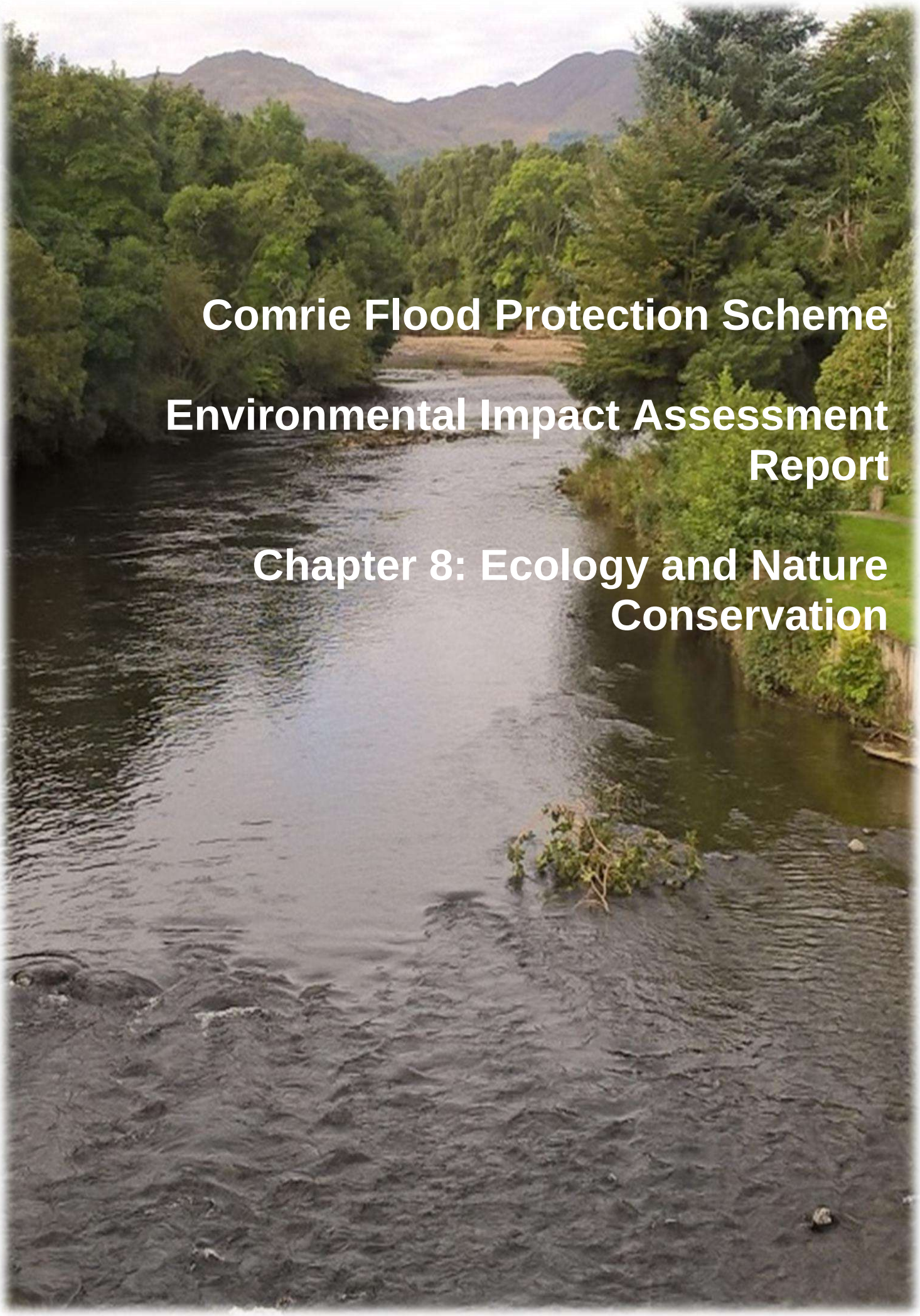

Comrie Flood Protection Scheme

Environmental Impact Assessment Report

Chapter 8: Ecology and Nature Conservation

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FIGURES

APPENDICES

Confidential information (Appendix 8.3 – 8.5) has been removed from this report.

8 Ecology and Nature Conservation

8.1 Introduction

8.1.1 This chapter describes and evaluates the current nature conservation interest of the study area as described within **Chapter 1: Introduction**. It assesses the potential impacts of the Comrie Flood Protection Scheme (the Scheme) on nature conservation interests during construction and operation, and where necessary, outlines mitigation measures to be incorporated into the design. An assessment of the significance of residual effects is also provided.

8.1.2 Hydrological interests are addressed in **Chapter 6: Water Environment & Fluvial Geomorphology** and hydrogeological and contaminated land interests are addressed in **Chapter 7: Hydrogeology and Contamination**. As a result of the presence of watercourses within the study area there is a degree of overlap with these chapters.

8.1.3 Supporting information and background reports are presented in the following Technical Appendices.

- Appendix 8.1 – Phase 1 habitat target notes and species list
- Appendix 8.2 – Bat tables and target notes
- Appendix 8.3 – Beaver survey results (2018 and 2019) CONFIDENTIAL
- Appendix 8.4 – RSPB response CONFIDENTIAL
- Appendix 8.5 – Otter survey results (2018 and 2019) CONFIDENTIAL
- Appendix 8.6 – Fish data (SEPA and Comrie Angling Club)
- Appendix 8.7 – Crayfish survey report (Practecology)
- Appendix 8.8 – INNS report
- Appendix 8.9 – Consultation summary

8.2 Policy and Guidance

8.2.1 Relevant legislation, policy and guidance documents have been considered as part of this assessment. This chapter pays regard to the requirements of and advice given in the following:

8.2.2 Legislation:

- Directive 2009/147/EC on the Conservation of Wild Birds (the Birds Directive) 1979;
- Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Flora and Fauna (the Habitats Directive);
- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) (The Habitats Regulations);

- Surface Waters (Fishlife) (Classification) (Scotland) Regulations 1997 (as amended);
- The Wildlife and Countryside Act 1981, as amended (WCA);
- The Protection of Badgers Act 1992 (as amended);
- The Salmon and Freshwater Fisheries (Consolidation)(Scotland) Act 2003 (as amended);
- The Wildlife and Natural Environment (Scotland) Act 2011 (as amended);
- The Nature Conservation (Scotland) Act 2004 (referencing the Convention on Biological Diversity (1992) and the Scottish Biodiversity Strategy which are implemented locally through the Tayside Local Biodiversity Action Plan (LBAP)1); and
- The EU Water Framework Directive (Directive 2000/60/EC) with regard to Groundwater Dependent Terrestrial Ecosystems [GWDTE] and ecological status (classed as High, Good, Moderate, Poor and Bad for ecological parameters).

8.2.3 The planning policy framework relevant to this EIA is set out in **Chapter 2: Flood Act Remit & Policy Background**. The policies set out below include those which are of relevance to the ecological assessment.

- The Flood Risk Management (Flood Protection Schemes, Potentially Vulnerable Areas and Local Plan Districts) (Scotland) Amendment Regulations 2017;
- Scottish Planning Policy (SPP) 2014 (Scottish Government, 2014);
- Planning Advice Note (PAN) 60 Planning for Natural History (Scottish Government, 2000); and
- Perth & Kinross Local Development Plan 2 (LDP)(2019) – Policies 38 (environment and conservation), 40 (Forestry, woodland and trees) and 41 (biodiversity).

8.2.4 Good practice ecological guidance:

With specific reference to the assessment of ecological effects, cognisance has been taken of the following good practice ecological guidelines:

- Chartered Institute of Ecology and Environmental Management (CIEEM) (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine. September 2018;
- CIEEM (2013). Guidelines for Preliminary Ecological Appraisals;
- Institute of Environmental Management and Assessment. (2005). Guidelines for Environmental Impact Assessment; and
- Historic Environment Scotland and Scottish Natural Heritage (2018). Environmental Impact Assessment Handbook. Version 5 (Appendix 3: Ecological Impact Assessment).

[1] Tayside LBAP. 2nd Edition 2016 – 2026. http://www.pkc.gov.uk/media/37386/Tayside-Local-Biodiversity-Action-Plan/pdf/Tayside_LBAP_report_GP_10_Web.

8.2.5 The assessment of ecological effects also took cognisance of the following:

- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3 Part 4, Ecology and Nature Conservation (The Highways Agency et al. 1993); and
- DMRB Interim Advice Note 130/10, Ecology and Nature Conservation: Criteria for Impact Assessment (The Highways Agency, 2010)[2].

8.3 Methodology

Overview

8.3.1 An EIA screening request under the Flood Risk Management (Flood Protection Schemes, Potential Vulnerable Areas and Local Plan Districts) (Scotland) Regulations 2010 was submitted in June 2015. This request was supported by a baseline environmental report[3] which highlighted the presence of three internationally designated sites within 10km of the Scheme, together with a list of protected and notable species potentially present within 2km. Following a positive screening decision in November 2016 (i.e. that EIA was required) (reference: 16/01863/SCRN) an EIA scoping request was submitted to Perth & Kinross Council in December 2016 (reference 16/02210/SCOP) and an updated scoping report was submitted in November 2017[4]. Together, the scoping documents and consultation responses set out a detailed list of ecological receptors which would require further consideration. How these are addressed in the assessment is detailed below.

