A9 DUALLING
PERTH TO INVERNESS

Appendix A12.3

Aquatic Ecology

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

ATKINS mouchel

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1. Desk Study

1.1 The Study Area

1.1.1 A Study Area was defined in order to identify aquatic habitats which could be affected by physical modification, water quality or water quantity effects as a result of the Proposed Scheme. For the purposes of the A9 Dualling environmental assessments, it was agreed that the Proposed Scheme plus 150m (the Study Area) was an appropriate extent within which to identify aquatic receptors potentially affected by the Proposed Scheme[i].

1.1.2 The Study Area is not synonymous with the Ecological Zone of Influence (EZoI) which can be specific to individual receptors. For example, a watercourse affected by physical modification within the Study Area could affect a migratory fish population beyond the Study Area (through, for example the severance of spawning habitat).

1.2 Identification of Aquatic Receptors

1.2.1 All watercourses and standing waterbodies within the Study Area were identified from geospatial analysis and Ordnance Survey (OS) mapping.

1.2.2 The Centre for Ecology and Hydrology (CEH) Digital River Network (DRN; digitised from 1:50,000 OS mapping) was used as the primary source for identifying ecologically important watercourses which may be affected by the Proposed Scheme.

1.2.3 In addition, watercourses not on the DRN were identified by hydrological walkover surveys undertaken by AMJV in August 2015. These were screened according to the criteria defined in Section 2 of this Technical Appendix, to validate their exclusion from the ecological assessment where identified as minor, mostly ephemeral, drainage pathways of negligible ecological importance for aquatic flora and fauna.

1.3 Data Collation

1.3.1 A number of data sources were used in support of the DMRB Stage 3 Assessment for aquatic ecology receptors. Data sources are listed below.

Publically Available Data

1.3.2 A number of publically available data sources are directly relevant to aquatic receptors including:

- Scottish Environment Protection Agency (SEPA) Water Framework Directive (WFD) Classification Data and River Basin Management Plan (RBMP) Waterbody Datasheets. The RBMP classifies rivers in terms of their Ecological Status at a 'waterbody' scale. Ecological Status is determined by a number of biological, physico-chemical and hydromorphological elements. Relevant data sources relating to the RBMP include:
  - SEPA River Basin Management Plans Interactive Map[ii]
  - Scotland's Environment website[iii]
- Scottish Natural Heritage (SNH) Interactive Map. The SNH Interactive Map delineates designated sites of importance for nature conservation
  - SNH Site Link[iv]

- Ordnance Survey contemporary mapping
  - Including Where's the Path website[v]

Supplementary Data Request

1.3.3 A number of data requests from regulators, stakeholders and record centres for aquatic receptors were submitted. Due to the mobility of many aquatic species (such as migratory salmonids), the data request was extended beyond the Study Area to identify all suitable data that could help inform the assessment of the effects of the Proposed Scheme. This has included the following data requests:

- SEPA river biological monitoring data within 2km of the Proposed Scheme collected since 2010. This included a request for taxa lists and biological metrics associated with aquatic macroinvertebrate, macrophyte and phytobenthos communities, as well as barriers to fish migration. Received (in part) 15th October 2015 and updated 2nd March 2016.
- Findhorn, Nairn and Lossie Fisheries Trust (FNLFT) electric fishing data within 2km of the Proposed Scheme collected since 2010. Received 24th May 2016.
- Scottish Natural Heritage (SNH) freshwater pearl mussel (*Margaritifera margaritifera*) survey data within 2km of the Proposed Scheme. Received 21st October 2015 and updated 1st June 2016.
- Cairngorms National Park Authority (CNPA) data including a list of priority species for consideration within the DMRB Stage 3 Assessment process. This list was created using the priority species list within the Cairngorms LBAP. The list contained 1200 species and was filtered down by the CNPA to 360 species based on rarity. The CNPA provided records for these species, alongside details of areas with potential to support such species based on a review of the Phase 1 habitat survey results. The records provided were classed as prioritised either "Red" or "Amber".
  - The Red species/habitats are those of highest priority, were there are records in the corridor and they are species and habitats which are particularly vulnerable and high priority for conservation. This includes for example aspen trees or confirmed records of a Cairngorms LBAP species.
  - Amber species/habitats are still considered high priority, but they are instances where there are no confirmed records but indication of habitat suitability had been provided by an expert in that particular group.

A9 Existing Data Sources

1.3.4 A number of existing data sources collected in support of the DMRB Stage 2 Assessment were of direct relevance to aquatic habitats and receptors including:

- CH2M Hill ecological review of watercourse crossing structures (reviewed May 2016)
- Atkins Mouchel Joint Venture (AMJV) Amphibian Habitat Suitability Index data for waterbodies (reviewed June 2016)
- AMJV watercourse geomorphological walkover data (reviewed June 2016)
- AMJV Phase 1 Habitat Survey data and protected species data (reviewed May 2016)

2. DMRB Stage 2 Screening Assessment

2.1.1 Following identification of all aquatic receptors within the Study Area, existing available data were used to help provide a preliminary valuation of the ecological importance of

each receptor for the Stage 2 DMRB Assessment and determine the need for further specific ecological survey as part of the DMRB Stage 3 Assessment.

2.1.2 Survey methods applied during the Stage 3 DMRB Assessment are further described in Section 3 of this Technical Appendix.

3. DMRB Stage 3 Survey Methods

3.1 Proportionality of Survey Effort

3.1.1 Surveys were undertaken only in the absence of existing baseline data or suitable proxies, ensuring that survey effort was proportionate to the requirement for robust ecological assessment. Existing baseline data (for example, proxy SEPA monitoring data) were reviewed to identify the validity of its use (spatially and temporally) in place of the requirement for additional scheme specific survey.

3.2 River Habitat Survey

3.2.1 Watercourses within the Study Area were identified as requiring River Habitat Survey (RHS[vi]) where:

- the watercourse is a permanent flowing system with a channel width nominally >1m; and
- the watercourse is to be lost/culverted/diverted or potentially experience a significant change in water quality or quantity and
- the watercourse is not obviously canalised or heavily managed; or
- the watercourse is an immediate tributary of, or falls within, a designated water-dependent site of importance for nature conservation

3.2.2 At each watercourse identified as requiring survey, a minimum RHS of 500m was undertaken, centred on the proposed design element (for example, a bridge crossing) i.e. 250m upstream and downstream of the specific design element.

3.2.3 In selected instances, for example where all design elements could not be covered within a standard 500m RHS section, this was extended to incorporate additional 500m sections to allow for characterisation of the full extent of habitat that could potentially be affected by the Proposed Scheme.

3.2.4 All RHS were undertaken in April 2016, by RHS accredited freshwater ecologists[1].

3.3 Fish Habitat Survey

3.3.1 Where RHS was undertaken, based on the criteria outlined in Section 3.2, it was augmented by a bespoke Fish Habitat Survey (FHS).

3.3.2 The survey comprised a habitat suitability assessment for key fish species (e.g. salmonids and lampreys) and life stages, identifying any key discrete habitat features of specific value (e.g. discrete spawning substrate or deep pools).

[1] Environment Agency Accredited RHS Surveyor Numbers: FA001 and FA008

3.3.3 All FHS were undertaken in conjunction with RHS, during April 2016, by competent freshwater ecologists.

3.3.4 The FHS made use of existing approaches for fish habitat classification, e.g. Hendry Cragg-Hine Habitat Classification[vii]. This approach allows key fisheries habitat features to be identified spatially, if required, in relation to Proposed Scheme design elements. This augments the RHS approach which summarises functional habitats at a survey reach scale.

3.4 Aquatic Macroinvertebrate Survey

3.4.1 Where RHS was undertaken, based on the criteria outlined in Section 3.2, it was augmented by a standard River Invertebrate Prediction and Classification Software (RIVPACS) method sampling protocol[viii] survey for aquatic macroinvertebrates.

3.4.2 The recognised survey seasons for RIVPACS macroinvertebrate survey are spring (March-May) and autumn (September-November). All macroinvertebrate survey and identification was undertaken in May 2016 (during the spring sampling season) by competent taxonomists, and quality assured by an independent macroinvertebrate taxonomist.

3.4.3 By default, a macroinvertebrate survey was undertaken downstream of the design element (the direction in which most impacts will propagate). Where practical, a survey was also undertaken upstream of the design element, in order to establish a control site for future construction/post-construction monitoring. Additional control site data has also been used to further characterise the ecological baseline for the DMRB Stage 3 Assessment.

3.4.4 Species level macroinvertebrate identification was undertaken to allow for the calculation of the Community Conservation Index (CCI)[ix] which has been used to assess community conservation value for the DMRB Stage 3 Assessment. The CCI provides a measure of overall community conservation value, and highlights specific species of conservation importance based on JNCC threat categories (after Wallace, 1991[x]).

3.4.5 Where multiple surveys were undertaken (i.e. upstream and downstream of the design element), the taxa list was amalgamated to calculate a reach-based (i.e. multi-site) CCI score.

3.4.6 In addition, a number of other standard biotic metrics (Average Score Per Taxon (ASPT)[xi], Proportion of Sediment-sensitive Invertebrates (PSI)[xii], and Lotic invertebrate Index for Flow Evaluation (LIFE)[xiii] were calculated, enabling an assessment of overall habitat quality in relation to water quality, flow character and benthic sediment loading. These metrics were calculated for individual survey sites only, as it is not appropriate to combine multi-site taxa lists for these metrics as has been undertaken for CCI.

3.4.7 Environmental variables required to generate RIVPACS community predictions were also collected. This ensures that, should it be required in future, the data collected will support a full site RIVPACS classification.

3.5 Aquatic Macrophyte Survey

3.5.1 The aquatic macrophyte assemblages of the upland river systems that within the Study Area are bryophyte (moss and liverwort) dominated systems, characterised by low vascular macrophyte abundance and diversity.

3.5.2 Aquatic macrophytes were therefore not subject to quantitative survey. Aquatic macrophyte identification and recording was undertaken on an *ad hoc* basis during RHS. This is considered to be an appropriate use of survey effort that enables identification of the macrophyte interest present that could be affected by the Proposed Scheme.

3.5.3 The Stage 2 DMRB Assessment proposed that should an exceptional case be identified during the RHS surveys (e.g. high floristic diversity), a macrophyte survey would be undertaken. No watercourse was identified that required further survey.

3.6 Waterbody National Pond Survey

3.6.1 Waterbody surveys, where required, were undertaken using the National Pond Survey (NPS[xiv]) method. Waterbodies were subject to NPS where:

- the waterbody is to be lost by any mechanism (drainage, land take to construction etc.) or is likely to experience a significant change in water quality or quantity as a result of the Proposed Scheme (e.g. severance of feeder surface/groundwater pathways to the waterbody) and
- the waterbody, based on amphibian Habitat Suitability Index (HSI) survey, supports at least 5% macrophyte coverage, is of moderate or good water quality and <80% is shaded or
- is within a designated site of importance for nature conservation

3.6.2 In addition, CNPA data provided identified “Red” waterbodies based on the screening for potential to support priority species (such as northern damselfly *Coenagrion hastulatum*). These ponds were found to overlap with those already identified as requiring survey based on the screening criteria applied.

3.6.3 NPS were undertaken in June 2016. Standard practice for NPS is to undertake three seasonal survey visits. However, a single summer survey visit using the NPS method was utilised for the purpose of the Stage 3 DMRB assessment. Three visits are required for a full NPS in order to collect seasonably variable information such as hydrology and water quality. The single summer visit method undertaken was considered sufficient to:

- characterise the pond
- identify species of conservation interest
- determine whether the pond qualifies as Priority Habitat under the Scottish Biodiversity List (SBL)[xv]

3.7 Freshwater Pearl Mussel Survey

3.7.1 Freshwater pearl mussel and its habitat are fully protected by law, under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). The species is also listed under Annex II of the Habitats Directive as a species whose conservation requires the designation of Special Areas of Conservation (SAC). Survey requirements for this legally protected species were determined in liaison with SNH and through application of the following criteria:

- there is a new or extended road crossing which could impact freshwater pearl mussel, their supporting habitat and/or host species or
- SNH data/historical information confirms the presence of freshwater pearl mussel in areas impacted by in channel working (e.g. bank protection) or an outfall feature (e.g. SuDS discharge) or

- areas with supporting habitat (identified through desk based review of data or by RHS) for freshwater pearl mussel, but where no data is available, are at risk of being impacted by in channel working/outfall features

3.7.2 Shallow water surveys were undertaken following standard SNH freshwater pearl mussel survey protocol for use in site-specific projects[xvi]. No deep water surveys were required due to the shallow nature of watercourses within the Study Area.

3.7.3 All surveys (with the exception of Funtack Burn) were undertaken in May 2016 by licensed surveyors.

3.7.4 Funtack Burn was brought into the Study Area at a later stage (February 2017), due to further development of the scheme design and the potential need to provide an access track for Dalmagarry Farm vehicles. Survey of the Funtack Burn was undertaken in February 2017, by licensed surveyors. Although the Funtack Burn crossing was subsequently removed from the Proposed Scheme, baseline freshwater pearl mussel results are included in this appendix for completeness.

3.8 Fish Survey

3.8.1 No scheme-specific fish survey was undertaken for the following reasons:

- Available baseline electric fishing data, consultation with relevant fisheries managers (e.g. the Findhorn, Nairn and Lossie Fisheries Trust (FNLFT)), and a precautionary approach to species distribution was deemed sufficient to identify species which may be present within the Study Area during construction and operation and
- Fish Habitat Survey (FHS) undertaken as part of baseline DMRB Stage 3 surveys would relate observed habitat potential to likely species presence to inform site-specific design and construction mitigation.

4. DMRB Stage 3 Desk Study and Survey Results

4.1 Watercourse Screening

4.1.1 A total of 16 watercourses were identified within the Study Area during the desk study. This includes nine watercourses that are crossed by the existing A9 or will be crossed by the Proposed Scheme and seven within 150m of the Proposed Scheme that are not crossed.

4.1.2 Following the application of the screening criteria as defined in Section 3 of this Technical Appendix, a total of six watercourses were identified as requiring further survey to assess their ecological value for the purpose of DMRB Stage 3 Assessment. These watercourses were:

- Allt na Frithe
- Allt Dubhag
- Dalmagarry Burn
- Allt na Loinne Mòire
- Allt na Slànaich
- Allt Creag Bheithin

4.1.3 The watercourses were subject to RHS, FHS, aquatic macroinvertebrate survey and freshwater pearl mussel survey according to the methods described in Section 3 of this Technical Appendix.

4.1.4 In addition to the above, Funtack Burn was brought into the Study Area at a later stage (February 2017), relative to all other watercourses, due to the potential need to provide an access track for Dalmagarry Farm vehicles. Due to the relatively non-intrusive nature of the proposed access bridge and limited potential impacts on the Funtack Burn, survey was limited to freshwater pearl mussel survey to confirm the absence of this protected species at this location. The Funtack Burn crossing was subsequently removed from the Proposed Scheme; however baseline freshwater pearl mussel results are included in this appendix for completeness.

4.1.5 Survey locations for all surveys undertaken are shown in Figures 12.8a-k and 12.12a-k.

4.2 River Habitat Survey Summary

4.2.1 River habitats within the Study Area were characteristic of the upland, historically managed landscape and 'flashy' hydrological regime of the low permeability catchment setting.

4.2.2 Common to all survey reaches, surveys recorded low vascular macrophyte abundance and diversity, a bed substrate dominated by gravel, pebble and cobble, and a range of flow types from high energy (e.g. chute flow) to low energy (smooth laminar flow).

4.2.3 All rivers surveyed exhibited a degree of historical modification, consistent with the rural (managed) landscape and the presence of existing infrastructure. Dominant bank land use was predominantly managed, consisting of heathland, coniferous plantation and rough pasture.

4.2.4 None of the rivers surveyed qualify as Priority Habitat under the published definition for rivers[xvii].

4.2.5 Individual site accounts are presented in Section 5.2, with Habitat Modification Score (HMS) calculations detailed in full in Annex A.

4.3 Fish Habitat Survey Summary

4.3.1 A variety of glide, pool and riffle/run habitat was recorded throughout the watercourses surveyed, with associated features such as large woody debris and undercut banks providing good habitat for salmonid fry and parr in particular. Salmonid spawning habitat was also recorded within the reaches surveyed.

4.3.2 The habitats present should be considered in context, i.e. in relation to the scale of the watercourses within which they occur. All watercourses surveyed are relatively minor, with average wetted widths ranging from approximately 0.5 to 2m, and average depths of 0.1-0.3m.

4.3.3 Habitats recorded at survey are likely to support resident populations of brown trout *Salmo trutta*, and potentially small numbers of other lithophilic gravel spawners such as common minnow *Phoxinus phoxinus* and lamprey. Other eurytopic species (those able to tolerate a wide range of environmental conditions) such as European eel *Anguilla anguilla* are likely to be supported by habitats present within the Study Area. However, species diversity is likely to be low, as is common for upland rivers of this type, and the

watercourses surveyed are unlikely to provide a major habitat resource for migratory salmonids or large native coarse species.

4.3.4 Juvenile salmonids were observed in small numbers throughout most reaches surveyed. In addition, available Findhorn, Nairn and Lossie Fisheries Trust (FNLFT) electric fishing data from 2011-2014 confirmed the presence of Atlantic salmon *Salmo salar* and trout fry and parr in relatively low abundance, as well as European eel and minnow in monitoring sites adjacent to the Study Area. Adult salmon were also observed spawning in the Dalmagarry Burn, upstream of its confluence with the Funtack Burn, in early November 2016.

4.3.5 None of the existing A9 crossings (or other structures observed at survey) pose impassable barriers to fish migration. However some crossings (such as the Allt na Frithe, Allt Dubhag and Allt na Loinne Mòire) may pose barriers to upstream fish migration at some flows.

4.3.6 Individual site accounts are presented in Section 5.2, with survey results presented in full in Annex B.

4.4 Aquatic Macroinvertebrate Survey Summary

4.4.1 River aquatic macroinvertebrate communities recorded across the Study Area are indicative of high flow velocity, low sedimentation, and low nutrient enrichment (i.e. good water quality).

4.4.2 Taxa diversity was relatively high, with 66 species recorded across the sites surveyed, including two Notable[2] species; the caseless caddis *Hydropscyche fulvipes* and water scavenger beetle *Helophorus arvernicus*. No taxa identified are included in the SBL.

4.4.3 Individual site accounts are presented in Section 5.2, with survey results presented in full in Annex C.

4.5 Freshwater Pearl Mussel Survey Summary

4.5.1 No live or dead freshwater pearl mussel were found in any watercourse within the Study Area. Some suitable habitat was identified at survey. However, this habitat was sub-optimal and sparsely distributed within the Study Area. A full account of all surveys undertaken is provided in Annex E and Annex F.

4.5.2 Given the absence of freshwater pearl mussel recorded during the surveys, the sub-optimal nature of habitat recorded, and the fact that no records of the species within 2km of the Proposed Scheme have been returned by SNH, impacts on this species within the Study Area have been scoped out of the assessment.

4.5.3 Small numbers of freshwater pearl mussel are likely to be present in the lower reaches of the River Findhorn[xviii]. Further consideration has been given to potential impacts on freshwater pearl mussel populations within the wider EZoI in Chapter 12. For example, barrier effects on migratory salmonids (freshwater pearl mussel host species) have the potential to affect mussel populations outside of the Study Area. Measures will be implemented to avoid and mitigate construction and operational impacts that could otherwise impact freshwater pearl mussel populations within the EZoI.

[2] *Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid; see Section 3.4.*

4.6 Waterbody Screening

4.6.1 A total of seven waterbodies were identified within the Study Area during the desk study.

4.6.2 Following the application of the screening criteria as defined in Section 3 of this Technical Appendix, five waterbodies were identified as requiring further survey to assess their ecological value for the purpose of DMRB Stage 3 Assessment.

4.6.3 The location of these five waterbodies (Ponds 4, 5, 7, 12 and 14) are shown in Figure 12.13e-h. Ponds 4, 5, 12 and 14 were also identified as "Red" in the CNPA data provided, based on their potential to support priority species, namely amphibians and northern damselfly *Coenagrion hastulatum* (see Section 1 for definition of CNPA classifications).

4.6.4 The waterbodies were subject to NPS as described in Section 3 of this Technical Appendix.

4.7 National Pond Survey Results Summary

4.7.1 Pond habitats within the Study Area were all slightly acidic, with high dissolved oxygen levels and relatively low dissolved solids. This is characteristic of the upland setting, hard geology and prevailing oligotrophic/dystrophic (low nutrient) conditions typical of much of the standing water in the region.

4.7.2 Common to all surveys, marginal habitats of the ponds were dominated by *Carex* species and soft rush *Juncus effusus.* However, overall wetland plant species richness varied notably between ponds, ranging from 8 to 28 species recorded.

4.7.3 Aquatic macroinvertebrate survey yielded 33 species across the five ponds surveyed, including two Notable[3] species; the highland great diving beetle *Dytiscus laponnicus* and the whirligig beetle *Gyrinus minutus*. No taxa identified are included in the SBL.

4.7.4 Individual pond species richness was indicative of moderate to good water quality, with a range of 11 to 21 species recorded across the Study Area.

4.7.5 No ponds surveyed qualify as Priority Habitat under the published definition for ponds[xix].

4.7.6 Individual site accounts are presented in Section 5.3, with raw survey results summarised Annex D.

5. Baseline Ecological Valuation

5.1 Approach to Ecological Valuation

5.1.1 The approach taken in ascribing nature conservation importance in a geographical context is outlined in the main ecological chapter (Chapter 12), as detailed in Table A5.1 below.

