AECOM Imagine it. Delivered.

Red John Pumped Storage Hydro Scheme

Volume 5, Appendix 7.1: Aquatic Ecology Survey Report

ILI (Highlands PSH) Ltd.

November 2018

Quality information

Prepared by	Checked by	Verified by	Approved by
Chris Wing Consultant Ecologist Liam Byrne Consultant Ecologist	Pamela Lowe Senior Ecologist	Peter Cowley Principal Aquatic Ecologist	Catherine Anderson Associate Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	November 2018	Submission	CA	Catherine Anderson	Associate Director

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Table of Contents

Tables

Figures

Appendix 7.1 Freshwater Ecology Survey Report

7.1 Introduction

Background

7.1.1 AECOM was appointed by Intelligent Land Investments (ILI) to carry out an Environmental Impact Assessment (EIA) for the proposed Red John Pumped Storage Hydro Scheme (hereafter referred to simply as the 'Development').

7.1.2 The area encompassed by the redline boundary of the Development is hereafter referred to as the 'Development Site'.

7.1.3 As part of the EIA process, the Red John Scoping Report (Appendix 4.2: Scoping Report) identified the potential for significant impacts on aquatic receptors and protected species such as Atlantic salmon *Salmo salar* and freshwater pearl mussel *Margaritifera margaritifera*. Salmon migrate between the River Moriston SAC (designated for both *S. salar* and *M. margaritifera*) and the sea via Loch Ness and may feasibly pass by the Tailpond Inlet / Outlet for the Development.

7.1.4 The scoping report also identified a number of high threat level Invasive Non-Native Species (INNS) which could potentially be spread into neighbouring catchments, which immediately adjoin the Development Site. These included salmon fluke *Gyrodactylus salaris* (a freshwater external parasite of salmon); however, this species is not currently endemic in the UK. Consultees responding to the scoping opinion raised concern about specific INNS in the Ness catchment: a flatworm (*Phagocata woodworthi*), the freshwater amphipod 'shrimp' (*Crangonyx pseudogracilis*) and Nuttall's waterweed (*Elodea Nuttallii*). Therefore surveys were scoped in for invasive plants, aquatic macrophytes and macroinvertebrates, and fish habitat assessment.

Purpose of this report

7.1.5 This report has been written as an Appendix to Chapter 7: Aquatic Ecology (Volume 2). It describes the methods used for freshwater ecology surveys and the results obtained. The results of the field surveys, in combination with the outcomes of desk study and on-going consultation, will be used to inform the Ecological Impact Assessment (EcIA).

Site Description and Sample Site Selection

7.1.6 Sample locations were selected based on their perceived potential to be impacted by the Development. Any watercourses where a crossing may be required or had the potential to be impacted by run-off were surveyed to assess their conservation value and establish a baseline. The majority of the sample sites are headwater streams which arise between Loch Ness and Loch Duntelchaig and run through a predominately wooded catchment before discharging into Loch Ness.

Legislative and Policy Context

7.1.7 This assessment been undertaken within the context of the following relevant legislative instruments, planning policies and guidance documents and legislative instruments:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive');
- Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the 'Water Framework Directive');
- Regulation 1143/2014 on invasive alien species;
- Convention on Wetlands of International Importance ('Ramsar convention');
- Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (the 'Habitats Regulations');
- Wildlife and Countryside Act 1981 (as amended) (the 'WCA');
- Nature Conservation (Scotland) Act 2004 (as amended);
- Wildlife and Natural Environment (Scotland) Act 2011 (as amended);
- Scottish Planning Policy (SPP) 2014;
- Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003;
- The Highland Wide Local Development Plan (HwLDP);
- Inverness and Nairn Local Biodiversity Action Plan (LBAP); and
- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd Edition (CIEEM, 2016).

7.2 Methods

Desk Study

7.2.1 The desk study used data requested from the Scottish Environment Protection Agency (SEPA) and the Highland Biological Recording Group (HBRG) to assess the distribution of protected aquatic species and INNS in and around the Development Site.

7.2.2 The information provided shall be used when considering the potential environmental impacts of the proposed scheme and survey scope.

Survey Sites

7.2.3 Survey sites were chosen according to the proximity of waterbodies to areas of proposed works such as watercourse crossings and the Tailpond Inlet / Outlet location. Each survey type was completed at each survey location, as shown in Table 7.1.

Table 7.1 Red John Aquatic Survey Sites

Survey Site Reference	Waterbody name (where known)	Central Site Grid Reference
KS01	Unnamed watercourse south of Allt a' Chruineachd	NH 58772 33087
KS02	Allt a' Chruineachd upstream of B852	NH 58886 33294
KS03	Allt a' Chruineachd upstream of track	NH 59108 33123
KS04	Tributary of Allt Dailinn	NH 60017 32945
KS05	Allt a' Mhinisteir	NH 60450 32921
KS06	Allt a' Mhinisteir	NH 60731 33473
KS07	Allt a' Mhinisteir	NH 60887 34144
KS08	Glaic na Ceardaich	NH 60984 34195
KS09	Glaic na Ceardaich	NH 60711 34134
KS10	Glaic na Ceardaich	NH 60376 34803
KS11	Unnamed watercourse	NH 59901 34564
KS12	Allt a' Chnuic Chonaisg	NH 59452 34063
KS13	Loch Ness shoreline	NH 58771 33368
KS14	Loch Ness shoreline	NH 58618 33194
KS15	Pond US of Tributary of Allt Dailinn	NH 60065 32968

Macrophyte Survey

7.2.4 The watercourses were surveyed between the 19 and the 21 June 2018. The survey methodology undertaken varied depending on the type of watercourse.

7.2.5 Survey of flowing watercourses followed the Environment Agency's Operational Instruction for surveying freshwater macrophytes in rivers (Ref 2). The survey was made by walking within the channel of each watercourse along a 100 m transect, where safely accessible. Any inaccessible areas were bypassed as necessary before re-entering the channel at the next available access point. A list of all macrophytes encountered was made and their relative abundance was recorded using Taxon Cover Values (TCV), detailed below (Table 7.2).

Table 7.2 Taxon Cover Values (TCV) and their associated percentage cover

TCV	Percentage cover for the macrophyte species
C1	<0.1 %
C2	0.1 to 1 %
C3	1 to 2.5 %
C4	2.5 to 5 %
C5	5 to 10 %
C6	10 to 25 %
C7	25 to 50 %
C8	50 to 75 %
C9	>75 %

7.2.6 A further 100 m transect was undertaken at the Tailpond Inlet / Outlet location within Loch Ness. All macrophytes encountered were recorded and their relative abundance was noted using the DAFOR scale. The strandline was also inspected for plant fragments. The relative abundance of each species present was recorded as below. If a species appears to be intermediate between two categories, it is generally assigned to the lower category.

- D = Dominant (greater than 75 % total cover);
- A = Abundant (51 to 75 % total cover);
- F = Frequent (26 to 50 % total cover);
- O = Occasional (11 to 25 % total cover; and
- R = Rare (1 to 10 % total cover).

7.2.7 The macrophyte survey within KS15 followed PSYM (Predictive SYstem for Multimetrics) methodology (Ref 7). The survey was undertaken by walking the perimeter of the pond and recording all wetland plants present within the outer edge of the pond (This is defined as the upper level at which water stands in winter). Deeper water areas were sampled by grapnel thrown from shallow water. This method was developed to provide a method for assessing the biological quality of still waters in England and Wales. Due to the location therefore the metrics could not be calculated, however the survey methodology is still valid. To maintain consistency with the other watercourses, each macrophyte species recorded was allocated a TCV.

Macroinvertebrate Survey

7.2.8 Biological macroinvertebrate sampling was undertaken by two suitably experienced aquatic ecologists to assess the biological quality of the surveyed waterbodies. Biological samples were taken using a standard Freshwater Biological Association (FBA) pattern pond net (mesh size: 1 mm) in line with the standard RIVPACS (Ref 10) and Environment Agency methodology (Ref 3). The instream habitats were ‘kick sampled’ where practicable, or ‘sweep sampled’, for 3 minutes followed by a 1- minute hand search of larger substrates.

7.2.9 This method allows characterisation of the invertebrate communities and establishes the biological quality of freshwater habitats. It does not generate a comprehensive list of every taxon present within the watercourse. To attempt to detect all species that occur, including those at low abundance, or occurring sporadically, would be impractical, would generate

unnecessary information and would not significantly improve the quality assessment of the waterbodies.

7.2.10 The collected samples were then preserved in Industrial Methylated Spirits (IMS) prior to laboratory processing.

Analysis of Aquatic Macroinvertebrate Samples

7.2.11 Each of the samples collected was sorted and analysed in a laboratory setting by suitably trained and experienced aquatic ecologists. Lists of the aquatic macroinvertebrate taxa present were produced in line with Environment Agency guidance (Ref 3). The aquatic macroinvertebrate samples were identified to 'mixed taxon level' using stereo-microscopes. Most groups were identified to species level (where practicable), with the exception of the following:

- Amber snails (Succineidae), which were identified to family;
- Pea mussels (*Pisidium* species), which were identified to genus;
- Worms (Oligochaeta) which were identified to order;
- Non-biting midge larvae (Chironomidae), which were identified to sub-family;
- Butterfly / moth larvae (Lepidoptera), which were identified to order; and
- Immature or damaged specimens, which were identified to the maximum resolution possible on a case-by-case basis.

7.2.12 The macroinvertebrate data were analysed using the following indices:

- Biological Monitoring Working Party (BMWP) scores and Average Score Per Taxon (ASPT) values (Ref 5) – an explanation of BMWP scores and ASPT is provided in Annex 7.1.1. Scores are derived based on the sensitivity of particular taxa (families) of macroinvertebrates to organic pollution. The average of the values for each taxon in a sample, known as ASPT (average score per taxon) is a stable and reliable index of organic pollution. Therefore these assessments can indicate to what extent an aquatic macroinvertebrate community is exposed to organic pollution (further information is provided in Annex 7.1.3). It is important to note that these indices can vary between geological regions and habitat types. Ditches for example are unable to support many of the high-scoring taxa associated with fast flowing habitats. Therefore the resultant metrics should be reviewed with an awareness of their potential limitations, and the site-specific context.
- Community Conservation Index (CCI) method (Ref 1) (

- Annex 7.1.2: Community Conservation Index (CCI) 7.1.2) – to assess the conversation value of the macro-invertebrate populations present and identify any unusual or rare species. The CCI classifies groups of freshwater macroinvertebrates according to their scarcity and nature conservation value in Great Britain as understood at the time the classification was developed. Species scores range from 1 to 10, with 1 being very common and 10 being Endangered. In some cases, the references used in the CCI classification to define scarcity and value have since been superseded by more recent assessments (e.g. Ref 8; Ref 4). The CCI cannot be modified to take account of such new information, but it has been considered when making the wider assessment of nature conservation value provided in this report.

Fish Habitat assessment

7.2.13 Fifteen survey sites potentially impacted by the Development were assessed over three days between the 19 and 21 June 2018.