8.3.2 SNH confirmed by email[5] that a Habitats Regulations Appraisal (HRA) for any potential effects on European designated sites would not be required.

8.3.3 The approach which has been agreed is for the following ecological receptors to be considered:

- Habitats (Phase 1 habitat survey) and areas of significant botanical interest;
- Badger (*Meles meles*);
- Bat species;
- European beaver (*Castor fiber*);
- Breeding birds;
- European otter (*Lutra lutra*);

[2] The current assessment was undertaken prior to the publication of new DMRB guidelines LA108 and LA118 in relation to biodiversity and the new guidance has not been considered in this assessment. The superseded guidance changes don't alter the assessment methodology or the conclusions in anyway.
[3] Mouchel (2015). Comrie Flood Protection Scheme – Environmental Baseline Report. Prepared on behalf of Perth & Kinross Council.
[4] Sweco (2017). Comrie Flood Protection Scheme – Scoping Report Update. Prepared on behalf of Perth & Kinross Council.
[5] Received from Fiona Mann, SNH Operations Officer on 24 Jan 2017.

- Water vole (Arvicola amphibius);
- Reptile species;
- Red squirrel (*Sciurus vulgaris*);
- Aquatic species; and
- Invasive non-native species including American signal crayfish (*Pacifastacus leniusculus*).

8.3.4 The rationale for surveys and assessment of each of these receptors is discussed below.

Ecological Study Area

8.3.5 The study area for the Scheme shown in **Figure 8.3** takes in the full extent of the Scheme together with areas which may be required for construction and environmental mitigations as described in **Chapter 3: Scheme Description & Alternatives**. The study area incorporates a significantly larger area than would be required for the construction and operation of the proposed scheme and, as such, this boundary forms the basis of the Phase 1 habitat survey area. Surveys for protected species, notably bats, otter, badger, beaver and invasive non-native species, were extended beyond this boundary up to 250m up and downstream along the River Earn, the Water of Ruchill and the River Lednock. This was done in order to ensure that sufficient survey data for these mobile species was available i.e. to demonstrate the availability of suitable features outside the study area into which potentially displaced individuals could disperse.

8.3.6 Parts of the Scheme are dominated by built-up areas associated with Comrie (to the north of the River Earn) and Dalginross (south of the River Earn); with the exception of those parts of the town which have been proposed for the construction and operation of different elements of the Scheme, no attempt has been made to survey the built-up areas. Where access to semi-natural habitat areas was not possible due to permission restrictions or for practical reasons (e.g. health and safety concerns; impenetrable vegetation) these areas have been surveyed from a distance using binoculars, with additional verification possible via publicly available aerial mapping.

Desk study

8.3.7 Baseline data on the nature conservation interest of the site and its surroundings, including information on designated nature conservation sites and protected species records, were sought from the following sources (searched in January 2019):

- SNH SiteLink website (https://sitelink.nature.scot/map) – information on statutory designated sites;
- Scotland's Environment website (https://www.environment.gov.scot/) – information relating to Ancient Woodland Inventory Scotland, felling

licence applications since 2012, species conservation (grey squirrel control areas) and native woodland survey of Scotland;

- Joint Nature Conservation Committee (JNCC) website (http://jncc.defra.gov.uk/) – legislative information;
- The 2020 Challenge for Scotland's Biodiversity[6];
- The Scottish Biodiversity List (SBL)[7];
- The Tayside Local Biodiversity Action Plan 2nd Edition 2016 - 2026[8]; and
- Aerial photos accessed from publicly available web sources.

8.3.8 Further information relevant to the scoping process, the evaluation of the nature conservation features that could be affected by the development and the assessment of its effects upon them, was obtained through relevant published literature (i.e. relevant guidance documents and scientific papers).

Field surveys

8.3.9 Observations of species' signs or sightings of individuals were noted whilst in the field. In addition, useful local knowledge and information, collected on an *ad hoc* basis by surveyors during the execution of their walkover surveys from encounters with landowners, occupiers and local land users, were also collected as anecdotal information, although we cannot guarantee their accuracy where it was not possible to confirm their veracity.

8.3.10 The locations of field signs and pertinent notes were recorded with the aid of the mobile app Collector (based on ESRI ArcGIS software) enabling mapping of field signs together with supporting photographs.

8.3.11 Following advice on the lifespan of ecological reports and surveys set out by CIEEM[9], protected species were re-surveyed in autumn 2019 (primarily, otter and beaver due to the nature of the scheme design). Beyond 18 months, it is recommended that a new review of ecological conditions is undertaken when mobile species are present as they can create new features of relevance to the overall assessment.

[6] https://www2.gov.scot/Resource/0042/00425276.pdf. This document is Scotland's response to the European Union Biodiversity Strategy for 2020 and UN 'Aichi' targets and a report detailing progress on the implementation of the Scottish Biodiversity Strategy is prepared to the Scottish Parliament every 4 years as required under the Nature Conservation (Scotland) Act 2004.
[7] https://www2.gov.scot/Topics/Environment/Wildlife-Habitats/16118/Biodiversitylist/SBL. Published 2013.
[8] http://www.pkc.gov.uk/media/37386/Tayside-Local-Biodiversity-Action-Plan/pdf/Tayside_LBAP_report_GP_10_Web.
[9] CIEEM. (2019). Advice note on the lifespan of ecological reports and surveys. CIEEM, Hampshire, UK

Phase 1 habitat survey

8.3.12 A Phase 1 habitat survey is a standardised method of recording and mapping characteristic vegetation and habitat types in accordance with JNCC guidelines[10]. Phase 1 habitat types were recorded along with an indication of the plant species present together with the structure, condition and extent of the habitat. Features of conservation interest were subject to a more detailed description with numbered target notes (TN) which link to a table of further detailed information on specific habitats and plant communities. Plant species present in the study area are listed in the habitat descriptions in **Appendix 8.1**.

Badgers

8.3.13 Evidence of badgers was searched for during site walkovers within the study area +250m buffer, focusing on the riparian edges and semi-natural habitats. Notes were taken on the general suitability for badger foraging and sett-building, i.e. the availability of livestock-grazed pasture and undisturbed woodland with good shrub coverage and well-drained soils[11]. The location of any badger evidence (e.g. setts, badger paths, footprints, fence push-ups, foraging signs/digging, latrines, dung or hair) was noted and where setts were recorded, the number of entrances and their level of usage was also taken down, in accordance with the standard badger survey methods[12,13]. Evidence of badgers were searched for in May and July 2018, with a re-survey undertaken in November 2019.

Bats

8.3.14 Broad habitats across the study area +250m buffer and the wider area were assessed for their suitability for roosting, foraging and commuting bats.

8.3.15 A preliminary roost assessment was conducted where trees located within the Scheme footprint together with a minimum 50m buffer were surveyed from the ground to identify the presence of any cracks, crevices, knot holes, woodpecker holes, wounds, or other features which bats could use for roosting (i.e. potential roost features [PRF])[14]. High-powered torches and binoculars were used to scrutinise features which were otherwise difficult to assess. Trees were classified as having low, moderate, or high potential for

[10] JNCC. (2010). *Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit*. JNCC, Peterborough. 80pp.
[11] E.g. https://www.nature.scot/sites/default/files/2017-07/Publication%201997%20-%20Naturally%20Scottish%20-%20Badgers.pdf
[12] Harris, S. *et al*. (1989). *Surveying Badgers*. The Mammal Society, London. 29pp.
[13] https://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/CSS/CSS_-_BADGER_April_2013.pdf
[14] Andrews, H. (2018). Bat Roosts in Trees. A guide to identification and assessment for tree care and ecology professionals. Exeter.

supporting roosting bats as described by the Bat Conservation Trust[15] (**Table 8.1**).

8.3.16 It was outwith the scope of the assessment to survey all structures within the study area; preliminary roost assessments of buildings and built structures were restricted to public buildings in the immediate vicinity of the Scheme including the public toilets, the Dalginross Bridge and the remains of the disused railway bridge. *Ad hoc* remarks by landowners, incidental observations of bats roosting and backtracking surveys provided additional information on roost locations and these were recorded as Bat Target Notes. Preliminary roost assessment surveys for trees were therefore carried out during May and July 2018, and in December 2019 in respect of trees in the grounds of Glenbuckie House.