Table A5.1: Importance Criteria

Importance	Criteria
International	**Ecosystems and Habitats**

[3] *Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid; see Section 3.4.*

Importance	Criteria
	Ecosystems or habitats essential for the maintenance of: · internationally designated areas or undesignated areas that meet the criteria for designation; and/or · viable populations of species of international conservation concern. **Species** Species whose presence contributes to: · the maintenance of qualifying habitats, communities and assemblages that occur within internationally designated sites or within undesignated areas that meet the criteria for such designation.
National	**Ecosystems and Habitats** Ecosystems or habitats essential for the maintenance of: · qualifying communities and assemblages that occur within nationally designated sites or within undesignated areas that meet the criteria for such designation; and/or · viable populations of species of national conservation concern. **Species** Species whose presence contributes to: · the maintenance of qualifying habitats, communities and assemblages that occur within nationally designated sites or within undesignated areas that meet the criteria for such designation; or · the maintenance and restoration of biodiversity and ecosystems at a national level, as defined in the Scottish Biodiversity Strategy (SBS) (Scottish Government, 2013, 2015).
Regional	**Ecosystems and Habitats** Ecosystems or habitats essential for the maintenance of: · communities and assemblages that occur within regionally important sites or localities listed as being of conservation importance in the Highland Biodiversity Action Plan (BAP) or Cairngorms Nature Action Plan (CNAP) (including Local Nature Reserves) or within undesignated areas that meet the criteria for such designation ; and/or · viable populations of species of regional conservation concern. **Species** Species whose presence contributes to: · the maintenance and restoration of biodiversity and ecosystems at a regional level, as defined in the Highland BAP or CNAP.
Authority Area	**Ecosystems and Habitats** Ecosystems or habitats essential for the maintenance of: · populations of species of conservation concern within the authority area. **Species** Species whose presence contributes to: · the maintenance and restoration of biodiversity and ecosystems within a relevant area such as Inverness and Nairn Local BAP.
Local	**Ecosystems and Habitats** Ecosystems or habitats essential for the maintenance of: · populations of species of conservation concern within the local area (for example a Local Nature Reserve (LNR)). **Species** Species whose presence contributes to: · the maintenance and restoration of biodiversity and ecosystems at a local level.

Importance	Criteria
Less than Local	**Ecosystems and Habitats** · Ecosystems or habitats that do not meet the above criteria, i.e., supporting at least populations of species of conservation concern within the local area **Species** · Features that are considered to be absent or do not meet any of the above criteria.

5.1.2 The valuations applied to aquatic receptors consider the receptor importance in the context of both intrinsic habitat quality and the species it has been identified to support. Had specific notable species, or species protected under specific legislation been identified during the DMRB Stage 3 Assessment, these may have been considered important enough to value in their own right, i.e. separately from the receptor. For example, a viable population of freshwater pearl mussel could be accorded a higher valuation than the watercourse in which it is found. Based on the survey results there was no requirement for species/population valuation as part of the assessment.

5.1.3 None of the watercourses or waterbodies within the Study Area are in themselves designated as non-statutory or statutory sites of nature conservation interest, nor do they fall within any such site. However, watercourses and waterbodies may be defined as Priority Habitat under the SBL if published criteria are met.

5.1.4 The Priority Habitat definitions for rivers[xx] and ponds[xxi] include a number of prescriptive criteria by which receptors may qualify. Interpretation is required for one of these criteria in relation to rivers. Headwaters (i.e. a watercourse within 2.5km of its furthest source) qualify only if they have not been 'significantly altered from their natural state'. For the purpose of this assessment headwaters will be considered 'significantly altered from their natural state' if they have a Habitat Modification Score of 3 (Obviously Modified) or more based on River Habitat Survey results.

5.1.5 Based on the absence of designated sites of nature conservation importance, watercourses and waterbodies meeting the criteria for inclusion in the assessment of the Proposed Scheme (see Section 3) are considered to be at a minimum of Local importance, and up to Authority importance for nature conservation (i.e. Priority Habitat under the SBL).

5.1.6 All watercourses and waterbodies not meeting the criteria for inclusion in the assessment of the Proposed Scheme (see Section 3) are assumed to be Less than Local importance for nature conservation.

5.2 Ecological Valuation of Watercourses

5.2.1 The ecological valuation of watercourses within the Study Area is set out in Table A5.2. Refer to Figure 12.8a-k for aquatic macroinvertebrate survey and freshwater pearl mussel survey watercourses and Figure 12.12a-k for river and fish habitat survey watercourses.

5.2.2 Results of all surveys undertaken are considered in relation to each watercourse receptor to determine its overall ecological valuation for the purpose of assessment.

5.2.3 Original survey data from surveys undertaken in support of the ecological valuations is presented in the relevant Annex as outlined in Section 4.

5.2.4 As discussed in paragraph 4.1.4, baseline freshwater pearl mussel survey results are included in Annex F for the Funtack Burn. As the potential crossing of the burn has been removed from the Proposed Scheme, no valuation is assigned to the Funtack Burn and it is not reported in Table A5.2 as there is no requirement for ecological impact assessment at this location.

5.2.5 All other watercourse ecological valuations are reported in Table A5.2.

Table A5.2: Watercourse Baseline Ecological Valuation (from south to north)

Watercourse: Allt na Frithe (Ch900)	**Central NGR: NH 79671 30012**
 P1030760 – upstream of A9	**Baseline Ecological Valuation** *Local* importance for nature conservation. The Allt na Frithe is highly dynamic in the upper extent of surveys undertaken and, despite a degree of historical habitat modification in lower reaches surveyed, provides a range of habitats that are likely to be locally important in supporting fish assemblages, and wider ecological communities. A 2011 FNLFT electric fishing survey approximately 500m upstream of the existing A9 crossing identified salmon and trout parr. It also supports a species-rich macroinvertebrate community indicative of high quality habitat, 'High' conservation value under the CCI scoring system, and including the Notable[4] caseless caddis *Hydropscyche fulvipes*.
WFD Characterisation · Classified WFD Waterbody – No · SEPA Monitoring Data Available for Watercourse – No · Receiving Downstream Classified WFD Waterbody – River Findhorn - Tomatin to Dorback Burn (WB ID 23004) · Overall Ecological Status of Receiving WFD Waterbody – Moderate Status (2014 Classification) **River Habitat Survey (Survey Code WC-022-RH-001)** · Representative Channel Dimensions: Water Depth: 0.15m Water Width: 3.5m Bankfull Width: 3.5m · Habitat Modification Score (HMS): 1130 · Habitat Modification Class (HMC): 4 (Significantly Modified) · Descriptive Summary: A dynamic tributary stream of the River Findhorn, the Allt na Frithe flows predominantly through rough pasture land use. Evidence of historical channel realignment associated with the existing A9 culvert crossing, an additional road bridge, and channel re-sectioning in places contribute to the HMC recorded. A range of bed substrates (boulder, cobble, gravel-pebble, sand), high and low energy flow types, point and side bars, and eroding and stable cliffs all provide excellent habitat diversity. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type. · Constraints: The effect of the grazing pasture land use on riparian vegetation was apparent upstream of the A9. Tree cover was sparse and associated wooded habitat features that would naturally be associated with a river of this type (i.e. shading, exposed bankside roots and large woody debris) were vastly reduced in comparison to downstream of the A9.	

[4] *Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid; see Section 3.4.*

Watercourse: Allt na Frithe (Ch900)	Central NGR: NH 79671 30012

Fish Habitat Survey (Survey Code WC-022-FH-001)

- Summary: The reach provides predominantly riffle habitat (within the context of a minor channel, and not present as 'discrete' riffles), with pool, glide and sparse spawning habitat also recorded. The size of the channel, stream gradient, and water depth observed at survey are likely to limit the salmonid use of this habitat resource. Undercut banks and Large Woody Debris (LWD) locally improve fish habitat diversity. A 2011 FNLFT electric fishing survey approximately 500m upstream of the existing A9 crossing identified salmon and trout parr in relatively low abundance (no other species were recorded). Small numbers of juvenile salmonids were also observed during freshwater pearl mussel surveys in this reach (see Annex E). Other lithophilic gravel spawners such as common minnow and lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However species diversity is likely to be low, as is common for upland rivers of this type.
- Salmonid Barrier Assessment: The existing A9 culvert is unlikely to present a major barrier to upstream movement by adult salmonids, or downstream migration by juveniles and smolt. It may present a barrier to other lifestages undertaking local upstream movement, but given the likely low utilisation of the watercourse by migratory salmonids, this may not be a major issue.

Aquatic Macroinvertebrate Survey (Survey Codes WC-022-AI-001 and WC-022-AI-002)

- The community is species rich, with 41 species recorded over two sample points (see Annex C.2). 28 families were represented (the Scottish mean is approximately 25[xxii], from a monitoring network comprising over 300 monitoring sites, most of which are located on much larger river systems than the Allt Dubhag). Of these, 23 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites (refer to Annex C for a complete list): WHPT (Family): 152.8 and 160.1. WHPT ASPT (Family): 6.40 and 7.00. LIFE (Species): 8.39 and 8.32. PSI (Species): 90 and 94.
- Biological metrics are indicative of good habitat diversity and water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 14.64 and 15.75 were recorded from respective sites, which are considered to be communities of 'Fairly High' and 'High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (i.e. producing a reach-based CCI score), the score is 15.75 - i.e. a community of 'High' conservation importance. In this case, the CCI score is predominantly driven by taxon richness and the presence of both the stonefly *Protonemura meyeri*, a Regionally Notable[5] species, and the caseless caddis *Hydropscyche fulvipes*, a Notable[6] species.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (WC-022-PM-001)

- No live or dead mussels were recorded. Habitat quality was classified as unsuitable to moderate within all habitat transects undertaken.

Priority Habitat Assessment

- The Allt na Frithe does not meet published criteria for definition as Priority Habitat.

[5] *Species thought to occur in fewer than five localities (regions) across Great Britain; see Section 3.4.*
[6] *Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid; see Section 3.4.*

Watercourse: Allt Dubhag (Ch1500)	Central NGR: NH 79373 30552
 P1000096 - downstream of A9	**Baseline Ecological Valuation** *Local* importance for nature conservation. The Allt Dubhag provides a range of habitats that are likely to be locally important in supporting fish assemblages, and wider ecological communities, despite extensive historical modifications. It also supports a species-rich macroinvertebrate community indicative of high quality habitat, and assessed as 'Fairly High' conservation value under the CCI scoring system.

WFD Characterisation

- Classified WFD Waterbody – No
- SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – River Findhorn - Tomatin to Dorback Burn (WB ID 23004)
- Overall Ecological Status of Receiving WFD Waterbody – Moderate Status (2014 Classification)

River Habitat Survey (Survey Code WC-019-RH-001)

- Representative Channel Dimensions: Water Depth: 0.15m Water Width: 1.0m Bankfull Width: 1.4m
- Habitat Modification Score (HMS): 1650
- Habitat Modification Class (HMC): 5 (Severely Modified)
- Summary: A dynamic minor upland stream through predominantly mixed plantation and rough pasture land use. Allt Dubhag is a direct tributary of the River Findhorn. Evidence of historical channel realignment associated with the existing A9 culvert crossing, an additional road bridge, and channel re-sectioning in places contribute to the HMC recorded. A range of bed substrates (cobble, gravel-pebble, sand and silt), high and low energy flow types, mid-channel and side bars, and extensive wooded habitat features (exposed bankside tree roots/large woody debris/fallen trees) all provide good habitat diversity in the context of a minor system. The only macrophyte functional groups (indicators of vegetative river habitat diversity) recorded were liverworts/mosses/lichens and filamentous algae, as is typical for a dynamic upland river of this type.
- Constraints: The effect of the grazing pasture land use on riparian vegetation was apparent upstream of the A9. Tree cover was sparse and associated wooded habitat features that would naturally be associated with a river of this type (i.e. shading, exposed bankside roots and large woody debris) were vastly reduced in comparison to downstream of the A9.

Fish Habitat Survey (Survey Code WC-019-FH-001)

- Summary: The reach provides a variety of glide, pool and riffle habitat (within the context of a minor channel). The lack of optimal spawning habitat, size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. Undercut banks and Large Woody Debris (LWD) locally improve fish habitat diversity. Small numbers of juvenile salmonids were observed during freshwater pearl mussel surveys in this reach (see Annex E). Other lithophilic gravel spawners such as common minnow and lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However species diversity is likely to be low, as is common for upland rivers of this type.
- Salmonid Barrier Assessment: The existing A9 culvert is unlikely to present a major barrier to upstream movement by adult salmonids, or downstream migration by juveniles and smolt. It may present a barrier to other lifestages undertaking local upstream movement, but given the

likely low utilisation of the watercourse by migratory salmonids, this may not be a major issue.

Aquatic Macroinvertebrate Survey (Survey Codes WC-019-AI-001 and WC-019-AI-002)

- The community is species rich, with 34 species recorded over two sample points (see Annex C.2). 27 families were represented (the Scottish mean is approximately 25[xxiii], from a monitoring network comprising over 300 monitoring sites, most of which are located on much larger river systems than the Allt Dubhag). Of these, 21 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites (refer to Annex C for a complete list): WHPT (Family): 120.6 and 165.2. WHPT ASPT (Family): 6.70 and 7.18. LIFE (Species): 8.53 and 8.76. PSI (Species): 89 (both).
- Biological metrics are indicative of good habitat diversity and water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 5.08 and 10.00 were recorded from respective sites, which are considered to be communities of 'Moderate' and 'Fairly High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (i.e. producing a reach-based CCI score), the score is 10.28 - i.e. a community of 'Fairly High' conservation importance. In this case, the CCI score is predominantly driven by taxon richness and the presence of the stonefly *Protonemura meyeri*, a Regionally Notable[7] species.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (WC-019-PM-001)

- No live or dead mussels were recorded. Habitat quality was classified as poor to moderate within all habitat transects undertaken.

Priority Habitat Assessment

- The Allt Dubhag enters the Study Area at approximately 2km from its furthest source and would therefore qualify as a 'headwater' under the Priority Habitat definition but for the level of historical modification recorded at survey. The Allt Dubhag is Severely Modified based on River Habitat Survey and it cannot be concluded that it has not been 'significantly altered from its natural state'. It meets no other listed criteria and is therefore not defined as Priority Habitat under the published definition.

[7] *Species thought to occur in fewer than five localities (regions) across Great Britain; see Section 3.4.*

Watercourse: Dalmagarry Burn (Ch3600)	Central NGR: NH 78747 32182
 P1030800 – upstream of A9	**Baseline Ecological Valuation** *Local* importance for nature conservation. The Dalmagarry Burn has been historically realigned but shows signs of natural recovery. Dynamic fluvial processes have given rise to a range of habitats that are likely to be locally important in supporting fish assemblages, and wider ecological communities. A 2011 FNLFT electric fishing survey approximately 600m upstream of the existing A9 crossing identified salmon and trout fry and parr. It also supports a species-rich macroinvertebrate community indicative of good quality habitat, and assessed as 'Fairly High' conservation value under the CCI scoring system.

WFD Characterisation

- Classified WFD Waterbody – No
- SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – Funtack Burn (WB ID 23008)
- Overall Ecological Status of Receiving WFD Waterbody – Good Status (2014 Classification)

River Habitat Survey (Survey Codes WC-016-RH-001 and WC-016-RH-002)

- Representative Channel Dimensions:
  - WC-016-RH-001: Water Depth: 0.15m Water Width: 3.0m Bankfull Width: 4.0m.
  - WC-016-RH-002: Water Depth: 0.15m Water Width: 2.5m Bankfull Width: 4.0m.
- Habitat Modification Scores (HMS):
  - WC-016-RH-001: 2611
  - WC-016-RH-002: 1696
- Habitat Modification Class (HMC):
  - WC-016-RH-001: 5 (Severely modified)
  - WC-016-RH-002: 5 (Severely modified)
- Summary: Dalmagarry Burn is a direct tributary of Funtack Burn. WC-016-RH-001 encompasses the A9 crossing whereas WC-016-RH-002 is downstream of the A9 crossing. Both reaches have been historically realigned, with reach WC-016-RH-001 also historically reinforced and embanked in parts. In total, reach WC-016-RH-001 is spanned by 3 bridges which, alongside more extensive channel and bank modifications, contributes to the higher HMS recorded for this reach. Both reaches showed signs of natural recovery with side bars and mid-channel bars creating variation in bed profiles and giving rise to both high and low energy flow types, providing a range of river microhabitats. A range of bed substrates were also recorded across both reaches (cobble, gravel-pebble and sand). Land use is predominantly rough pasture across both survey reaches. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: The effect of land use on riparian vegetation was apparent, particularly in reach WC-016-RH-001. Tree cover was sparse and associated wooded habitat features that would naturally be associated with a river of this type (i.e. shading, exposed bankside roots and large woody debris) were absent. Reach WC-016-RH-002 runs arrow-straight, with little sign of recovering natural sinuosity that would have been present within the river, prior to its realignment.

Fish Habitat Survey (Survey Codes WC-016-FH-001 and WC-016-FH-002)

- Summary: Both reaches provide a variety of glide, pool and riffle/run habitat (within the context of a minor channel). Spawning habitat was present but more predominant in lower reaches, downstream of the A9. Undercut banks and wooded habitat features in lower reaches locally

improve fish habitat diversity. A 2011 FNLFT electric fishing survey approximately 600m upstream of the existing A9 crossing identified salmon and trout fry and parr (no other species were recorded), with salmon parr recorded in relatively high abundance (17 parr per 100m^2). Small numbers of juvenile salmonids and common minnow were also observed during freshwater pearl mussel surveys in this reach (see Annex E). Other lithophilic gravel spawners such as lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However species diversity is likely to be low, as is common for upland rivers of this type.

- Salmonid Barrier Assessment: There were no crossings or artificial structures on reach WC-016-FH-002. The existing A9 bridge (and adjacent field access bridge) and upstream rail bridge are unlikely to pose barriers to fish movement. The A9 bridge (and an adjacent field access bridge) spans natural bed substrate. Although the bed is artificial beneath the railway bridge, the natural bed gradient is largely maintained and the channel reinforcement is not perched.

Aquatic Macroinvertebrate Survey (Survey Codes WC-016-AI-001 and WC-016-AI-002)

- The community is species rich, with 32 species recorded over two sample points (see Annex C.2). 24 families were represented (the Scottish mean is approximately 25[xxiv], from a monitoring network comprising over 300 monitoring sites, most of which are located on much larger river systems than the Dalmagarry Burn). Of these, 21 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites (refer to Annex C for a complete list): WHPT (Family): 112.4 and 128.7. WHPT ASPT (Family): 6.61 and 7.15. LIFE (Species): 8.54 and 8.39. PSI (Species): 95 and 89.
- Biological metrics are indicative of good habitat diversity and water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 5.25 and 10.63 were recorded from respective sites, which are considered to be communities of 'Moderate' and 'Fairly High' conservation importance under the system.
- Considering the assemblages across the two sites sampled (i.e. producing a reach-based CCI score), the score is 10.53 - i.e. a community of 'Fairly High' conservation importance. The score in this case is driven predominantly by taxon richness across the sites samples, which is indicative of the habitat diversity provided by the stream despite historical modifications.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (WC-016-PM-001)

- No live or dead mussels were recorded. Habitat quality was classified as unsuitable to within all habitat transects undertaken.

Priority Habitat Assessment

- Dalmagarry Burn does not meet published criteria for definition as Priority Habitat.

Watercourse: Allt na Loinne Mòire (Ch6700)	Central NGR: NH 75924 34234
 P1030905 - downstream of A9	**Baseline Ecological Valuation** *Local* importance for nature conservation. The Allt na Loinne Mòire is highly dynamic in the upper extent of surveys undertaken and, despite the historical habitat modification in lower reaches surveyed, provides a range of habitats that are likely to be locally important in supporting fish assemblages, and wider ecological communities. It also supports a species-rich macroinvertebrate community indicative of high quality habitat, and assessed as 'Fairly High' conservation value under the CCI scoring system.

WFD Characterisation

- Classified WFD Waterbody – No
- SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – River Moy Burn (WB ID 23009)
- Overall Ecological Status of Receiving WFD Waterbody – Good Status (2014 Classification)

River Habitat Survey (Survey Codes WC-011-RH-001 and WC-011-RH-002)

- Representative Channel Dimensions:
  - WC-011-RH-001: Water Depth: 0.15m Water Width: 2.4m Bankfull Width: 4.5m.
  - WC-011-RH-002: Water Depth: 0.15m Water Width: 1.8m Bankfull Width: 2.2m.
- Habitat Modification Scores (HMS):
  - WC-011-RH-001: 84
  - WC-011-RH-002: 1340
- Habitat Modification Class (HMC):
  - WC-011-RH-001: 2 (Predominantly Unmodified)
  - WC-011-RH-002: 4 (Significantly Modified)
- Summary: The Allt na Loinne Mòire is a direct tributary of the Moy Burn. WC-011-RH-001 is upstream of the existing A9 crossing whereas WC-011-RH-002 encompasses the A9 crossing. The combination of the A9 itself, channel and bank re-sectioning apparent at survey (there is evidence of historical impounding structures and an associated realignment), and the presence of a railway bridge within the same reach give rise to the different HMS and HMC recorded between the reaches. The Allt na Loinne Mòire was highly dynamic through survey reach WC-011-RH-001, with side bars, point bars and natural berms all present from ongoing lateral channel migration. The system becomes increasingly uniform through the lower survey reach (WC-011-RH-002), as a result of historical modifications. However a range of bed substrates were recorded across both reaches (boulder, cobble, gravel-pebble, sand and silt), with high and low energy flow types and bank profiles (including eroding cliff habitats) providing good habitat diversity throughout. Land use varied between the survey reaches, with extensive moorland (peat bog) associated with reach WC-011-RH-001 and rough pasture extensive throughout reach WC-011-RH-002. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: The effect of land use on riparian vegetation is apparent. Managed moorland was devoid of any trees. Wooded habitat features that would naturally be associated with a river of this type (i.e. shading, exposed bankside roots and large woody debris) were absent throughout reach WC-011-RH-001. Grazing and coniferous plantation activities have also suppressed bank vegetation on both banks downstream of the A9 throughout reach WC-011-RH-002 though localised stands were present.

Fish Habitat Survey (Survey Codes WC-011-FH-001 and WC-011-FH-002)

- Summary: Both reaches provide a variety of glide, pool and riffle habitat (within the context of a minor channel). Spawning habitat is present but more predominant in upper reaches- limited in extent by water depth (typically averaging only 0.05m to 0.1m). The size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource, although small numbers of juvenile salmonids were observed within the reach during freshwater pearl mussel surveys (see Annex E). Other lithophilic gravel spawners such as minnow and lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However species diversity is likely to be low, as is common for upland rivers of this type.
- Salmonid Barrier Assessment: There are no crossings or artificial structures on reach WC-011-FH-001. The existing A9 culvert could present a barrier to fish movement at some flows within reach WC-011-FH-002. The culvert bed is artificial, and the gradient results in high velocity chute flow. The invert level is also perched above the bed at the downstream outlet. A further structure (a railway bridge) at the end of the reach is unlikely to present a barrier to fish movement.

