The beck is bordered by grazing pasture along with scattered adjacent mature trees, scrub, hedgerows, and rushes. The beck is crossed by a road overbridge (Long Lane). At the eastern survey reach there is an adjacent woodland which surrounds the private pond.

The beck is double-fenced on the western survey reach, and single fenced (on the southern elevation) within the eastern survey reach.

Aquatic vegetation was absent. Occasionally the channel was choked by adjacent terrestrial vegetation.

The width and depth of the beck varied and was between 0.5 - 2 m wide, and 0.15 - 1 m deep. The deep section was noted at the downstream end of the road bridge section.

Flow types were variable and included extensive areas of smooth, unbroken standing waves, rippled, and no perceptible flow with additional rare areas of chute flow noted.

The channel bed was variable throughout the survey reach and included extensive areas of gravel-pebble, cobble, and silt (eastern survey reach). Additional

Example substrate at the road bridge:

Adjacent habitat western survey reach:

Adjacent habitat eastern survey reach (woodland):

substrate types more rarely noted included boulders, sand, clay and organic (leaves/ twigs). Embankments of the beck were earth (i.e. mixed substrate) dominated. The eastern survey reach which was unfenced was a more uniform flow type and substrate and may have been historical dredged or straightened as it followed the field boundary and was deeper than the western section downstream.

Litter was not noted within the beck. The beck is double fenced within the western survey reach where disturbance is low. Within the eastern survey reach it is unfenced on the northern elevation and at the time of the survey, there was evidence of livestock poaching / trampling on one side of the embankment. This section may also be subject to some level of nutrient enrichment from the adjacent livestock.

Otter considerations

No mature tree roots, large cavities under boulders or pipes were noted which may be used as otter holts. The surrounding vegetation was dense in places but this was confined to the western survey reach and was a thin strip approximately 2 – 4 m wide.

The pond at the upstream (eastern) survey reach may be fish stocked and could provide suitable forage, holt or other couch opportunities for otter.

Water vole suitability

In general, the beck is considered too shallow, narrow and over-shaded by adjacent vegetation (western survey reach) or too disturbed (eastern survey reach) for use by water vole. Sections of the beck considered deep enough for use by water vole were generally confined to small pools. Sections of the beck in the eastern survey reach, and not over-shaded by trees were poached by livestock and there was a lack of bankside vegetation suitable for water vole foraging.

White-clawed crayfish suitability

The western survey reach of the beck has suitable areas for crayfish refuge in the form of scattered boulders, cobbles and woody debris. There are no weirs within the surveyed stretch.