Table 8.1: Bat roost classifications and descriptions utilised to assess trees within the zone of influence of Comrie Flood Protection Scheme

Classification	Description
Low	A structure or tree in which PRFs are present but these are of marginal value due to their superficial or exposed nature, or there is insufficient space, shelter or suitable conditions for anything other than temporary use by individual/very small numbers of bats.
Moderate	A structure or tree that has no confirmed presence of bats, but which has at least one PRF (e.g. crevice, rot hole, wall cavity, flaking bark, deadwood, holes, snag ends, double leaders or dense ivy) which is unlikely to support a roost of high conservation status (i.e. a maternity roost or hibernaculum).
High	A structure or tree with PRFs which are suitable for bat roosting due to their size and nature, and which are considered to be of high value (by virtue of their position, proximity to commuting/foraging habitat, aspect and other aspects of their character) to bats seeking roosting or hibernation locations.

8.3.17 A series of night-time bat surveys were undertaken in order to identify key areas of bat activity (i.e. foraging and commuting) and to pinpoint possible bat roosts within trees and buildings adjacent to the rivers, with cognisance of the locations of Moderate and High-potential trees identified during preliminary roost assessments. The bat surveys were undertaken at the same stage as the emerging Scheme design and no surveys have been carried out at individual trees identified in the preliminary roost assessment as having roost potential. Instead, surveys were undertaken in accordance with the principles described as back-tracking in the BCT guidelines whereby teams of surveyors were placed on commuting routes (in this case river corridors) close to roost sources identified during the preliminary roost assessments (see **section 8.3.14**) and made observations of bats commuting away from roosts at sunset or back to roosts at sunrise, or of swarming behaviour displayed outside roost entrances.

[15] Collins, J. (2016). Bat surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition). Bat Conservation Trust, London.

8.3.18 Surveys were led by licenced bat specialists with assistance from experienced surveyors, all of whom were in contact via mobile phone throughout the surveys. Surveys took place within the bat activity period of April – September inclusive and commenced 15 minutes before sunset (earlier where trees were located within dark riparian corridors) and until it was too dark (typically 90 minutes – 2 hours after sunset) and at dawn commenced 90 minutes prior to sunrise and finished at sunrise, or later if bats were still active with at least ten minutes after the last bat was seen. Surveys were undertaken in the ideal conditions stated in the BCT guidelines (i.e. temperatures in excess of 10°C, little wind, no rain). Details of the locations and times of back-tracking surveys are provided in **Appendix 8.2**.

8.3.19 Bat calls were recorded with Anabat Walkabout detectors and any bats emerging from or re-entering structures or trees were noted using appropriate survey forms. Calls were analysed using Anabat Insight sound analysis software utilising Russ (2012)[16] as reference material.

Beaver

8.3.20 In-field walkovers of the riparian areas affected by the proposed scheme were undertaken to identify any evidence of beaver use of the site. Signs of beaver were recorded inclusive of feeding evidence (e.g. stripped bark, teeth marks, and chewed branches) as well as signs of any dams or lodges within the surrounding habitat. Notes were also taken on the relative suitability of the riparian habitats for the construction of beaver lodges and foraging in accordance with standard survey methods for beavers[17]. Evidence of beavers were searched for in May and July 2018, with a re-survey undertaken in November 2019.

Birds

8.3.21 No dedicated bird surveys were undertaken within the study area. This was decided following consultation with the RSPB, SNH and Perth & Kinross Council which revealed no records of Schedule 1 or designated bird populations within the study area and 250m buffer.

Otter

8.3.22 Notes were taken on the general suitability of watercourses and water bodies to support otter, and field signs such as spraints (faeces) and footprints, together with potential resting sites, defined as:

[16] Russ, J. (2012). *British Bat Calls: A Guide to Species Identification*. Pelagic Publishing, Exeter. 204pp.
[17] Campbell-Palmer, R. *et al*., (2018). *Survey of the Tayside area Beaver Population 2017-2018.* Scottish Natural Heritage Commissioned Report No. 1013. 57pp.

- Holt – an underground resting site deep enough that the back of the cavity cannot readily be seen;
- Couch – an above-ground resting site that can be used for sleeping or grooming;
- Breeding site: a term used to identify an area of land in which otters breed, within which a natal holt is located;
- Natal holt – a discrete holt used by female to give birth to and nurse the cubs.

8.3.23 Surveys were undertaken wherever possible in low flow conditions such that signs could be identified without them being washed away. Surveys were undertaken in accordance with standard survey guidance in May and July 2018, with a re-survey in November 2019[18].

Water vole

8.3.24 Notes were taken on the general suitability of watercourses to support water vole, including riparian and emergent vegetation, in accordance with CIEEM: Competencies for Species Survey: Water Vole[19] and the Water Vole Conservation Handbook[20].

Red squirrel

8.3.25 Notes were taken on the general suitability of woodland blocks to support this species during walkover surveys undertaken between May and July 2018; observations were made of feeding signs e.g. chewed pine cones, and dreys in accordance with standard survey guidance[21]. Surveys were undertaken in May and July 2018 and a follow-up survey was undertaken in November 2019.

Aquatic species

8.3.26 No detailed surveys were undertaken for fish or fish habitat. The aquatic ecology assessment has been undertaken on the basis of the fish and fish habitat data provided by the Comrie Angling Club and SEPA (see **Appendix 8.6**) and from incidental observations made by Practecology Ltd. surveyors undertaking surveys for American signal crayfish (see **Appendix 8.7**).

[18] Chanin, P. (2003). Monitoring the Otter *Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series No. 10. English Nature: Peterborough.
[19] https://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/CSS/CSS_-_WATER_VOLE_April_2013.pdf
[20] Strachan, R., Moorhouse, T. and Gelling, M. (2011). Water Vole Conservation Handbook. 3rd Edition, Wildlife Conservation Research Unit, Oxford.
[21] Cresswell, W.J., Birks, J.D.S., Dean, M., Pacheco, M., Trewhella, W.J., Wells, D. & Wray, S. (2012). UK BAP Mammals: Interim Guidance for Survey Methodologies, Impact Assessment and Mitigation. Southampton, UK: The Mammal Society

Invasive non-native species

8.3.27 A survey of the site for invasive, non-native species (INNS) was undertaken, involving the identification and mapping of stands of plant species listed under the Wildlife & Countryside Act 1981 (as amended), and those considered to be priorities for action as defined by the Tayside Local Biodiversity Action Plan 2016 – 2026[22] such as Japanese knotweed *Fallopia japonica*, Himalayan balsam *Impatiens glandulifera* or giant hogweed *Heracleum mantegazzianum*. Further survey details are provided in **Appendix 8.8**. Surveys for INNS were undertaken in summer 2018 and the results of these surveys were used to inform an INNS management plan; INNS treatment by herbicidal spraying was undertaken in summer 2019 and a check was carried out in early September 2019 to ensure that all areas had been successfully treated.

Approach to Assessment

8.3.28 It is impractical for an assessment of the ecological impacts of a development project to consider every feature (species and habitat) that may be affected since those features that are widespread, unthreatened and/or resilient to development impacts will remain viable and sustainable even if the project goes ahead. The identification of habitats and species to be included in the Ecological Impact Assessment (EcIA) depends on their being valuable in biodiversity, social and/or economic terms and also by being potentially affected by the project. Where there is no potential for valuable ecological receptors to be affected it is not necessary for them to be considered unless they also benefit from legal protection.

8.3.29 Each ecological feature has a range of characteristics which may deem them to be important within a defined geographical context. For the purpose of this assessment, the geographical contexts are:

- International and European
- National (UK)
- Regional (Scotland)
- District (Perth and Kinross)
- Local (site and vicinity).

8.3.30 In terms of both habitats and species, importance (which also reflects their sensitivity) may relate to their naturalness, relative rarity, the size of the habitat or population, the level of connectedness to other habitats or species populations, how easily they spread or disperse, whether they are threatened or whether they are typical or natural.

[22] http://www.pkc.gov.uk/media/37386/Tayside-Local-Biodiversity-Action-Plan/pdf/Tayside_LBAP_report_GP_10_Web

8.3.31 For designated sites, the importance of the ecological feature should reflect the geographical context of the designation (see above).

8.3.32 Features of international conservation importance are listed in Annex I (habitats) and Annexes II, IV and V (species) of the Habitats Directive or (for bird species) listed in Annex I of the Birds Directive.

8.3.33 Habitats and species of principal importance to biodiversity in Scotland are listed in the Scottish Biodiversity List (Part 1 section 2 of the Nature Conservation (Scotland) Act 2004) although the size and quality (e.g. whether they are degraded or unfavourable condition) will also affect their value.

8.3.34 Legal protection under European or national legislation (see **section 8.2.2**) denotes all protected species as important from an EcIA perspective.

8.3.35 Legally controlled species, i.e. Invasive non-native species (INNS) listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) are considered important species because of legal requirements to control or manage them.

8.3.36 Inclusion of habitats or species on the Tayside Local Biodiversity Action Plan, red lists or rare species lists - whether because of specific threats to survival or because of a rate of decline - also denotes value.