Aquatic Macroinvertebrate Survey (Survey Codes WC-011-AI-001, WC-011-AI-002 and WC-011-AI-003)

- The community is highly species rich, with 51 species recorded over three sample points (see Annex C.2). 31 families were represented (the Scottish mean is approximately 25[xxv], from a monitoring network comprising over 300 monitoring sites, most of which are located on much larger river systems than the Allt na Loinne Mòire). Of these, 22 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- Key community biological metrics for respective sampling sites (range; refer to Annex C for a complete list): WHPT (Family): 127.9 to 176.2. WHPT ASPT (Family): 7.34 to 7.66. LIFE (Species): 8.24 to 8.72. PSI (Species): 81 to 91.
- Biological metrics are indicative of good habitat diversity and water quality, high flow velocity conditions and low channel sedimentation. In particular, the range of species recorded across the sampling points is indicative of the habitat diversity present within the reach.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 10.67, 12.65, and 10.42 were recorded from respective sites, which are considered to be communities of 'Fairly High' conservation importance under the system.
- Considering the assemblages across the three sites sampled (i.e. producing a reach-based CCI score), the score is 12.5 - i.e. remains a community of 'Fairly High' conservation importance. The score in this case is driven predominantly by high taxon richness across the sites samples, which is indicative of the habitat diversity present across the sites sampled.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (WC-007-PM-001)

- No live or dead mussels were recorded. Habitat quality was classified as unsuitable to within all habitat transects undertaken.

Priority Habitat Assessment

- The Allt na Loinne Mòire does not meet published criteria for definition as Priority Habitat. The upper reaches of the river within the Study Area (i.e. the Predominantly Unmodified reach WC-011-RH-001) would qualify as a headwater (and therefore Priority Habitat) were it not for the fact that it is approximately 2.7km from its furthest source (the maximum permitted is 2.5km under the definition).

Watercourse: Allt na Slànaich (Ch8200)	Central NGR: NH 75036 34735
 P1030977 - upstream of A9	**Baseline Ecological Valuation** *Local* importance for nature conservation. The Allt na Slànaich is a highly dynamic minor stream system, despite evidence of historical habitat modification. It provides a range of habitats that are likely to be locally important in supporting fish assemblages, and wider ecological communities. It also supports a macroinvertebrate community indicative of high quality habitat, and assessed as 'Fairly High' conservation value under the CCI scoring system.

WFD Characterisation

- Classified WFD Waterbody – No
- SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – River Moy Burn (WB ID 23009)
- Overall Ecological Status of Receiving WFD Waterbody – Good Status (2014 Classification)

River Habitat Survey (Survey Code WC-007-RH-001)

- Representative Channel Dimensions: Water Depth: 0.1m Water Width: 1.6m Bankfull Width: 1.6m
- Habitat Modification Score (HMS): 845
- Habitat Modification Class (HMC): 4 (Significantly Modified)
- Summary: A dynamic upland stream flowing through predominantly coniferous plantation and rough pasture land use. The Allt na Slànaich is a direct tributary of the Moy Burn. Evidence of historical channel realignment associated with the existing A9 culvert crossing, bank poaching, and channel re-sectioning all contribute to the high HMC recorded. A range of bed substrates (boulder, cobble, gravel-pebble, sand and silt), high and low energy flow types, bank profiles (including eroding cliff habitats), and exposed bankside tree roots/large woody debris provide good habitat diversity in the context of a minor system. The only macrophyte functional group (indicators of vegetative river habitat diversity) recorded was liverworts/mosses/lichens, as is typical for a dynamic upland river of this type containing large substrates.
- Constraints: Extensive grazing has suppressed bank vegetation on both banks downstream of the A9. Similarly, tree cover (and therefore channel shading and other wooded habitat features) is sparser downstream of the A9.

Fish Habitat Survey (Survey Code WC-007-FH-001)

- Summary: The reach provides extensive shallow riffle/run habitat with some glide and pool habitat recorded, providing productive habitat for salmonid fry in particular. A lack of optimal spawning habitat, the size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. Other lithophilic gravel spawners such as minnow and lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However species diversity is likely to be low, as is common for upland rivers of this type.
- Salmonid Barrier Assessment: The existing A9 crossing is not considered to present a significant constraint to upstream adult migration or downstream juvenile/smolt migration. The A9 crossing retains a natural bed structure and is likely to be passable at most flows.

Aquatic Macroinvertebrate Survey (Survey Codes WC-007-AI-001, WC-007-AI-002 and WC-007-AI-003)

- The community is species-rich considering the scale of the river habitats present, with 31

species recorded over three sample points (see Annex C.2). 24 families were represented (the Scottish mean is approximately 25[xxvi], from a monitoring network comprising over 300 monitoring sites, most of which are located on much larger river systems than the Allt na Slànaich). Of these, 22 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.

- Key community biological metrics for respective sampling sites (range; refer to Annex C for a complete list): WHPT (Family): 110.7 to 157.1. WHPT ASPT (Family): 7.38 to 7.86. LIFE (Species): 8.68 to 8.8. PSI (Species): 93 to 100.
- Biological metrics are indicative of good habitat diversity and water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 11.39, 10.00 and 13.33 were recorded from respective sites, which are considered to be communities of 'Fairly High' conservation importance under the system.
- Considering the assemblages across the three sites sampled (i.e. calculating a reach-based CCI score), the score is 11.74- i.e. remains a community of 'Fairly High' conservation importance. The scores are driven both by taxon richness, and the rarity of constituent species. In this case, the CCI score is predominantly driven by taxon richness and the presence of the stonefly *Protonemura meyeri*, a Regionally Notable[8] species.
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (WC-007-PM-001)

- No live or dead mussels were recorded. Habitat quality was classified as unsuitable to within all habitat transects undertaken.

Priority Habitat Assessment

- The Allt na Slànaich does not meet published criteria for definition as Priority Habitat.

[8] *Species thought to occur in fewer than five localities (regions) across Great Britain; see Section 3.4.*

Watercourse: Allt Creag Bheithin (Ch8300)	Central NGR: NH 74847 34724
 P1030940 – downstream of A9	**Baseline Ecological Valuation** *Local* importance for nature conservation. The Allt Creag Bheithin is a dynamic stream system, despite a degree of historical habitat modification. It provides a range of habitats that are likely to be locally important in supporting fish assemblages and wider ecological communities. It also supports a macroinvertebrate community indicative of high quality habitat, 'High' conservation importance under the CCI scoring system, and including the Notable[9] water scavenger beetle *Helophorus arvernicus*.

WFD Characterisation

- Classified WFD Waterbody – No
- SEPA Monitoring Data Available for Watercourse – No
- Receiving Downstream Classified WFD Waterbody – River Moy Burn (WB ID 23009)
- Overall Ecological Status of Receiving WFD Waterbody – Good Status (2014 Classification)

River Habitat Survey (Survey Code WC-004-RH-003)

- Representative Channel Dimensions: Water Depth: 0.4m Water Width: 1.0m Bankfull Width: 1.2m
- Habitat Modification Score (HMS): 480
- Habitat Modification Class (HMC): 3 (Obviously Modified)
- Summary: A sinuous upland stream through predominantly moorland and rough pasture land use, the Allt Creag Bheithin flows into the Allt na Slànaich, which is itself a direct tributary of the Moy Burn. Evidence of historical channel realignment associated with the existing A9 culvert crossing drives the overall HMC recorded. A range of bed substrates (gravel-pebble, cobble and sand), high and low energy flow types, bank profiles (including eroding cliff habitats), and large woody debris provide good habitat diversity in the context of a minor system. Few macrophyte functional groups (indicators of vegetative river habitat diversity) were recorded, but this is expected for a dynamic upland river of this type.
- Constraints: Extensive grazing has suppressed bank vegetation on both banks downstream of the A9. Similarly, tree cover (and therefore channel shading and other wooded habitat features) is relatively sparse.

Fish Habitat Survey (Survey Code WC-004-FH-003)

- Summary: The reach provides extensive glide habitat and areas of shallow riffle/run habitat, particularly downstream of the A9 culvert, providing productive habitat for salmonid fry. A lack of optimal spawning habitat, as well as size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource, although small numbers of juvenile salmonids were observed within the reach during freshwater pearl mussel surveys (see Annex E). Other lithophilic gravel spawners such as minnow and lamprey may be present in low numbers, given habitat suitability, in addition to eurytopic species such as European eel. However species diversity is likely to be low, as is common for upland rivers of this type.
- Salmonid Barrier Assessment: The existing A9 culvert is not considered to present a significant constraint to upstream adult salmonid migration or downstream juvenile/smolt migration. Invert level, flow and culvert length all likely to be passable at most flows.

Aquatic Macroinvertebrate Survey (Survey Codes WC-004-AI-005 and WC-004-AI-006)

- The community is species-rich, with 35 species recorded over two sample points (see Annex C.2). 24 families were represented in total (the Scottish mean is approximately 25[xxvii], from a monitoring network comprising over 300 monitoring sites, most of which are located on much

[9] *Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid; see Section 3.4.*

larger river systems than the Allt Creag Bheithin). Of these, 22 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.

- Key community biological metrics for respective sampling sites (refer to Annex C for a complete list): WHPT (Family): 144.7 and 101.9. WHPT ASPT (Family): 7.24 and 7.28. LIFE (Species): 8.75 and 8.71. PSI (Species): 95 and 96.
- Biological metrics are indicative of good habitat diversity and water quality, high flow velocity conditions and low channel sedimentation.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. CCI scores of 13.13 and 11.79 were recorded from respective sites, which are considered to be communities of 'Fairly High' conservation importance under the scoring system.
- Considering the assemblages recorded across both sites (i.e. calculating a reach-based CCI score), the score is 15.91- or a community of 'High' conservation importance. The score is driven both by taxon richness, and the rarity of constituent species. In this case, the CCI score is driven in part by the presence of the water scavenger beetle *Helophorus arvernicus*, a Notable species[10].
- No taxa identified are included in the SBL.

Freshwater Pearl Mussel Survey (Survey Code WC-004-PM-001)

- No live or dead mussels were recorded. Some small pockets of sub-optimal habitat were present but most of the streambed was too unstable to support freshwater pearl mussels. Habitat quality was classified as unsuitable to moderate within habitat transects undertaken.

Priority Habitat Assessment

- The Allt Creag Bheithin enters the Study Area at approximately 2km from its furthest source and would therefore qualify as a 'headwater' under the Priority Habitat definition but for the level of historical modification recorded. The Allt Creag Bheithin is Obviously Modified based on River Habitat Survey and it cannot be concluded that it has not been 'significantly altered from its natural state'. It meets no other listed criteria and is therefore not defined as Priority Habitat under the published definition.

5.3 Ecological Valuation of Waterbodies

5.3.1 The ecological valuation of waterbodies within the Study Area is set out in Table A5.3. Results of all NPS surveys undertaken are considered in relation to each waterbody receptor to determine its overall ecological valuation for the purpose of assessment.

5.3.2 Original survey data from surveys undertaken in support of the ecological valuations is presented in Annex D.

5.3.3 For pond locations refer to Figure 12.3a-k.

[10] *Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid; see Section 3.4.*

Table A5.3: Waterbody Baseline Ecological Valuation (from south to north)

Pond Number: P14	**Central NGR: NH 79490 30802**
	**Baseline Ecological Valuation** *Local* importance for nature conservation. A permanent pond with good water quality and a macroinvertebrate assemblage assessed as 'Moderate' conservation value under the (adapted) CCI scoring system (but with no specific notable species) and a species-rich macrophyte community including a number of truly aquatic vascular plants and charophytes.

National Pond Survey (Survey Code WB-005-PS-001)

- Pond Area (winter level): 965m^2
- Water Area (at survey): 95m^2
- Summary: Permanent pond within coniferous plantation, peat bog and parkland land use. Estimated to be approximately 0.55m deep at its deepest point. Estimated at survey to have a base composed of 55% peat, 40% clay/silt and 5% gravel. Evidence of recent management (tree planting and coir bank protection) and light wildfowl grazing activity at survey. Three outflows were identified at survey, and the pond was considered to have mixed hydrological dependence (i.e. groundwater/water table surface water run-off and precipitation). Water quality sampling confirms the pond is slightly acidic, with high dissolved oxygen levels and relatively low dissolved solids (see Annex D.1).
- Macroinvertebrate Community: The community was moderately species-rich, with 18 species recorded (See Annex 6.D.2). 18 families were represented in total, of which 16 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 95 and BMWP ASPT was 5.94, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 15.00 was recorded, which is considered to represent a community of 'High' conservation importance under the system. However, the CCI system advocates interpretation of scores in these circumstances- no taxa identified are included in the SBL, and the CCI score is artificially high due to the very low proportion of species present which score under the CCI system (i.e. the number of taxa the overall score is based on). The overall conservation value of the macroinvertebrate community is 'Moderate'.
- Macrophyte Community: The community was species-rich, with 25 non-tree/shrub species recorded in total (See Annex E.3). The community was dominated by marginal species but truly aquatic constituents were also represented in bog pondweed, mare's tail, bulbous rush, intermediate water starwort, common duckweed *Lemna minor*, and the charophytes *Chara virgata* and *Nitella opaca*.

Priority Habitat Assessment:

- The pond does not meet published criteria for definition as Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 1.3.3 for definition): Red.

Pond Number: P12	Central NGR: NH 79508 30912
	**Baseline Ecological Valuation** *Local* importance for nature conservation. A permanent pond with moderately good water quality and a macroinvertebrate assemblage assessed as 'Fairly High' conservation value under the CCI scoring system (but with no specific notable species) and a moderately species-rich macrophyte community.

National Pond Survey (Survey Code WB-004-PS-001)

- Pond Area (winter level): 680m^2
- Water Area (at survey): 680m^2
- Summary: Permanent pond within wet grassland and coniferous plantation, estimated to be approximately 0.45m deep at its deepest point. Evidence of recent management (tree clearance) and light wildfowl grazing activity at survey. Two inflows and an outflow were identified at survey, and the pond was considered to have mixed hydrological dependence (including groundwater/water table, inflow, precipitation and surface water run-off). Water quality sampling confirms the pond is slightly acidic, with high dissolved oxygen levels and relatively low dissolved solids (see Annex D.1).
- Macroinvertebrate Community: The community was moderately species-rich, with 20 species recorded (See Annex 6.D.2). 19 families were represented in total, of which 14 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 76 and BMWP ASPT was 5.43, indicative of moderate water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 13.75 was recorded, which is considered to represent a community of 'Fairly High' conservation importance under the system.
- Macrophyte Community: The community was species-rich, with 24 non-tree/shrub species recorded in total (See Annex E.3). The community was dominated by marginal species but truly aquatic constituents were also represented in bog pondweed, mare's tail, bulbous rush *Juncus bulbosus*, intermediate water starwort *Callitriche hamulata*, and the stonewort *Chara virgata*.

Priority Habitat Assessment:

- The pond does not meet published criteria for definition as Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 1.3.3 for definition): Red.

Pond Number: P7	Central NGR: NH 78705 32846
	**Baseline Ecological Valuation** *Less than Local* importance for nature conservation. A semi-permanent, heavily managed, grazed and nutrient enriched pond with poor water quality and a macroinvertebrate/macrophyte community of negligible ecological importance.

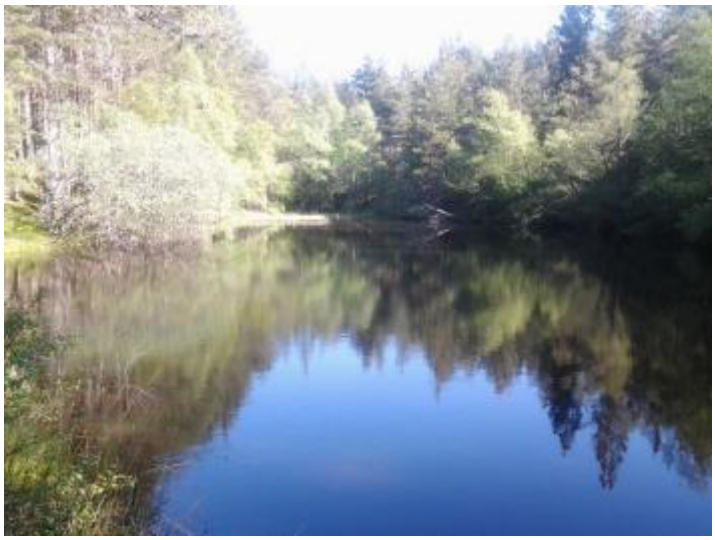
National Pond Survey (Survey Code WB-003-PS-001)

- Pond Area (winter level): 300m^2
- Water Area (at survey): 50 m^2
- Summary: Semi-permanent pond within rough pasture, estimated to be approximately 0.5m deep at its deepest point, but heavily silted with only a shallow water head (approximately 0.05m). Estimated at survey to have a base composed of 100% silt. Evidence of recent management (tree clearance) and intensive livestock grazing activity at survey. No inflows or outflows were identified at survey, and the pond was considered to have mixed hydrological dependence (including groundwater/water table and precipitation). Water quality sampling could not be undertaken at this site due to the insufficient water depth and high level of suspended silt.
- Macroinvertebrate Community: The community was species-poor, with 10 species recorded (See Annex 6.D.2). Nine families were represented in total, of which 7 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 30 and BMWP ASPT was 4.28, indicative of poor water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 15.00 was recorded, which is considered to represent a community of 'High' conservation importance under the system. However, the CCI system advocates interpretation of scores under these circumstances- no taxa identified are included in the SBL, and the CCI score is artificially high due to the very low proportion of species present which score under the CCI system (i.e. the number of taxa the overall score is based on). The overall conservation value of the macroinvertebrate community is negligible.
- Macrophyte Community: The community was species poor, with 8 non-tree/shrub species recorded in total (See Annex E.3). All species recorded were algae or marginal emergent taxa, i.e. no truly aquatic vascular plants were recorded.

Priority Habitat Assessment:

- The pond does not meet published criteria for definition as Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 1.3.3 for definition): None.

Pond Number: P5	Central NGR: NH 76972 34016
	**Baseline Ecological Valuation** *Local* importance for nature conservation. A permanent, unmanaged pond with good water quality and a macroinvertebrate assemblage assessed as 'Fairly High' conservation value under the CCI scoring system, but with no specific notable species and a species-poor macrophyte community with no truly aquatic vascular plants.

National Pond Survey (Survey Code WB-002-PS-001)

- Pond Area (winter level): 1320m^2
- Water Area (at survey): 1320m^2
- Summary: Permanent pond within coniferous plantation, estimated to be approximately 0.7m deep at its deepest point. Estimated at survey to have a base composed of 65% peat, 25% clay/silt and 5% pebbles and 5% gravel. No evidence of recent management and no grazing activity apparent at survey. A single outflow was identified at survey, and the pond was considered to have mixed hydrological dependence (including groundwater/water table, precipitation and surface water run-off). Water quality sampling confirms the pond is slightly acidic, with high dissolved oxygen levels and relatively low dissolved solids (see Annex D.1).
- Macroinvertebrate Community: The community was moderately species rich, with 17 species recorded (See Annex 6.D.2). 14 families were represented in total, of which 12 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 79 and BMWP ASPT was 6.58, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 15.91 was recorded, which is considered to represent a community of 'Fairly High' conservation importance under the system. However, no taxa identified are included in the SBL, and the CCI score could be considered artificially high due to the relatively low proportion of species present which score under the CCI system (i.e. the number of taxa the overall score is based on).
- Macrophyte Community: The community was species poor, with 11 non-tree/shrub species recorded in total (See Annex 1.1.1.1.1A.1). All species recorded were algae, bryophyte or marginal emergent taxa, i.e. no truly aquatic vascular plants were recorded.

Priority Habitat Assessment:

- The pond does not meet published criteria for definition as Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 1.3.3 for definition): Red.

Pond Number: P4	Central NGR: NH 76836 34096
	Baseline Ecological Valuation *Local* importance for nature conservation. A permanent, unmanaged pond with good water quality, a species rich macrophyte community, and a macroinvertebrate assemblage assessed as 'Very High' conservation value under the CCI scoring system, including two Notable[11] species; the highland great diving beetle *Dytiscus laponnicus* and the whirligig beetle *Gyrinus minutus*.

National Pond Survey (Survey Code WB-001-PS-001)

- Pond Area (winter level): 1,900m^2
- Water Area (at survey): 1,900m^2
- Physical Summary: Permanent pond within coniferous plantation, estimated to be over 1m in depth at its deepest point. Estimated at survey to have a base composed of 60% peat, 35% clay/silt and 5% gravel. No evidence of recent management and no grazing activity apparent at survey. No inflows or outflows were identified at survey, and the pond was considered to have mixed hydrological dependence (i.e. groundwater/water table, precipitation and surface water run-off). Water quality sampling confirms the pond is slightly acidic, with high dissolved oxygen levels and relatively low dissolved solids (see Annex D.1).
- Macroinvertebrate Community: The community was moderately species rich, with 17 species recorded (See Annex 6.D.2). 15 families were represented in total, of which 13 were 'scoring' families (NTAXA) - families which contribute to biological metric calculations for water quality.
- The community BMWP was 85 and BMWP ASPT was 6.54, indicative of good water quality, accepting that this metric is more appropriate for the assessment of running water.
- The CCI scoring system is used to assess the intrinsic conservation importance of the community present. A CCI score of 29.75 was recorded, which is considered to represent a community of 'Very High' conservation importance under the system. In this case, the CCI score is predominantly driven by the presence of two Notable[12] species; the highland great diving beetle *Dytiscus laponnicus* and the whirligig beetle *Gyrinus minutus*. However, no taxa identified are included in the SBL, and the CCI score could be considered artificially high due to the relatively low proportion of species present which score under the CCI system (i.e. the number of taxa the overall score is based on).
- Macrophyte Community: The community was moderately species rich, with 18 species recorded in total (See Annex 1.1.1.1.1A.1). The community is dominated by marginal species but truly aquatic constituents were also represented in bog pondweed *Potamogeton polygonifolius* and mare's tail *Hippuris vulgaris*.

Priority Habitat Assessment:

- The pond does not meet published criteria for definition as Priority Habitat.

CNPA Desk-Based Habitat Classification (see Section 1.3.3 for definition): Red.

[11] *Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid; see Section 3.4.*
[12] *Scarce in Great Britain and thought to occur in less than 100 10km squares of the National Grid; see Section 3.4.*

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Annex A. River Habitat Survey Results

A.1 Habitat Modification Score (HMS) and Habitat Modification Class (HMC)

A.1.1 The Habitat Modification Score (HMS) is an indication of artificial modification to river channel morphology. To calculate the HMS for a site, points are allocated for the presence and extent of artificial features such as culverts and weirs and also modifications caused by the re-profiling and reinforcement of banks. Greater and more severe modifications result in a higher score. The cumulative points total provides the Habitat Modification Score (HMS).