7.2.14 At each of the 15 sites fish spawning habitat potential was assessed over a 100 m stretch of the watercourse. Key aquatic features such as channel dimensions, mesohabitat coverage, habitat features, substrate composition, accessibility for migratory species and potential spawning areas for salmonids were analysed following SEPA's Guidance for applicants on supporting information requirements for hydropower applications (Ref 9).

Limitations

7.2.15 The aim of a desk study is to help characterise the baseline context and provide valuable background information that would not be captured by a single site survey alone. Information obtained during the course of a desk study is dependent upon local recorders and organisations having submitted records for the area of interest. As such, a lack of records for a particular habitats or species does not necessarily mean that the habitats or species do not occur in the study area. Likewise, the presence of records for particular habitats and species does not automatically mean that these still occur within the area of interest or are relevant in the context of the Development.

7.2.16 The fish habitat assessments and macrophytes surveys were undertaken in favourable weather conditions and in the appropriate seasons for the habitats being assessed.

7.2.17 All plant species found were identified to species level, where technically feasible based on the material available and the season of survey. Certain plant species cannot be identified reliably if they lack the features necessary to allow identification, for example mature megaspores are required to allow identification of Quillwort (*Isoetes* gp.).

7.2.18 In terms of macroinvertebrates, there are no significant limitations to the work undertaken as sites were surveyed during good weather conditions and low flow conditions. Whilst spring and autumn are considered optimal for flowing waterbodies, the fact that these waterbodies were surveyed in summer is not considered a significant limitation as standard methods were applied and the data collected is considered representative of the conditions present and appropriate for assessment of value. In addition, sampling was completed early in the summer season (June - August) and the geographic location of the site effectively means that this is comparable with late-spring sampling.

7.2.19 Given the nature of biological survey it is not possible to be certain that all of the species present in a waterbody will be detected. Where juvenile or damaged specimens were collected, species level identification is not always possible. Not all macroinvertebrate

species that use waterbodies are present at all times of year and therefore some may be overlooked when surveying. Other species that may be present at other times of year, sporadically and/or in low numbers may not have been recorded. This is not considered a significant limitation as standard methods were applied and the data collected is considered representative of the conditions present and appropriate for assessment of value.

7.3 Results

Desk Study

Invasive Non-Native Species

7.3.1 SEPA and HBRG provided INNS data which holds 23 records of non-native species including Himalayan balsam, Japanese knotweed and giant hogweed (*Heracleum mantegazzianum*). No records were found to be within the Development Site boundary; however, Japanese knotweed was found <2 km north from the site in 2015 (Table 7.3). There were nine other records of INNS within 10 km of the Development Site boundary with Himalayan balsam and Japanese knotweed found in the River Enrick. Nuttall's waterweed (*Elodea nutallii)* was present in Urquhart bay in Loch Ness and there are two records of giant hogweed. The terrestrial New Zealand flatworm (*Arthurdendyus trainulatus*) was recorded approximately 6 km away from the Development Site boundary in 2010 (Figure 7.1.1 available at the end of this appendix).

Table 7.3 INNS Species Records and Distance from the Development Site Boundary*.

Species	Distance from Development Site boundary (km)	Location from Development Site	Date recorded
Japanese Knotweed	1.66	North	2015
New Zealand Flatworm	6.05	North	2010
Nuttall's waterweed	6.30	West	2008
Seep monkeyflower *Mimulus guttatus*	6.30	East	2015
Himalayan balsam	6.95	West	2007
Japanese Knotweed	6.95	West	2007
Himalayan balsam	6.99	West	2009
Giant Hogweed	8.30	North	2012
Himalayan balsam	8.65	West	2007
Giant Hogweed	9.30	North	1992

**Data from SEPA and HBRG (records <10 km from Development Site boundary only shown).*

Fish

7.3.2 A single record of Arctic char (*Salvelinus alpinus*) caught by rod and line in 1991 in Loch Killin approximately 20 km from the Development Site boundary is the only fish record present from the HBRG data set (Figure 7.1.2 available at the end of this appendix). Arctic char (a Scottish Biodiversity Action Plan (BAP) species) are known to be present within Loch Ness along with a number of other protected species including Atlantic salmon (*Salmo salar*), European eel (*Anguilla anguila*) and river, brook and sea lamprey species (*Lampetra fluviatilis, Lampetra planeri* and *Petromyzon marinus*).

Macrophytes

7.3.3 Nineteen records of six different macrophyte species were found in the HBRG dataset. *Ranunculus flammula, Hydrocotyle vulgaris* and *Pontentilla Palustris* were found inside the Development Site boundary (Figure 7.1.2 and Table 7.4 below).

7.3.4 No designated macrophyte records were present in the HBRG dataset in the proximity of the development site. These species were previously designated under International Union for Conservation of Nature (IUCN) for England from vulnerable, near threatened to *Carex limosa* listed as endangered; however, now all are listed as least concern.

Table 7.4 Macrophytes Species Records and Distance from the Development Site Boundary*.

Species	Number of recordings	Nearest Distance from Development Site boundary (km)	Location from Development Site boundary	Date recorded
Slender sedge *Carex lasiocarpa*	4	28.0	South West	2007,2015
Bog-sedge	1	8.4	West	2015
Marsh pennywort	2	0	Within boundary	2007
Marsh cinquefoil *Comarum palustre*	3	0	Within boundary	2007
Lesser spearwort	8	0	Within boundary	1991, 2007
Least bur-reed *Sparganium natans*	1	24.0	South West	2007

** Data from SEPA and HBRG.*

Macroinvertebrates

Twelve records of nine different designated macroinvertebrate species were present in the HBRG dataset. None were found within the Development Site boundary (Figure 7.1.3 available available at the end of this appendix). Two records of *Prionocera pubescens* a Scottish BAP Diptera ('true fly') species was found 4.3 km from the Development Site boundary. *Donacia crassipes* and *Cyphon ochraceus* (Scottish BAP water beetle species) were found at around 8 8 km from the Development Site boundary in 1992 and 1993 respectively. The six other species species which included another aquatic beetle *Donacia aquatica* and five Diptera species: *Cheilosia chrysocoma*, *Hypoderma diana*, *Tanyptera nigricornis*, *Thereva handlirschi* and *Tipula limbata* were recorded >10 km outside the Development Site boundary (

7.3.5 Table 7.5).

Table 7.5 Macroinvertebrate Species Records and Distance from the Development Site Boundary.

Species	Nearest Distance from Development Site boundary (km)	Location from Development Site boundary	Date recorded
Cyphon ochraceus	8.0	North	1993
Donacia aquatica	24.0	West	2007
Donacia crassipes	8.6	West	1992
Cheilosia chrysocoma	11.6	South West	2011
Hypoderma diana	48.0	South West	2009
Prionocera pubescens	4.0	West	2017
Tanyptera nigricornis	29.0	South West	2017
Thereva handlirschi	18.8	South	2010
Tipula limbata	15.3	South West	2015

** Data from SEPA and HBRG.*

Summary

7.3.6 There are no records of INNS within the Development Site boundary, but as these have been raised as a specific concern and are known to be present within the catchment, and are likely to be under-recorded, surveys of the site will accurately establish their presence / absence.

7.3.7 Macroinvertebrate sampling will identify high value watercourses within the Development Site, and fish spawning habitat assessments which will indicate areas that have high potential to support spawning habitat for salmonid and lamprey species (Figure 7.1.4 available at the end of this appendix).

Desk Study Evaluation

INNS

7.3.8 In the Scoping Opinion for the Development (Appendix 4.3: Scoping Opinion), both Scottish Water and SEPA raised concerns about the potential for cross-catchment spread of INNS, specifically:

- The flatworm *Phagocata woodworthi;*
- Nuttall's waterweed *Elodea Nuttallii;* and
- The freshwater amphipod *Crangonyx pseudogracilis.*

7.3.9 Neither *Phagocata woodworthi* nor *Crangonyx pseudogracilis* were recorded in the desk study within the Loch Ness catchment. However, these species are likely to be under-recorded and *Crangonyx* in particular is a relatively widespread and established species. It is considered that the proposed macroinvertebrate survey of the watercourses and Loch Ness shoreline within the Development Site will facilitate the identification of these aquatic species, should they be present.

7.3.10 Nuttall's waterweed has been recorded 6.3 km to the west of the Development Site boundary in Loch Ness, and therefore there is the potential for this species to occur within the Development Site, notably at the Tailpond Inlet / Outlet location on the shore of Loch

Ness. The proposed aquatic macrophyte survey will establish the presence or likely absence of this species through survey of the proposed sampling locations in the minor watercourses, and through macrophyte survey and grapnel sampling of Loch Ness.

7.3.11 It should be noted that the risk of cross-catchment spread of INNS has been effectively negated by the choice of Option B, i.e. a closed-loop system with no connection to the waterbodies in the neighbouring catchment, including Loch Duntelchaig. However, there will remain a risk of the spread of INNS through construction works, site access and earthworks.

Fish

7.3.12 The fish species Arctic char was identified in the desk study in Loch Killin, approximately 20 km from the Development Site boundary. This species is also known to be present in Loch Ness, along with other species raised in the Scoping Opinion (Appendix 4.3) including Atlantic salmon, European eel, brown / sea trout, and lamprey species (sea, river and brook lamprey). The proposed fish spawning habitat assessment survey will identify habitat with the potential to support breeding populations of these species, and inform the requirement for further fish surveys, pending further detail of the proposed works and likely impacts to the minor watercourses and shoreline of Loch Ness.

*M*acrophytes

7.3.13 No protected macrophyte species were identified in the desk study. Species previously listed under the IUCN Red List are now all listed as Least Concern. The proposed aquatic macrophyte survey will identify protected, notable or invasive plant species that may be present within the watercourses, in Loch Ness at the proposed Tailpond Inlet / Outlet location, or in riparian habitats.

Macroinvertebrates

7.3.14 Nine macroinvertebrate species with national or local designation were identified, including a Scottish BAP cranefly species, *Prionocera pubescens*, whose larvae are aquatic, and two Scottish BAP water beetle species. The remaining six species records include five Scottish BAP species and one Dipteran species that are no longer designated.

7.3.15 No macroinvertebrate species records were identified within the Development Site.

7.3.16 The proposed aquatic macroinvertebrate survey will establish the presence or likely absence of protected, notable and invasive aquatic species in the watercourses and Loch Ness in the Development Site boundary. This will include survey for the freshwater pearl mussel *Margaritifera margaritifera*; the potential for the aquatic habitats to support this species depends upon the presence of suitable salmonid host fish species, upon the gills of which the mussel's larval stage, Glochidia, attach. The proposed fish habitat assessment will aim to establish the likelihood of the watercourses and waterbodies to support salmonid fish species, and therefore support the freshwater pearl mussel.

7.4 Field Survey

KS01

7.4.1 This was a small headstream approximately 0.5 m in width with shallow stony banks and an average depth of 10 cm (NH 58543 32862) (Plate 1). The channel was comprised of small stony substrate with a series of riffle, step and pool habitats. It had clear water and was flowing at approximately 10 – 25 cm/sec. It arose within woodland, heavily shading the channel. A pipe system was present above the sample site, with some evidence that minor abstraction was undertaken at certain times.