8.3.37 For the purposes of this EcIA the ecological importance of each feature identified through the desk study, consultation and field survey process will be considered in line with the above criteria and professional judgement will be used to determine whether the feature is important and should be carried through to the assessment stage as an Important Ecological Feature (IEF).

Assessment of significance

8.3.38 The assessment of the significance of predicted impacts on IEFs is based on both the value (sensitivity) of a receptor and the nature and magnitude of the impact that the proposed development would have on it. The assessment methodology no longer employs a matrix system and effects are hereby characterised using the parameters described below. A significant effect, as defined in CIEEM (2018) is one which 'either supports or undermines biodiversity conservation objectives for important ecological components or for biodiversity in general.'

8.3.39 Effects can be considered significant at a range of scales from international to local.

8.3.40 In broad terms, significant effects encompass impacts on the structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution).

8.3.41 Professional judgement has been used to categorise the significance of each effect as Major, Moderate or Minor. Any effects categorised as either moderate or major are considered significant in the context of the EcIA. Below this threshold is not significant in EIA terms. The terms are defined as:

- Major effect – where the proposed Scheme would result in a permanent or long-term effect on the distribution or abundance of the important ecological feature (a negative effect would be considered to affect the conservation objectives of the feature);
- Moderate effect - where the proposed Scheme would result in a permanent or long-term effect on the distribution or abundance of the important ecological feature (a negative effect would not be considered to affect the conservation objectives of the feature); and
- Minor effect - where the proposed Scheme would result in no discernible (unable to detect via monitoring) improvement or deterioration of the feature.

8.3.42 On identification of the activities during the construction and operation phases that may result in effects on IEFs, each effect is characterised taking account of the following parameters, considering only those characteristics relevant to determining the significance of impacts on the feature:

Positive or Negative

8.3.43 A positive impact is a change that improves the quality of the environment or impacts that may halt or slow an existing decline in quality of the environment. A negative impact is a change which reduces the quality of the environment.

Extent

8.3.44 This is defined as the geographical area over which the impact will occur. In relation to habitats, the extent and magnitude will be the same.

Magnitude

8.3.45 Magnitude refers to the ‘size’ of the impact such as the total area of habitat or the number of individuals impacted. The description of an impact’s magnitude is quantitative where possible.

Duration

8.3.46 This is defined as the expected duration of the impact and is determined in relation to the Important Ecological Feature’s characteristics and lifecycle.

Timing and frequency

8.3.47 The number of times an activity occurs which will influence the resulting impacts and the timing of an impact upon the ecological feature's life-stages or seasonal behaviour.

Reversibility

8.3.48 An impact is considered to be irreversible (permanent) if it is 'one from which recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it'. An impact is considered reversible (temporary) where 'spontaneous recovery is possible, or which may be counteracted by mitigation' (CIEEM, 2018).

8.3.49 Any effect considered unlikely to occur or if it did occur would not be significant to the Important Ecological Feature are not discussed within this chapter.

Requirement for Mitigation

8.3.50 Following the determination of ecological importance and identification/assessment of potential ecological effects, professional judgement was used, coupled with an understanding of the legal framework outlined above, to assess and determine the requirements for appropriate mitigation. Mitigation is proposed (where practicable) at the relevant scale of significance, using the following hierarchy: avoidance, mitigation, compensation, enhancement.

Assessment of Residual Ecological Effects

8.3.51 Residual ecological effects have been assessed using the same methodology as the potential effects but taking into consideration committed mitigation.

Assessment of Cumulative Ecological Effects

8.3.52 Cumulative effects of multiple threats or pressures can make habitats and species more sensitive to change. The cumulative effects of the proposed Scheme have been considered in combination with other developments within a potential zone of influence including developments currently in planning, consented or operational.

Assumptions and limitations

8.3.53 Surveys along Milton Burn in 2018 were constrained by the presence of very dense invasive species (primarily Himalayan balsam and Japanese knotweed) stands during surveys which meant that access to the full extent of this watercourse (where it falls within the study area +250m buffer) was not possible. As this feature is a considerable distance from the Scheme

this is not seen to be a constraint to the assessment. The lower reach of Milton Burn between the A85 and River Earn was clear of dense vegetation during the 2019 surveys due to seasonal vegetation dieback and survey was possible during this time. The lower reach of the River Lednock between the A85 and River Earn were, in part, inaccessible in 2019 due to high water levels. This area is within the study area.

8.3.54 A single bat survey, undertaken to the west of Aros Field East was undertaken in conditions regarded as suboptimal, with intermittent showers of drizzle throughout the survey culminating in sustained heavier rainfall which cut the survey short by approximately 15 minutes.

8.3.55 Phase 1 habitat surveys were not constrained by timing or effort. Dense stands of INNS present during surveys in late summer limited access to a small degree and potentially reduced the detectability of some plant species.

8.4 Consultation

8.4.1 Key correspondence received from statutory consultees also influenced the overall scope of this EIAR. Statutory consultees and other relevant non-statutory organisations were consulted throughout the EIA process to identify key ecological and nature conservation issues associated with the Scheme and to obtain existing data/information to inform the ecological assessment. A summary of responses from the key ecological stakeholders is shown here:

- Scottish Natural Heritage (SNH) stated that because there are no SSSI or Natura 2000 sites within the vicinity of the proposed works they had no concerns about the proposals in relation to these designations. SNH also commented that Perth & Kinross Council should satisfy itself that other natural heritage interests such as protected species or locally important habitats are addressed through its evaluation of the application, which may include consultation with other agencies. Correspondence from SNH following receipt of the update scoping report included the view that work pertaining to great crested newt is unnecessary for this scheme since the location is beyond the current mapped range of GCN as shown on the NBN atlas. SNH welcomed the inclusion of invasive non-native species as a factor to be considered. SNH also welcomed the inclusion of beaver and stated that this species was known to be present in the Earn. They advised that this species was anticipated to become a European Protected Species [EPS] in early 2018, together with a suite of advice and licencing scheme once legal protection is given[23].

[23] Note that subsequent to this consultation response and dating from 1 May 2019, Eurasian beaver has been added to the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and is now an EPS. Protection also extends to lodges and burrows used for breeding and can apply to dams. Further details are available on the SNH website https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/licensing/species-licensing-z-guide/beavers-and-licensing.

- SEPA's correspondence requested that measures to protect fish ecology are included in the EIA Report, and also stated that invasive species are present within the area and that any biosecurity or mitigation required during construction are included in the EIA Report.
- The Tay District Salmon Fisheries Board – which has statutory duties over the River Earn and the Water of Ruchill due to their status as salmonid rivers – provided some fish data and recommended that Comrie Angling Club be consulted separately for more relevant data on fish and fish ecology.
- Perth & Kinross Council approved the list of species provided in the update scoping report and also stated that invasive and notable species would be picked up during surveys for other species.

8.4.2 The details of all consultations undertaken for this assessment are included in **Appendix 8.9**.

8.5 Baseline Environment

8.5.1 Scientific names of animal species identified through consultation, by the desk study and through field surveys are presented directly in this report; names of plants recorded during Phase 1 habitat surveys are found in **Appendix 8.1**.

8.5.2 With the exception of surveys for American signal crayfish, all surveys and assessments were undertaken by Sweco ecologists. Details of the professional credentials and experience of the team members are as follows:

- Claire Hopkins is a Principal Ecological Consultant with Sweco and a full member of CIEEM. She holds an SNH licence to survey bats (licence 110500) and otters (licence 120715) and has over 14 years' experience of undertaking ecological surveys.
- Chris Rodger is a former Senior Ecological Consultant with Sweco and a full member of CIEEM. He has over 10 years' experience of undertaking ecological surveys. Chris is a habitats specialist and ornithologist.
- Erik Paterson is an Ecological Consultant with Sweco and an associate member of CIEEM. He holds an SNH licence to survey bats (Licence no. 123642) and has over 7 years' experience of undertaking ecological surveys.
- Matthew Rea is a former Ecological Consultant with Sweco and a graduate member of CIEEM. He has over 3 years' experience in undertaking ecological surveys.
- Kirsty Myron is an Ecological Consultant with Sweco and a graduate member of CIEEM. She has over 4 years' experience in undertaking ecological surveys.
- American signal crayfish surveys were completed by Practecology Ltd, led by Dr Iain Adderton CIEEM.

Designated sites

Statutory designated sites

8.5.3 No statutory designated sites are located within the study area. However, three statutory sites of International importance were identified within 10km of the study area and two sites of national importance were identified within 2km of the study area. These are summarised in **Table 8.3** and shown in **Figure 8.1**.