A.1.2 A Habitat Modification Class (HMC) protocol has been developed which allocates the condition of the channel in a site to one of five modification classes, based on the total score (1 = near-natural; 5 = severely modified) - See Table. Higher HMS scores reflect more artificial intervention and modification of the river channel within a site.

Table A.1: River Habitat Modification Class

Habitat Modification Class	Description	Habitat Modification Score
1	Pristine/semi-natural	0 - 16
2	Predominantly unmodified	17 - 199
3	Obviously modified	200 - 499
4	Significantly modified	500 - 1399
5	Severely modified	1400 +

A.2 Summary Habitat Modification Results

A.2.1 Survey habitat modification results and overall HMC are presented for each site surveyed within the Study Area.

Allt Creag Bheithin – RHS Habitat Modification Scoring and Key Photos

Site Reference:	**WC-004-RH-003**
River Name:	**Allt Creag Bheithin**
Date:	**11/04/2016**
Surveyor:	**Bonnie Boulton**
Accreditation Code:	**FA008**
Spot Check 1 NGR (Start):	**NH7465134656**
Spot Check 6 NGR:	**NH7484734724**
End NGR:	**NH7503934847**
HMS Calculated by:	**Liam Atherton**

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts	0
B	Sweep-up artificial features - Culverts	400
	HMS: Culverts sub-score	**400**
C	Spot check bank material	0
D	Spot check bank modification - RI	0
E	Sweep-up bank profiles - RI	0
F	Sweep-up artificial features - revetments	0
G	Spot check channel substrate	0
H	Spot check channel modification - RI	0
	HMS: Bank & bed reinforcement sub-score	**0**
I	Spot check bank modification - RS	0
J	Sweep-up bank profiles - RS	80
K	Spot check channel modification - RS	0
L	Sweep-up channel modification - over deepened	0
	HMS: Bank & bed resectioning sub-score	**80**
M	Spot check bank modification - Berms (BM)	0
N	Spot check bank modification - EM	0
O	Sweep-up bank profiles - Artificial two-stage	0
P	Sweep-up bank profiles - Embanked	0
Q	Sweep-up bank profiles - set back embankment	0
	HMS: Berms & embankments sub-score	**0**
R	Sweep-up artificial features - weirs/dams/sluices	0
	HMS: Weirs/dams/sluices sub-score	**0**
S	Sweep-up artificial features - bridges	0
	HMS: Bridges sub-score	**0**
T	Spot check bank modification - poaching (PC or PC(B))	0
U	Sweep-up bank profiles - poached	0
	HMS: Poaching sub-score	**0**
V	Sweep-up artificial features - fords	0
	HMS: Fords sub-score	**0**
W	Sweep-up artificial features - outfall	
X	Sweep-up artificial features - deflectors	0
	HMS: Outfall/deflectors sub-score	**0**
	Total HMS	**480**

P1000024 - Upstream of A9

P1000030 - Upstream of A9

P1000033 - Upstream of A9

P1000034 - Downstream of A9

P1000044 - Downstream of A9

P1000046 - Downstream of A9

Allt na Slànaich – RHS Habitat Modification Scoring and Key Photos

Site Reference:	**WC-007-RH-001**
River Name:	**Allt Na Slanaich**
Date:	**13/04/2016**
Surveyor:	**Liam Atherton**
Accreditation Code:	**FA001**
Spot Check 1 NGR (Start):	**NH7496634529**
Spot Check 6 NGR:	**NH7503034710**
End NGR:	**NH7515634896**
HMS Calculated by:	**Liam Atherton**

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts	
B	Sweep-up artificial features - Culverts	
	HMS: Culverts sub-score	
C	Spot check bank material	
D	Spot check bank modification - RI	
E	Sweep-up bank profiles - RI	
F	Sweep-up artificial features - revetments	
G	Spot check channel substrate	
H	Spot check channel modification - RI	
	HMS: Bank & bed reinforcement sub-score	
I	Spot check bank modification - RS	
J	Sweep-up bank profiles - RS	
K	Spot check channel modification - RS	
L	Sweep-up channel modification - over deepened	
	HMS: Bank & bed resectioning sub-score	
M	Spot check bank modification - Berms (BM)	
N	Spot check bank modification - EM	
O	Sweep-up bank profiles - Artificial two-stage	
P	Sweep-up bank profiles - Embanked	
Q	Sweep-up bank profiles - set back embankment	
	HMS: Berms & embankments sub-score	
R	Sweep-up artificial features - weirs/dams/sluices	
	HMS: Weirs/dams/sluices sub-score	
S	Sweep-up artificial features - bridges	
	HMS: Bridges sub-score	
T	Spot check bank modification - poaching (PC or PC(B))	
U	Sweep-up bank profiles - poached	
	HMS: Poaching sub-score	
V	Sweep-up artificial features - fords	
	HMS: Fords sub-score	
W	Sweep-up artificial features - outfall	
X	Sweep-up artificial features - deflectors	
	HMS: Outfall/deflectors sub-score	
	Total HMS	

P1000194 - Upstream of A9

P1000195 - Upstream of A9

P1000205 - Upstream of A9

P1000206 - Downstream of A9

P1000212 - Downstream of A9

P1000217 - Downstream of A9

Allt na Loinne Mòire – RHS Habitat Modification Scoring and Key Photos

Site Reference:	**WC-011-RH-001**
River Name:	**Allt Na Loinne Moire**
Date:	**13/04/2016**
Surveyor:	**Bonnie Boulton**
Accreditation Code:	**FA008**
Spot Check 1 NGR (Start):	**NH7583634019**
Spot Check 6 NGR:	**NH7593534238**
End NGR:	**NH7615534204**
HMS Calculated by:	**Liam Atherton**

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts
B	Sweep-up artificial features - Culverts
	HMS: Culverts sub-score
C	Spot check bank material
D	Spot check bank modification - RI
E	Sweep-up bank profiles - RI
F	Sweep-up artificial features - revetments
G	Spot check channel substrate
H	Spot check channel modification - RI
	HMS: Bank & bed reinforcement sub-score
I	Spot check bank modification - RS
J	Sweep-up bank profiles - RS
K	Spot check channel modification - RS
L	Sweep-up channel modification - over deepened
	HMS: Bank & bed resectioning sub-score
M	Spot check bank modification - Berms (BM)
N	Spot check bank modification - EM
O	Sweep-up bank profiles - Artificial two-stage
P	Sweep-up bank profiles - Embanked
Q	Sweep-up bank profiles - set back embankment
	HMS: Berms & embankments sub-score
R	Sweep-up artificial features - weirs/dams/sluices
	HMS: Weirs/dams/sluices sub-score
S	Sweep-up artificial features - bridges
	HMS: Bridges sub-score
T	Spot check bank modification - poaching (PC or PC(B))
U	Sweep-up bank profiles - poached
	HMS: Poaching sub-score
V	Sweep-up artificial features - fords
	HMS: Fords sub-score
W	Sweep-up artificial features - outfall
X	Sweep-up artificial features - deflectors
	HMS: Outfall/deflectors sub-score
	Total HMS

P1000143 - Upstream of A9

P1000149 - Upstream of A9

P1000153 - Upstream of A9

P1000154 - Upstream of A9

P1000164 - Upstream of A9

P1000166 - Upstream of A9

Allt na Loinne Mòire – RHS Habitat Modification Scoring and Key Photos

Site Reference:	**WC-011-RH-002**
River Name:	**Allt Na Loinne Moire**
Date:	**13/04/2016**
Surveyor:	**Bonnie Boulton**
Accreditation Code:	**FA008**
Spot Check 1 NGR (Start):	**NH7618934193**
Spot Check 6 NGR:	**NH7639934303**
End NGR:	**NH7651234485**
HMS Calculated by:	**Liam Atherton**

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts
B	Sweep-up artificial features - Culverts
	HMS: Culverts sub-score
C	Spot check bank material
D	Spot check bank modification - RI
E	Sweep-up bank profiles - RI
F	Sweep-up artificial features - revetments
G	Spot check channel substrate
H	Spot check channel modification - RI
	HMS: Bank & bed reinforcement sub-score
I	Spot check bank modification - RS
J	Sweep-up bank profiles - RS
K	Spot check channel modification - RS
L	Sweep-up channel modification - over deepened
	HMS: Bank & bed resectioning sub-score
M	Spot check bank modification - Berms (BM)
N	Spot check bank modification - EM
O	Sweep-up bank profiles - Artificial two-stage
P	Sweep-up bank profiles - Embanked
Q	Sweep-up bank profiles - set back embankment
	HMS: Berms & embankments sub-score
R	Sweep-up artificial features - weirs/dams/sluices
	HMS: Weirs/dams/sluices sub-score
S	Sweep-up artificial features - bridges
	HMS: Bridges sub-score
T	Spot check bank modification - poaching (PC or PC(B))
U	Sweep-up bank profiles - poached
	HMS: Poaching sub-score
V	Sweep-up artificial features - fords
	HMS: Fords sub-score
W	Sweep-up artificial features - outfall
X	Sweep-up artificial features - deflectors
	HMS: Outfall/deflectors sub-score
	Total HMS

P1000171 - Upstream of A9

P1000173 - Upstream of A9

P1000180 - Upstream of A9

P1000181 - Downstream of A9

P1000184 - Downstream of A9

P1000187 - Downstream of A9

Dalmagarry Burn – RHS Habitat Modification Scoring and Key Photos

Site Reference:	**WC-016-RH-001**
River Name:	**Dalmagarry Burn**
Date:	**12/04/2016**
Surveyor:	**Liam Atherton**
Accreditation Code:	**FA001**
Spot Check 1 NGR (Start):	**NH7848932173**
Spot Check 6 NGR:	**NH7873832174**
End NGR:	**NH7899332078**
HMS Calculated by:	**Liam Atherton**

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts
B	Sweep-up artificial features - Culverts
	HMS: Culverts sub-score
C	Spot check bank material
D	Spot check bank modification - RI
E	Sweep-up bank profiles - RI
F	Sweep-up artificial features - revetments
G	Spot check channel substrate
H	Spot check channel modification - RI
	HMS: Bank & bed reinforcement sub-score
I	Spot check bank modification - RS
J	Sweep-up bank profiles - RS
K	Spot check channel modification - RS
L	Sweep-up channel modification - over deepened
	HMS: Bank & bed resectioning sub-score
M	Spot check bank modification - Berms (BM)
N	Spot check bank modification - EM
O	Sweep-up bank profiles - Artificial two-stage
P	Sweep-up bank profiles - Embanked
Q	Sweep-up bank profiles - set back embankment
	HMS: Berms & embankments sub-score
R	Sweep-up artificial features - weirs/dams/sluices
	HMS: Weirs/dams/sluices sub-score
S	Sweep-up artificial features - bridges
	HMS: Bridges sub-score
T	Spot check bank modification - poaching (PC or PC(B))
U	Sweep-up bank profiles - poached
	HMS: Poaching sub-score
V	Sweep-up artificial features - fords
	HMS: Fords sub-score
W	Sweep-up artificial features - outfall
X	Sweep-up artificial features - deflectors
	HMS: Outfall/deflectors sub-score
	Total HMS

P1000047 - Upstream of A9

P1000053 - Upstream of A9

P1000058 - Upstream of A9

P1000062 - Downstream of A9

P1000067 - Downstream of A9

P1000068 - Downstream of A9

Dalmagarry Burn – RHS Habitat Modification Scoring and Key Photos

Site Reference:	**WC-016-RH-002**
River Name:	**Dalmagarry Burn**
Date:	**12/04/2016**
Surveyor:	**Bonnie Boulton**
Accreditation Code:	**FA008**
Spot Check 1 NGR (Start):	**NH7944831952**
Spot Check 6 NGR:	**NH7919531997**
End NGR:	**NH7895532078**
HMS Calculated by:	**Liam Atherton**

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts
B	Sweep-up artificial features - Culverts
	HMS: Culverts sub-score
C	Spot check bank material
D	Spot check bank modification - RI
E	Sweep-up bank profiles - RI
F	Sweep-up artificial features - revetments
G	Spot check channel substrate
H	Spot check channel modification - RI
	HMS: Bank & bed reinforcement sub-score
I	Spot check bank modification - RS
J	Sweep-up bank profiles - RS
K	Spot check channel modification - RS
L	Sweep-up channel modification - over deepened
	HMS: Bank & bed resectioning sub-score
M	Spot check bank modification - Berms (BM)
N	Spot check bank modification - EM
O	Sweep-up bank profiles - Artificial two-stage
P	Sweep-up bank profiles - Embanked
Q	Sweep-up bank profiles - set back embankment
	HMS: Berms & embankments sub-score
R	Sweep-up artificial features - weirs/dams/sluices
	HMS: Weirs/dams/sluices sub-score
S	Sweep-up artificial features - bridges
	HMS: Bridges sub-score
T	Spot check bank modification - poaching (PC or PC(B))
U	Sweep-up bank profiles - poached
	HMS: Poaching sub-score
V	Sweep-up artificial features - fords
	HMS: Fords sub-score
W	Sweep-up artificial features - outfall
X	Sweep-up artificial features - deflectors
	HMS: Outfall/deflectors sub-score
	Total HMS

P1000073 – Downstream of A9

P1000077 - Downstream of A9

P1000080 - Downstream of A9

P1000081 - Downstream of A9

P1000086 - Downstream of A9

P1000092 - Downstream of A9

Allt Dubhag – RHS Habitat Modification Scoring and Key Photos

Site Reference:	**WC-019-RH-001**
River Name:	**Allt Dubhag**
Date:	**12/04/2016**
Surveyor:	**Bonnie Boulton**
Accreditation Code:	**FA008**
Spot Check 1 NGR (Start):	**NH7948130611**
Spot Check 6 NGR:	**NH7933730472**
End NGR:	**NH7917830417**
HMS Calculated by:	**Liam Atherton**

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts
B	Sweep-up artificial features - Culverts
	HMS: Culverts sub-score
C	Spot check bank material
D	Spot check bank modification - RI
E	Sweep-up bank profiles - RI
F	Sweep-up artificial features - revetments
G	Spot check channel substrate
H	Spot check channel modification - RI
	HMS: Bank & bed reinforcement sub-score
I	Spot check bank modification - RS
J	Sweep-up bank profiles - RS
K	Spot check channel modification - RS
L	Sweep-up channel modification - over deepened
	HMS: Bank & bed resectioning sub-score
M	Spot check bank modification - Berms (BM)
N	Spot check bank modification - EM
O	Sweep-up bank profiles - Artificial two-stage
P	Sweep-up bank profiles - Embanked
Q	Sweep-up bank profiles - set back embankment
	HMS: Berms & embankments sub-score
R	Sweep-up artificial features - weirs/dams/sluices
	HMS: Weirs/dams/sluices sub-score
S	Sweep-up artificial features - bridges
	HMS: Bridges sub-score
T	Spot check bank modification - poaching (PC or PC(B))
U	Sweep-up bank profiles - poached
	HMS: Poaching sub-score
V	Sweep-up artificial features - fords
	HMS: Fords sub-score
W	Sweep-up artificial features - outfall
X	Sweep-up artificial features - deflectors
	HMS: Outfall/deflectors sub-score
	Total HMS

P1000095 - Downstream of A9

P1000096 - Downstream of A9

P1000103 - Downstream of A9

P1000106 - Upstream of A9

P1000110 - Upstream of A9

P1000113 - Upstream of A9

Allt na Frithe – RHS Habitat Modification Scoring and Key Photos

Site Reference:	**WC-022-RH-001**
River Name:	**Allt na Frith**
Date:	**12/04/2016**
Surveyor:	**Liam Atherton**
Accreditation Code:	**FA001**
Spot Check 1 NGR (Start):	**NH7973830088**
Spot Check 6 NGR:	**NH7958929857**
End NGR:	**NH7936329767**
HMS Calculated by:	**Liam Atherton**

RHS Habitat Modification Score & Habitat Modification Class Scoring System

A	Spot check channel modification - Culverts
B	Sweep-up artificial features - Culverts
	HMS: Culverts sub-score
C	Spot check bank material
D	Spot check bank modification - RI
E	Sweep-up bank profiles - RI
F	Sweep-up artificial features - revetments
G	Spot check channel substrate
H	Spot check channel modification - RI
	HMS: Bank & bed reinforcement sub-score
I	Spot check bank modification - RS
J	Sweep-up bank profiles - RS
K	Spot check channel modification - RS
L	Sweep-up channel modification - over deepened
	HMS: Bank & bed resectioning sub-score
M	Spot check bank modification - Berms (BM)
N	Spot check bank modification - EM
O	Sweep-up bank profiles - Artificial two-stage
P	Sweep-up bank profiles - Embanked
Q	Sweep-up bank profiles - set back embankment
	HMS: Berms & embankments sub-score
R	Sweep-up artificial features - weirs/dams/sluices
	HMS: Weirs/dams/sluices sub-score
S	Sweep-up artificial features - bridges
	HMS: Bridges sub-score
T	Spot check bank modification - poaching (PC or PC(B))
U	Sweep-up bank profiles - poached
	HMS: Poaching sub-score
V	Sweep-up artificial features - fords
	HMS: Fords sub-score
W	Sweep-up artificial features - outfall
X	Sweep-up artificial features - deflectors
	HMS: Outfall/deflectors sub-score
	Total HMS

P1000118 - Downstream of A9

P1000117 - Downstream of A9

P1000121 - Downstream of A9

P1000123 - Upstream of A9

P1000126 - Upstream of A9

P1000135 - Upstream of A9

Annex B. Fish Habitat Survey Results

Allt Creag Bheithin

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA									
Site reference:	WC-004-FH-003			**Surveyor(s):**	Liam Atherton				
River name:	Allt Creag Bheithin			**Associated RHS survey ref:**	WC-004-RH-003				
Date:	11/04/2016			**Number of photos:**	28				
Time (GMT):	14.45			**Photo references:**	019-046				
Upstream NGR	NH7465134656			**Adverse survey conditions?**	No	Yes			
Downstream NGR:	NH7503934847								
Survey direction:	u/s to d/s	d/s to u/s		If yes, state:					
Site surveyed from:	Left Bank	Channel	Right Bank						

Prior to undertaking the survey ensure the following:
You have read the readme for this survey.
You have appropriate permission and it is safe to survey.
You are not lone working.
Your survey team is competent in watercourse habitat recognition.
You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	~~400 - 500~~
Start NGR					**500m REACH**
Finish NGR					**See NGRs above**
RHS corresponding spot check					

Fisheries Information												
Habitat Type	**Description**	**Species/Life-stage**	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach
Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm	Salmonid recruitment										0
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding										85
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge										1
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning										14
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat										0
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat										0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge										0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat										0
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental									0	

Comments:

Relatively sinuous but minor channel through moorland (upstream of A9 culvert crossing) and grazing pasture (downstream of A9 culvert crossing). Not a sufficient degree of habitat complexity to justify 100m transect surveys, although the reach overall provides extensive glide habitat with areas of shallow riffle/run habitat recorded, particularly downstream of the A9 culvert, providing productive habitat for salmonid fry. Riffle habitat typically not occuring as discrete features. A lack of spawning habitat, as well as size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. The A9 culvert is not considered to present a significant constraint to upstream adult migration or downstream juvenile/smolt migration. Invert level, flow and culvert length all likely to be passable at most flows.

Allt na Slànaich

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA

Site reference:	WC-007-FH-001	**Surveyor(s):**	Liam Atherton
River name:	Allt na Slanaich	**Associated RHS survey ref:**	WC-007-RH-001
Date:	13/04/2016	**Number of photos:**	23
Time (GMT):	15:00	**Photo references:**	194-217
Upstream NGR	NH7496634529	**Adverse survey conditions?**	No / Yes
Downstream NGR:	NH7515634896		
Survey direction:	u/s to d/s / d/s to u/s	If yes, state:	
Site surveyed from:	Left Bank / Channel / Right Bank		

Prior to undertaking the survey ensure the following:
You have read the readme for this survey.
You have appropriate permission and it is safe to survey.
You are not lone working.
Your survey team is competent in watercourse habitat recognition.
You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	~~400 - 500~~
Start NGR					**500m REACH**
Finish NGR					**See NGRs above**
RHS corresponding spot check					

Fisheries Information												
Habitat Type	**Description**	**Species/Life-stage**	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach
Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm	Salmonid recruitment										0
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding										16
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge										4
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning										80
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels.	Salmonid parr (1+) habitat										0
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat										0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge										0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat										0
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental									0	

Comments:

Relatively active minor stream through coniferous plantation (upstream of A9 culvert crossing) and grazing pasture (downstream of A9 crossing). Not a sufficient degree of habitat complexity to justify 100m transect surveys. The reach overall provides extensive shallow riffle/run habitat with some glide and pool habitat recorded, providing productive habitat for salmonid fry in particular. Riffle habitat typically not occuring as discrete features. A lack of spawning habitat, the size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. The A9 crossing is not considered to present a significant constraint to upstream adult migration or downstream juvenile/smolt migration. The A9 crossing retains a natural bed structure and is likely to be passable at most flows.

Allt na Loinne Mòire

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA

Site reference:	WC-011-FH-001	**Surveyor(s):**	Liam Atherton
River name:	Allt na Loine Moire	**Associated RHS survey ref:**	WC-011-RH-001
Date:	13/04/2016	**Number of photos:**	28
Time (GMT):	10:30	**Photo references:**	141-167
Upstream NGR	NH7583634019	**Adverse survey conditions?**	No / Yes
Downstream NGR:	NH7615534204		
Survey direction:	u/s to d/s / d/s to u/s	If yes, state:	
Site surveyed from:	Left Bank / Channel / Right Bank		

Prior to undertaking the survey ensure the following:

- You have read the readme for this survey.
- You have appropriate permission and it is safe to survey.
- You are not lone working.
- Your survey team is competent in watercourse habitat recognition.
- You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	~~400 – 500~~
Start NGR					**500m REACH**
Finish NGR					**See NGRs above**
RHS corresponding spot check					

Fisheries Information

Habitat Type	Description	Species/Life-stage	0 - 100 Feature tally	0 - 100 % by reach	100 - 200 Feature tally	100 - 200 % by reach	200 - 300 Feature tally	200 - 300 % by reach	300 - 400 Feature tally	300 - 400 % by reach	~~400 – 500~~ Feature tally	~~400 – 500~~ % by reach
Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm	Salmonid recruitment										5
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding										34
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge										5
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning										55
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels. *(overlaps with spawning habitat)*	Salmonid parr (1+) habitat										5
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat										0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge										1
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat										0
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental									0	

Comments:

Relatively active minor stream through moorland (peat bog); not a sufficient degree of habitat complexity to justify 100m transect surveys. The reach overall provides a variety of glide, pool and riffle habitat (within the context of a minor channel). Riffle habitat typically not occuring as discrete features. Spawning habitat is more predominant in upper reaches- but is limited in extent by water depth (typically averaging 0.05m to 0.1m). The size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. There are no crossings or artifical structures on this reach.