7.4.2 A single red algae species (*Batrachospermum* sp.) was recorded and accounted for < 1 % of the coverage of the watercourse.

7.4.3 Site KS01 was a minor watercourse with a steep gradient and a continuum of step pool habitats making it unsuitable for any migratory fish species and also very unlikely to support minor species such as sticklebacks (*Gasterosteus aculeatus*).

7.4.4 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 113. ASPT; 6.3). The site had a fairly high conservation value (CC1; 13.57), however all animals identified were of local status or lower with one regionally notable taxa recorded, the stonefly *Leuctra moselyi*.

Plate 1: Survey site KS01

KS02

7.4.5 This was a small headstream approximately 0.4 m in width with cut in banks and an average depth of 10 cm (NH 58867 33300) (Plate 2). The channel was comprised of small stony substrate with a series of riffle, step and pool habitats. It had clear water and was flowing at approximately 10 – 25 cm/sec. It arose within woodland, heavily shading the channel.

7.4.6 A single bryophyte (*Platyhypnidium* sp.) was recorded and accounted for < 1 % of the coverage of the watercourse.

7.4.7 Site KS02 similarly to site KS01 was a steep shallow burn which was unsuitable for migratory fish species due to access restraints and poor spawning habitat present.

7.4.8 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 104. ASPT; 5.8). The site had a fairly high conservation value (CC1; 10.9), however all animals identified were of local status or lower.

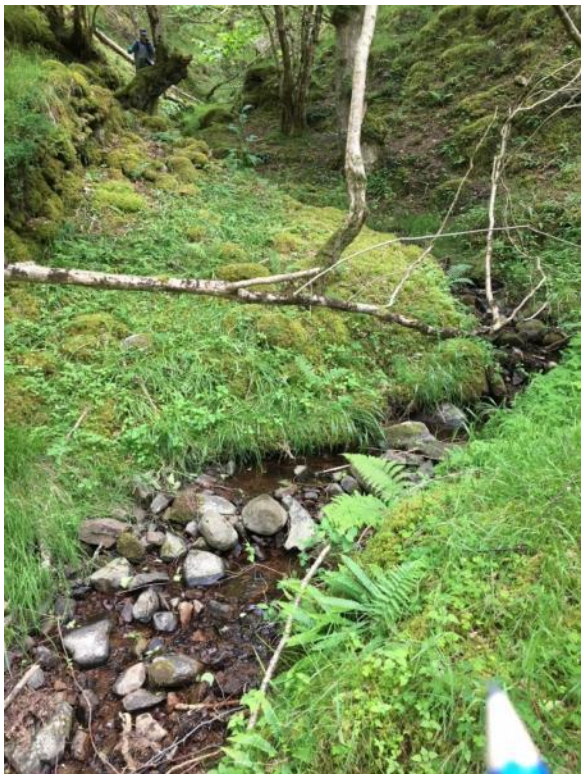


Plate 2: Survey site KS02

KS03

7.4.9 The sample site occurred within the same watercourse as KS03, but was taken from higher in its catchment, towards its source (NH 59091 33142) (Plate 3). The watercourse was very similar in characteristic to KS02, however the water depth was substantially shallower, at approximately 5 cm.

7.4.10 No aquatic macrophytes were recorded within this stretch.

7.4.11 Site KS03 located upstream of site KS02 again was a steep shallow burn with 'v' shaped banks and multiple natural step and woody debris barriers. The habitat was unsuitable for migratory fish species and no spawning habitat was present.

7.4.12 The biological quality of this site was slightly impacted by organic pollution in terms of BMWP (BMWP; 72) but had an ASPT that indicated a very good, unpolluted, unimpacted quality (ASPT; 5.5). The site had a fairly high conservation value (CCI; 12.5), however all animals identified were of local status or lower with one regionally notable taxa recorded, the stonefly larva *Leuctra moselyi*.

Plate 3: Survey site KS03

KS04

7.4.13 Small drain with shallow earth banks occurring with occasional gorse (*Ulex* sp.) along the banks (NH 59922 32850) (Plate 4). It was approximately 0.4 m in width with an average depth of 10 cm. The channel was dominated by silt with occasional boulders; it had clear water with little to no flow and was surveyed downstream of a pond (KS15).

7.4.14 Eight species of macrophytes were recorded along the survey section. The assemblage was dominated by emergents such as white beak sedge (*Rhynchospora alba*) and jointed rush (*Juncus articulatus*). No rare or notable species were recorded. The community coverage was approximately 20 % of the channel. Bryophytes were absent.

7.4.15 No suitable salmonid spawning habitat was present at this site, it would be suitable for minor fish species such as stickleback. No access was available for migratory species to reach this site.

7.4.16 The biological quality of this site was of a moderately impacted water quality in terms of BMWP but the ASPT indicated a good, clean but slightly impacted quality (BMWP; 54, ASPT; 5.4). The site had a low conservation value and only common species of taxa were recorded.

Plate 4: Survey site KS04

KS05

7.4.17 Small drain with cut in earth banks occurring within conifer plantation (NH 60444 32915) (Plate 5). Average width was approximately 0.3 m with an average depth of 0.1 m. It had little to no flow at the time of the survey. Clear water and silt substrate with the channel heavily shaded from the surrounding woodland and adjacent vegetation.

7.4.18 Three species of macrophytes were recorded along the survey section. The assemblage consisted of the emergent species bottle sedge (*Carex rostrata)* and bulbous sedge (*Juncus bulbosus*) with the floating leaved unbranched bur-reed (*Sparganium emersum*). No rare or notable species were recorded. The community coverage was approximately 2 % of the channel; bryophytes were absent.

7.4.19 Site KS05 was of poor potential to support fish. The watercourse was heavily shaded with silt clay substrate and no flow heterogeneity. Access for migratory fish species was restricted lower down the catchment by natural impassable barriers.

7.4.20 The biological quality of this site was of moderate biological quality indicating it was moderately impacted by organic pollution (BMWP; 42, ASPT; 5.3). The site had a moderate conservation value with all taxa recorded being frequent species or lower with one occasional species recorded, the caseless caddisfly larva *Holocentropus dubius*.

Plate 5: Survey site KS05

KS06

7.4.21 Small headwater stream downstream of KS05. Within the survey area it ran along the boundary of a conifer plantation and an access track (NH 60747 33420) (Plate 6). The channel was comprised of small stony substrate with riffle and run habitats and the average wetted width was approximately 0.5 m with an average depth of 0.1 m. It had clear water and was flowing at approximately 10 – 25 cm/sec. The channel received moderate shading from the adjacent woodland and bankside scrub.

7.4.22 KS06 was downstream from KS05 and of better habitat quality with a wider variety of substrates and flows. Boulders were dominant along with some riffle sections. An outfall pipe was present from under the track discharging into the stream causing brown staining of the water, possibly ochre (Plate 7). No salmonid spawning habitat was present at this site.

7.4.23 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 126. ASPT; 6.3). The site had a fairly high conservation value (CC1; 11.7), however all animals recorded were of occasional status or lower.

Plate 6: Site KS06

Plate 7: Outfall pipe present at site KS06 with potential water contamination of ochre.

KS07

7.4.24 Small headwater stream downstream of KS06. Within the survey area the stream ran through a recently felled conifer plantation (NH 60885 34134) (Plate 8). The channel was comprised of large stony substrate with riffle, run, pool and step habitats with shallow banks. The average wetted width was approximately 1 m with an average depth of 0.1 m. It had clear water and was flowing at approximately 10 – 25 cm/sec.

7.4.25 Only green filamentous algae was recorded within this stretch and accounted for < 1% of the coverage of the watercourse.

7.4.26 KS07 was a shallow stream surrounded by an area of felled conifer plantation meaning there was no shading. This was sub-optimal for fish due to the lack of cover. There were some localised areas of riffle/pool habitat present with diverse range of substrates which could be utilised by resident brown trout for spawning. However this was very localised and the lack of cover here would indicate it was not, in balance, suitable to support spawning fish due to increased risk of aerial predation.

7.4.27 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 123. ASPT; 6.5). The site had a fairly high conservation value (CC1; 11.9), however all animals recorded were of occasional status or lower.

Plate 8: Survey site KS07

KS08

7.4.28 Small headwater stream approximately 0.4 m in width with earth banks and an average depth of 10 cm (NH 60885 34134) (Plate 9). The channel was comprised of a stony substrate with a series of riffle and run habitats. It had clear water and was flowing at approximately 10 – 25 cm/sec.

7.4.29 Ten species of macrophytes were recorded along the survey section. No rare or notable species were recorded. The assemblage was dominated by submerged stonewort (*Chara globularis*) with emergent species including jointed and bulbous rush (*Juncus articulates)*, black sedge (*Carex nigra*) and marsh horsetail *(Equisetum palustre)*. The community coverage was approximately 9 % of the channel which included approximately 2 % coverage of bryophytes, pale liverwort (*Chiloscyphus* sp.) and forked veilwort (*Metzgeria furcata*).

7.4.30 KS08 was upstream of KS09 and there was a large wetland area upstream of the site (Plate 10). There was potential for resident brown trout at this site with more shading than KS07 present from extensive bracken and trees in the riparian zone. Riffle, run and pool habitats were present with a good mixture of cobbles, pebbles, boulders and gravels. A fish was seen at this site whilst conducting the macroinvertebrate survey; however the species could not be identified. Spawning habitat for resident trout here was very localised due to the small nature of the stream; however, juvenile habitat here is suitable. A weir was present between sites KS08 and KS09 which would potential impede any longitudinal movement of trout in this watercourse (Plate 11).

Plate 9: Site KS08

Plate 10: **Site KS08 and wetland area upstream.**

Plate 11: Weir located between sites KS08 and KS09.

7.4.31 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 156. ASPT; 6.8). The site had a high conservation value (CC1; 15.6), however all animals recorded were of occasional status or lower.

KS09

7.4.32 Small headwater stream downstream of KS07 and KS08. It was slightly larger, approximately 1.3 m in width and 0.15 m deep with clear water and was flowing at approximately 10 – 25 cm/sec (NH 60641 34222) (Plate 12). The channel was comprised of small stoney substrate with riffle, step and pool habitats. Along the survey stretch there was a low flowing side channel with a mature island. The watercourse ran along the boundary of a conifer plantation, providing a moderate amount of shading for the channel.

7.4.33 Only mole pelt algae (*Vaucheria* sp.) and brook moss (*Hygrohypnum* sp.) were present within the survey section and accounted for < 1% of the coverage of the watercourse.

7.4.34 This site had a variety of flows, substrate and mesohabitats suitable for resident brown trout. Woody debris, pools and riffles present here potentially provided good habitat for juvenile fish along with suitable areas for spawning (Plate 12). The stream here was wider than the two upstream sites (KS07 and KS08). The weir upstream between this site and KS08 would potentially act as a barrier to any upstream migratory movements and it was also highly likely that downstream due to the gradient and natural impassable obstacles no access was available for migratory species.

Plate 2: Example of suitable resident brown trout habitat present at site KS9.

7.4.35 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 132. ASPT; 7.3). The site had a fairly high conservation value (CC1; 11.0), however all animals recorded were of occasional status or lower.