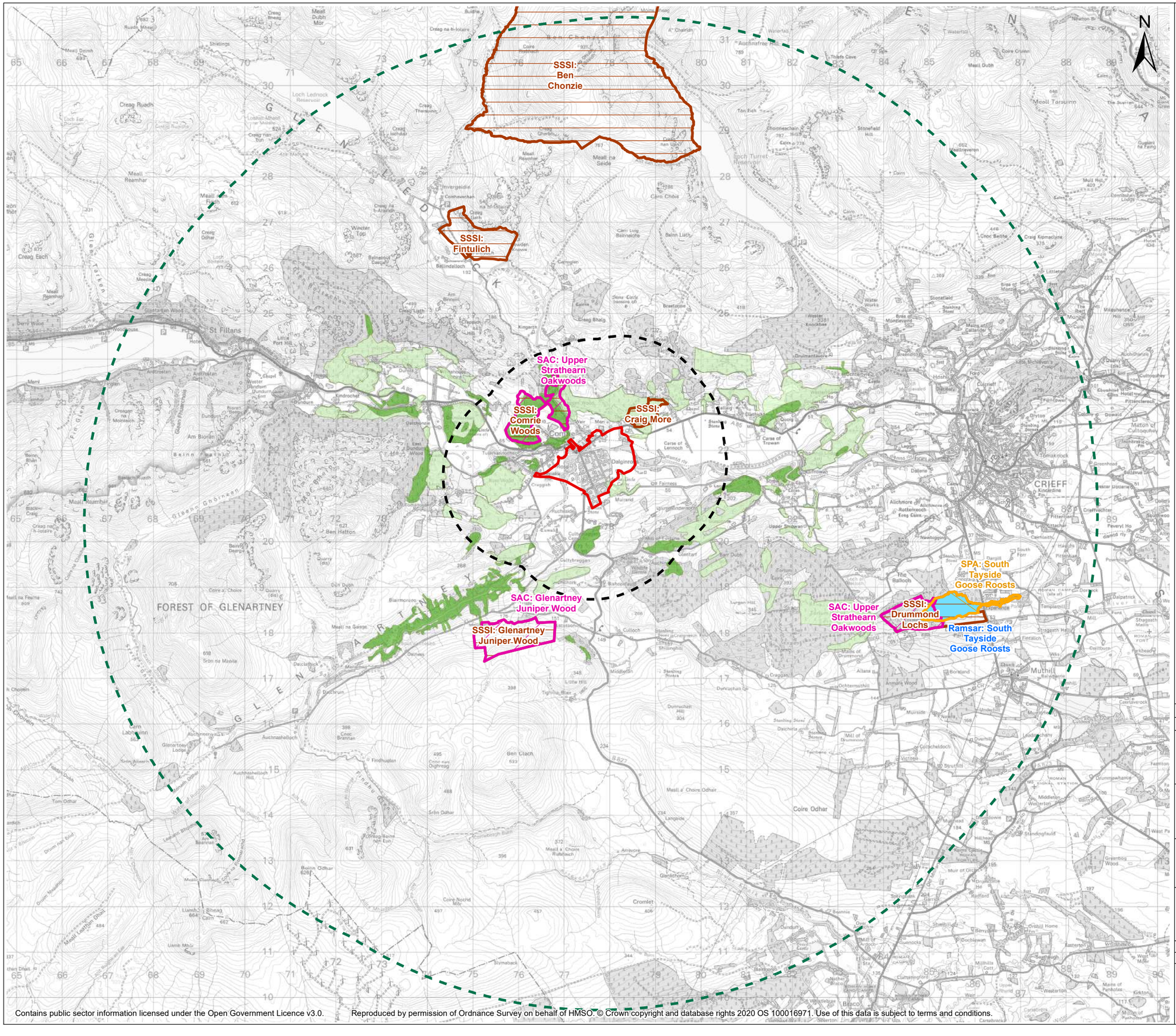
Table 8.3: Statutory designated sites

Site name	Designation	Size	Distance from study area
Upper Strathearn Oakwoods	SAC	154.8ha	400m (north)
Glenartney Juniper Wood	SAC	101.45ha	2.6km (south)
South Tayside Goose Roosts	SPA/Ramsar	3331ha	7.1km (south-east)
Comrie Woods	SSSI (Biological)	89.19ha	400m (north)
Craig More	SSSI (Geological)	27.94ha	280m (east)

8.5.4 Two designated sites (the Upper Strathearn Oakwoods and Glenartney Juniper Wood) are designated as Special Areas of Conservation (SAC) under Council Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora (the Habitats Directive), the principal aim of which is to maintain or restore the European protected habitats and species listed in the annexes at Favourable Conservation Status, as defined in Articles 1 and 2.

8.5.5 The Upper Strathearn Oakwoods SAC comprises a complex of woodland sites, all of which lie within 10km of the study area. The qualifying Annex I habitat for which the site is selected is western acidic oak woodland and is toward the eastern end of the habitat's range within Scotland. The complex includes one of the most extensive deciduous woodlands in Tayside, which was formerly managed for coppice wood production and has good structural diversity. The woods are of national importance for their lichen flora with many epiphytic species characteristic of old woodland.

8.5.6 Glenartney Juniper Wood holds the largest extent of juniper formations in Tayside. The juniper occurs widely at moderate altitude within a wide range of habitat mosaics and is regenerating well. The Annex I habitat for which it is a primary reason for site selection is juniper formations on heaths or calcareous grasslands.



Legend

- EIA Study Area
- EIA Study Area - 2km Buffer
- EIA Study Area - 10km Buffer
- Site of Special Scientific Interest (SSSI)
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Ramsar Site

Ancient Woodland

- Ancient (of semi-natural origin)
- Long-established (of plantation origin)

0 2 4 Km

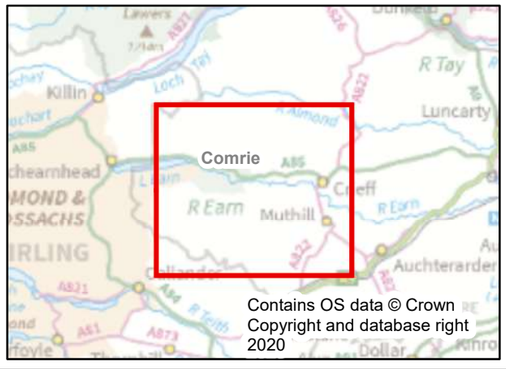


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Figure 8.1 - Designated Sites

Scale @ A3	1:80,000
Project No.	119702

8.5.7 One designated site (the South Tayside Goose Roosts SPA) receives statutory protection under the EU Directive on the Conservation of Wild Birds (79/409/EEC). The South Tayside Goose Roosts SPA is designated under Article 4.2 of the Directive by regularly supporting populations of European importance of the following migratory species listed on Annex I of the Directive (wigeon, pink-footed goose and greylag goose). This SPA also qualifies under Article 4.2 by regularly supporting in excess of 20,000 individual waterfowl which includes internationally important populations of birds including pink-footed goose and greylag goose.

8.5.8 Ramsar sites receive protection under the Convention on Wetlands of International Importance, which came into force in 1975. The South Tayside Goose Roost Ramsar site comprises seven lochs, a number of smaller water bodies and other wetland habitats in Strathearn and Strathallan to the west of Perth. The site overlaps with three SSSIs, the closest of which – Drummond Lochs SSSI – lies within 10km of the study area. The Ramsar site is internationally important as a roost for greylag and pink-footed geese.

8.5.9 SSSIs receive statutory protection under the Wildlife and Countryside Act 1981 (as amended). Within 2km of the study area there is a single site – Comrie Woods SSSI – associated with the Upper Strathearn Oakwoods SAC noted above. This upland oak woodland is in two sections: the westernmost lies on low hillsides of Glen Lednock and the easternmost straddles both sides of the gorge of the River Lednock. The woods represent some of the most extensive in Perth and Kinross and show a variety of woodland types, the majority of which is primary (ancient) woodland formerly managed for coppice and has good structural diversity and many ancient woodland indicators.

8.5.10 An additional nationally designated site – Craig More SSSI – is also situated within the 2km search distance but since its designation is for geological reasons it is not included further within this assessment.

Non-statutory designated sites

8.5.11 No ancient woodland sites were identified within the study area. Extensive areas of ancient woodland were identified within 2km of the study area which include Pollyriggs, Twenty Shilling Woods and Laggan Woods (associated with the Upper Strathearn Oakwoods SAC and Comrie Woods SSSI sites noted above); Mill and Ross Woods to the west of Comrie; Cowden Wood to the south, and parts of Lennoch Wood to the east of Comrie. The locations of long-established woodlands are shown in **Figure 8.1**.

8.5.12 LNRs are locally important for natural heritage and are designated and managed by local authorities. These locally important Sites receive protection through inclusion within the Tayside Local Development Plan.

The desk study did not establish the presence of any LNRs within 2km of the study area.

Desk study

8.5.13 Records of notable species within a 2km search area extending from the study area, were provided by Perth & Kinross Council in January 2019. Of relevance to the scope of this chapter, records of the species shown in **Table 8.4** were provided for the search area. These records are also shown in **Figure 8.2**.