Allt na Loinne Mòire

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA

Site reference:	WC-011-FH-002	**Surveyor(s):**	Liam Atherton
River name:	Allt na Loine Moire	**Associated RHS survey ref:**	WC-011-RH-002
Date:	13/04/2016	**Number of photos:**	24
Time (GMT):	11:45	**Photo references:**	168-190
Upstream NGR	NH7618934193	**Adverse survey conditions?**	No / Yes
Downstream NGR:	NH7651234485		
Survey direction:	u/s to d/s / d/s to u/s	If yes, state:	
Site surveyed from:	Left Bank / Channel / Right Bank		

Prior to undertaking the survey ensure the following:
You have read the readme for this survey.
You have appropriate permission and it is safe to survey.
You are not lone working.
Your survey team is competent in watercourse habitat recognition.
You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	~~400 - 500~~
Start NGR					500m REACH
Finish NGR					See NGRs above
RHS corresponding spot check					

Fisheries Information												
Habitat Type	**Description**	**Species/Life-stage**	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach
Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm	Salmonid recruitment										40
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding										25
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge										30
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning										5
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels. *(overlaps with spawning)*	Salmonid parr (1+) habitat										40
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat										0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge										0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat										0
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental									1	

Comments:

Relatively active minor stream through moorland (peat bog) and grazing pasture upstream of the A9 culvert and grazing pasture/broadleaved plantation downstream of the A9 culvert. Not a sufficient scale of habitat complexity to justify 100m transect surveys. The reach overall provides a variety of glide, pool and riffle/run habitat (within the context of a minor channel). Riffle habitat typically not occuring as discrete features. Spawning habitat is more predominant in upper reaches. The size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. The A9 culvert could present a barrier to fish movement at some flows. The culvert is bed is artificial, and the gradient results in high velocity chute flow. The invert level is also perched above the bed at the downstream outlet. A further structure (a railway bridge) at the end of te reach is unlikely to present a barrier to fish movement.

Dalmagarry Burn

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA

Site reference:	WC-016-FH-001	**Surveyor(s):**	Liam Atherton
River name:	Dalmagarry Burn	**Associated RHS survey ref:**	WC-016-RH-001
Date:	12/04/2016	**Number of photos:**	26
Time (GMT):	09:45	**Photo references:**	047-072
Upstream NGR	NH7848932173	**Adverse survey conditions?**	No / Yes
Downstream NGR:	NH7899332078		
Survey direction:	u/s to d/s / d/s to u/s	If yes, state:	
Site surveyed from:	Left Bank / Channel / Right Bank		

Prior to undertaking the survey ensure the following:
You have read the readme for this survey.
You have appropriate permission and it is safe to survey.
You are not lone working.
Your survey team is competent in watercourse habitat recognition.
You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	~~400 – 500~~
Start NGR					**500m REACH**
Finish NGR					**See NGRs above**
RHS corresponding spot check					

Fisheries Information												
Habitat Type	**Description**	**Species/Life-stage**	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach
Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm	Salmonid recruitment										10
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding										30
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge										30
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning										60
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels. *(overlaps with spawning)*	Salmonid parr (1+) habitat										10
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat										0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge										0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat										0
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental									0	

Comments:

Relatively active stream through grazing pasture. Not a sufficient scale of habitat complexity to justify 100m transect surveys. The reach overall provides a variety of glide, pool and riffle/run habitat (within the context of a minor channel). Riffle habitat typically not occuring as discrete features. Spawning habitat is more predominant in lower reaches, downstream of the A9. The size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. Undercut banks in lower reaches locally improve fish habitat diversity. The A9 bridge and upstream rail bridge are unlikely to pose barriers to fish movement. The A9 bridge (and an adjacent field access bridge) span natural bed substrate. Although the bed is artificial beneath the railway bridge, the natural bed gradient is largely maintained and the channel reinforcement is not perched.

Dalmagarry Burn

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA

Site reference:	WC-016-FH-002	**Surveyor(s):**	Liam Atherton
River name:	Dalmagarry Burn	**Associated RHS survey ref:**	WC-016-RH-002
Date:	12/04/2016	**Number of photos:**	22
Time (GMT):	11:50	**Photo references:**	73-94
Upstream NGR	NH7944831952	**Adverse survey conditions?**	No / Yes
Downstream NGR:	NH7895532078		
Survey direction:	u/s to d/s / d/s to u/s	If yes, state:	
Site surveyed from:	Left Bank / Channel / Right Bank		

Prior to undertaking the survey ensure the following:
You have read the readme for this survey.
You have appropriate permission and it is safe to survey.
You are not lone working.
Your survey team is competent in watercourse habitat recognition.
You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	~~400 - 500~~
Start NGR					**500m REACH**
Finish NGR					**See NGRs above**
RHS corresponding spot check					

Fisheries Information												
Habitat Type	**Description**	**Species/Life-stage**	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach
Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm	Salmonid recruitment										45
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding										15
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge										5
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning										35
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels. *(overlaps with spawning)*	Salmonid parr (1+) habitat										45
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat										0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge										0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat										5
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental									0	

Comments:

Relatively uniform stream through historical realigment through grazing pasture; not a sufficient scale of habitat complexity to justify 100m transect surveys. The reach overall provides a variety of glide, pool and riffle/run habitat (within the context of a minor channel). Riffle habitat typically not occuring as discrete features. The size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. Undercut banks and Large Woody Debris (LWD) locally improve fish habitat diversity. There are no artifical structures and therefore no potential bariers to local fish movement.

Allt Dubhag

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA

Site reference:	WC-019-FH-001	**Surveyor(s):**	Liam Atherton
River name:	Allt Dubhag	**Associated RHS survey ref:**	WC-019-RH-001
Date:	12/04/2016	**Number of photos:**	22
Time (GMT):	14:00	**Photo references:**	95-116
Upstream NGR	NH7948130611	**Adverse survey conditions?**	No / Yes
Downstream NGR:	NH7917830417		
Survey direction:	u/s to d/s / d/s to u/s	If yes, state:	
Site surveyed from:	Left Bank / Channel / Right Bank		

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You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	~~400 – 500~~
Start NGR					**500m REACH**
Finish NGR					**See NGRs above**
RHS corresponding spot check					

Fisheries Information												
Habitat Type	**Description**	**Species/Life-stage**	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach
Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm	Salmonid recruitment										0
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding										10
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge										15
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning										75
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels. *(overlaps with spawning)*	Salmonid parr (1+) habitat										0
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat										0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge										0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat										10
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental									1	

Comments:

Relatively active minor stream through mixed plantation; not a sufficient scale of habitat complexity to justify 100m transect surveys. The reach overall provides a variety of glide, pool and riffle habitat (within the context of a minor channel). Riffle habitat typically not occuring as discrete features. The absence of spawning habitat, size of the channel and water depth observed at survey are likely to limit the salmonid use of this habitat resource. Undercut banks and Large Woody Debris (LWD) locally improve fish habitat diversity. The A9 culvert is unlikely to present a major barrier to upstream movement by adult salmonids, or downstream migration by juveniles and smolt. It may present a barrier to other lifestages undertaking local upstream movement, but given the likely low utilisation of the watercourse by salmonids, this may not be an issue.

Allt na Frithe

FISH HABITAT ASSESSMENT FIELD SURVEY PROFORMA

Site reference:	WC-022-FH-001	**Surveyor(s):**	Liam Atherton
River name:	Allt na Frith	**Associated RHS survey ref:**	WC-022-RH-001
Date:	12/04/2016	**Number of photos:**	25
Time (GMT):	16:15	**Photo references:**	117-140
Upstream NGR	NH7973830088	**Adverse survey conditions?**	No / Yes
Downstream NGR:	NH7936329767		
Survey direction:	u/s to d/s / d/s to u/s	If yes, state:	
Site surveyed from:	Left Bank / Channel / Right Bank		

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You have an appropriate risk assessment that fulfils project and client requirements.

	Survey Reach (m)				
	0 - 100	100 - 200	200 - 300	300 - 400	~~400 - 500~~
Start NGR					500m REACH
Finish NGR					See NGRs above
RHS corresponding spot check					

Fisheries Information												
Habitat Type	**Description**	**Species/Life-stage**	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach	Feature tally	% by reach
Spawning habitat	Stable un-compacted gravel up to 30cm deep not containing excessive silt. Substrate size 1.3-10.2cm	Salmonid recruitment										5
Glides	Smooth laminar flow with little surface turbulence & generally >30cm deep.	Salmonid productive habitat/feeding										5
Pools	No perceptible flow & usually >1m deep. Substrate with a proportion of sand and silt.	Salmonid productive habitat/refuge										5
Riffle/run	Shallow (<20cm). Substrate dominated by gravels and cobbles.	Salmonid fry (0+) habitat Lamprey spawning										85
	Faster and deeper (20-40cm) than above habitat. Substrate of boulders, cobbles & gravels. *(overlaps with spawning)*	Salmonid parr (1+) habitat										5
Fine sediment	Stable, fine sediment at least 150mm deep. Low water velocity with shallow water depth <40cm. Presence of organic detritus and shaded provides optimal habitat.	Lamprey ammocoete habitat										0
Macrophyte beds	Submerged and emergent macrophytes providing localised hydraulic diversity	Productive habitat/refuge										0
Flow constrictions	Physical features providing a narrowing of the channel resulting in increased velocity and depth	Productive habitat										5
Obstructions to migration	Impassable falls, weirs, bridge sills etc.; shallow braided sections preventing upstream migration during low flows.	Detrimental									1	

Comments:

Relatively active minor stream through a predominant grazing pasture land use; not a sufficient scale of habitat complexity to justify 100m transect surveys. The reach overall predominantly provides riffle habitat (within the context of a minor channel, and not present as 'discrete' riffles), with pool, glide and sparse spawning habitat recorded. The size of the channel, stream gradient, and water depth observed at survey are likely to limit the salmonid use of this habitat resource. Undercut banks and Large Woody Debris (LWD) locally improve fish habitat diversity. The A9 culvert is unlikely to present a major barrier to upstream movement by adult salmonids, or downstream migration by juveniles and smolt. It may present a barrier to other lifestages undertaking local upstream movement, but given the likely low utilisation of the watercourse by salmonids, this may not be an issue.

Annex C. Aquatic Macroinvertebrate Survey Results

C.1 Site Physical Variables

Site code	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002	WC-022-AI-001	WC-022-AI-002
Site name	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002	WC-022-AI-001	WC-022-AI-002
Watercourse	Allt Creag Bheithin	Allt Creag Bheithin	Allt na Slanaich	Allt na Slanaich	Allt na Slanaich	Allt na Loinne Moire	Allt na Loinne Moire	Allt na Loinne Moire	Dalmagarry Burn	Dalmagarry Burn	Allt Dubhag	Allt Dubhag	Allt na Frithe	Allt na Frithe
Date	19/05/2016	19/05/2016	19/05/2016	19/05/2016	19/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016
Collector	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM	EB/SM
NGR	NH 74751 34704	NH 75028 34832	NH 74814 34307	NH 74958 34607	NH 75064 34788	NH 75889 34101	NH 76149 34235	NH 76461 34405	NH 79319 31980	NH 78501 32180	NH 79306 30442	NH 79492 30616	NH 79631 29920	NH 79738 30078
Distance from source (km)	1.5	1.8	3.1	3.5	3.7	3.0	3.5	4.0	6.3	5.4	3.3	3.6	5.7	5.9
Altitude (m)	295	290	315	300	290	310	300	290	285	275	300	290	290	280
Slope (m/km)	50	40	44	50	40	200	125	125	143	111	111	333	100	500
Discharge Category														
Average width (m)	1	0.5	2	2	2.5	2	1	1.5	3.5	2.5	2	2.5	3	3
Average depth (m)	0.15	0.2	0.1	0.15	10	0.15	0.4	0.15	0.2	0.1	0.2	0.15	0.25	0.25
Average channel depth (m)	0.3	1	2	0.3			0.6	0.4	0.3	0.5	0.4	0.3	1.5	0.3
Bedrock														
Boulders	1		2	2	1	2		5	2		2	2	5	5
Cobbles	50		25	40	35	71		74	66	15	25	10	75	73
Pebbles	30	5	28	30	34	20	25	15	30	40	45	47	13	10
Gravel	15	45	25	15	20	5	70	5	10	40	30	35	5	10
Sand	4	50	20	13	10	2	5	1	2	5	2	5	2	
Silt												<1		2
Clay														
Detritus	None	None	None	None	None	None	None	None	None	None	None	Local	None	None
Torrent														
Riffle	ü	ü	ü	ü	ü	ü		ü	ü	ü	ü	ü	ü	ü
Pool											ü			
Run	ü	ü		ü			ü		ü			ü	ü	
Glide							ü				ü			
Slack	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü		ü	ü	ü
Ditch														
Waterfall														
Cascade						ü					ü		ü	ü
Rapid						ü		ü	ü				ü	
Ponded reach														
Marginal deadwater														
Exposed bedrock														
Mature island														
Unvegetated mid bar										ü				
Vegetated mid bar														
Unvegetated side bar			ü	ü									ü	
Vegetated side bar												ü		
Unvegetated point bar														
Silt deposit														
Sand deposit			ü		ü	ü								
Trickle														
Sewage litter	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Odour	None	None	None	None	None	None	None	None	None	None	None	None	None	None
Turbidity	Slighty peaty	Slighty peaty	Clear	None	Clear	Clear	Peaty	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Shade	None	None	None	Light	None	None	None	None	None	None	Light	Moderate	None	None
Flow	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Sewage fungus	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present
Overlay silt	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present
Ochre	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present
Filamentous algae	30%	Not present	5%	<1%	<1%	0.5	Not present	15%	1%	<1	Not present	Not present	Not present	Not present
Non-filamentous algae	Not present	Not present	Not present	<1%	Not present	Not present	Not present	Not present	Not present	Not present	40	Not present	3	5
Macrophyte	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	Not present	<1%	Not present
Moss	50%	1%	2%	2%	2%	2%	1%	60%	1%	5%	2%	2%	1%	2%
Primary Landuse	Rough pasture	Moorland/ Heat	Corniferous wood	Corniferous wood	Rough pasture	Moorland/ Heat	Moorland/ Heat	Rough pasture	Improved rough pasture	Improved rough pasture	Corniferous wood	Corniferous wood	Improved rough pasture	
Secondary Landuse	Broadleaf	Corniferous wood						Corniferous wood	Moorland/ Heat	Corniferous wood	Wetland	Broadleaf		Broadleaf
Primary Bank Structure	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)	Simple (2-3 dominant vegetation type)
pH	7.05	6.92	6.63	6.95	7.13	7.53	7.20	7.02	7.60	7.08	7.24	7.20	7.54	7.49
oC	8.39	8.42	8.19	8.06	8.59	10.37	10.93	10.35	11.38	10.25	9.03	8.91	19.66	18.76
Conductivity µs/cm	168	153	64	64	64	75	67	69	63	76	97	128	150	121
TDS	84	76	32	32	32	38	33	35	31	38	48	64	75	60
Sal	0.08	0.07	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.06	0.07	0.06
DO %	98	96.3	97.1	97.4	100.5	103.9	96	103.5	104	97.7	102.6	101.3	100	101.6
DO (ppm)	11.09	10.8	11.01	11.07	11.33	11.13	10.17	11.01	10.91	10.5	11.32	11.27	8.78	9.12
Velocity (m/s)	0.18	0.46	0.24	0.44	0.37	0.40	0.31	0.43	0.39	0.47	0.35	0.20	0.90	0.55

C.2 Site Taxa Lists

					Site Name	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002	WC-022-AI-001	WC-022-AI-002
					Watercourse	Allt Creag Bheithin	Allt Creag Bheithin	Allt na Slanaich	Allt na Slanaich	Allt na Slanaich	Allt na Loinne Moire	Allt na Loinne Moire	Allt na Loinne Moire	Dalmagarry Burn	Dalmagarry Burn	Allt Dubhag	Allt Dubhag	Allt na Frithe	Allt na Frithe
					Survey Date	19/05/2016	19/05/2016	19/05/2016	19/05/2016	19/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016
Taxa	**Family/Order**	**Genus**	**Species**																
Ephemeroptera-Mayflies																			
	Ameletidae	*Ameletus*	*inopinatus*	Mayfly (Brown dun)				5	1	1	1								
	Baetidae			Mayfly															
		Alainites	*muticus*	Mayfly		3	7					37	5	1	4			1	
		Baetis	*rhodani*	Mayfly (Large dark olive)		45	36	153	218	193	322	4	124	32	32	114	104	218	13
		Baetis	*scambus*	Mayfly														41	44
	Ephemerellidae	*Serratella*	*ignita*	Mayfly(Blue-winged olive)														39	40
	Heptageniidae			Mayfly				6				1	1		3		1		2
		Ecdyonurus	sp.						1										
		Heptagenia	*lateralis*	Mayfly					2		54								1
		Heptagenia	*sulphurea*	Mayfly (Yellow may dun)				10		5				2				8	
		Heptagenia	sp.	Mayfly										2	2				
		Rhithrogena	*semicolorata*	Mayfly (Olive upright)		14		22	10	6	3		1		1				
		Rhithrogena	sp.	Mayfly								1							
	Siphlonuridae			Mayfly (Summer mayfly)									3						2
		Siphlonurus	*lacustris*	Mayfly (Summer mayfly)								31							
Plecoptera-Stoneflies																			
	Chloroperlidae	*Chloroperla*	*tripunctata*	Stonefly						2	1				4				
		Siphonoperla	*torrentium*	Stonefly		5		5	1		9	23	8	2	6	20	16	18	18
			sp.	Stonefly (Large summer dun)				1						1	1				
	Leuctridae	*Leuctra*	*inermis*			21	13	49	12	2	36	26	52	11	13	77	181	10	9

					Site Name	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002	WC-022-AI-001	WC-022-AI-002
					Watercourse	Allt Creag Bheithin	Allt Creag Bheithin	Allt na Slanaich	Allt na Slanaich	Allt na Slanaich	Allt na Loinne Moire	Allt na Loinne Moire	Allt na Loinne Moire	Dalmagarry Burn	Dalmagarry Burn	Allt Dubhag	Allt Dubhag	Allt na Frithe	Allt na Frithe
					Survey Date	19/05/2016	19/05/2016	19/05/2016	19/05/2016	19/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016
Taxa	**Family/Order**	**Genus**	**Species**																
		Leuctra	sp.						2	5					1				1
	Nemouridae		sp.	Stonefly															1
		Amphinemura	*sulcicollis*	Stonefly		51	38	17	16	13		9	7			2	3	6	5
		Amphinemura	sp.	Stonefly							3								
		Nemoura	*cinerea*	Stonefly									1						
		Nemoura	*erratica*	Stonefly								1							
		Nemoura	sp.	Stonefly		1						2				1			
		Protonemura	*meyeri*	Stonefly			2	1					8				3		1
		Protonemura	sp.	Stonefly							2	1							
	Perlidae	*Dinocras*	*cephalotes*	Stonefly						1									
	Perlodidae	*Isoperla*	*grammatica*	Stonefly (Yellow Sally)		41	19	13	3	13	5	24	16	3	2		2	2	1
	Taeniopterigidae	*Brachyptera*	*risi*	Stonefly (Willowflies)			5	3	7		8		10		1		3		
Trichoptera-Caddisflies																			
	Glossosomatidae		*sp.*	Cased caddisfly						10									
		Glossosoma	*conformis*					1	18	1									
		Glossosoma	sp.						9										
	Goeridae		sp.	Cased caddisfly			3												
		Silo	*pallipes*	Cased caddisfly		16							1						
		Silo	sp.	Cased caddisfly									1				6		
	Hydroptilidae	*Hydroptila*	sp.	Cased caddisfly				6											
	Hydropsychidae	*Hydropsyche*	*fulvipes*	Caseless caddisfly														1	1
		Hydropsyche	*siltalai*	Caseless caddisfly														4	4

				Site Name	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002	WC-022-AI-001	WC-022-AI-002
				Watercourse	Allt Creag Bheithin	Allt Creag Bheithin	Allt na Slanaich	Allt na Slanaich	Allt na Slanaich	Allt na Loinne Moire	Allt na Loinne Moire	Allt na Loinne Moire	Dalmagarry Burn	Dalmagarry Burn	Allt Dubhag	Allt Dubhag	Allt na Frithe	Allt na Frithe
				Survey Date	19/05/2016	19/05/2016	19/05/2016	19/05/2016	19/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016
Taxa	**Family/Order**	**Genus**	**Species**															
	Lepidostomatidae			Cased caddisfly										3				
		Lepidostoma	*hirtum*	Cased caddisfly													1	1
	Leptoceridae	*Athripsodes*	sp.	Long-horned caddisfly														1
	Limnephilidae		sp.	Cased caddisfly		78	16	15	8	8		87	51	1	7	55	50		
		Drusus	*annulatus*	Cased caddisfly		2		1											
		Ecclisopteryx	*guttulata*	Cased caddisfly								1							
		Halesus		Cased caddisfly		6		1		1		1			3				
		Halesus	*digitatus*	Cased caddisfly			3												
		Halesus	*radiatus*	Cased caddisfly					4		1				1				
		Limnephilus	*rhombicus*	Cased caddisfly								1							
		Micropterna	*sp.*	Cased caddisfly													1		
		Potamophylax	*cingulatus*	Cased caddisfly		2							1						
		Potamophylax	*latipennis*	Cased caddisfly			2												
	Odontoceridae	*Odontocerum*	*albicorne*	Cased caddisfly									1						
	Polycentropodidae	*Polycentropus*	*flavomaculatus*	Caseless caddisfly													5	2	
		Polycentropus	sp.	Caseless caddisfly														1	
		Plectrocnemia	*conspersa*	Caseless caddisfly				1				3				2	1	1	
		Plectrocnemia	sp.									1							
	Rhyacophilidae			Caseless caddisfly														2	
		Rhyacophila	*dorsalis*	Caseless caddisfly		1		7	3				4	1		1	4	1	1
		Rhyacophila	sp.						1							2		3	
	Sericostomatidae	*Sericostoma*	*personatum*	Cased caddisfly				1											