KS10

7.4.36 This sample location occurred within the same watercourse as KS07, KS08 and KS09. Again, it was slightly larger, 2 m in width and 0.10 m deep with clear water and was flowing at approximately 25 – 50 cm/sec (NH 60523 34588) (Plate 13). The channel was comprised of predominately bedrock with run, riffle, cascade and pool habitats. This stretch flowed through broadleaf woodland, with a moderate level of shading of the channel.

7.4.37 Mole pelt algae and brook moss were present within the survey section and accounted for < 1% of the coverage of the watercourse.

7.4.38 Two large natural waterfalls (>2 m in height) followed by deeper pools were present at this site, which would be impassable for migratory fish species (Plate 13). There was good resident trout habitat here similar to sites KS08 and KS09, indicating that only an isolated brown trout population would be viable.

Plate 3: Impassable natural waterfalls at site KS10

7.4.39 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 113. ASPT; 7.1). The site had a fairly high conservation value (CCI; 12.2), however all animals recorded were of occasional status or lower, with the exception of one taxa of regionally notable status, the stonefly larva *Leuctra moselyi*.

KS11

7.4.40 A small headstream approximately 1 m in width with shallow stoney banks and an average depth of 10 cm (NH 59882 34585) (Plate 14). The channel was comprised of small stony substrate with overlying woody debris and supported a series of riffle, step and pool habitats. It had clear water and was flowing at approximately 10 – 25 cm/sec. The watercourse flowed down a steep gradient along the margin of a broad-leaved woodland and a former conifer plantation, with a moderately shaded channel. Bankside vegetation included a 2 x 6 m stand of variegated yellow archangel (*Lamiastrum galeobdolon* subsp. *Argentatum*) and rhododendron (*Rhododendron ponticum*) (NH59896 34557).

7.4.41 No macrophyte species were recorded within this stretch.

7.4.42 This and site KS12 were very similar to sites KS01 and KS02 with steep banks and gradient and multiple physical barriers to migratory fish species in the form of step pools and large woody debris. This site was slightly wider than those described above but as previously there was no potential spawning habitat present.

7.4.43 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 120. ASPT; 6.0). The site had a fairly high conservation value (CC1; 12.5) however all animals recorded were of local status or lower.

Plate 4: Survey site KS11.

KS12

7.4.44 A small headstream approximately 1 m in width with cut-in vegetated earth banks and an average depth of 5 cm (NH 59406 34044) (Plate 15). The channel was comprised of small stony substrate with overlying woody debris and supported a series of riffle, step and pool habitats. It had clear water and was flowing at approximately 10 – 25 cm/sec. The watercourse flowed down a steep gradient through broadleaf woodland, with a moderately shaded channel.

7.4.45 No macrophyte species were recorded within this stretch.

7.4.46 Low quality habitat for fish species was recorded at this survey location, with steep banks, small channel and multiple barriers to fish migration.

7.4.47 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 101. ASPT; 6.3). The site had a fairly high conservation value (CC1; 11.5) however all animals recorded were of occasional status or lower.

Plate 5: Survey site KS12.

KS13

7.4.48 This site was located on the eastern margin of Loch Ness (NH 58802 33354) (Plate 16), in close proximity to a fish farm. The site had shallow margins comprised of large stoney substrate. This section was fairly exposed and with dynamic conditions from the waves. The water was slightly turbid at the time of the survey. A strandline was present, approximately 5 m from the water's edge and beyond this was broadleaf woodland.

7.4.49 Four submerged macrophytes were recorded along the survey area in addition to abundant green filamentous algae. The assemblage consisted of the submerged shoreweed (*Littorella uniflora)* and quillwort (*Isoetes* sp.) and alternative water milfoil (*Myriophyllum alterniflorum)* with common water moss (*Fontinalis antipyretica*). No rare or notable species were recorded and the community present was considered typical of an oligotrophic lake.

7.4.50 This site was in the margins of Loch Ness which is known for populations of salmonids and lamprey species. The habitat here was unsuitable for spawning as the substrate was uniformly larger boulders with no finer material which would provide suitable spawning habitat for these species (Plate 17). The high energy wave action would have washed any finer materials from this area.

Plate 16: Site KS13

Plate 7: Example of substrate composition in the margins of Loch Ness at site KS13

7.4.51 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 110. ASPT; 7.3). The site had a moderate conservation value (CC1; 8.8) however all animals recorded were of occasional status or lower. Two individuals of the invasive shrimp *Crangonyx pseudogracilis* were recorded at this site.

KS14

7.4.52 This is located on the eastern margin of Loch Ness (NH 58687 33180) (Plate 18). The site had shallow margins comprised of large stony substrate. This section of shoreline was fairly exposed and subject to dynamic conditions from the wave action. A strandline was present, approximately 5 m from the water's edge and beyond this was broadleaf woodland.

7.4.53 Four submerged macrophytes were recorded along the survey area in addition to abundant green filamentous algae. The assemblage consisted of the submerged shoreweed and quillwort and alternative water milfoil with common water moss . No rare or notable species were recorded and the community present was considered typical of an oligotrophic lake.

7.4.54 This site was to the south west of site KS13 and was more sheltered resulting in less less wave action. A wider variety of substrate types were present potentially better suited to supporting salmonid spawning in these areas. No redds or any signs of spawning activity were recorded.

7.4.55 The biological quality of this site was very high, indicating very good, unpolluted and unimpacted water quality (BMWP; 137 ASPT; 6.9). The site had a moderate conservation value (CC1; 10.7) however all animals recorded were of local status or lower.

Plate 8: Survey site KS14.

KS15

7.4.56 This pond was located upstream of KS04. It was approximately 1400 sq m with a silt substrate and supported two vegetated islands (Plate 19). The banks were shallow and vegetated with locally abundant gorse bushes. The water was approximately 20 cm deep and was clear at the time of the survey.

7.4.57 Nine species of macrophytes were recorded along the survey section. No rare or notable species were recorded. The assemblage was dominated by submerged stonewort (*Chara virgata*) and floating bulbous rush with bog pondweed (*Potamogeton polygonifolius*) and broad-leaved pondweed (*Potamogeton natans*). Around the margins it supported a number of emergent species including bottle sedge, white beak-sedge, black sedge and marsh horsetail. The community coverage was approximately 60 % of the channel.

7.4.58 This pond was not accessible to migratory species due to barriers downstream throughout the catchment. It could support minor species such as stickleback but had no potential to support resident trout populations and suitable spawning habitat was not recorded.

7.4.59 The biological quality of this site was of good, clean but slightly impacted biological quality in terms of BMWP (BMWP; 96) but was indicated to be very good, unpolluted and unimpacted in terms of ASPT (ASPT; 6.0) The site had a moderate conservation value (CC1; 14.2) however all animals recorded were of local status or lower.

Plate 19: Survey site KS15.

7.5 Discussion and recommendations

Macrophytes

Flowing Water Habitats (KS01 – KS12)

7.5.1 No rare or notable species were recorded within any of the sample sites. The species present were typical of transitional habitats located between moorland acid grassland and adjacent areas of standing and flowing water. For example several sedge and rush species were recorded that grow on drainage impeded ground and the margins of waterbodies. The diversity of strictly aquatic species was limited as a consequence of the prevailing habitat conditions as described in more detail below.

7.5.2 All of the sites surveyed were located on small oligotrophic headwater streams typical of upland catchments in this part of Scotland. Watercourses in this type of catchment typically support macrophyte communities characterised by an abundance of bryophytes. Higher plants in comparison are generally confined to the margins and are typified by emergent rushes and sedges, and plants of transitional wetland habitat.

7.5.3 However, in the watercourses surveyed, macrophytes were not well-developed, being of relatively sparse cover and of limited species diversity. This is considered a function of the habitat conditions associated with these small watercourses.

7.5.4 The main limiting factors for macrophytes are the small size, limited water depth and flow, and relative uniformity of channel morphology which limits the niches available to macrophytes; shading from surrounding woodland which further reduces suitability for many species, particularly higher plants; the composition of the substrate that was typified by an abundance of small stony substrate; and the relatively steep gradients which are unlikely to provide sufficient bed stability during winter spate conditions to allow the development of extensive or diverse stands of macrophytes.

7.5.5 Similar macrophytes communities are likely to be very common across the wider landscape and therefore the macrophyte communities present are considered to be of no greater than local nature conservation value; however, they are an important component of the local

landscape and provide a valuable resource for aquatic macroinvertebrates and other aquatic and terrestrial fauna.

Loch Ness (KS13 and 14)

7.5.6 No rare or notable species, or INNS, were recorded within either of the sample sites. The current WFD status for aquatic macrophytes and other aquatic plants (Phytobenthos) in Loch Ness is 'High' (Cycle 2 2016). This highlights that Loch Ness is supports a macrophytes community associated with little or no human pressure. The communities surveyed were species poor and the species present are fairly typical of a large oligotrophic lake.

7.5.7 The macrophyte community was similar at both sites and does not indicate that the potential Tailpond Inlet / Outlet location is a particularly sensitive area for macrophytes. This section is exposed and subject to dynamic conditions, together with seasonally fluctuating water levels, thus limiting the available niches for plants to exploit. The communities present are likely to occur in numerous other locations within Loch Ness and in other similar lochs within the local area. As such, macrophyte community is considered to be of no greater than local nature conservation value.

7.5.8 Nuttall's waterweed has been previously been recorded within Loch Ness approximately 6.3 km from the Development Site boundary. As the surveys were limited to shallower water there is still the potential for it to occur in close proximity to the potential sampling locations. Therefore its absence from the survey data should not necessarily mean that it is absent from the wider area.

Standing Water (KS15)

7.5.9 KS15 was dominated by macrophytes and supports moderate species diversity. None of the species present are rare or threatened and instead are all typical of the habitat conditions present.

7.5.10 The community present was similar to the flowing sites and supported a number of species typical of transitional habitats located between moorland acid grassland and adjacent areas of standing and flowing water. Again, several sedge and rush species were recorded that grow on drainage impeded ground and the margins of waterbodies. The diversity of strictly aquatic species was limited to delicate stonewort and broad-leaved pondweed, neither of which are rare, and are likely to occur in similar habitats across the wider landscape.

7.5.11 As such, the macrophyte community is considered to be of no greater than local nature conservation value. However, it does provide a valuable local resource for fauna, in particular aquatic macroinvertebrate community.

Fish Habitat

7.5.12 Due to the high gradient, steep banks and the number of impassable barriers for migration throughout the catchment, migratory species including salmon, sea trout, sea lamprey and river lamprey are unlikely to be present and/or utilising the flowing watercourses for spawning throughout the site (sites KS1-KS12).

7.5.13 Salmon and sea trout are also unlikely to be utilising the margins of Loch Ness to spawn as it is widely understood that migratory salmonids prefer to spawn in rivers and streams (Ref 6). Migratory species however will be utilising the loch as a migratory pathway from the sea to rivers such as the river Moriston which is a designated SAC for salmon. Loch Ness Impacts such as entrainment from the Development would need to be carefully considered

as well as potential knock on effects to another protected species, including the freshwater pearl mussel which relies on juvenile salmon for reproduction.