N

Legend

- EIA Study Area
- EIA Study Area - 2km Buffer

Species Records

- Small Cow-Wheat
- Common Pipistrelle
- Pipistrelle
- Common Toad
- Common Frog
- Slow Worm
- Eurasian Beaver
- European Otter
- Grey Squirrel
- Red Squirrel
- Hedgehog
- Swift
- Tree Sparrow

0 0.5 1 Km

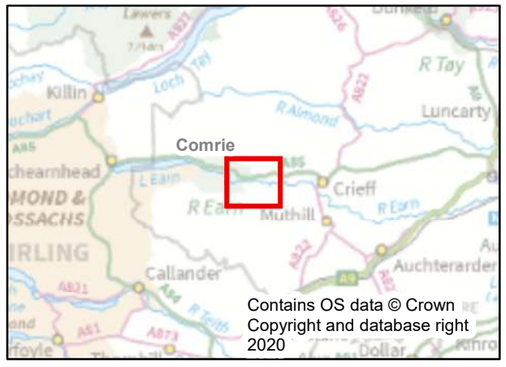

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Figure 8.2 - Perth & Kinross Council Records

Scale @ A3	1:22,000
Project No.	119702

Table 8.4 – Species records provided by Perth & Kinross Council

Species Name *Latin name*	Legislative / Conservation Status				
	Conservation (Natural Habitats, &c.) regulations 1994	Wildlife & Countryside Act 1981	Historical UK Biodiversity Action Plan (UKBAP)	Local Biodiversity Action Plan (LBAP)	Birds of Conservation Concern 4 List (Amber = A, Red = R)
Birds					
Sparrowhawk *Accipiter nisus*				X	
Kingfisher *Alcedo atthis*		X[1]		X	A
Common Swift *Apus apus*				X	A
Barnacle Goose *Branta leucopsis*					A
Reed Bunting *Emberiza schoeniclus*				X	A
Spotted Flycatcher *Muscicapa striata*			X	X	R
Tree Sparrow *Passer montanus*			X	X	R
Bullfinch *Pyrrhula pyrrhula*				X	A
Song Thrush *Turdus philomelos*			X	X	R
Herpetofauna					
Slow-Worm *Anguis fragilis*		X	X	X	
Common Toad *Bufo bufo*		X	X	X	
Common Frog *Rana temporaria*		X		X	
Invertebrates					
Pearl Bordered Fritillary *Boloria euphrosyne*		X	X	X	
Mammals					
Eurasian Beaver *Castor fiber*	X[2]				
Hedgehog *Erinaceus europaeus*		X	X	X	
Brown Hare *Lepus europaeus*		X	X		
European Otter *Lutra lutra*	X		X	X	
Common Pipistrelle *Pipistrellus pipistrellus*	X			X	
Soprano Pipistrelle *Pipistrellus pygmaeus*	X		X	X	
Grey Squirrel *Sciurus carolinensis*					
Red Squirrel *Sciurus vulgaris*	X		X	X	
Plants					
Small Cow-Wheat *Melampyrum sylvaticum*			X	X	

[1] listed on Schedule I of the Wildlife & Countryside Act

[2] added to this legislation on 1st May 2019.

8.5.14 The RSPB provided confidential records of red kite nest sites in the vicinity of Comrie. The details of these are contained within **Confidential Appendix 8.4**. and further details are not provided here.

Habitats

8.5.15 A total of 13 Phase 1 habitat types were recorded within the study area. These are summarised in **Table 8.5** and shown in **Figure 8.3**.

Table 8.5. The estimated total area of each Phase 1 habitat type within the study area

Phase 1 code	Phase 1 Habitat name	Area (ha)
A1.1.1	Broadleaved woodland - semi-natural	17.72
A1.1.2	Broadleaved woodland - plantation	1.13
A1.2.2	Coniferous woodland – plantation	0.14
A3.1	Parkland/scattered trees – broadleaved	1.49
A3.3	Mixed Parkland/scattered trees	0.29
B2.2	Neutral grassland - semi-improved	6.75
B4	Improved grassland	21.73
G2	Running water	9.76
J1.1	Cultivated/disturbed land – arable	30.82
J1.2	Cultivated/disturbed land - amenity grassland	5.81
J2.3.2	Hedge with trees - species-poor	0.27
J3.4	Caravan site	3.58
J3.6	Buillding[1]	58.36
Total		157.85

[1] Includes buildings and gardens within Comrie village

N

Legend

- EIA Study Area
- Target Notes

Phase 1 Habitat Survey

- A3.1 - Broadleaved Parkland/scattered trees
- J2.2.2 - Defunct hedge - species-poor
- J2.3.2 - Hedge with trees - species-poor
- A1.1.1 - Broadleaved woodland - semi-natural
- A1.1.2 - Broadleaved woodland - plantation
- A1.2.2 - Coniferous woodland - plantation
- A3.1 - Broadleaved Parkland/scattered trees
- A3.3 - Mixed Parkland/scattered trees
- B2.2 - Neutral grassland - semi-improved
- B4 - Improved grassland
- G2 - Running water
- J1.1 - Cultivated/disturbed land - arable
- J1.2 - Cultivated/disturbed land - amenity grassland
- J3.4 - Caravan site
- J3.6 - Buildings

0 200 400 Metres

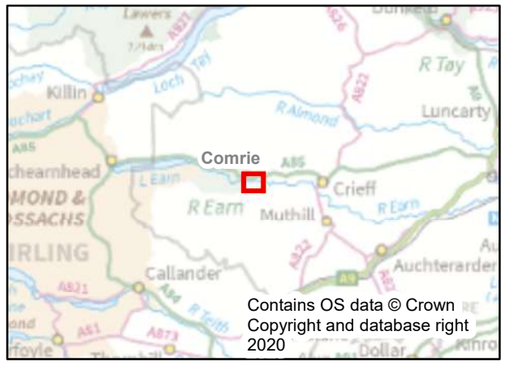

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Figure 8.3 -
Phase 1 Habitat Survey

Scale @ A3	1:8,000
Project No.	119702

8.5.16 Additional information on the type of habitats encountered during the Phase 1 survey are provided below. Target notes shown in **Figure 8.3** provide additional information on the typical species observed for the habitat categories and can be found within **Appendix 8.1**.

8.5.17 Where appropriate, the broad habitat is further described by reference to NVC community. It should be noted, however, that this is intended to give more indication of the species and habitat observed and should not be regarded as definitive NVC categorisation. The detailed assessment required for full categorisation to NVC community/sub-community is beyond the remit of the surveys undertaken.

8.5.18 No UKBAP of LBAP plant species were encountered during surveys. The only such species highlighted during the consultation was small cow-wheat (with records over 1km to the north of the study area). This species closely resembles common cow-wheat, *Melampyrum pratense,* which was encountered during associated surveys outside (to the west of) the study area. Neither species were encountered within the study area.

Broadleaved woodland - semi-natural

8.5.19 The woodland within the study area was equated to lowland mixed deciduous woodland, broadly analogous with NVC community W8 *Fraxinus excelsior - Acer campestre - Mercurialis perennis* woodland. Lowland Mixed Deciduous Woodland is a UKBAP priority habitat. As such, this habitat is described in greater detail here.

8.5.20 The plant community is not typical, primarily due to the presence of a high proportion of non-native species and disturbance. Resultantly, these woodlands are poor in terms of species diversity. The dominant canopy tree is sycamore, with ash only frequent and less abundant than would be expected in this community. This is possibly due to sycamore's greater resilience to grazing than ash, but also possibly reflecting planting history and/or ash-dieback (first recorded in the overlapping tetrad in 2016).

8.5.21 The field layer was generally sparse in terms of typical indicator species; cover of dog's mercury was less extensive than nearby areas of upland ashwood (W9) noted incidentally, and the ground layer was often bare. The structure was reasonably varied, with a good representation of native understorey trees. However, there were also numerous non-native shrubs in the understorey, mainly snowberry and gooseberry. The field layer/understorey space was often completely overwhelmed by dense stands of Japanese knotweed and, to a lesser extent, Himalayan balsam. The paucity of the ground and field layer can be explained in part by the dominance of Japanese knotweed, which is an INNS and which shades out other ground layer species. However, there was often very sparse lower strata in areas where the knotweed was absent. This is thought to be due to the early mature and pole immature sycamore forming deep shade by a continuous canopy.

8.5.22 Grazing and historical management are also possible contributory factors to the woodland condition, although deer grazing appeared moderate and no signs of recent management activity were encountered.

Broadleaved woodland - plantation

8.5.23 This comprised an area of beech-dominated 'policy woodland' (plantations associated with large estate buildings, mainly dating from early 19th century) near the cemetery on South Crieff Road. This is listed as Ancient woodland: plantation-origin.

Coniferous woodland – plantation

8.5.24 This comprised a small stand of mixed non-native conifers (mainly Sitka spruce, planted for landscaping purposes) in the vicinity of Comrie Fire Station.