					Site Name	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002	WC-022-AI-001	WC-022-AI-002
					Watercourse	Allt Creag Bheithin	Allt Creag Bheithin	Allt na Slanaich	Allt na Slanaich	Allt na Slanaich	Allt na Loinne Moire	Allt na Loinne Moire	Allt na Loinne Moire	Dalmagarry Burn	Dalmagarry Burn	Allt Dubhag	Allt Dubhag	Allt na Frithe	Allt na Frithe
					Survey Date	19/05/2016	19/05/2016	19/05/2016	19/05/2016	19/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016
Taxa	**Family/Order**	**Genus**	**Species**																
Diptera- True Flies																			
	Ceratopogonidae	*Ceratopogon*	sp.	Biting midge								6	2	1	4		1	5	9
	Chironomidae			Non-biting midge					2		3					18	3		
		Chironominae (Tanytarsini)					1					25	8			10	5	5	13
		Diamesinae					216	1					1	23				15	6
		Prodiamesinae										1							
		Tanypodinae					2					23	7	3		1	1	4	1
		Orthocladiinae/Diamesinae				2	57	19	1	4		33	105	7	1	16	7	32	30
	Empididae			Dance fly		1						1			1				
		Chelifera				3	10						1			1			
		Hemerodromia						4			5			3		5	6		1
	Limoniidae			Limoniid Crane fly														1	
		Eloeophila				1							1	1	1				
		Neolimnomyia													1		1		
	Muscidae	*Limnophora*		House fly															1
	Pediciidae	*Dicranota*				10		8	3	1	1	13	2	3	5	2	2	5	2
		Pedicia															1		
	Psychodidae					2												1	
	Simuliidae			Blackfly					1	1						2		1	
		Prosimulium				2													
		Simulium				3							8						
			angustipes/velutinum										1						
			armoricanum				3					3	3		2				

					Site Name	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002	WC-022-AI-001	WC-022-AI-002
					Watercourse	Allt Creag Bheithin	Allt Creag Bheithin	Allt na Slanaich	Allt na Slanaich	Allt na Slanaich	Allt na Loinne Moire	Allt na Loinne Moire	Allt na Loinne Moire	Dalmagarry Burn	Dalmagarry Burn	Allt Dubhag	Allt Dubhag	Allt na Frithe	Allt na Frithe
					Survey Date	19/05/2016	19/05/2016	19/05/2016	19/05/2016	19/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016
Taxa	**Family/Order**	**Genus**	**Species**																
			cryophilum gp													5			
			ornatum gp										1			6			
			aryegatum/variegatum gp										10				1		
	Tipulidae	*Tipula*		Cranefly							1								
Insects-Water Bugs																			
	Corixidae														2				
	Veliidae	*Velia*	*caprai*	Water cricket												4			
Insects-Water Beetles																			
	Dytiscidae		(larvae)	Diving beetle														1	3
		Hydroporus	sp.	Diving beetle															1
		Oreodytes	*sanmarkii*	Diving beetle		13	16	9	3	3	3	16	2	2	6	19	51	83	75
	Elmidae	*Elmis*	*aenea*	Riffle beetle		43	11	2	4	1	2	2	29		2	8	73	18	20
		Esolus	*parallelepipedus*	Riffle beetle														9	3
		Limnius	*volckmari*	Riffle beetle		70	2	3			2	2	8	5	26			7	6
		Oulimnius	*tuberculatus*	Riffle beetle								3	3		1			1	4
		Oulimnius	sp.	Riffle beetle									1						11
	Hydraenidae	*Hydraena*	*gracilis*	Minute moss beetle		4	2				2		1	3	2	1	6	3	3
	Hydrophilidae	*Anacaena*	*globulus*	Beetle					1				1				1		
		Helophorus	*arvernicus*	Water scavenger beetle		1													
	Scirtidae		sp.	Marsh beetle												1			
Odonata- Dragonflies																			
	Cordulegastridae	*Cordulegaster*	*boltonii*	Golden-ringed dragonfly								2							

					Site Name	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002	WC-022-AI-001	WC-022-AI-002
					Watercourse	Allt Creag Bheithin	Allt Creag Bheithin	Allt na Slanaich	Allt na Slanaich	Allt na Slanaich	Allt na Loinne Moire	Allt na Loinne Moire	Allt na Loinne Moire	Dalmagarry Burn	Dalmagarry Burn	Allt Dubhag	Allt Dubhag	Allt na Frithe	Allt na Frithe
					Survey Date	19/05/2016	19/05/2016	19/05/2016	19/05/2016	19/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016	18/05/2016
Taxa	**Family/Order**	**Genus**	**Species**																
Arachnids																			
	Hydracarina			Water mite		1	7		1			5	6	4	1	6	2	6	7
Molluscs																			
	Ancylidae	*Ancylus*	*fluviatilis*	River limpet										1					
	Lymnaeidae	*Lymnaea*	*peregra*	Wandering pond snail														2	
		Lymnaea	sp.															3	
	Sphaeriidae			Freshwater molluscs		5						3							
		Pisidium	sp.	Pea mussel												1	1		
Tricladida- Flatworms																			
	Planariidae	*Polycelis*	*felina*	Flatworm							1		33	3	8	41	18		
Oligochaeta-Worms				Aquatic worm		8	1	1		1	1	30	2	4		1	2	61	103
		Lumbricidae		Aquatic worm									4		1				

C.3 Site Biotic Metrics

Site Name	WC-004-AI-005	WC-004-AI-006	WC-007-AI-001	WC-007-AI-002
Watercourse	Allt Creag Bheithin	Allt Creag Bheithin	Allt na Slanaich	Allt na Slanaich
Survey Date	19/05/2016	19/05/2016	19/05/2016	19/05/2016
Biological Monitoring Working Party (BMWP) (Family)	106	81	126	112
NTAXA	17	13	18	16
Average Score Per Taxon (ASPT)	6.24	6.23	7.00	7.00
WHPT (Family)	145	102	157	133
WHPT ASPT	7.24	7.28	7.86	7.84
LIFE (Lotic-Invertebrate Index for Flow Evaluation) (TL5)	8.75	8.71	8.8	8.68
LIFE Score Category (Indication only)	High sensitivity to reduced flows	High sensitivity to reduced flows	High sensitivity to reduced flows	High sensitivity to reduced flows
Proportion of sediment -sensitive invertebrates (PSI) (TL5)	95.00	96.20	100.00	92.86
River Bed Condition (PSI)	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented
CCI Score (Species)	13.13	11.79	11.39	10
Conservation Value	Fairly High	Fairly High	Fairly High	Fairly High

Site Name	WC-007-AI-003	WC-011-AI-001	WC-011-AI-002	WC-011-AI-003
Watercourse	Allt na Slanaich	Allt na Loinne Moire	Allt na Loinne Moire	Allt na Loinne Moire
Survey Date	19/05/2016	18/05/2016	18/05/2016	18/05/2016
Biological Monitoring Working Party (BMWP) (Family)	108	111	109	138
NTAXA	16	17	17	20
Average Score Per Taxon (ASPT)	6.75	6.53	6.41	6.90
WHPT (Family)	111	128	139	176
WHPT ASPT	7.38	7.52	7.34	7.66
LIFE (Lotic-Invertebrate Index for Flow Evaluation) (TL5)	8.73	8.72	8.24	8.31
LIFE Score Category (Indication only)	High sensitivity to reduced flows	High sensitivity to reduced flows	High sensitivity to reduced flows	High sensitivity to reduced flows
Proportion of sediment -sensitive invertebrates (PSI) (TL5)	100.00	91.30	80.65	86.84
River Bed Condition (PSI)	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented
CCI Score (Species)	13.33	10.67	12.65	10.42
Conservation Value	Fairly High	Fairly High	Fairly High	Fairly High

Site Name	WC-016-AI-001	WC-016-AI-002	WC-019-AI-001	WC-019-AI-002
Watercourse	Dalmagarry Burn	Dalmagarry Burn	Allt Dubhag	Allt Dubhag
Survey Date	18/05/2016	18/05/2016	18/05/2016	18/05/2016
Biological Monitoring Working Party (BMWP) (Family)	92	109	93	128
NTAXA	15	17	17	20
Average Score Per Taxon (ASPT)	6.13	6.41	5.47	6.40
WHPT (Family)	112	129	121	165
WHPT ASPT	6.61	7.15	6.70	7.18
LIFE (Lotic-Invertebrate Index for Flow Evaluation) (TL5)	8.54	8.39	8.53	8.76
LIFE Score Category (Indication only)	High sensitivity to reduced flows	High sensitivity to reduced flows	High sensitivity to reduced flows	High sensitivity to reduced flows
Proportion of sediment -sensitive invertebrates (PSI) (TL5)	95.00	89.29	88.89	88.89
River Bed Condition (PSI)	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented
CCI Score (Species)	5.25	10.63	5.08	10.00
Conservation Value	Moderate	Fairly High	Moderate	Fairly High

Site Name	WC-022-AI-001	WC-022-AI-002
Watercourse	Allt na Frithe	Allt na Frithe
Survey Date	18/05/2016	18/05/2016
Biological Monitoring Working Party (BMWP) (Family)	128	133
NTAXA	20	19
Average Score Per Taxon (ASPT)	6.40	7.00
WHPT (Family)	153	160
WHPT ASPT	6.95	7.28
LIFE (Lotic-Invertebrate Index for Flow Evaluation) (TL5)	8.39	8.32
LIFE Score Category (Indication only)	High sensitivity to reduced flows	High sensitivity to reduced flows
Proportion of sediment -sensitive invertebrates (PSI) (TL5)	90.24	94.44
River Bed Condition (PSI)	Minimally sedimented/ Unsedimented	Minimally sedimented/ Unsedimented
CCI Score (Species)	14.64	15.75
Conservation Value	Fairly High	High

Annex D. National Pond Survey Results

D.1 Site Physico-chemical Variables

Site	WB-001-PS-001	WB-002-PS-001	WB-003-PS-001	WB-004-PS-001	WB-005-PS-001
NGR	NH7684034092	NH7697234016	NH7870532846	NH7950830912	NH7949030800
pH	6.07	5.68	Not sampled	6.57	6.58
Temperature	15.3	14.94	Not sampled	11.27	12.5
Conductivity (µS cm^{-3})	31	24	Not sampled	166	230
Total Dissolved Solids	15	12	Not sampled	83	115
Salnity (PSU)	0.01	0.01	Not sampled	0.08	0.11
Dissolved oxygen (%)	80.7	82.5	Not sampled	88.2	68
Dissolved oxygen (mg/l)	7.69	7.97	Not sampled	9.27	6.55

D.2 Site Macroinvertebrate Composition

					Pond name	WB-001-PS-001	WB-002-PS-001	WB-003-PS-001	WB-004-PS-001	WB-005-PS-001
					Survey date	14/06/2016	14/06/2016	14/06/2016	15/06/2016	15/06/2016
Taxa	**Family/Order**	***Genus***	**Species**	**Common Name**	**Species CCI**					
Insects - Flies/larvae										
Ephemeroptera-Mayflies										
	Baetidae	*Cloeon*	*dipterum*	Pond Olive	**1**			1	77	13
	Leptophlebiidae						7			
		Leptophlebia	sp.			1	1			
		Leptophlebia	*vespertina*	Claret Dun	**3**	11	2		41	101
Trichoptera-Caddisflies										
	Leptoceridae	*Mystacides*	sp.	Cased caddisfly					1	1
		Mystacides	*azurea*	Cased caddisfly	**2**					3
	Limnephilidae			Cased caddisfly					6	1
		Limnephilus	*marmoratus*	Cased caddisfly	**3**	6				1
	Polycentropodidae	*Cyrnus*	*flavidus*	Caseless caddisfly	**5**	2	1			9
	Phryganeidae	*Phryganea*	*bipunctata*	Cased caddisfly	**2**	3	5			
Diptera- True Flies										
	Ceratopogonidae			Biting midge			2		2	
	Chaoboridae	*Chaoborus*	sp.	Phantom midge		30		1	3	
	Chironomidae			Non-biting midge		139	16	11	12	69
	Cylindrotomidae			Moss craneflies					1	
	Dixidae	*Dixella*	sp.	Dixid midges		1				1
Odonata - Dragonflies and Damselfies										
	Aeshnidae			Hawkers		2	6			1
		Aeshna	*juncea*	Common hawker	4	4				
	Corduliidae			Emeralds			2		20	12
	Coenagriidae	*Enallagma*	*cyathigerum*	Common blue damselfly	2		1			
		Ischnura	*elegans*	Blue-tailed damselfly	1		1			
	Libellulidae	*Libellula*	*quadrimaculata*	Four-spotted chaser	4	1				
	Lestidae	*Lestes*	*sponsa*	Emerald damselfly	4	1	13	2	13	18

Continued Overleaf

					Pond name	WB-001-PS-001	WB-002-PS-001	WB-003-PS-001	WB-004-PS-001	WB-005-PS-001
					Survey date	14/06/2016	14/06/2016	14/06/2016	15/06/2016	15/06/2016
Taxa	**Family/Order**	***Genus***	**Species**	**Common Name**	**Species CCI**					
Insects-Water Beetles										
	Dytiscidae			Diving beetle		8	3	6	23	9
		Acilius	sp.	Diving beetle larvae		10	6			
		Acilius	*sulcatus*	Diving beetle	**5**	1	2			
		Dytiscus	sp.	Diving beetle larvae		7				2
		Dytiscus	*laponnicus*	Highland Great Diving Beetle	**7**	1				
		Hydrophorus	sp.				2			
	Gyrinidae			Whirligig beetle		4				1
		Gyrinus	*minutus*	Whirligig beetle	**7**	5				
		Gyrinus	*caspius*	Whirligig beetle	**3**	2	4			
	Haliplidae	*Haliplus*	*lineatocollis*	Crawling water beetle	**1**				3	2
		Haliplus	sp.							4
	Hydrophilidae			Water scavenger beetle		1			3	
Insects-Water Bugs										
	Corixidae			Water boatman		52	67	85	30	23
		Callicorixa	*wollastoni*		**5**			2	1	
		Hesperocorixa	*castanea*		**4**	3	1			
		Hesperocorixa	*sahlbergi*		**2**			1	1	
		Sigara	*scotti*		**5**		2			
	Gerridae			Pond skater		2	1	1		
		Gerris	sp.							
		Gerris	*lacustris*		**1**		3			
	Notonectidae	*Notonecta*	sp.	Backswimmer				22	48	16
		Notonecta	*obliqua*		**5**				1	1
Arachnids										
	Hydracarina			Water mite			8		1	4
Crustaceans										
	Copepod						1			
	Daphnia			Water flea				3	407	109
Molluscs										
	Lymnaeidae	*Lymnaea*		Freshwater snail					38	2
		Lymnaea	sp.	Freshwater snail						4
		Lymnaea	*peregra*	Wandering pond snail	**1**				3	
	Sphaeriidae			Pea mussel					17	86
Oligochaeta-Worms										
	Oligochaeta			Aquatic worm				3	21	
					CCI Score	29.75	15.91	15.00	13.75	15.00
					Value	Very High	Fairly High	Low	Fairly High	High
					Average Score Per Taxon (ASPT)	6.54	6.58	4.29	5.43	5.94

D.3 Site Macrophyte Composition

	WB-001-PS-001	WB-002-PS-001	WB-003-PS-001	WB-004-PS-001	WB-005-PS-001
Submerged					
Callitriche hamulata				R	R
Hippuris vulgaris	A			O	O
Juncus bulbosus				R	R
Charophyte					
Chara virgata				D	R
Nitella opaca					R
Bryophyte					
Sphagnum sp.	R	R	R		
Algae					
Gelatinous blue-green algae	R	R			
Floating					
Lemna minor					R
Potamogeton polygonifolius	R			R	R
Emergent					
Anthoxanthum odoratum	R				
Cardamine pratensis	R			R	
Carex curta	O	R	R	O	R
Carex echinata		R			
Carex nigra	O	O	R	O	O
Carex oedocarpa (C. demissa)				R	
Carex panicea				R	R
Carex rostrata	LA	O	D	O	D
Cirsium palustre				R	R
Eleocharis palustris				LF	
Eriophorum angustifolium		O	R	R	O
Eriophorum vaginatum	R				R
Galium palustre	R			R	R
Galium uliginosum			R		
Glyceria fluitans	R	R		LF	R
Holcus lanatus					R
Juncus acutiflorus/articulatus				R	
Juncus bufonius agg.				R	
Juncus effusus	R	O	O	R	R
Luzula multiflora					R
Menyanthes trifoliata		LA			
Mimulus guttatus				R	
Myosotis secunda				R	R
Potentilla erecta			R		R
Potentilla palustris	O	R			R
Ranunculus flammula	R			R	R
Rumex obtusifolius	R				
Sparganium erectum				R	R
Vaccinum myrtillus	R				
Viola palustris				R	R
Trees and shrubs					
Betula pendula	R	R		R	R
Pinus sp.				R	R
Salix sp.		R			R
Sorbus aucuparia				R	
% Filamentous algae	0	0	0	0	0
% Submerged species	80	<1	0	84	15
% Floating leaved species	<1	0	0	1	1
% Emergent species	20	2	75	10	84
% Total cover	100	2	75	95	100

Annex E. Freshwater Pearl Mussel Technical Report (Waterside Ecology)

E.1 Summary

E.1.1 The freshwater pearl mussel *Margaritifera margaritifera* is a globally threatened bivalve mollusc. It has been estimated that up to half of the world's remaining populations are in Scotland. The freshwater pearl mussel is fully protected under the Wildlife and Countryside Act (1981) (as amended) of Great Britain. It is also listed on Annexes II and V of the EC Habitats Directive (Council Directive 92/43/EEC) and Appendix III of the Bern Convention.

E.1.2 The dualling of the A9 road will require the creation of a number of new stream crossings and modifications to some existing crossings. Such works have the potential to impact on freshwater pearl mussels and the habitats that support them. AMJV commissioned Waterside Ecology to undertake a habitat suitability assessment and freshwater pearl mussel survey of potentially suitable watercourses associated with six crossing locations along the route of the A9 between Moy and Tomatin. All are within the catchment of the River Findhorn.

E.1.3 Surveys were completed by a team of two experienced surveyors during good weather and water conditions on 16th and 17th May 2016. Some additional survey of Allt na Loinne Moire took place on 13th April 2017, also in good conditions. The standard procedure recommended by SNH was followed throughout and surveys covered a minimum of 0.5 km downstream of each crossing location and 0.1 km upstream.

- No live or dead freshwater pearl mussels were found in any of the surveyed watercourses.
- Some suitable habitat for freshwater pearl mussels was found in the survey reaches around four of the six crossing locations. Most of this habitat was sub-optimal and sparsely distributed.
- Given the absence of evidence of freshwater pearl mussels, works at the proposed crossings are considered to have little or no potential to affect this species.
- A relict population of freshwater pearl mussels has been recorded further downstream in the River Findhorn and standard procedures should be followed to protect water quality during all works around watercourses.

E.2 Background

Current survey

E.2.1 This survey of freshwater pearl mussels *Margaritifera margaritifera* was commissioned to minimise risk to the species during construction works relating to the dualling of the A9 trunk road between Moy and Tomatin. The modified and/or upgraded route will cross several streams, some of which provide potential habitat for freshwater pearl mussels, a globally threatened bivalve mollusc. If mussels were present, the dualling of the A9 may have potential to impact them directly through destruction at watercourse crossings or indirectly through changes to habitats and water quality.

E.2.2 Estimates suggest that Scotland holds up to half of the world's known viable populations of freshwater pearl mussel (Cosgrove et al. 2000). Even here, the species has undergone rapid decline during the last 100 years as a result of pollution, over-

exploitation by pearl fishermen, declines in salmonid host stocks and habitat degradation (Young et al. 2000; Watt et al. 2015). Under the Wildlife and Countryside Act (1981) of Great Britain as amended by the Nature Conservation Scotland Act (2004), it is an offence to intentionally or recklessly kill, injure take or disturb freshwater pearl mussels or to damage their habitat. The species is also listed on Annexes II and V of the EC Habitats Directive and Appendix III of the Bern Convention. The freshwater pearl mussel is a 'Priority Species' under the UK and Scottish Biodiversity Action Plans requiring the implementation of a Species Action Plan dedicated to its survival (Biodiversity Steering Group 1995).

Relevant aspects of freshwater pearl mussel ecology

E.2.3 Freshwater pearl mussels mature at an age of 10 to 15 years and a length of approximately 65 mm. The adults are typically dioecious, populations consisting of separate males and females. Mussel larvae, called glochidia, are released in late summer. The glochidia are parasitic and encyst on the gills of host fish. They are highly host-specific and in the UK can only complete their development on Atlantic salmon *Salmo salar* or trout *Salmo trutta* (Young & Williams 1984). Those glochidia which successfully settle on a host remain there until the following spring when they drop off and begin their life as a free-living mussel. They must drop into suitable substrate of clean sand or gravel or they will fail to establish. Huge losses are associated with each stage of this lifecycle making the freshwater pearl mussel particularly vulnerable to adverse conditions (Skinner et al. 2003). Pearl mussels are long lived and can live for more than 100 years (Bauer 1992), reaching 12 to 15 cm in length.

E.2.4 Freshwater pearl mussels live buried or partly buried in the beds of clean, unpolluted streams and rivers where they subsist by filtering and feeding on minute organic particles (Skinner at al 2003). Detailed studies suggest an optimum water depth of 0.3-0.4 m and optimum current velocities of 0.25 to 0.75 ms^{-1} at intermediate water levels (Hastie et al. 2000). Riverbed substrate characteristics are critical for freshwater pearl mussels. Preferred substrate consists of small sand patches stabilised among stones and boulders. In slower flowing streams, riffle areas with a mixture of cobbles, boulders and sand provide important, oxygen rich and relatively silt free habitats. Pearl mussels are thought to be at their most vulnerable at the stage where they leave the host fish and settle into the substrate. At this stage they are much less tolerant of siltation, eutrophication or pollution than are adult mussels.

Local status

E.2.5 There are no records of freshwater pearl mussels from any of the target streams (SNH unpublished data). However, all of the target streams lie within the catchment of the River Findhorn, where a small population of freshwater pearl mussels has been identified in recent years (Aquaterra Ecology 2012; Watt et al. 2015).

E.3 Aims

E.3.1 The aim of the current survey was to undertake a habitat suitability assessment and freshwater pearl mussel population survey of potentially suitable watercourses in relation to the dualling of the A9 between Moy and Tomatin.