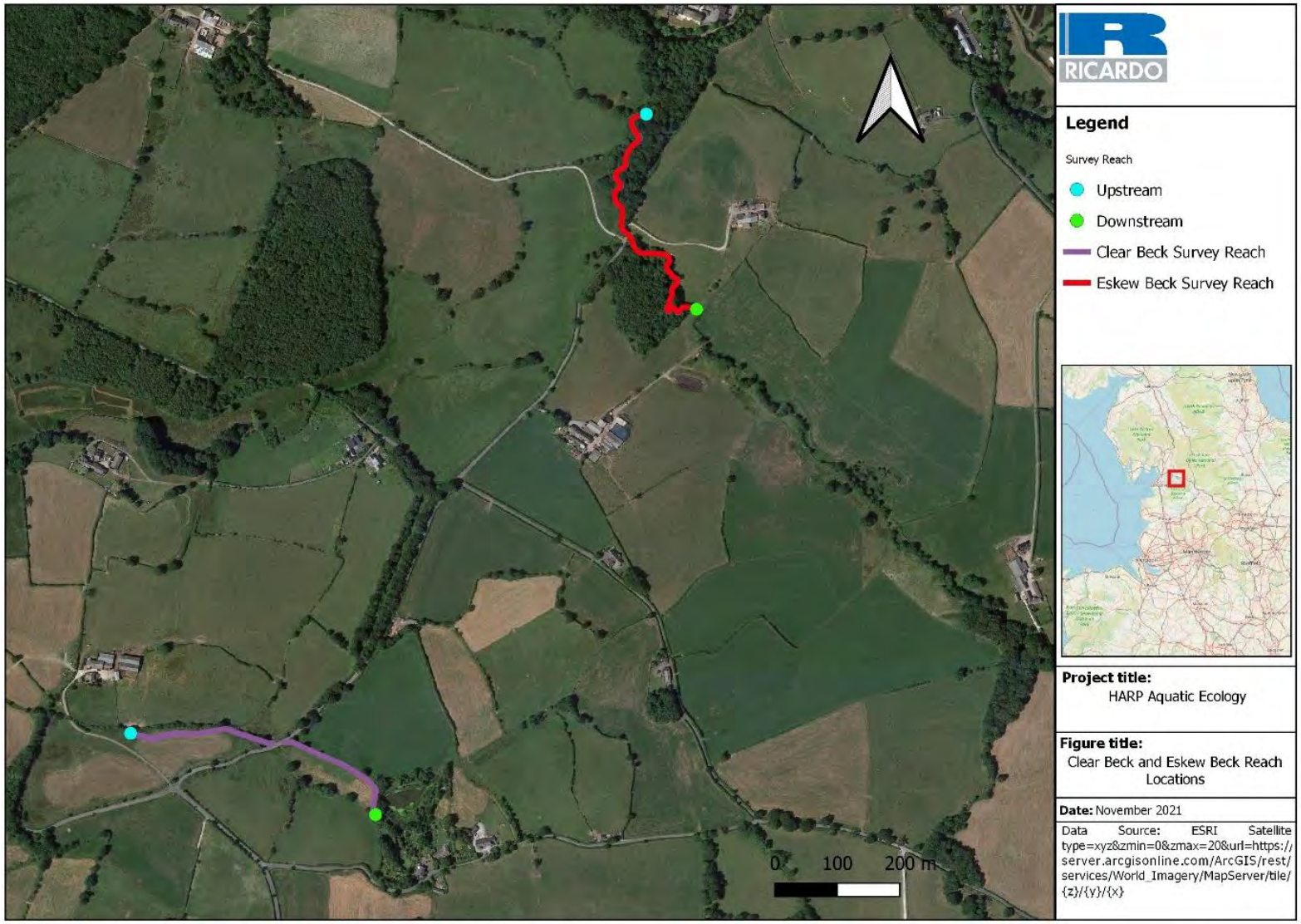
The eastern survey reach is slower flowing and dominated by a more silted substrate which lacks obvious refuges for crayfish.

Fish habitat suitability

The beck substrate is variable within the western survey reach and provides opportunities for salmonid species in the form of refuges amongst boulders, cobbles, and deadwood. Due to the small size and habitats present it is likely to support only limited populations juvenile salmonids.

Fine sediments suitable for lamprey juveniles were not noted along the water edge.

Appendix 1: Survey maps



RICARDO

Legend

Eskew.Beck

Survey Reach
- Upstream
- Downstream

Habitat
- Mammal Hole
- Potential Otter Holt Location

Project title:
HARP Aquatic Ecology

Figure title:
Otter and Water Vole Survey Results
Eskew Beck

Date: November 2021

Data Source: ESRI Satellite type=xyz&zmin=0&zmax=20&url=https://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer/tile/{z}/{y}/{x}

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Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Supplementary Environmental Information

Appendix B5 Annex 3: Gamble Hole Farm Pasture Biological Heritage Site - Baseline and Monitoring Survey Methods

February 2022

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Project No:	B27070CT
Document Title:	Proposed Bowland Section Supplementary Environmental Information (SEI) Appendix B5 Annex 3: Gamble Hole Farm Pasture BHS - Baseline and Monitoring Survey Methods
Document ID:	LCC_RVBC-BO-SEI-Appendix B5 Annex 3
Revision:	0
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Client Name:	United Utilities Water Ltd
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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved

Contents

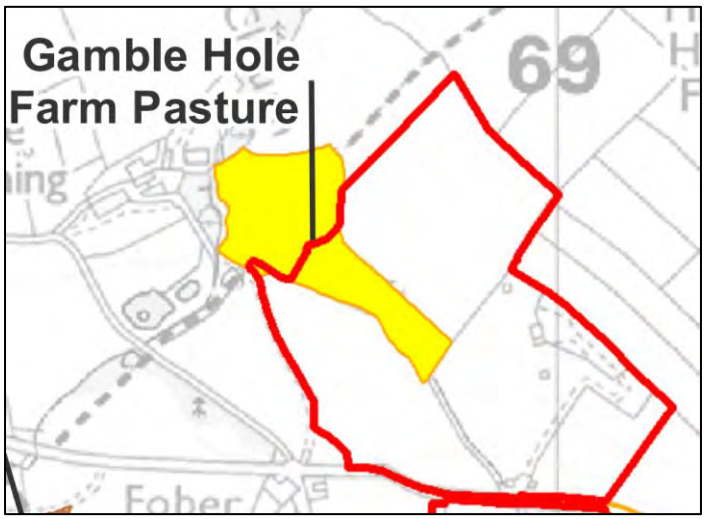
1. Introduction

1.1 Background

1) United Utilities plc is seeking planning consent for the Haweswater Aqueduct Resilience Programme (HARP), which is a proposal to replace the underground tunnel sections of the existing 110 km Haweswater Aqueduct. One of the replacement tunnels runs between Newton-in-Bowland in the south crossing beneath the Bowland Fells to Lower Houses in the north (southeast of Wray).

2) The launch compound for the tunnel is west of the Newton-in-Bowland village within Ribble Valley Borough Council. Due to the requirement to connect the replacement tunnel to the retained sections of the existing aqueduct, the planning boundary of the launch compound includes part of the Gamble Hole Farm Pasture Biological Heritage Site (BHS). Figure 1 shows the BHS (yellow area) and the proposed planning boundary (redline).

Figure 1: Gamble Hole Farm Pasture BHS and Newton-in-Bowland Compound Planning Boundary



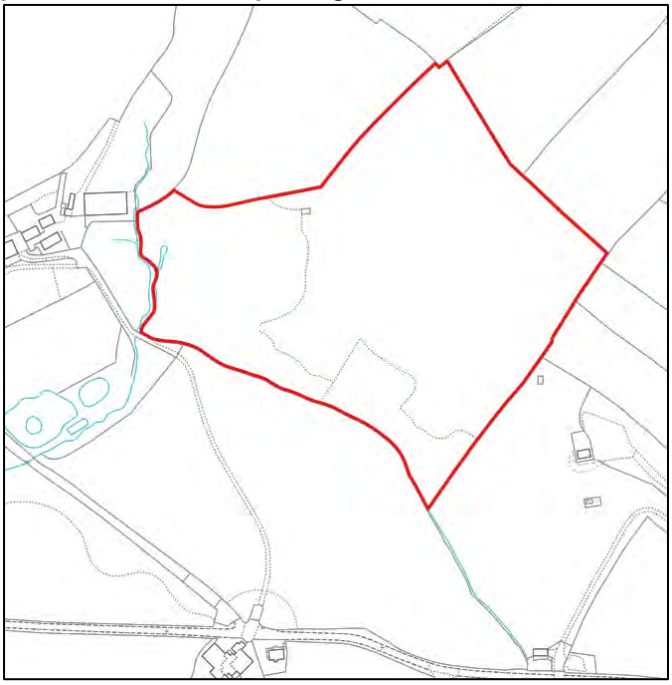
3) Although the southeast part of BHS falls within the redline boundary, works will be prevented from accessing the designation with one exception. Due to the steep topography and associated technical requirements, the launch portal for the tunnel will be serviced by a one-way road system within the compound. This road system will cross the BHS at the point where the area of valuable habitats arer narrowest. It will comprise a bridge section to take the construction track across the watercourse and the M23/M26 habitats. The southern foundations will be outside the designation and within poor semi-improved grassland. The northern foundations and a short section of the adjoining road will be within the BHS boundary but in an area of poor semi-improved grassland.