Parkland/scattered trees and mixed Parkland/scattered trees

8.5.25 This category was reserved for areas where trees formed less than 30% cover, including avenues of trees. Avenues of trees were often those retained along old field margins, possibly marking old, now defunct hedgerows. This category was also used to describe tree avenues leading to, or surrounding properties within agricultural landscapes (such as farmhouses). The broadleaved trees were mainly beech, sycamore, ash and hawthorn. Where the trees were sufficiently close or along an embankment preventing cultivation, the intervening space was generally occupied by a species-poor and agriculturally enriched neutral grassland (equating to NVC community MG1: *Arrhenatherum elatius* grassland but containing many agricultural 'weeds' indicative of enrichment). The avenues of trees to the west of Water of Ruchill follow old (now defunct) hedgerows.

8.5.26 Lines of scattered trees are also present within and adjacent to private residences within Comrie (e.g. as those within Glenbuckie – TN09). The majority of private gardens were not assessed with the exception of Glenbuckie where structures are proposed within the grounds of a private residence. Broadly speaking, private residences within Comrie comprise a variety of native species (e.g. Scots pine) and ornamental species (e.g. Leyland cypress).

Neutral grassland - semi-improved

8.5.27 The large field east of Comrie Holiday Park was dominated by damp rush pasture, with Yorkshire fog and soft rush dominant. This habitat corresponds with NVC community MG10, *Holcus lanatus-Juncus effusus* rush-pasture which overlaps with several Phase 1 categories. The type observed here is typical of damp, improved grassland where management is less intensive or has recently ceased. Semi-improved neutral grassland was the most appropriate Phase 1 category due to limited species diversity (moderate to

high grazing from sheep and clear signs of agricultural improvement) and the ground conditions being relatively dry (ruling out Marshy Grassland).

8.5.28 Throughout the site were small area of semi-improved neutral grassland, generally too small in extent to map. These were mainly found as small uncultivated strips and margins within the arable landscape. Uncultivated field edges, shelterbelts/gardens and areas between trees along avenues contained species-poor neutral grassland. These were dominated by false-oat grass, with much Cock's-foot and belong to the NVC community MG1: *Arrhenatherum elatius* grassland. However, as is typical of these small areas within arable landscape, the grassland had sparse herb cover, instead dominated by species favouring enriched soils such as cleavers nettles and large docks.

Improved grassland

8.5.29 Areas mapped as improved grassland were grazing fields dominated by perennial ryegrass and crested dog's-tail, conforming to the NVC Community MG6 *Lolium perenne-Cynosurus cristatus* grassland. These fields were generally close-cropped and species-poor, with only a few agriculturally-favoured vascular plants such as white clover, ribwort plantain and common mouse-ear.

Running water

8.5.30 These areas were the watercourses of the River Earn, River Lednock and Water of Ruchil, all of which are high-energy upland watercourses on a shingle substrate. Rivers are a UKBAP Priority Habitat, but a detailed description of these watercourses is beyond the remit of a Phase 1 survey. The watercourses were mainly flanked by riparian woodland (described under Broadleaved woodland - semi-natural). Further information on the watercourses including geomorphological characteristics, is provided in **Chapter 6: Water Environment & Fluvial Geomorphology** of the EIAR.

Cultivated/disturbed land - arable

8.5.31 These fields were mainly under cereal crops and are found to the east of Comrie to the south of the River Earn; and in fields between Dalginross and the Water of Ruchill, south of Tomnagaske.

Cultivated/disturbed land - amenity grassland

8.5.32 These are areas of short improved grassland used for recreational purposes (parks, recreation grounds, playing fields etc) and were present in several areas within the village of Comrie.

Hedge with trees - species-poor / defunct hedge – species-poor

8.5.33 The hedgerows present within the agricultural landscape were largely discontinuous and ran along old and abandoned field edges, no-longer maintained as functional hedges. Many such field margins are demarked by avenues of trees, as described above and it is unclear whether these comprise retained trees from now long-defunct hedge lines. The length of the discontinuous hedge lines had a greater length of gap than hedge (with gaps filled by species-poor grassland, occasionally ruderal vegetation). The lengths of hedge were mainly filled by hawthorn and elder and not under any clear management. Beech hedges were present within the study area, but these were mainly surrounding properties or woodland compartments.

8.5.34 Although hedges are a priority UKBAP Habitat, the hedges present in the agricultural landscape of the study area were of such limited extent and poor quality that considerable management would be required to bring them into a favourable conservation status. This is possibly an objective for habitat enhancement, with the additional benefit of linking discrete and fragmented areas of woodland habitat.

Built-up areas

8.5.35 Much of the study area comprised the town of Comrie, mapped as a built-up area (J3). Other built-up areas included Comrie Holiday Park (J3.4) and individual buildings (J3.5). Larger areas of public amenity land within Comrie were mapped, although private gardens were not surveyed or mapped.

8.5.36 There are no statutory protected habitats (i.e. Annex I habitats) within the study area and there is no direct overlap between the Scheme and the woodland habitats identified within the desk study area that are associated with the Upper Strathearn Oakwoods SAC described above. Two UK BAP priority habitats (lowland mixed deciduous woodland and hedgerows) were recorded within the study area, corresponding with Phase 1 habitat types A1.1.1 (broadleaved woodland semi-natural), A1.1.2 (broadleaved woodland plantation) and J2.3.2 (hedge with trees – species-poor). These two habitats together with rivers (which is a priority habitat listed on the Scottish Biodiversity List and Tayside LBAP 2016-26) are considered to be Important Ecological Features and are therefore considered further as part of the assessment of ecological effects.

Badger

8.5.37 No records of badger were returned from the desk study or from the consultation exercise.

8.5.38 No badger field signs were identified during surveys and the study area +250m is considered largely unsuitable for sett creation, comprising the village of Comrie and intensively managed arable fields. Woodland habitats present alongside the river corridors provide potential areas of sett creation

however these are heavily disturbed by recreational users and no evidence of this species was found.

8.5.39 Although badger is common and widespread across Central Scotland, the absence of field signs and the lack of suitable habitat within the study area mean that badger is not assessed as an Important Ecological Feature and will not be considered further as part of the assessment of ecological effects.

Bats

8.5.40 The desk study returned records of common pipistrelle and pipistrelle (species unknown) within the wider area.

8.5.41 The River Earn, Water of Ruchill and River Lednock form a network of linear features across lowland Perthshire; their wooded banks provide roosting opportunities, sheltered foraging habitat and a three-dimensional structure along which bats can navigate between roosts and foraging areas. The high proportion of woodland habitat within and in the vicinity of Comrie represents optimal habitat for the region in terms of the availability of potential roosting opportunities and diverse foraging habitat for a range of invertebrate prey species. During night-time surveys undertaken as part of the assessment, bat activity was routinely observed to include behaviour indicating bats roosting outwith the study area and commuting into the study area along the rivers. A number of trees with bat roost potential were recorded in the vicinity of the Scheme (see **Figure 8.4** in **Appendix 8.2**) and a series of back-tracking surveys were undertaken to pinpoint roost locations. No tree roosts were confirmed within the Scheme and the features identified within each tree were considered small/superficial enough that the risk of large numbers of bats at a sensitive period of their life cycle (e.g. during maternity or hibernation periods) was low.

8.5.42 A number of bat roosts were confirmed within buildings and these were:

- A mixed-species (soprano pipistrelle and Daubenton's bat) maternity roost in the upper parts of St Margaret's Church (**Figure 8.4a, S5**);
- A brown long-eared maternity roost in the attic of Craigvannie, which is a short distance outside the study area to the west of Comrie;
- Two further pipistrelle roosts (including maternity roosts) at the Mill of Ross, which is more than 1km upstream of the study area; and
- An additional three structures including an old railway bridge, a wall and public convenience were considered to have some (low – moderate) roost potential.

8.5.43 Observations made during night-time surveys indicate the likely presence of further roosts within properties on Lochay Drive in Dalginross, and a number of other buildings are likely to support bat roosts at different times of the year. The remains of a former railway viaduct at the confluence of the River Earn and the Water of Ruchill offers some potential as a bat roost.

8.5.44 The following species were recorded during surveys (or signs were observed as noted above): common pipistrelle, soprano pipistrelle, Daubenton's bat, natterer's bat and brown long-eared bat. These species are all within their natural range in Comrie. The summer of 2018, at the time of the bat survey work, was recognised to be particularly warm and bat activity levels were observed to be high with large numbers of feeding passes and individual bats of several species using the dark river corridors.

8.5.45 Bats are collectively assessed as an Important Ecological Feature due to the desk study providing historical records of bats over the wider area, coupled with the established use and importance of the study area +250m buffer for roosting, foraging and commuting. Consequently, bats are considered further as part of the assessment of ecological effects.

Beaver

8.5.46 Desk study and consultation responses together with anecdotal reports from members of the public locally made up a number of historic records of beaver within the search area.