E.4 Methods

Overall approach

E.4.1 Surveys were carried out on six watercourses, identified as having some potential to sustain populations of freshwater pearl mussels (Table 1).

Table 1: Stream crossings and survey reaches

Survey Code	Stream Name	Survey Extent
WC-004-PM-001	Allt Creag Bheithin	NH 75238 35003 (Allt na Slanaich) to NH 74788 34696
WC-007-PM-001	Allt na Slanaich	NH 75081 34855 to NH 74790 34244
WC-011-PM-001	Allt na Loinne Moire	NH 76868 34600 to NH 75833 34016
WC-016-PM-001	Dalmagarry Burn	NH 79241 31983 to NH 78531 32196
WC-019-PM-001	Allt Dubhag	NH 79656 30687 to NH 79282 30419
WC-022-PM-001	Allt na Frithe	NH 79749 30099 (R. Findhorn) to NH 79598 29890

E.4.2 The survey first identified areas of suitable mussel habitat within each stream. These habitats were then searched for the presence of freshwater pearl mussels. Following standard SNH recommended survey method (http://www.snh.gov.uk/docs/A372955.pdf) the linear stream surveys extended a minimum of 100 m upstream of Proposed Scheme crossing locations to 500 m downstream. A general survey was made by wading in the water and walking the riverbanks. The aim was to identify those areas that might harbour mussels, based on their known habitat preferences and surveyor experience. Where apparently suitable habitat was found, an intensive search for mussels was conducted.

Mussel habitat assessment

E.4.3 Stream habitats within each 600m reach were surveyed in a series of contiguous sections, each of approximately 100m in length. Data recorded within each reach were substrate stability, stream width, typical depth and substrate composition (Wentworth scale). Notes were kept on features that may be important in determining mussel presence e.g. active siltation or signs of enrichment.

E.4.4 Habitat quality for freshwater pearl mussels was assessed as being optimal, sub-optimal or unsuitable based on the criteria in Table 2. Dependent on the quality and quantity of mussel habitat, each survey section was given an overall habitat quality score (Table 3). These methods were developed by Era & Cosgrove & Hastie Associates (2007) and Waterside Ecology & Cosgrove & Hastie Associates (2009) on behalf of Scottish Natural Heritage.

Table 2: Mussel habitat suitability assessment criteria

Suitability	Assessment criteria
Optimal	Evidence of long-term riverbed stability. Significant pockets of fine sediments (clean sands and gravels) stabilised by primary substrates (e.g. boulders). Considered to be suitable habitat for juvenile M. margaritifera. Generally characterised by mixed sediments and intermediate flows.
Sub-optimal	Evidence of long-term, intermediate riverbed stability and/or a few areas that could support significant numbers of adult M. margaritifera. Generally characterised by partly sorted sediments and variable flows.
Unsuitable	No significant optimal or sub-optimal habitat observed. Generally characterised by extreme flows, mobile, well-sorted sediments and/or unsuitable substrate types.

Table 3: Habitat quality scoring system for survey sections

Mussel habitats present	Score for section
Long stretches and/or numerous patches of good quality, optimal habitat.	Excellent
Significant stretches and/or numerous patches of reasonable quality, mixed	Good

Mussel habitats present	Score for section
optimal/sub-optimal habitat.	
Long stretches and/or numerous patches of sub-optimal habitat, but very little optimal habitat.	Moderate
Some, but very little sub-optimal habitat.	Poor
No suitable habitat found.	Unsuitable

Mussel populations

E.4.5 All potentially suitable habitats were searched for the presence of mussels using an adapted version of the standard methods described by Young et al. (2003) and as recommended by SNH. The searches were conducted in the following manner:

- Searches were made using a glass-bottomed viewing bucket or bathyscope;
- Viewing was conducted under favourable conditions, i.e. good light, clear water, low flows;
- Searches were made in water sufficiently shallow for safe wading;
- Searches were made in an upstream direction checking favourable sites, e.g. in the shelter of cobbles, boulders or overhanging banks; and
- Loose debris and trailing weed were moved gently aside but no disturbance of the river bed was carried out.

E.4.6 All surveys were carried out under license by a team of two experienced surveyors led by Dr Jon Watt on 16th and 17th May 2016. Survey conditions were excellent with good light and clear water.

E.5 Results

Overview

E.5.1 Some potentially suitable habitat was present in four of the six surveyed reaches (Table 4). However, no live freshwater pearl mussels or dead shells were found in any of the watercourses that were surveyed.

Table 4: Summary of habitat and mussel population surveys

Survey code	Number of survey sections in each category					Mussels found (n)
	Unsuitable	Poor	Moderate	Good	Excellent	
WC-004-PM-001	1	3	2	0	0	0
WC-007-PM-001	6	0	0	0	0	0
WC-011-PM-001	5	2	4	2	0	0
WC-016-PM-001	6	0	0	0	0	0
WC-019-PM-001	0	4	1	0	0	0
WC-022-PM-001	1	1	4	0	0	0

Allt Creag Bheithin (WC-004-PM-001)

E.5.2 The Allt Creag Bheithin flows into the Allt na Slanaich at NH 7508 3486 and the survey commenced in Allt na Slanaich approximately 200 m downstream of the confluence.

E.5.3 Downstream of the confluence with Allt Creag Bheithin the Allt na Slanaich has a typical wet width of 1.8m with a bed width of 2m. The streambed is dominated by cobble and pebble substrates, which are rather unstable. Current speed is moderate with varied flows including riffle, run and glide (Figure 1a). Some small pockets of sub-optimal habitat are present but most of the streambed is too unstable to support freshwater pearl mussels. Habitat quality was classified as poor to unsuitable and no live or dead mussels were found.

E.5.4 From its confluence with Allt na Slanaich to WC-004 (existing A9 crossing) the Allt Creag Bheithin has a wet width of 1.4m and a stable streambed of cobble, boulder and coarse sand. There are widespread patches of sub-optimal habitat for mussels and overall habitat quality was classified as moderate. However, no live mussels or dead shells were found. Upstream of the A9 the Allt Creag Bheithin is slow flowing and meandering. Wet width is mainly less than 1m and streambed substrate is mainly loose, unstable sand and gravel. In many places this persists as a thin layer over clay. Habitat quality for mussels is poor and none were found.

E.5.5 Survey sections in this and other streams are listed in Appendix I and details of substrate composition and other physical characteristics in representative 50m transects are provided as Appendix II.

Figure 1: Typical survey reaches, WC-004-PM-001

a) Allt na Slanaich NH 7524 3500

b) Allt Creag Bheithin NH 7504 3489

c) Allt Creag Bheithin NH 7489 3476

d) Allt Creag Bheithin NH 7483 3470

Allt na Slanaich (WC-007-PM-001)

E.5.6 The survey commenced at the confluence of Allt na Slanaich and Allt Creag Bheithin.

E.5.7 Downstream of the existing A9 crossing the Allt na Slanaich typically has a wet width of 1.7m and a bed width of 3m. Current speed is moderate to fast and substrates are dominated by cobble, pebble and boulder. The stream flows through improved pasture and bankside vegetation is sparse (Figure 2a). The streambed is unstable and entirely unsuited to freshwater pearl mussels.

E.5.8 The existing A9 crossing is a large culvert that was judged passable for host fish. Upstream of this the Allt na Slanaich flows through conifer plantation. The stream is meandering and current speed is moderate. Rapid erosion is evident on the outside of bends and large, unvegetated point bars of pebble and cobble are present (Figure 2b and c). The stream typically has a wet width of 2m and a bed width of 4m. Depth is mainly less than 0.1m and substrates are dominated by unstable cobbles and pebbles.

E.5.9 Crossing WC-007 will be located in a section of moderately unstable stream at NH 74827 34387 (Figure 2d). Here and in the reaches immediately upstream the habitat remains too unstable to support mussels and none were found. No host fish were seen in the Allt na Slanaich, although parts of it appeared well suited to juvenile salmon.

Figure 2: Typical survey reaches, WC-007-PM-001

a) Allt na Slanaich NH 7508 3489

b) Allt na Slanaich NH 7498 3460

c) Allt na Slanaich NH 7490 3447

d) Allt na Slanaich NH 7483 3439

Allt na Loinne Moire (WC-011-PM-001)

E.5.10 The survey commenced at the confluence of Allt na Loinne Moire and Moy Burn, approximately 0.6 km downstream of the A9 road.

E.5.11 Immediately upstream of Moy Burn the first 400 m of the Allt na Loinne Moire provides long reaches of stable streambed with substrates of cobble, boulder and coarse sand. The gradient is moderate and depths typically range from 10 to 25 cm (Figure 4-3a). These reaches appear well suited to freshwater pearl mussels, although none were found. The stream banks are wooded and mainly stable. However, a debris dam at NH 7674 3456 has caused bank erosion and streambed scouring along approximately 15 m of the watercourse. Habitat quality deteriorates upstream of NH 7668 3456 with increasing evidence of siltation of the stable substrates. The channel beneath the B9154 and the railway has been modified and is entirely unsuited to freshwater pearl mussels. This modified channel includes a 20 m long sloping concrete ramp at NH 7655 3449 that was judged impassable to migratory salmonids.

E.5.12 Habitat quality between the railway and the A9 is moderate to poor, with some evidence of siltation and enrichment, including from a septic tank overflow at NH 7644 3456. A culvert carries the stream beneath the A9.

E.5.13 The first 300 m of stream upstream of the A9 road is typified by boulder and cobble substrates surrounded by coarse sand and gravel (Figure 3a and b). Many of the boulders and larger cobbles support bryophytes indicating long term streambed stability. Wet width is typically 1.2m and average depth is 0.15 to 0.2m. Areas of potentially suitable habitat for freshwater pearl mussels are widespread and overall habitat quality in the two most downstream survey sections was classified as moderate. Depositions of peat fragments and a little silt were judged to reduce habitat quality, which might otherwise have been classified as good. Upstream of NH 7615 3419 the channel is narrowly incised between peat and earth bank faces Figure 3c). The streambed is composed of unstable sand and gravel and was judged unsuitable for freshwater pearl mussels. This type of habitat extends to approximately NH 7599 3425, upstream of which the channel is unstable and braided. The main channel in the braided reach has substrates dominated by unstable sand and silt while the smaller braids have deposits of unstable pebble. None of these channels is suited to mussels.

E.5.14 The crossing will be located upstream of the braided reach. Habitats here and in the 100m of channel immediately upstream are characterised by moderate to fast current speeds and unstable substrates of cobble, pebble and boulder (Figure 3d). This habitat is unsuitable for freshwater pearl mussels. No freshwater pearl mussels or dead shells were found in any the survey sections up or downstream of WC-011. Small numbers of host fish were seen in eight of the 13 most downstream survey sections (Appendix I). These included four sections upstream of the barrier between the B9154 and the railway (Appendix I).

Figure 3: Typical survey reaches, WC-011-PM-001

a) Allt na Loinne Moire NH 7672 3456

b) Allt na Loinne Moire NH 7624 3421

c) Allt na Loinne Moire NH 7599 3426

d) Allt na Loinne Moire NH 7591 3414

Dalmagarry Burn (WC-016-PM-001)

E.5.15 The survey commenced downstream of the existing A9 road and the adjacent railway line.

E.5.16 The two most downstream survey sections are characterised by unstable, angular substrates of cobble and pebble in a broad shallow stream (Figure 4). Wet width is approximately 4m with a bed width of 4.5m. Depth is typically 0.1m. The channel lacks meanders or a defined thalweg and may have been straightened in the past, although this is uncertain. Streambed substrate is clearly very mobile and instream habitat in these sections is consequently entirely unsuitable for freshwater pearl mussels. The wet width of the stream decreases around NH 7895 3208 and from here to the A9 road the stream has a meandering channel with rapid erosion and deposition on the various bends. The mobile substrates of cobble and pebble provide no suitable habitat for freshwater pearl mussels (Figure 4b and c).

E.5.17 Upstream of the A9 the banks are more stable and there are fewer large depositional features (Figure 4d). The stream is approximately 3.5m wide with typical depths of 0.1 to 0.2m. There is a higher proportion of boulder than in the reaches downstream and a few pockets of coarse sand are present. However, these are not stable and habitat quality remains almost entirely unsuitable. No live or dead freshwater pearl mussels were found in the Dalmagarry Burn. Host fish were seen throughout the survey reaches. Common minnows *Phoxinus phoxinus* were seen in the slower reaches.

Figure 4: Typical survey reaches, WC-016-PM-001

a) Dalmagarry Burn NH 7924 3198

b) Dalmagarry Burn NH 7895 3208

c) Dalmagarry Burn NH 7887 3213

d) Dalmagarry Burn NH 7868 3221

Allt Dubhag (WC-019-PM-001)

E.5.18 The survey extended from the River Findhorn confluence upstream to the minor road bridge at NH 7928 3042.

E.5.19 The first 150m of the Allt Dubhag upstream of the River Findhorn is 1.5m wide with an average depth of approximately 0.15m. Gradient is moderate. Patches of potentially suitable habitat for pearl mussels are scattered throughout this reach in the form of coarse sand stabilised by large cobbles and boulders (Figure 5a). A little bank erosion is evident on the outside of bends but the channel is mainly stable. From NH 7949 3062 to the A9 road the gradient increases and the streambed is less stable. There are many exposed side and point bars along the meandering channel and much of the streambed appears unstable. The stream is heavily shaded and many trees have fallen into or collapsed over the channel making access difficult. Substrate is primarily cobble and pebble with some sand and gravel. Most of the instream habitat is too unstable to support mussels although a few isolated patches of potentially suitable habitat were noted (Appendix I). The stream flows beneath the A9 via a concrete culvert (Figure 5c).

E.5.20 Upstream of the A9 the gradient is moderate with mixed substrates and flow types (Figure 5d). Wet width is typically around 1.5 to 2.0m. The banks are partly wooded and mainly stable. Patches of sub-optimal mussel habitat are widespread but sparse and overall habitat quality was classified as poor. No live mussels or dead shells were found in the survey reaches of Allt Dubhag. Host fish were seen throughout.

Figure 5: Typical survey reaches, WC-019-PM-001

a) Allt Dubhag NH 7964 3070

b) Allt Dubhag NH 7947 3057

c) Allt Dubhag NH 7941 3054

d) Allt Dubhag NH 3928 3042

Allt na Frithe (WC-022-PM-001)

E.5.21 The Proposed Scheme crossing is located on the Allt na Frithe adjacent to the existing A9 crossing. This is some 150m upstream of the confluence of Allt na Frithe with the River Findhorn. Therefore the survey commenced in the River Findhorn downstream of the confluence.

E.5.22 Suitable habitat for freshwater pearl mussels in the River Findhorn survey reaches is restricted to the left side of the channel. Habitat midstream is too unstable and the right side of the channel is characterised by shallow, unstable depositional habitats. Suitable habitats were easily surveyed by wading. Patches of sub-optimal habitat are widespread close to the riverbank in water that is typically 0.5m deep. These habitats comprise stable sand and gravel collected around the base of large boulders. However, despite intensive searching no live or dead mussels were found. Host fish, mainly juvenile salmon, were seen throughout. In the reaches between the River Findhorn and the A9 the Allt na Frithe has a wet width of approximately 3m and a moderate to fast current speed. Substrate comprises boulder, cobble and pebble (Figure 6b). These substrates are rather unstable and suitable habitat for freshwater pearl mussels is lacking. The stream flows beneath the A9 via a 40m long culvert that may impede movements of host fish (Figure 6c).

E.5.23 Upstream of the A9 the stream is meandering and the channel is unstable, with rapid erosion on the outside of bends. Substrate is mainly coarse and unstable and there is very little suitable habitat for freshwater pearl mussels. No live mussels or dead shells were found in Allt na Frithe and host fish appeared to be scarce.

Figure 6: Typical survey reaches, WC-022-PM-001

a) River Findhorn NH 7974 3009

b) Allt na Frithe NH 7920 3016

c) Allt na Frithe NH 7967 3000

d) Allt na Frithe NH 7963 2992

E.6 Discussion

Survey limitations

E.6.1 Despite the presence of small patches of suitable, mainly sub-optimal, habitat in several streams no freshwater pearl mussels were found in any of the survey reaches. Due to the small size of most streams it is probable that the great majority of suitable habitats in the survey reaches were thoroughly searched. While it is conceivable that a small number of freshwater pearl mussels could have remained undetected this limitation applies to any freshwater pearl mussel survey conducted using the standard methodologies. As a proportion of freshwater pearl mussels including smaller juveniles may be buried in the substrate, any complete census would require the destructive searching of all loose material including all potentially suitable mussel habitats. Clearly this is unacceptable and impractical, and such detailed surveys could not be conducted over long reaches of river. This limitation notwithstanding, the lack of evidence of live or dead freshwater pearl mussels or empty shells suggests that it is highly unlikely that freshwater pearl mussels occur in the target reaches of any of the watercourses.

Potential impacts of construction

E.6.2 The lack of any evidence of freshwater pearl mussels in the survey reaches suggests that the creation of new crossings and/or modification of existing crossings will not impact negatively on this species.

E.6.3 Small numbers of freshwater pearl mussel are likely to be present in the lower reaches of the River Findhorn (Watt et al. 2015). As such the species could potentially be present in small numbers further upstream, including in reaches closer to the current survey area. Standard mitigation measures to avoid negative impacts on watercourses, streambed habitats or host salmonid populations should be implemented. Freshwater mussels, their habitats and hosts are likely to be sensitive to elevated levels of fine material in the form of silt and other particulate matter, and silt controls may be required to protect potentially suitable mussel and fish habitats both in the survey reaches and in receiving waters downstream. Juvenile mussels in particular are likely to be wholly intolerant of silty conditions (Hastie et al. 2000).

E.7 References

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Appendix I: Habitat survey sections

Survey Code	Section code	NGR Downstream	NGR Upstream	Quality	Live mussels (n)	Dead shells (n)	Host fish seen
WC-004-PM-001	4/1	275238 835003	275217 834908	Poor	0	0	None
WC-004-PM-001	4/2	275217 834908	275146 834893	Poor	0	0	Few
WC-004-PM-001	4/3	275146 834893	275 081 834855	Unsuitable	0	0	None
WC-004-PM-001	4/4	275081 834855	275016 834821	Moderate	0	0	Few
WC-004-PM-001	4/5	275016 834821	274872 834771	Moderate	0	0	Few
WC-004-PM-001	4/6	274872 834771	274788 834696	Poor	0	0	None
WC-007-PM-001	7/1	275081 834855	275046 834758	Unsuitable	0	0	None
WC-007-PM-001	7/2	275046 834758	275000 834665	Unsuitable	0	0	None
WC-007-PM-001	7/3	275000 834665	274955 834587	Unsuitable	0	0	None
WC-007-PM-001	7/4	274955 834587	274934 834491	Unsuitable	0	0	None
WC-007-PM-001	7/5	274934 834491	274823 834377	Unsuitable	0	0	None
WC-007-PM-001	7/6	274823 834377	274790 834244	Unsuitable	0	0	None
WC-011-PM-001	11/1	276868 834600	276785 834581	Good	0	0	Few
WC-011-PM-001	11/2	276785 834581	276682 834563	Good	0	0	Few
WC-011-PM-001	11/3	276682 834563	276600 834507	Moderate	0	0	None
WC-011-PM-001	11/4	276600 834507	276484 834423	Unsuitable	0	0	Few
WC-011-PM-001	11/5	276484 834423	276381 834270	Moderate	0	0	Few
WC-011-PM-001	11/6	276381 834270	276334 834236	Poor	0	0	None
WC-011-PM-001	11/7	276334 834236	276242 834213	Moderate	0	0	Few
WC-011-PM-001	11/8	276242 834213	276152 834193	Moderate	0	0	Few
WC-011-PM-001	11/9	276152 834193	276093 834229	Poor	0	0	Few

Survey Code	Section code	NGR Downstream	NGR Upstream	Quality	Live mussels (n)	Dead shells (n)	Host fish seen
WC-011-PM-001	11/10	276093 834229	275991 834255	Unsuitable	0	0	Few
WC-011-PM-001	11/11	275991 834255	275843 834244	Unsuitable	0	0	None
WC-011-PM-001	11/12	275843 834244	275910 834144	Unsuitable	0	0	None
WC-011-PM-001	11/13	275910 834144	275833 834015	Unsuitable	0	0	None
WC-016-PM-001	16/1	279241 831983	279138 831997	Unsuitable	0	0	Few
WC-016-PM-001	16/2	279138 831997	279049 832050	Unsuitable	0	0	None
WC-016-PM-001	16/3	279049 832050	278952 832081	Unsuitable	0	0	Few
WC-016-PM-001	16/4	278952 832081	278884 832124	Unsuitable	0	0	Few
WC-016-PM-001	16/5	278884 832124	278675 832212	Unsuitable	0	0	Few
WC-016-PM-001	16/6	278675 832212	278531 832196	Unsuitable	0	0	Few
WC-019-PM-001	19/1	279656 830687	279582 830643	Moderate	0	0	Few
WC-019-PM-001	19/2	279582 830643	279499 830608	Poor	0	0	Few
WC-019-PM-001	19/3	279499 830608	279434 830588	Poor	0	0	None
WC-019-PM-001	19/4	279434 830588	279401 830529	Poor	0	0	Few
WC-019-PM-001	19/5	279401 830529	279282 830419	Poor	0	0	None
WC-022-PM-001	22/1	279694 830482	279692 830395	Moderate	0	0	Few
WC-022-PM-001	22/2	279691 830293	279691 830293	Moderate	0	0	Few
WC-022-PM-001	22/3	279691 830293	279686 830207	Moderate	0	0	Few
WC-022-PM-001	22/4	279686 830207	279737 830094	Moderate	0	0	Few
WC-022-PM-001	22/5	279737 830094	279675 829964	Unsuitable	0	0	Few
WC-022-PM-001	22/6	279675 829964	279598 829890	Poor	0	0	None

Appendix II: Detailed 50m habitat transects

Survey code	Transect code	NGR downstream	NGR upstream	Substrate stability	Wet width (m)	Bed width (m)	Average depth (m)	Adjacent land use	Substrate composition (%)						Mussels (n)	Comment
									SI	SA	GR	PE	CO	BO		
WC-004-PM-001	T4A	275238 835003	275228 834950	Unstable	1.8	2.0	0.15	IG	0	5	5	20	65	5	0	Unstable cobble and pebble. Moderate current speed with mixed flow types. Very few pockets of sub-optimal habitat only.
WC-004-PM-001	T4B	275040 834888	275016 834821	Stable	1.4	1.4	0.1	IG	+	10	5	5	55	25	0	Very stable cobble and boulder with widespread patches of coarse sand and gravel. Sub-optimal but widespread suitable habitat. Host fish present.
WC-004-PM-001	T4C	274830 834697	274788 834696	Moderate	0.8	0.8	0.1	CO/BL	5	40	20	20	20	5	0	Small meandering stream. Narrow between steeply incised banks. Fine substrates often in thin layer over clay/earth. Poor/unsuitable for mussels. No fish seen.
WC-007-PM-001	T7A	275000 834665	274976 834595	Unstable	1.7	3.0	0.15	CO	0	5	10	20	50	15	0	Very unstable and entirely unsuitable for freshwater pearl mussels. No fish seen.
WC-007-PM-001	T7B	274934 834491	274885 834456	Unstable	2.0	4.0	0.07	CO	0	5	10	20	50	15	0	Broad and shallow with very unstable substrate and rapid bank erosion. Unsuitable. No fish seen.
WC-007-PM-001	T7C	274823 834377	274824 834820	Unstable	2.0	4.0	0.1	CO	0	5	10	20	55	10	0	Broad and shallow with very unstable substrate and rapid bank erosion. Unsuitable. No fish seen.
WC-011-	T11A	276741	276682	Stable	1.5	1.5	0.15	BL	+	15	10	10	45	20	0	Stable channel with moderate gradient.