7.5.14 A fish rescue will be required during the proposed construction of the cofferdam as it is highly likely that fish will congregate in these sheltered areas during construction and then become trapped as the cofferdam is sealed.

7.5.15 Resident brown trout populations may be present in the suitable habitats of sites KS08, KS09 and KS10. Spawning habitat is also present here in the form of pools, riffles and a variety of coarse substrates. These populations would be localised between the larger migration barriers such as the weir above site KS08 and the multiple waterfalls at site KS10. If present these would be small populations restricted due to the size of the watercourses and abundance of foodstuffs from macroinvertebrates or allochthonous input. Electric fishing surveys would help inform the presence of resident brown trout populations and their extent throughout the catchment – particularly at sites KS08, KS09 and KS10, if direct impacts to the watercourses are proposed at these locations.

Macroinvertebrates

7.5.16 In terms of conservation value, KS05, KS13, KS14 and KS15 were of moderate conservation value and KS04 was of low conservation value; the remaining sites surveyed were either of fairly high or high conservation value. There were no taxa recorded that were Red Data Book RDB1 (Endangered), RDB2 (Vulnerable), RDB3 (Rare), or Notable (but not RDB status). Some sites contained taxa that were regionally notable (KS01, KS03 and KS10), namely the stonefly larva *Leuctra moselyi*. This species in its aquatic stage is typically found between May and September. It has a limited distribution, being recorded in upland areas of northern Scotland, upland Wales, northern and south-western England, and is rare but locally abundant. It is found in small stony streams like those typical of this site.

7.5.17 Sites were also assessed to determine if they were potentially impacted by organic pollution using the BMWP and ASPT metrics. Eleven of the fifteen sites had BMWP scores that were indicative of very good, unpolluted and unimpacted status. KS03 and KS15 both had potential slightly impacted status; however, KS15 is a pond and would ideally need a PSYM assessment to inform an accurate assessment of pond quality. If direct impacts to pond KS15 were proposed, further assessment following PSYM methodology would be recommended.

7.5.18 KS04 and KS05 both had a moderately impacted status; however, these sites were small drains so the decrease in BMWP here is considered likely to be due to habitat conditions rather than an impact from an organic input. For example, impacts in relation to land drainage, nutrient input from runoff as a result of land use practises, or dredging to facilitate land drainage.

7.5.19 Due to the high biological quality of the majority of waterbodies surveys, pollution prevention measures such as temporary silt fencing, SuDs features and attenuation ponds are recommended for construction works.

7.5.20 Similar macroinvertebrate communities are likely to be common across the wider landscape and therefore the macroinvertebrate communities present are considered to be of no greater than local nature conservation value.

7.5.21 The invasive shrimp *Crangonyx pseudogracilis* was present at site KS13 (Loch Ness). This is the only surveyed site in which this species was recorded. It was not present in the other Loch Ness sampling location (KS14) or in the smaller waterbodies surveyed nearby. The

River Basin Management Plan (RBMP) for Loch Ness in 2016 scored 'Good' Water Framework Directive (WFD) status for alien species; however, as INNS have been established as present through desk study and site survey, it is likely that the WFD status for this element will reduce. Caution is necessary for works at this site to prevent the transport of INNS into other areas and to prevent the upstream transport of these species. Biosecurity measures should be implemented throughout the development.

7.5.22 A caveat of this assessment is that it is based on a data set that consists of a single survey. The survey was also conducted in the summer. Spring and autumn are considered more ideal for macroinvertebrate surveys and a macroinvertebrate assessment would usually consist of at least two seasons of data (i.e. both spring and autumn). It is recommended that further surveys are conducted on these waterbodies, with a minimum of repeat survey of the same sampling locations in autumn 2019.

7.6 References

Ref 1. Chadd, R. and Extence, C. (2004) The conservation of freshwater macro-invertebrate populations: a community based classification scheme. Aquatic Conserv. Mar. Freshw. Ecosyst. 14: 597-624

Ref 2. Environment Agency (2007) Surveying Freshwater Macrophytes in Rivers. Operational Instruction 131_07

Ref 3. Environment Agency (last issue: 2014) Freshwater macro-invertebrate analysis of riverine samples. Operational instructions 024_08.

Ref 4. Foster, G.N. (2010) A review of the scarce and threatened Coleoptera of Great Britain Part (3): Water beetles of Great Britain. Species Status 1. Joint Nature Conservation Committee, Peterborough

Ref 5. Hawkes, H.A. (1997) Origin and Development of the Biological Monitoring Working Party Score System. Water Research 32 (3): 964-968

Ref 6. Jonsson, B. and Jonsson, N. (2011) Ecology of Atlantic Salmon and Brown Trout: Habitat as a Template for Life Histories. Fish & Fisheries Series 33, Springer Science+Business Media B.V.

Ref 7. Pond Action (2002) A Guide to Monitoring the Ecological Quality of Ponds and Canals Using PSYM. Pond Action, Oxford

Ref 8. Seddon, M.B. Killeen, I.J. & Fowles, A.P. (2014) A Review of the Non-Marine Mollusca of Great Britain: Species Status No. 17. NRW Evidence Report No 14. Natural Resources Wales, Bangor

Ref 9. SEPA (2005) Guidance for applicants on supporting information requirements for hydropower applications. The Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR).

Ref 10. Wright, J.F., Sutcliffe, D.W. & Furse, M.T. (2000) Assessing the biological quality of freshwaters: RIVPACS and other techniques. Freswater Biological Association, Cumbria.

Annex 7.1.1: Biological Monitoring Working Party (BMWP) System

7.1 Overview

7.1.1 There are about 4,000 species of aquatic macroinvertebrates in the British Isles. To simplify the analysis of the samples and the data we do not identify individual species but only the major types (taxa), mostly at the family taxonomic level. A key piece of information is the number of different taxa at a site. A fall in the number of taxa indicates ecological damage, including pollution (organic, toxic and physical pollution such as siltation, and damage to habitats or the river channel).

7.1.2 For consistency, we only report taxa used in the BMWP (Biological Monitoring Working Party) system (see below). Some animals are more susceptible to organic pollution than others and the presence of sensitive species indicates good water quality. This fact is taken into account by the BMWP System.

7.1.3 The BMWP system assigns a numerical value to about 80 different taxa (known as the BMWP-scoring families) according to their sensitivity to organic pollution. The average of the values for each taxon in a sample, known as ASPT (average score per taxon) is a stable and reliable index of organic pollution. Values lower than expected indicate organic pollution.

7.1.4 The most useful way of summarising the biological data was found to be one that combined the number of taxa and the ASPT. The best quality is indicated by a diverse variety of taxa, especially those that are sensitive to pollution. Poorer quality is indicated by a smaller than expected number of taxa, particularly those that are sensitive to pollution. Organic pollution sometimes encourages an increased abundance of the few taxa that can tolerate it.

7.1.5 The biotic scores can be interpreted by following the guidelines in the table below (taken from Armitage et al., 1983; Chapman, 1996; Mason, 2002). However, these categories are for guidance only and it should be remembered that maximum achievable values will vary between geological regions.

7.1.6 For example, pristine lowland streams in East Anglia will always score lower than pristine Welsh mountain streams as they are unable to support many of the high-scoring taxa associated with fast flowing habitat. BMWP scores and ASPT for different types of watercourse are dependent on the quality and diversity of habitat, natural water chemistry (associated with variables such as geology and distance from source), altitude, gradient, time of year the sample was taken and other factors.

Table 0.1 A Guide to Interpreting BMWP Score and ASPT

BMWP score	ASPT	Interpretation
0-10	<3.0	Very poor, heavily polluted
11-40	3.0-4.3	Poor, polluted or impacted
41-70	4.3-4.8	Moderate, moderately impacted
71-100	4.8-5.4	Good, clean but slightly impacted
>100	>5.4	Very good, unpolluted, unimpacted

Annex 7.1.2: Community Conservation Index (CCI)

7.1 Overview

7.1.1 The Community Conservation Index (Ref 1) allows a classification of the nature conservation value associated with a macroinvertebrate community. The CCI score for one sample is derived from individual Conservation Scores (CS), assigned to some species of aquatic macroinvertebrates and relating closely to the available published Red Data Books (Bratton, 1991a, 1991b; Shirt, 1987). Conservation Scores assigned to individual species vary from 1 to 10, as detailed in Table 0. below. The derived CCI scores generally vary from 0 to > 20, as detailed in

7.1.2 Table 0.6 below, which also provides a guide to interpreting CCI scores.

Table 0.1 Conservation Scores from the Community Conservation Index

Conservation Score	Relation to Red Data Books
10	RDB1 (Endangered)
9	RDB2 (Vulnerable)
8	RDB3 (Rare)
7	Notable (but not RDB status)
6	Regionally notable
5	Local
4	Occasional (species not in categories 10-5, which occur in up to 10% of all samples from similar habitats)
3	Frequent (species not in categories 10-5, which occur in up to >10-25% of all samples from similar habitats)
2	Common (species not in categories 10-5, which occur in up to >25-50% of all samples from similar habitats)
1	Very common (species not in categories 10-5, which occur in up to >50-100 % of all samples from similar habitats)

** Ref 1*

Table 0.6 General guide to CCI scores

CCI Score	Description	Interpretation
0 to 5.0	Sites supporting only common species and/or community of low taxon richness	Low conservation value
> 5.0 to 10.0	Sites supporting at least one species of restricted distribution and/or a community of moderate taxon richness	Moderate conservation value
> 10.0 to 15.0	Sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness	Fairly high conservation value
> 15.0 to 20.0	Sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness	High conservation value
> 20.0	Sites supporting several rarities, including species of national importance and/or a community of very high taxon richness	Very high conservation value

** Ref 1*

Annex 7.1.3: Raw Survey Data

Table 0.1 Raw macrophyte data

Taxonomic Group	Common Name	Latin Name	Flowing water samples												Standing Water samples		
			KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
Microalgae	Red Algae	*Batrachospermum sp*	1							1	1						
Microalgae	Fragile Stonewort	*Chara globularis*								4							
Microalgae	Delicate Stonewort	*Chara virgata*				1											7
Microalgae	Mole pelt algae	*Vaucheria sp.*										1					
Bryophtye	Feathermoss	*Platyhypnidium spp.*		1													
Bryophtye	Pale Liverwort	*Chiloscyphus sp.*								2	1						
Bryophtye	Forked veilwort	*Metzgeria furcata*								2							
Bryophtye	Brook-moss	*Hygrohypnum spp.*										2					
Bryophtye	Common water moss	*Fontinalis antipyretica*													O	O	
Bryophtye	Hooked scorpion-	*Scorpidium scorpioides*															2

Taxonomic Group	Common Name	Latin Name	Flowing water samples												Standing Water samples		
			KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
	moss																
Vascular Plant	Marsh horsetail	*Equisetum palustre*								1							2
Vascular Plant	Common spike-rush	*Eleocharis palustris*				1											
Vascular Plant	Joined rush	*Juncus articulatus*				4		2		2							
Vascular Plant	Bulbous Rush (emergent form)	*Juncus bulbosus*					1	2		1							
Vascular Plant	Bulbous Rush (floating form)	*Juncus bulbosus*															4
Vascular Plant	Bog pondweed	*Potamogeton polygonifolius*				3		2		1							1
Vascular Plant	Broad-leaved pondweed	*Potamogeton natans*															3
Vascular Plant	Lesser spearwort	*Ranunculus flammula*				3		1		1							
Vascular Plant	Unbranched bur-reed	*Sparganium emersum*				1	2										