1.2 Requirement

4) There is some potential for shading from the bridge and changes to groundwater conditions (from works outside the valuable BHS habitats) to impact the designation, therefore a mitigation and compensation package will be delivered as part of the proposed scheme.

5) United Utilities (UU) have an agreement with the landowner to purchase the field that includes the BHS. Figure 2 illustrates the area to be purchased which includes BHS land outside of the redline planning boundary as well as the BHS within the planning boundary.

Figure 2: Land purchase area encompassing Gamble Hole Farm Pasture BHS



6) The designation is not currently under active management for the special interest features of the site, therefore this purchase will allow UU to bring the site under a favourable management regime. To allow a comprehensive management plan to be produced a method for describing and reporting on baseline site conditions is required.

7) The following section of this report describes the bespoke botanical survey method that has been designed in consultation with Lancashire Wildlife Trust to ensure sufficiently detailed baseline information is gathered. The survey will not only inform the initial version of the 30 year management plan, but is designed to be repeatable to assess the effectiveness of the management prescriptions and allow for adaptive management to be implemented as required. In addition to assessing the success of habitat management, the monitoring will also identify if any habitat changes are resulting from the development proposals.

2. Method

2.1 Introduction

8) Following detailed discussions including a site walkover with representatives from Lancashire Wildlife Trust, a bespoke botanical survey method has been produced to ensure sufficiently detailed baseline botanical information is gathered. United Utilities have an agreement with the landowner to purchase the field that includes the BHS, thus ensuring there will be no access restrictions to undertaking baseline monitoring. It also secures access for future monitoring and habitat management requirements.

9) A three-tiered approach is proposed, the aim is to firstly determine the botanical diversity on site and the general distribution of species across the site. Secondly, to confirm the complex mix of vegetation communities present and finally, to accurately map the distribution of key notable species. The proposed survey method is detailed below.

2.2 Proposed Baseline Survey Methods

10) To ensure all vascular plant species present are identified, the site will be visited three times across the 2022 survey season.

- Visit 1 – May
- Visit 2 - July
- Visit 3 – September

11) Each survey visit will comprise three elements:

Step 1

12) The BHS and immediately adjacent habitat will be split into 25x25m grid squares (no. 68 squares in total) and species DAFOR will be recorded within each grid square. During this element the areas / grid squares of greatest diversity and botanical interest, such as vegetation associated with tufa forming springs, will be identified for more detailed assessment (existing NVC data will also be used to inform this decision). The grids are illustrated at drawing G7478.082 at the end of this document. A detailed drone photography survey will also be undertaken in early May to aid the mapping of the areas of greatest botanical interest.

Step 2

13) Following a review of findings of Step 1, the 25x25m squares identified to have greatest botanical interest will be surveyed in greater detail. Based on a 5x5m grid a minimum of 5 grid squares (within each 25x25m grid highlighted for further survey) will be surveyed as NVC quadrats with species frequency recorded using the Domin scale. Quadrats will sample representative areas of vegetation present. Where there is a mix of vegetation communities a greater number of quadrats will be utilised to ensure all communities present are sufficiently sampled. Additional quadrats will also be located within areas potentially impacted by works if these are not already highlighted for more detailed assessment.