Survey code	Transect code	NGR downstream	NGR upstream	Substrate stability	Wet width (m)	Bed width (m)	Average depth (m)	Adjacent land use	Substrate composition (%)						Mussels (n)	Comment
									SI	SA	GR	PE	CO	BO		
PM-001		834565	834563													Widespread areas of suitable habitat for freshwater pearl mussels. Host fish present.
WC-011-PM-001	T11B	276242 834213	276194 834197	Moderate	1.2	1.2	0.15	MH	+	20	5	20	50	5	0	Widespread patches of sub-optimal habitat in sand stabilised by boulder. Deposited peat fragments reduce quality. Host fish present.
WC-011-PM-001	T11C	275991 834255	275944 834295	Unstable	0.7	0.7	0.1	WH	35	30	15	10	10	0	0	Incised channel gives way to unstable braids. Incised reach is unstable sand. Sand, pebble and earth streambed in braids. Unsuitable.
WC-011-PM-001	T11D	275910 834144	275894 834088	Unstable	1.5	3.0	0.1	MH	0	10	10	25	45	10	0	Very unstable streambed. Unstable side and point bars indicate much transport and deposition. No fish seen. Completely unsuitable for mussels.
WC-016-PM-001	T16A	279241 831983	279194 831996	Unstable	4.0	4.5	0.1	RP/BL	+	5	10	35	50	0	0	Small mobile substrates in broad shallow stream. Too unstable for mussels and totally unsuitable. Host fish seen.
WC-016-PM-001	T16B	278919 832089	278860 832139	Unstable	2.5	4.5	0.2	RP	0	5	10	30	50	5	0	Meandering stream with large depositional bars. Mobile unstable substrates. Unsuitable for mussels.
WC-016-PM-001	T16C	286672 832199	278591 832169	Unstable	3.5	3.5	0.15	RP	0	2	3	20	60	15	0	Mainly unstable with a handful of tiny pockets of sub-optimal habitat. Very poor overall. Host fish seen.
WC-019-PM-001	T19A	279616 830671	279582 830643	Stable	1.5	1.5	0.15	CO/GA	0	15	10	15	50	10	0	Patches of suitable habitat in coarse sand stabilised by cobble and boulder. Host fish seen.

Survey code	Transect code	NGR downstream	NGR upstream	Substrate stability	Wet width (m)	Bed width (m)	Average depth (m)	Adjacent land use	Substrate composition (%)						Mussels (n)	Comment
									SI	SA	GR	PE	CO	BO		
WC-019-PM-001	T19B	279474 830565	279434 830588	Unstable	1.8	2.5	0.1	CO	+	10	10	40	30	10	0	Moderately unstable with erosion and deposition on bends. Densely overplanted with conifers at upstream end. Many fallen trees. Poor. Host fish seen.
WC-019-PM-001	T19C	279318 830459	279282 830419	Moderate	1.5	2.0	0.1	CO	+	15	10	15	50	10	0	Widespread but sparse patches of suitable habitat. A little unstable. Host fish seen.
WC-022-PM-001	T22A	279704 830157	279725 830108	Stable	30	35	0.5	CO/RP	0	5	5	5	25	60	0	Suitable habitat restricted to left side of channel as stable pockets of sand around large boulders. Rest of channel is too unstable. Juvenile salmon present.
WC-022-PM-001	T22B	279737 830094	279716 830050	Unstable	2.8	2.5	0.15	RP	+	2	3	15	35	45	0	Fast flowing and rather unstable. A few short slower flowing stretches with deposited peat and silt. Mainly unsuitable.
WC-022-PM-001	T22C	279628 829921	279598 829890	Unstable	2.5	3.0	0.15	RP	+	+	5	10	60	25	0	Unstable and meandering with unvegetated point bars. Many silt and peat deposits in slower reaches. No fish seen. Very poor for freshwater pearl mussels.

Land use: BL=broadleaf trees, CO=conifer plantation, GA=garden, IG=improved grazing, MH=moorland heath, RP=rough pasture, WH=wet heath Substrates: SI=silt, SA=sand, GR=gravel, PE=pebble, CO=cobble, BO=boulders

Annex F. Freshwater Pearl Mussel Funtack Burn Addendum (Waterside Ecology)

F.1 Summary

F.1.1 The dualling of the A9 road will require a number of changes to nearby roads and tracks, including any associated watercourse crossings. One of these is the upgrading of an existing track and bridge at the Funtack Burn (NH 790 322), a tributary of the River Findhorn. Construction of the proposed new bridge has the potential to impact on stream habitats in nearby reaches of the Funtack Burn. AMJV commissioned Waterside Ecology to undertake a habitat suitability assessment and freshwater pearl mussel survey of these reaches.

F.1.2 The survey was completed by Jon Watt on 20th February 2017 under Animal License number 94487. The standard procedure recommended by SNH was followed throughout and survey covered some 700m of the channel downstream of the crossing location and 130m upstream.

- No live or dead freshwater pearl mussels were found.
- Suitable substrates for freshwater pearl mussels were found to be widespread in the lower and middle parts of the survey reach.
- The upper parts of the survey reach, close to the proposed crossing, comprise pool and deep glide. Mussel habitat quality in these areas is poor and siltation was evident.
- The channel has been subject to dredging and straightening in past decades and this is likely to have extirpated any mussels that may previously have been present as well as reducing habitat quality.
- Given the absence of evidence of freshwater pearl mussels, works at the proposed crossing location are considered unlikely to affect this species.
- A relict population of freshwater pearl mussels has been recorded further downstream in the River Findhorn and standard procedures should be followed to protect water quality during all works around watercourses.

F.2 Background

Current survey

F.2.1 This survey of freshwater pearl mussels *Margaritifera margaritifera* was commissioned to minimise risk to the species during construction works relating to the dualling of the A9 trunk road between Moy and Tomatin. A new crossing is to be constructed over the Funtack Burn at NH 790 322. The burn may provide suitable habitat for freshwater pearl mussels, a globally threatened bivalve mollusc. If mussels were present, the construction of a new crossing could have potential to impact them directly through destruction, or indirectly through changes to habitats or water quality.

F.2.2 Estimates suggest that Scotland holds up to half of the world's known viable populations of freshwater pearl mussel (Cosgrove et al. 2000). Even here the species has undergone rapid decline during the last 100 years as a result of pollution, over-

exploitation by pearl fishermen, declines in salmonid host stocks and habitat degradation (Young et al. 2000; Watt et al. 2015). Under the Wildlife and Countryside Act (1981) of Great Britain as amended by the Nature Conservation Scotland Act (2004), it is an offence to intentionally or recklessly kill, injure take or disturb freshwater pearl mussels or to damage their habitat. The species is also listed on Annexes II and V of the EC Habitats Directive and Appendix III of the Bern Convention. The freshwater pearl mussel is a 'Priority Species' under the UK and Scottish Biodiversity Action Plans requiring the implementation of a Species Action Plan dedicated to its survival (Biodiversity Steering Group 1995).

Relevant aspects of freshwater pearl mussel ecology

F.2.3 Freshwater pearl mussels mature at an age of 10 to 15 years and a length of approximately 65 mm. The adults are typically dioecious, populations consisting of separate males and females. Mussel larvae, called glochidia, are released in late summer. The glochidia are parasitic and encyst on the gills of host fish. They are highly host-specific and in the UK can only complete their development on Atlantic salmon *Salmo salar* or brown trout *Salmo trutta* (Young & Williams 1984). Those glochidia which successfully settle on a host remain there until the following spring when they drop off and begin their life as a free-living mussel. They must drop into suitable substrate of clean sand or gravel or they will fail to establish. Huge losses are associated with each stage of this lifecycle making the freshwater pearl mussel particularly vulnerable to adverse conditions (Skinner *et al*. 2003). Pearl mussels are long lived and can live for more than 100 years (Bauer 1992), reaching 12 to 15 cm in length.

F.2.4 Freshwater pearl mussels live buried or partly buried in the beds of clean, unpolluted streams and rivers where they subsist by filtering and feeding on minute organic particles (Skinner *at al* 2003). Detailed studies suggest an optimum water depth of 0.3-0.4 m and optimum current velocities of 0.25 to 0.75 ms^{-1} at intermediate water levels (Hastie *et al*. 2000). Riverbed substrate characteristics are critical for freshwater pearl mussels. Preferred substrate consists of small sand patches stabilised among stones and boulders. In slower flowing streams, riffle areas with a mixture of cobbles, boulders and sand provide important, oxygen rich and relatively silt free habitats. Pearl mussels are thought to be at their most vulnerable at the stage where they leave the host fish and settle into the substrate. At this stage they are much less tolerant of siltation, eutrophication or pollution than are adult mussels.

Local status

F.2.5 There are no records of freshwater pearl mussels from the target stream (SNH unpublished data). However, the Funtack Burn is within the catchment of the River Findhorn, where a small population of freshwater pearl mussels has been identified in recent years (Aquaterra Ecology 2012; Watt et al. 2015).

F.3 Aims

F.3.1 The aim of the current survey was to undertake a habitat suitability assessment and freshwater pearl mussel population survey of the Funtack Burn near Dalmagarry (NH 790 322).

F.4 Methods

Overall approach

F.4.1 The survey first identified areas of suitable mussel habitat. These habitats were then searched for the presence of freshwater pearl mussels. The method followed standard

SNH recommendations (http://www.snh.gov.uk/docs/A372955.pdf). The linear stream survey extended some 130 m upstream of the proposed crossing location and 700 m downstream. A general survey was made by wading in the water and walking the riverbanks. The aim was to identify those areas that might harbour mussels, based on their known habitat preferences and surveyor experience. Where apparently suitable habitat was found a search for mussels was conducted.

Mussel habitat assessment

F.4.2 Stream habitat within the target reach was surveyed in a series of contiguous sections, each of approximately 100 m in length. Data recorded within each reach were substrate stability, stream width, typical depth and substrate composition (Wentworth scale). Notes were kept on features that may be important in determining mussel presence e.g. siltation or signs of enrichment.

F.4.3 Habitat quality for freshwater pearl mussels classified as optimal, sub-optimal or unsuitable based on the criteria in Table 1. Dependent on the quality and quantity of mussel habitat, each survey section was given an overall habitat quality score (Table 2). These methods were developed by Era & Cosgrove & Hastie Associates (2007) and Waterside Ecology & Cosgrove & Hastie Associates (2009) on behalf of Scottish Natural Heritage.

Table 1: Mussel habitat suitability assessment criteria

Suitability	Assessment criteria
Optimal	Evidence of long-term riverbed stability. Significant pockets of fine sediments (clean sands and gravels) stabilised by primary substrates (e.g. boulders). Considered to be suitable habitat for juvenile M. margaritifera. Generally characterised by mixed sediments and intermediate flows.
Sub-optimal	Evidence of long-term, intermediate riverbed stability and/or a few areas that could support significant numbers of adult M. margaritifera. Generally characterised by partly sorted sediments and variable flows.
Unsuitable	No significant optimal or sub-optimal habitat observed. Generally characterised by extreme flows, mobile, well-sorted sediments and/or unsuitable substrate types.

Table 2: Habitat quality scoring system for survey sections

Mussel habitats present	Score for section
Long stretches and/or numerous patches of good quality, optimal habitat.	Excellent
Significant stretches and/or numerous patches of reasonable quality, mixed optimal/sub-optimal habitat.	Good
Long stretches and/or numerous patches of sub-optimal habitat, but very little optimal habitat.	Moderate
Some, but very little sub-optimal habitat.	Poor
No suitable habitat found.	Unsuitable

Mussel populations

F.4.4 Potentially suitable habitats were searched for the presence of mussels using an adapted version of the standard methods described by Young et al. (2003) and as recommended by SNH. The searches were conducted in the following manner:

- Searches were made using a glass-bottomed viewing bucket or bathyscope;
- Searches were made in water sufficiently shallow for safe wading;

- Searches were made in an upstream direction checking favourable sites, e.g. in the shelter of cobbles, boulders or overhanging banks; and
- Loose debris and trailing weed were moved gently aside but no disturbance of the river bed was carried out.

F.4.5 The survey was carried out under Animal License number 94487 by Dr Jon Watt on 20th February 2017. Water level was slightly elevated due to showers and snow-melt. Visibility was restricted to approximately 1.0 to 1.2 m, depending on light conditions, due to slight cloudiness in the water. Weather was partly overcast with sunny intervals.

F.5 Results

Mussel habitat

F.5.1 The survey extended from road bridge at NH 7969 3196 upstream to NH 7895 3234, a distance of approximately 0.83 km. The proposed new crossing, a single span bridge, would be constructed at the site of an existing footbridge at NH 7904 3223. The target reach was surveyed in seven contiguous sections numbered F1 to F7, starting downstream (Appendix I). The proposed new bridge would be constructed at the upstream end of F6.

F.5.2 The confluence of the Funtack Burn and Dalmagarry Burn is located approximately 10 m upstream of the road bridge. Here the channel has substrates of cobble and pebble in run and riffle flow types (Figure 1a). The substrates around the confluence are largely unsuitable for freshwater pearl mussels but provide good spawning habitat for host salmonids and salmon redds were discernible. All of the survey reaches upstream of the confluence have been dredged and straightened in past decades and this has profoundly impacted on the nature of stream habitats.

F.5.3 Sections F1 and F2 are approximately 7 m wet width. Wet width equals bed width throughout and simple dredged channel is lacking in diversity. The channel is trapezoidal in cross section with steeply sloping sides and a flat streambed. With the exception of the area around the Dalmagarry Burn confluence, flow type is deep glide. Substrate is dominated by cobble and sand, providing some potentially suitable habitat for freshwater pearl mussels. However silt over the cobbles and along the margins suggests that habitat quality is sub-optimal. A few patches of macrophyte (<10 % cover overall) indicate long term substrate stability. Detailed habitat transect TFA was located in section F2 and provides representative data on substrate composition and depth (see Appendix II). The modified, embanked bank faces are grassy and treeless.

F.5.4 Sections F3 to F5 provide a little more diversity than F1 or F2. Flow types include deep glide, shallow glide and run. The faster flowing runs had a depth of 0.15 to 0.25 m at the time of survey. Maximum depth in the glides was 0.7 m. Width varies from 7 m to 8 m. Habitat quality for freshwater pearl mussels in F3 was classified as good, with the better habitat in runs and shallow glides where widespread areas of clean sand stabilised by cobble are present. Habitat quality in F4 and F5 was classified as moderate, since these sections mainly comprise deep glide and silt impacts are more evident than in F3. The shallow margins alongside each bank are silted. Submerged macrophytes are abundant with over 60% cover of the streambed in the shallower reaches. The modified bank faces are grassy, stable and treeless.

F.5.5 Section F6 extends for 170 m downstream of the crossing site at the existing footbridge. The downstream 130 m of the section provide some sub-optimal habitat for freshwater pearl mussels in water depths of 0.2 to 0.5 m. Suitable spawning habitat for host fish is present and at least one salmon redd was discernible. Substrate is mainly cobble and sand. The presence of macrophytes indicates long term stability. Habitat transect TFB was sited in this reach. The upstream end of section F6, closest to the footbridge, comprises pool and deep glide with very slow current speed. Maximum depth at the

time of survey was approximately 1.5 m and exceeded the limit of visibility. It was apparent from the visible streambed (approximately 50% of the total in the 40 m of stream immediately downstream of the footbridge) that habitat quality for freshwater pearl mussels in this area is poor. Silt was evident coating the tops of the cobbles and boulders. Silt was also evident when sandy substrates were disturbed and the shallower sloping margins are also heavily silted and unsuited to freshwater pearl mussels. The modified bank faces are treeless and stable with the exception of a short eroding reach approximately 100 m downstream of the footbridge (Figure 1c).

F.5.6 Section F7 extends for 130 m upstream of the footbridge. The stream has a wet width of approximately 8 m and flow type throughout is pool and deep glide with depths up to 1.5 m. Visibility was restricted to approximately 1.0 m so approximately 50% of the streambed remained un-surveyed. Visible habitat was similar to that at the upstream end of F6, with silted cobble, boulder and sand. Macrophytes are mainly absent (<5 % cover). Habitat quality for freshwater pearl mussels was judged to be poor. Transect TFC (Appendix II) comprised the first 50 m of stream above the footbridge.

Figure 1: Survey reaches, WC-019-PM-001

a) Section 1 NH 7969 3196

b) Section 2, transect TFA, NH 7958 3198

c) Section 6, transect TFB, NH 7913 3219

d) Section 7, transect TFC, NH 7904 3223

Mussel populations

F.5.7 No live freshwater pearl mussels or dead shells were found in any of the reaches that were surveyed.

F.6 Discussion

Survey limitations

F.6.1 Despite the presence of widespread patches of suitable freshwater pearl mussel habitat in several survey sections no live or dead mussels were found. Total search time was approximately 5 hours, so survey intensity was high and it is probable that most suitable habitats in the survey reach were inspected. The exceptions were the deeper areas of pool habitat in the top 40 m of section F6 and throughout F7, where some 50% of the channel width was too deep to survey due to cloudiness in the water. It is considered improbable that mussels would be present in these reaches since:

a) Deep pool habitat is generally poor for mussels;

b) Habitat quality in the visible areas of the pools was poor, with the better habitat between 1 and 2 m from the riverbank. There was no indication from visible substrates that habitat quality improved with increasing depth;

c) There was clear evidence of long term silt impacts in the slow flowing pool habitats of F6 and F7, with a layer of stable silt overlying the cobbles and boulders. Mussels are largely intolerant of silt.

d) No freshwater pearl mussels were found in F2 to F5 or in the lower reaches of F6, all of which provided better quality habitats than the deep pools and glides near the footbridge.

F.6.2 Despite the limitations imposed by cloudy water in the deepest pools, the lack of evidence of live or dead freshwater pearl mussels or empty shells in the better habitats suggest that it is unlikely that freshwater pearl mussels occur in the target reaches of Funtack Burn.

Potential impacts of construction

F.6.3 The lack of any evidence of freshwater pearl mussels in the survey reaches suggests that the creation of new crossing will not impact negatively on this species.

F.6.4 Small numbers of freshwater pearl mussel are likely to be present in the lower reaches of the River Findhorn (Watt et al. 2015). As such the species could potentially be present in small numbers in other parts of the river. Arguably, mussels might also be present in the lower reaches of Funtack Burn, which have not been subject to dredging. However, limited evidence from the current survey (i.e. cloudy water at moderate stream discharge, evidence of silt impacts) may suggest this is unlikely. Nevertheless, standard mitigation measures to avoid negative impacts on watercourses, streambed habitats or host salmonid populations should be implemented. Salmon redds and adult salmon carcasses were present in the survey reaches, suggesting it is an important spawning area for host salmonids in the Findhorn catchment. Freshwater mussels, their habitats and hosts are likely to be sensitive to increased levels of fine material in the form of silt and other particulate matter, and control measures may be required to prevent any further siltation of suitable mussel and fish habitats both in the survey reaches and in receiving waters downstream. Juvenile mussels in particular are likely to be wholly intolerant of silty conditions (Hastie et al. 2000).

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Appendix I: Habitat survey sections

Survey section	NGR Downstream	NGR Upstream	Quality	Live mussels (n)	Dead shells (n)	Host fish seen
F1	279689 831959	279583 831985	Poor	0	0	None
F2	279583 831985	279493 832020	Moderate	0	0	None
F3	279493 832020	279404 832060	Good	0	0	None
F4	279404 832060	279303 832103	Moderate	0	0	None
F5	279303 832103	279214 832142	Moderate	0	0	None
F6	279214 832142	279035 832225	Poor to moderate	0	0	None
F7	279035 832225	278965 832342	Poor	0	0	None

Appendix II: Detailed 50m habitat transects

Transect code	NGR downstream	NGR upstream	Substrate stability	Wet width (m)	Bed width (m)	Average depth (m)	Adjacent land use	Substrate composition (%)						Mussels (n)	Comment
								SI	SA	GR	PE	CO	BO		
TFA	279583 331982	279525 832015	stable	7	7	0.6	IG	+	40	5	15	40	0	0	Modified channel dredged and straightened. Simple trapezoidal channel form without thalweg. Substrate of stable cobble with sand. Margins are silted. No host fish seen (but adult salmon carcass on bank – probable otter predation).
TFB	279137 832175	279053 832220	stable	8	8	0.4	IG	+	30	10	10	45	5	0	Modified channel dredged and straightened. Run and glide flow types. Approximately 60% macrophyte cover in shallower habitats. Substrate of stable cobble and sand. Habitat apparently suitable for freshwater pearl mussel but none found. No fish seen but one salmon redd visible near downstream end of section.
TFC	279035 832225	278965 832342	stable	8	8	0.8	CO/IG	5	35	5	5	45	10	0	Modified channel dredged and straightened. Deep and slow flowing – pool habitat. Coating of silt on top of boulders and stable cobbles. Sloping margins are silted. Some clean sand in 0.7 m depth, mainly near left bank. Overall quality for mussels is poor. Less than 5% vegetation. No fish seen.

Land use: CO=conifer plantation, IG=improved grazing
Substrates: SI=silt, SA=sand, GR=gravel, PE=pebble, CO=cobble, BO=boulder
+=present in small, unquantifiable amounts or as fine deposits over other sediments