Taxonomic Group	Common Name	Latin Name	Flowing water samples												Standing Water samples		
			KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
Vascular Plant	White beak-sedge	*Rhynchospora alba*				5											2
Vascular Plant	Common yellow sedge	*Carex demissa*				2											
Vascular Plant	Bottle sedge	*Carex rostrata*					2										4
Vascular Plant	Black sedge	*Carex nigra*								2							1
Vascular Plant	Shoreweed	*Littorella uniflora*													R	R	
Vascular Plant	Alternate water-milfoil	*Myriophyllum alterniflorum*													R	R	
Vascular Plant	Quillwort	*Isoetes sp.*													R	R	
Total Number of taxa recorded			1	1	0	8	3	4	0	10	3	2	0	0	4	4	9
Total % cover of macrophytes			0%	<1%	0%	20%	2%	2%	<1%	9%	<1%	<1%	0%	0%	N/A	N/A	60%
Total % cover of filamentous algae			0%	0%	0%	0%	0%	0%	<1%	0%	<1%	0%	0%	0%	A	A	0%

Table 0.2 Macroinvertebrate species list and metrics

BMWP group	Species	BMWP score	Conservation Score	Flow group	FSSR Score	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
Flatworms																				
Planariidae	*Polycelis sp.*	5			D		10					1				1				
Planariidae	*Polycelis felina*	5	3	II	C	3	44	8								1				
Snails																				
Zonitoides	*Zonitoides nitidus*	-	4				1										1			
Limpets and mussels																				
Anyclidae	*Ancylius fluviatilis*	6	1	II			1	3									1			
Sphaeriidae	Sphaeriidae (juvenile / damaged)	3		IV	D					3										
Sphaeriidae	*Sphaerium sp.*	3			D						1									
Sphaeriidae	*Pisidium sp.*	3			D			2	35		2	1	1			5				
Worms																				
Oligochaeta		1			D	2	1				1	2	3			2	4		60	
Leeches																				
Glossiphoniidae	*Glossiphonia sp.*	3		IV	C														1	
Mites																				
Hydracarina		-				1	4				5		1	2				1	3	1
Crustaceans																				
Gammaridae	*Gammarus sp.*	6			B										1	90				
Gammaridae	*Gammarus pulex*	6	1	II	B											30				
Crangonyctidae	*Crangonyx pseudogracilis*	6	1	III	D													2		
Mayflies																				
Baetidae	Baetidae (juvenile / damaged)	4		II	A							2		1	10	10			2	
Baetidae	*Baetis sp.*	4		II	A			3			4	9	1	1						
Baetidae	*Baetis rhodani*	4	1	II	A	10	25	8			32	10	9	40	40	5	1			
Baetidae	*Alainites muticus*	4	2	II	A	20	142	25			8	24	65	18	60	30	27			
Baetidae	*Nigrobaetis sp.*	4		II	A						5									

BMWP group	Species	BMWP score	Conservation Score	Flow group	FSSR Score	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
Baetidae	*Centroptilum luteolum*	4	4	III	C						8	14	1						3	
Baetidae	*Cloeon sp.*	4		IV	D															35
Heptageniidae	Heptageniidae (juvenile / damaged)	10		I	A							3		1	2		1			
Heptageniidae	*Rhitrogena sp.*	10			A								3		7					
Heptageniidae	*Rhithrogena semicolorata*	10	2	I	A									4	13	1				
Heptageniidae	*Electrogena lateralis*	10	2	I	A	8					1	16		1						
Heptageniidae	*Ecdyonorus sp.*	10		I	A						1	14	8	26	8			26	40	
Heptageniidae	*Ecdyonurus torrentis*	10	2	I	A								1							
Leptophlebiidae	Leptophlebiidae (juvenile / damaged)	10		II	B				46			9	9	1						1
Ephemerellidae	*Serratella ignita*	10	1	II	A						1	9	71	36	2			75	325	
Caenidae	*Caenis sp.*	7			D															2
Caenidae	*Caenis horaria*	7	1	IV	D				10											
Caenidae	*Caenis luctuosa*	7	1	IV	D				35											
Caenidae	*Caenis rivulorum*	7	3	II	C														8	
Stoneflies																				
Nemouridae	Nemouridae (juvenile / damaged)	7		IV	C					2							2			
Nemouridae	*Protonemura sp.*	7		I	A		2													
Nemouridae	*Amphinemura sp.*	7		II	B										1					
Nemouridae	*Amphinemura sulcicollis*	7	2	II	B	1							1		1			16	60	
Nemouridae	*Nemurella picteti*	7	2	IV	C												2			
Nemouridae	*Nemoura sp.*	7			C			2			1							1		
Leuctridae	*Leuctra sp.*	10			A		17				5	34	25	13	12	34	6	16	15	
Leuctridae	*Leuctra nigra*	10	4	II	B		3				4		1	3	10	10				
Leuctridae	*Leuctra fusca*	10	1	II	A								1	3					3	
Leuctridae	*Leuctra moselyi*	10	6	I	A	15		1							7					
Perlodidae	Perlodidae (juvenile / damaged)	10		I	A													1	12	
Perlodidae	*Diura bicaudata*	10	3	I	A													5	1	
Perlidae	Perlidae (juvenile / damaged)	10		I	A										8	4				

BMWP group	Species	BMWP score	Conservation Score	Flow group	FSSR Score	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
Perlidae	*Dinocras cephalotes*	10	4	I	A							1	3	4	9	3				
Chloroperlidae	*Chloroperla torrentium*	10	1	I	A	1					5				1			21	25	
Damselflies																				
Coenagrionidae	Coenagrionidae (juvenile / damaged)	6		IV	D				60											10
Coenagrionidae	*Enallagma cyathigerum*	6	2	IV					1											
Lestidae	*Lestes sponsa*	8	4	IV																1
Dragonflies																				
Cordulegasteridae	*Codulegaster boltonii*	8		II	D					8	4		3							
Libellulidae	Libellulidae (juvenile / damaged)	8		IV	C															1
True bugs																				
Gerridae	Gerridae (nymph / damaged)	5		IV					10											15
Gerridae	*Gerris lacustris*	5	1	IV					1											
Veliidae	Veliidae (nymph / damaged)	-		IV		1				1	10					1				
Veliidae	*Velia sp.*	-					1	1					1	1			4			
Veliidae	*Velia caprai*	-	2	III			1													
Corixidae	Corixidae (nymph / damaged)	5		IV	D				1											80
Corixidae	*Hesperocorixa castanea*	5	4	V	D															1
Corixidae	*Sigara scotti*	5	5	V	C															2
Notonectidae	Notonectidae (nymph / damaged)	5		IV																2
Beetles																				
Gyrinidae	Gyrinidae (larvae / damaged)	5		IV																5
Dytiscidae	Dytiscidae (larvae / damaged)	5		IV	D	1		1									3		2	2
Dytiscidae	*Oerodytes sanmarkii*	5	2	II	B													1	2	
Dytiscidae	*Agabus bipustulatus*	5	1	IV	D						1									
Dytiscidae	*Agabus guttatus*	5	5	II	B	1											1			
Hydrophilidae	Hydrophilidae (larvae / damaged)	5		IV	D								1			1	1			1
Hydrophilidae	*Helophorus brevipalpis*	5	1	IV	D				1								1			
Hydrophilidae	*Anacaena globulus*	5	1	IV	C		3	2		2			2							

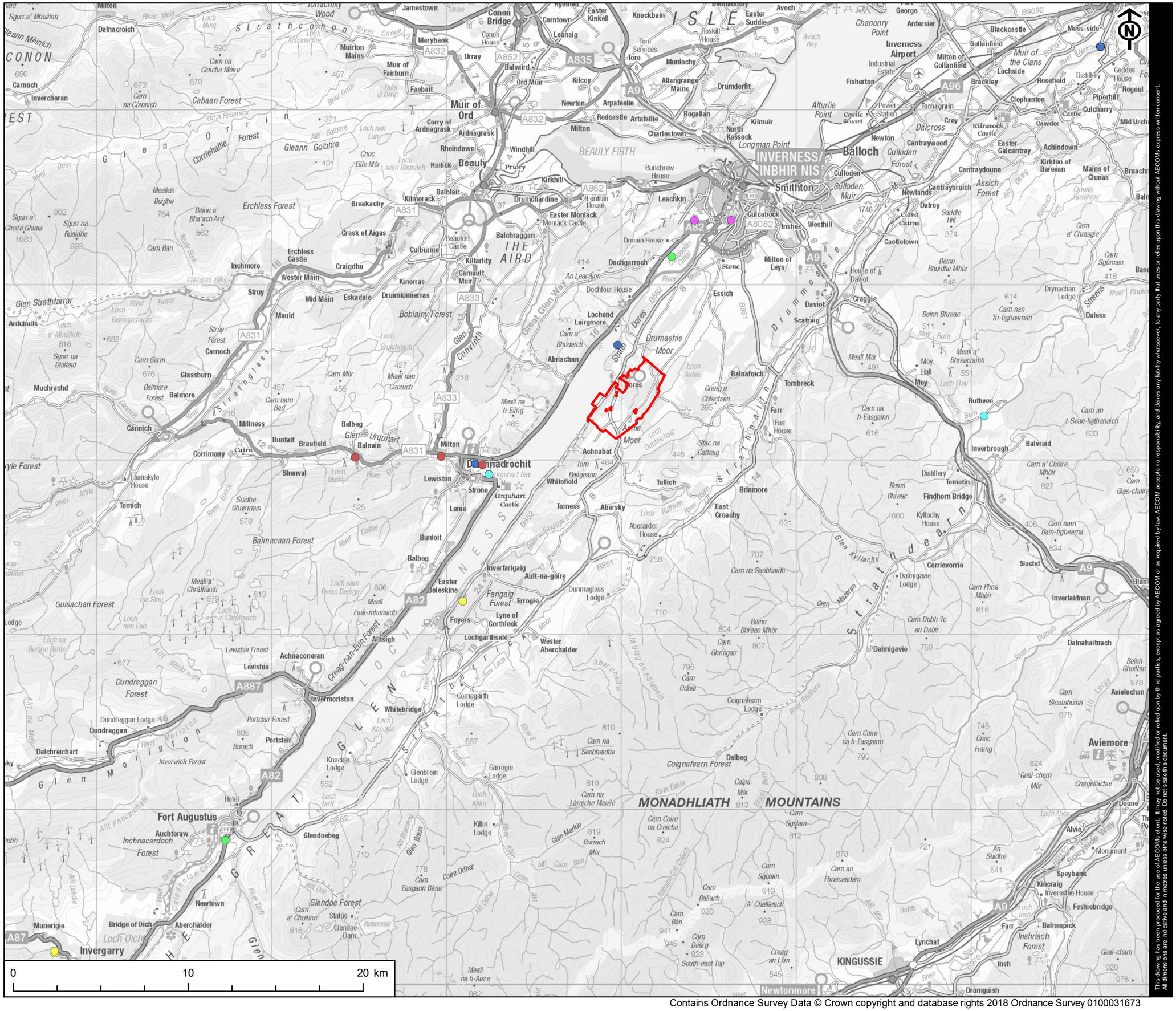
BMWP group	Species	BMWP score	Conservation Score	Flow group	FSSR Score	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
Hydraenidae	*Hydraena sp.*	5			B														2	
Hydraenidae	*Hydraena gracilis*	5	1	II	B							2			6			1		
Scirtidae	Scirtidae (larvae / damaged)	5		IV	B	60	60	50		4	18	1	14	10	5	20	11			
Elmidae	*Elmis aena*	5	1	II	B		1						3	4	6	2		1		
Elmidae	*Esolus parallelepipedus*	5	4	II	C													6		
Elmidae	*Limnius volckmari*	5	2	II	B										2			10	30	
Elmidae	*Oulimnius sp.*	5		IV	C						1							1	1	
Terrestrial beetle/non identifiable beetle		-								1										
Alderflies																				
Sialidae	Sialidae (juvenile / damaged)	4		IV	D															
Sialidae	*Sialis sp.*	4			D							1	1							
Sialidae	*Sialis lutaria*	4	1	IV	D				1						1					1
Sialidae	*Sialis fuliginosa*	4	5	II	B									1						
Caddisflies																				
Rhyacophilidae	*Rhyacophila sp.*	7		I	A						1		2							
Rhyacophilidae	*Rhyacophila dorsalis*	7	1	I	A		1							1						
Glossosomatidae	Glossosomatidae (juvenile / damaged)	7		II	A							1					4			
Glossosomatidae	*Agapetus sp.*	7		II	A											9				
Glossosomatidae	*Agapetus fuscipes*	7	1	II	A	6	8									21	2			
Philopotamidae	*Philopotamus montanus*	8	2	I	A	2	3	6				1	4	1						
Philopotamidae	*Wormaldia sp.*	8		I	A	1							4	1						
Philopotamidae	*Wormalidia occipitalis*	8	2	I	A							9	5			1				
Polycentropodidae	Polycentropodidae (juvenile / damaged)	7		IV	B					5						1	1			
Polycentropodidae	*Plectrocnemia conspersa*	7	2	II	B		4				1	1				2	2			
Polycentropodidae	*Plectrocnemia geniculata*	7	3	I	B	7														
Polycentropodidae	*Polycentropus flavomaculatus*	7	2	II	B													10	15	