Step 3

14) As a final layer of survey, individual count and GPS mapping will be undertaken of a small number of key target species rare to Lancashire. This would cover notable species that are recorded only rarely onsite where the distribution and frequency would not be sufficiently detailed as a result of the grid survey method detailed at Step 1. In consultation with Lancashire Wildlife Trust, the species covered by Step 3 are listed below, but may be extended if additional notable plants are identified:

- Marsh helleborine *Epipactis palustris*
- Charophyte (stonewort) *Chara vulgaris ssp. Longibracteata*

- Bogbean *Menyanthes trifoliata*
- Tawny sedge *Carex hostiana*
- Long-stalked yellow-sedge *Carex lepidocarpa (Carex viridula ssp. Brachyrrhyncha)*
- Few flowered spike-rush *Eleocharis quinquefolia*
- Grass of Parnassus *Parnassia palustris*
- Globeflower *Trollius europaeus*
- Fen bedstraw *Galium uliginosum*

15) The surveys will be carried using GPS enabled tablets that show the surveyors location in relation to the site and the grid squares, along with the use of marker cones, this will enable the surveyors to survey each grid square with reasonable accuracy. 5x5m areas were chosen as this level of accuracy is reasonable and allows for GPS discrepancies over numerous visits.

16) The data across the 3 visits will be combined to produce:

- Heat maps displaying the distribution and frequency of key species across the BHS and immediately adjacent land. Heat mapping will also be utilised to display overall species diversity across the site.
- An updated map displaying the distribution of NVC communities within and immediately adjacent to the BHS boundary. Features like springs and channels will also be mapped.
- Detailed location plans of the particularly rare/notable species identified for more detailed distribution mapping.

17) The key species for which individual heat maps will be produced will be determined through consultation with the Lancashire Wildlife Trust once field work is complete and initial results are known.

2.3 Monitoring

18) The survey and mapping methods are designed to be repeatable for monitoring purposes. The frequency of monitoring to be determined following completion of the baseline surveys, and in light of timetables for site activities including habitat management and construction works. The frequency of monitoring will be determined in consultation with Lancashire Wildlife Trust, however, it is anticipated that during the enabling, construction and reinstatement period monitoring would be bi-annual and carried out in July (likely to be the most prolific month in terms of species identification). Then reduced to every 4 years, again to be confirmed following findings of monitoring and through consultation. The drone photography survey will be repeated in the first May that follows works commencing adjacent to the BHS to aid the identification changes to the distribution of vegetation communities that may arise. Further drone surveys will initially follow the same frequency of field surveys but may be reduced if they do not provide useful data at this frequency, again this would be confirmed through consultation.

2.4 Habitat Management Plan

19) The results of the baseline surveys will inform the initial 30 year Habitat Management Plan and the repeat surveys will be used to review the effectiveness of the management prescriptions. They will also aid in the identification of any changes in BHS habitats as a result of the proposed HARP development. This can then feed into the ongoing reviews of the habitat management prescriptions to ensure and adaptive management approach is taken.

N
W E
S

Legend

Gamble Hole Farm Pasture

NVC Habitats 2019

Fen meadow

NVC Habitats 2020

M22/M26

M23

M23/M26

MG6

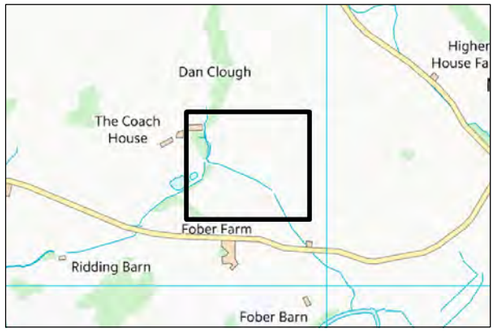
S7

Proposed Survey Grids

5m grids - 1,220 in total

25m grids - 68 in total

Note:
The locations of habitats and habitat features are indicative.



Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
1	MAR21	Original issue	CW	MK	VG	LS

THE ENVIRONMENT PARTNERSHIP

Client: United Utilities

Project: HAWESWATER AQUEDUCT RESILIENCE PROGRAMME

Drawing Title: Gamble Hole Pastures Biological Heritage Site - Proposed Botanical Survey Grids

Drawing Status: FINAL

Scale @ A3	1:1,200	DO NOT SCALE
Jacobs No.		
Client No.		

Drawing No.: G7478.082 Gamble Hole Pastures BHS - Proposed Survey Grids

0 100 m