BMWP group	Species	BMWP score	Conservation Score	Flow group	FSSR Score	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
Polycentropodidae	*Holocentropus dubius*	7	4	V						1										
Psychomyiidae	*Tinodes waeneri*	8	1	III	B														6	
Hydropsychidae	*Diplectrona felix*	5	4	II	A	15	80	10			3					25				
Hydroptilidae	*Hydroptila sp.*	6																4	4	
Limnephilidae	Limnephilidae (juvenile / damaged)	7		IV	B		3									5	6	3		
Limnephilidae	*Limnephilus lunatus*	7	1	IV	C				4											1
Limnephilidae	*Potamophylax latipennis*	7	2	II	B														1	
Limnephilidae	*Potamophylax cingulatus*	7	2	II	B		3	35								1	2			
Limnephilidae	*Chaetopteryx villosa*	7	3	II	B	30	31	40			2	9	1	1		1	8			
Beraeidae	*Beraea sp.*	10			A								1							
Beraeidae	*Beraea maurus*	10	3	II	A												2			
Odontoceridae	*Odontocerum albicorne*	10	3	I	B	4	3				2	1	1	4	4	1	2			
Leptoceridae	Leptoceridae (juvenile / damaged)	10		IV										1						
Leptoceridae	*Athripsodes sp.*	10																	2	
Leptoceridae	*Atripsodes bilineatus*	10	5	II	A														4	
Leptoceridae	*Mystacides azurea*	10	2	IV	D															5
Sericostomatidae	Sericostomatidae (juvenile / damaged)	10		II	B										1			10		
Sericostomatidae	*Sericostoma personatum*	10	1	II	B								1	1				2	8	
Trichoptera pupae/Trichoptera non ID		-									1			1						
Trueflies																				
Chironomidae	Chironomidae (damaged / pupea)	2					32			10	1	10		6				1		4
Chironomidae	Tanypodinae	2				160	130	110	75		12	17	5	10	10	6	127		2	12
Chironomidae	Orthocladiinae	2				40	324	40			27	15	10	31	15	20	28	4		
Chironomidae	Chironomini	2					32					16				1				
Chironomidae	Tanytarsini	2					1714	50			64	21	3	14	2	15	3			6
Chironomidae	Prodiamesinae	2											1				15			

BMWP group	Species	BMWP score	Conservation Score	Flow group	FSSR Score	KS01	KS02	KS03	KS04	KS05	KS06	KS07	KS08	KS09	KS10	KS11	KS12	KS13	KS14	KS15
Pediciidae	Pediciidae	5			B						1									
Pediciidae	*Pedicia* sp.	5		II	B								1							
Pediciidae	*Dicranota* sp.	5		II	B	2	6			1	3	1	1	1			1			
Limoniidae	Limoniidae	5			B	1				1	1					2				
Limoniidae	*Eleophila* sp.	5			B											2	1			
Simuliidae	Simuliidae (damaged / juvenile)	5		II	A	3	4				18			6	1	5				
Simuliidae	*Simulium* sp.	5			B								3	1						
Simuliidae	*Simulium cryophilum*	5	4		A										2					
Dixidae	*Dixa* sp.	-			B	2	1	3					1		1	1				
Dixidae	*Dixa nebulosa*	-	4									1	3		1					
Dixidae	*Dixa puberula*	-	5		A											1				
Empididae		-										1		1	2	1	1			
Ceratopogonidae		-					7							2		1		2		
Ptychopteridae	*Ptychoptera sp.*	-		II	D											1				
Other Taxa																				
Lepidoptera		-							1						1					
Nematoda		-										1		3				1		
Collembola		-						1					1				1			
Plecoptera		-										1								
Thaumaleidae		-													2					
Ostracoda		-															2			
Number of scoring families (BMWP)						18	18	13	10	8	20	19	23	18	16	20	16	15	20	16
Number of non-scoring families (BMWP)						3	5	3	1	2	3	4	4	6	4	5	5	3	1	1
Total number of families (BMWP)						21	23	16	11	10	23	23	27	24	20	25	21	18	21	17
BMWP score						113	104	72	54	42	126	123	156	132	113	120	101	110	137	96
ASPT (BMWP)						6.3	5.8	5.5	5.4	5.3	6.3	6.5	6.8	7.3	7.1	6.0	6.3	7.3	6.9	6.0
CCI Score						13.57	10.9	12.5	3.4	7.5	11.7	11.9	15.6	11.0	12.2	12.5	11.5	8.8	10.7	14.2
Total Number of species						14	17	10	7	3	13	13	18	15	16	16	13	12	14	6

Project Management Initials: CA Designer: LC Checked: PC Approved: CS

Scale @ A3 1:200,000



AECOM

PROJECT
RED JOHN PUMPED STORAGE HYDRO

CLIENT
ILI (Highlands PSH) Ltd.

KEY

🟥 Development Site boundary

▨ Excluded from Development Site boundary

Aquatic species

● Elodea nutallii

● Giant hogweed

● Himalayan balsam

● Japanese knotweed

● New Zealand Flatworm

● Rhododendron ponticum

● Seep monkeyflower

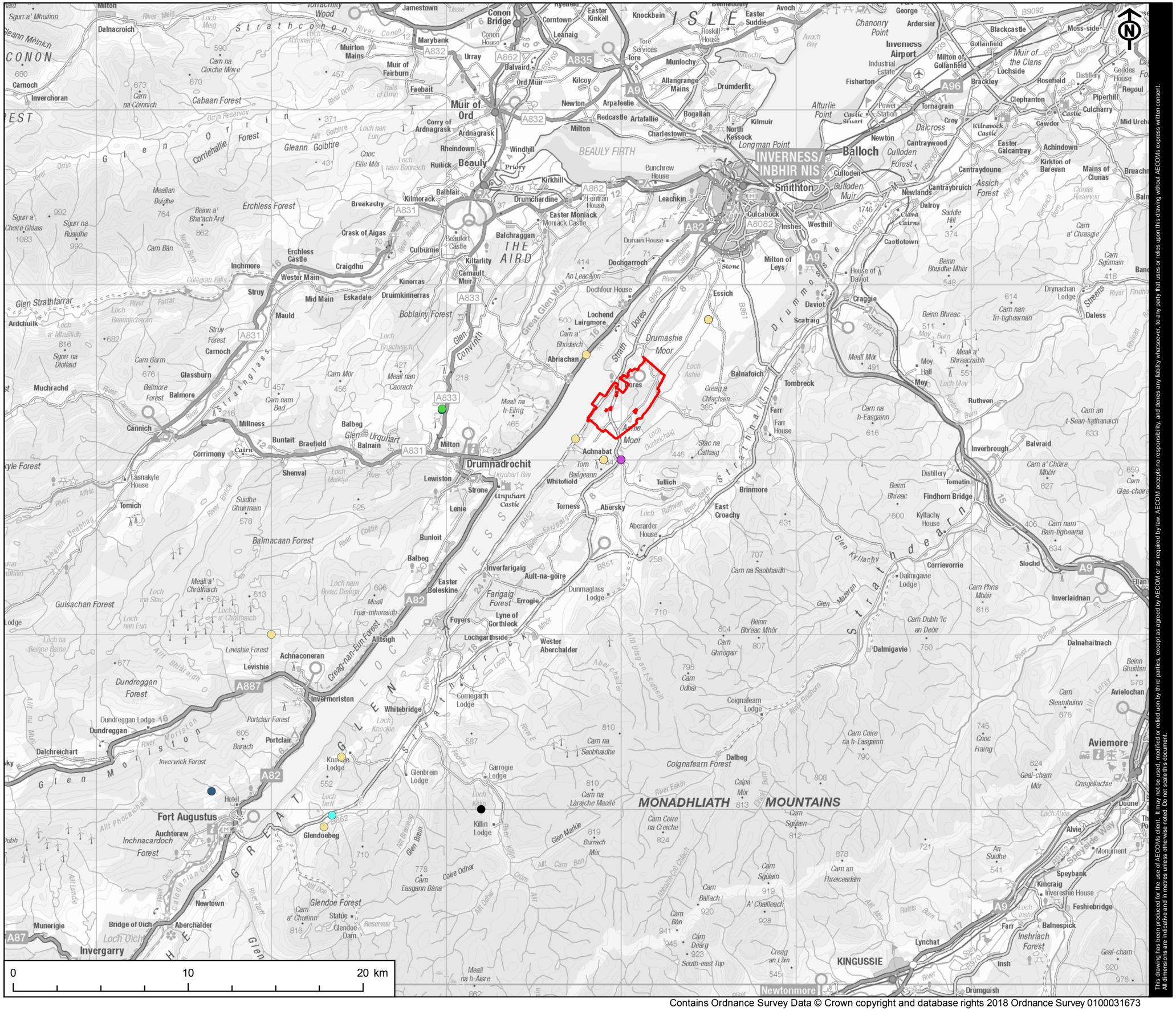
TITLE
FIGURE 7.1.1
INVASIVE NON-NATIVE SPECIES
(DESK STUDY RESULTS)

REFERENCE
RJ_181031_EIA_A7.1.1_v2

SHEET NUMBER 1 of 1

DATE 31/10/18

Project Management Initials: CA Designer: LC Checked: PC Approved: CS



Scale @ A3 1:200,000

Contains Ordnance Survey Data © Crown copyright and database rights 2018 Ordnance Survey 0100031673

AECOM

PROJECT
RED JOHN PUMPED STORAGE HYDRO

CLIENT
ILI (Highlands PSH) Ltd.

KEY
- 🟥 Development Site boundary
- ▨ Excluded from Development Site boundary

Fish species
- ● Arctic Charr

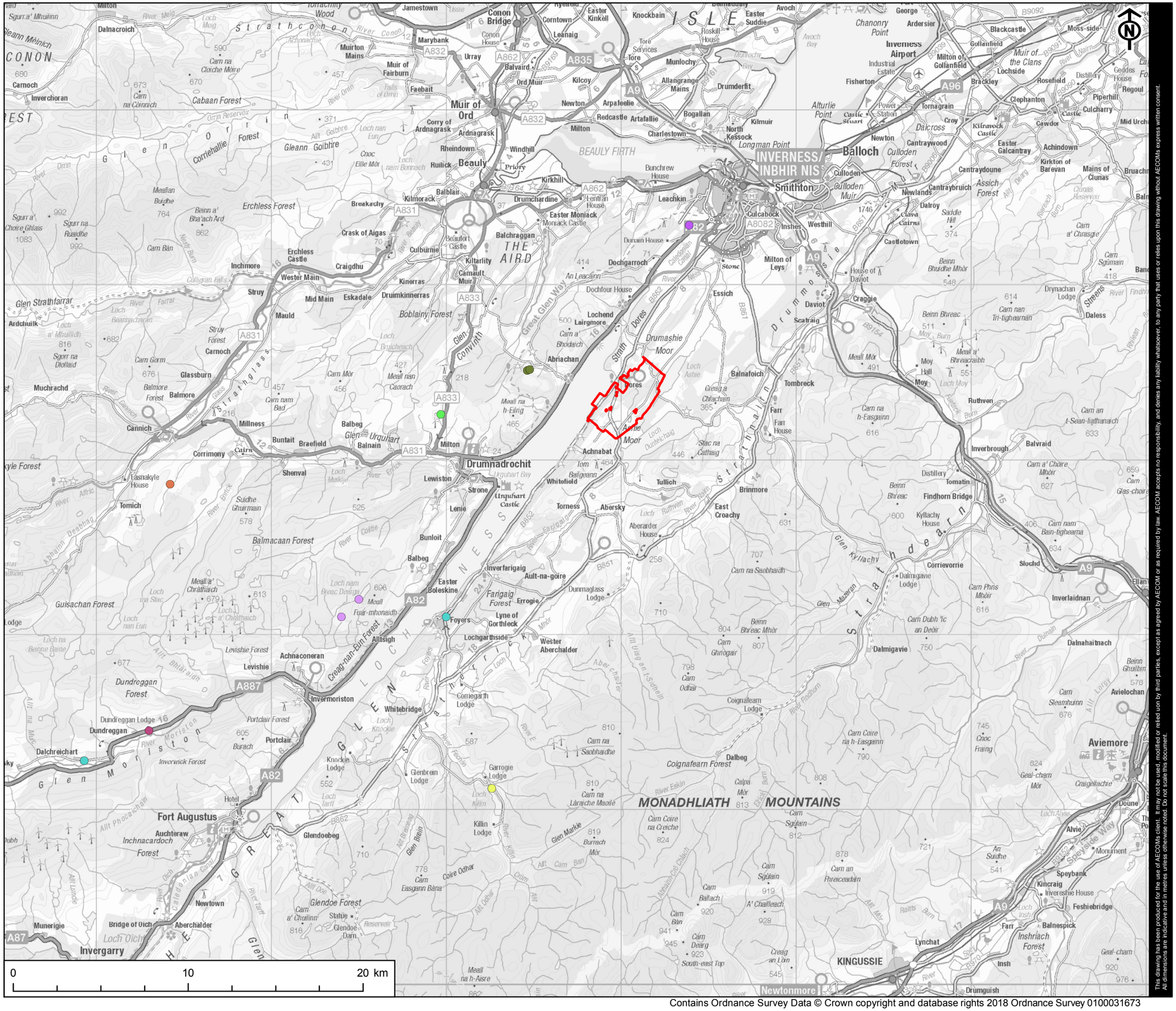
Macrophyte species
- ● Carex lasiocarpa
- ● Carex limosa
- ● Hydrocotyle vulgaris
- ● Potentilla palustris
- ● Ranunculus flammula
- ● Sparganium natans

TITLE
FIGURE 7.1.2
FISH AND MACROPHYTES
(DESK STUDY RESULTS)

REFERENCE
RJ_181031_EIA_A7.1.2_v2

SHEET NUMBER	DATE
1 of 1	31/10/18

Project Management Initials: CA Designer: LC Checked: LB Approved: CS



Scale @ A3 1:200,000

Contains Ordnance Survey Data © Crown copyright and database rights 2018 Ordnance Survey 0100031673

AECOM

PROJECT
RED JOHN PUMPED STORAGE HYDRO

CLIENT
ILI (Highlands PSH) Ltd.

KEY
- ▭ Development Site boundary
- ▨ Excluded from Development Site boundary

Macroinvertebrate species
- ● Cheilosia chrysocoma
- ● Cyphon ochraceus
- ● Donacia aquatica
- ● Donacia crassipes
- ● Prionocera pubescens
- ● Tanyptera nigricornis
- ● Thereva handlirschi
- ● Tipula limbata

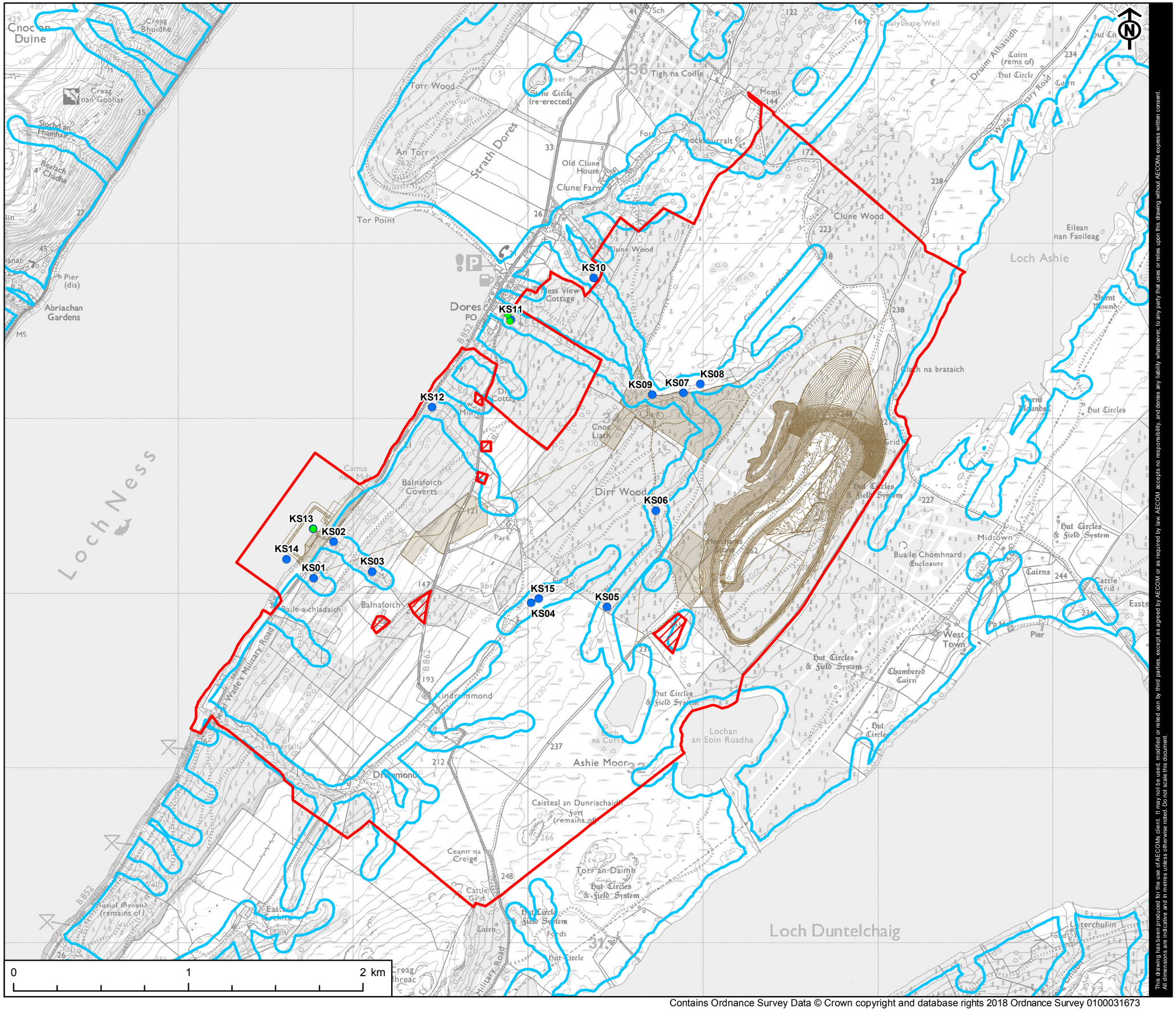
This drawing has been produced for the use of AECOM's client. It may not be used, modified or relied uon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies upon this drawing without AECOM's express written consent. All dimensions are indicative and in metres unless otherwise noted. Do not scale this document.

TITLE
FIGURE 7.1.3
MACROINVERTEBRATES
(DESK STUDY RESULTS)

REFERENCE
RJ_181031_EIA_A7.1.3_v2

SHEET NUMBER	DATE
1 of 1	31/10/18

Project Management Initials: CA Designer: LC Checked: SY Approved: CA



Scale @ A3 1:20,000

AECOM

PROJECT
RED JOHN PUMPED STORAGE HYDRO

CLIENT
ILI (Highlands PSH) Ltd.

KEY
- Development Site boundary
- Excluded from Development Site boundary
- Above ground infrastructure - Line
- Above ground infrastructure - Area
- 50m survey area
- Invertebrate kick sampling location
- INNS

TITLE
FIGURE 7.1.4
INVERTEBRATE KICK SAMPLING LOCATIONS

REFERENCE
RJ_181031_EIA_A7.1.4_v2

SHEET NUMBER
1 of 1

DATE
31/10/18

aecom.com