8.5.47 Despite becoming extinct in Scotland in around the 16th century, a population of European beaver has been known to be present living free in the Tay river catchment since around 2001, possibly as a result of deliberate releases[24]. An official SNH-funded study of the Tayside beaver population was undertaken in 2012 in order to assess the size of the population and to identify the distribution and impact of beavers on Tayside. The River Earn was included in this study, and one of the beaver groups studied overlapped with the study area, with group activity focused on the (now former) fish farm at Tullybannocher and feeding signs recorded along the River Earn and the Water of Ruchill. The official study had found that the River Earn displayed a comparatively high density of beaver groups, with a mean territory size of 3.4-3.8km of linear waterway. The main watercourses were considered large enough to negate the need for dam-building.

8.5.48 During field surveys undertaken in 2018 and 2019 for this study signs of beaver were recorded throughout the study area +250m boundary, including gnawed tree trunks, chewed bark, smooth sections of bank and claw/scratch marks on bankside trees (see **Figure 8.6a, Figure 8.6b** in **Appendix 8.3**). Local members of the public who spoke to surveyors noted having seen beaver on the river although no direct sightings were made by the surveyors (for example during bat surveys). Conspicuous signs were visible all along the surveyed stretches of the River Earn and the Water of Ruchill, with no available small bank-side trees on the River Lednock to indicate signs of beaver in 2018. A single burrow was recorded by Practecology surveyors in 2018; this was outwith the study area but

[24] Campbell, R.D., Harrington, A., Ross, A. and Harrington, L. 2012. Distribution, population assessment and activities of beavers in Tayside. Scottish Natural Heritage Commissioned Report No. - SNH use only

within 250m buffer to the west of Comrie (PractBE1). Surveyors visited the official beaver trial focus area at the fish farm upstream of the study area in 2018 (as part of an earlier iteration of the study area) and no recent signs indicating the presence of a significant group were evident, indicating that the focus for this group may have shifted.

8.5.49 The 2019 re-survey revealed signs of beaver continuing to be prevalent throughout the study area and +250m boundary, with foraging signs increasing in frequency, particularly on the periphery of the study area and +250m buffer (away from the urban area) (see **Figure 8.6b** in **Appendix 8.3**). The lower reach of Milton Burn was accessible in 2019 and evidence of foraging were present (see, CF46); several gnawed willow trees. No signs were found on the River Lednock however in 2019. Fresh beaver scat was also found on the banks of the River Earn west of Comrie near Ross (see, CF14). The burrow found in 2018 was not present and was presumed to be flooded out, at present.

8.5.50 Beaver is assessed as an Important Ecological Feature due to the desk study providing historical records, coupled with the species' established use of the study area +250m buffer for commuting and feeding, as confirmed by 2018 and 2019 surveys. The presence of a single burrow in 2018 indicates that beaver do use the +250m buffer for resting although the study area itself continues to appear devoid of lodges or burrows. The beaver population present likely have a large territory, utilise a large area for foraging and also occasionally use the study area as a resting site. Consequently, beaver is considered further as part of the assessment of ecological effects.

Birds

8.5.51 The desk study returned records of nine bird species of conservation significance (**Table 8.2**) within the search area and the RSPB returned records of red kite nests within the vicinity of Comrie.

8.5.52 In addition, a number of incidental observations of birds were made during surveys undertaken in 2018 for other species/species groups. Birds of note included grey wagtail (red-listed) the several additional amber-listed species including; dipper, dunnock and willow warbler. A redstart (female feeding brood) was seen just to the east of the study area.

8.5.53 Birds are collectively assessed as an Important Ecological Feature due to the desk study providing historical records, coupled with the availability of semi-natural habitats (i.e. woodland, hedgerows and grassland habitats) which birds may use for nesting. Consequently, nesting birds are considered further as part of the assessment of ecological effects. Wintering birds (i.e. roosting and foraging areas for overwintering geese and waders) are not considered separately as IEFs as there is no standing water or suitable foraging land.

Otter

8.5.54 The desk study returned records of otter on the River Earn and the Water of Ruchill as well as minor watercourses across the wider area (see **Figure 8.2**).

8.5.55 During the 2018 surveys, numerous signs of otter were recorded along the three main watercourses within the study area +250m buffer (see **Figure 8.5a** in **Appendix 8.5**). These included spraints of various ages and also included a sighting in 2018 by one of the surveyors of an adult (assumed to be a female) and cub on the Water of Ruchill.

8.5.56 Fish dominates the otter diet[25] although they will also feed on a range of taxa such as amphibians, crustaceans[26], mammals and birds. Fish data which have been provided by the Comrie Angling Club fishing returns and SEPA electrofishing data (see **Appendix 8.6**) confirm the following species (all of which are otter prey species) to be present in the River Earn and the Water of Ruchill:

- Atlantic salmon;
- Brown/sea trout;
- European eel;
- Lamprey species; and
- Common minnow.

8.5.57 In terms of resting sites otters often sleep in simple structures or in the open (i.e. couches, as distinct from underground holts). In 2018, Sweco surveyors located a number of structures (see, **Figure 8.5a** in **Appendix 8.5**) which showed signs of use by otter (e.g. couches at figure locations: OT2, OT5, OT12, OT21, OT22, OT23 and OT26; holts at OT9 and OT20) and potential features recognised as being suitable for resting (e.g. OT3, OT6, OT13, OT14, OT15, OT18 and OT25). There are likely to be a number of resting sites within each home range and these are used ephemerally[27]. A small number of below-ground structures (holts) were also recorded during surveys, typically beneath tree roots in overhanging sections of the riverbank (OT9 and OT20).

8.5.58 The 2019 re-survey revealed otter to continue to be active within the study area and +250m buffer (see, **Figure 8.5b** in **Appendix 8.5**). Spraint, a path and an adjoining slide were found on the River Earn and the Water of Ruchill

[25] Carss, D.N., Nelson, K.C., Bacon, P.J & Kruuk, H. (1998). Otter prey selection in relation to fish abundance and community structure in two different freshwater habitats. Symposia of the Zoological Society of London, 71, 191-214.
[26] Sweco ecologists found otter spraint containing the remains of American signal crayfish at a location outside the study area on the River Earn in summer 2018.
[27] Kruuk, H., Carss, D.N. Conroy, J.W.H. & Gaywood, M.J 1998. Habitat use and conservation of otters
Lutra lutra in Britain: a review. Symposia of the Zoological Society of London, 71, 119-134.

(e.g. LL4, LL1 and LL8). However, in contrast to 2018, no structures or signs were found on the River Lednock. A new holt, couch and adjoining slides, were found on the River Earn within the +250m buffer (e.g. LL3, LL7, LL9); the riverbank opposite the holt is within the study area. Fresh spraint was found above this holt (e.g. LL2). Data relating to breeding sites are sparse due to the secretive nature of females around their breeding sites[28] but it is known that cubs will generally remain in the natal holt for around two months after birth and stay with the mother for several months thereafter. Breeding sites typically need to be free from significant disturbance and at low risk of flooding. None of the resting sites identified in 2018 and 2019 are considered to meet these criteria as all three main watercourses are subject to significant disturbance from recreational users of the river banks (e.g. dog walkers) and the river itself (anglers). The study area +250m buffer has suffered a number of flooding events in recent years (see **Chapter 6: Water Environment & Fluvial Geomorphology**) and highly fluctuating water levels make resting sites unsuitable for breeding/natal holts which need to be above flood levels in order to provide safe refuge for a number of weeks whilst cubs are inside.

8.5.59 Otters in freshwater habitats are understood to have large home ranges with males roaming across up to 50km of watercourse and overlapping with a number of females which may use up to 25km of linear habitat. As such, the female and cub observed during summer 2018 are unlikely to be the only individuals utilising the three main rivers of the catchment and there may be up to one other male and one or two females using the watercourses for foraging and commuting. Riverbanks are used as terrestrial routes for moving up-and downstream particularly during spate conditions, and overland routes will also be used occasionally. Given the built-up nature of the majority of the study area +250m buffer, overland routes are likely to be restricted to field boundaries and minor ditches to the east and west of the village.

8.5.60 Otter is reported to be present throughout Tayside and Clackmannanshire and was calculated to be at or close to 100% carrying capacity in this region[29]. A highly significant increase in otter activity in this region was recorded in 2003 compared with 1978 levels; its success largely due to improvements in water quality (the Water of Ruchill has Good ecological status and the River Lednock and the River Earn have Moderate status according to SEPA's water quality assessment classification[30]; all three have High status in terms of freedom of movement for migratory fish (see **Sections 8.5.71 to 8.5.76** below).

[28] Liles, G. 2003. Otter Breeding Sites: Conservation and Management. Conserving Natura 2000 Rivers
Conservation Techniques Series No. 5, English Nature Peterborough.
[29] Strachan, R. (2007). National survey of otter *Lutra* distribution in Scotland 2003–04. Scottish Natural Heritage Commissioned Report No. 211 (ROAME No. F03AC309).
[30] https://www.sepa.org.uk/data-visualisation/water-classification-hub/

8.5.61 Otter is assessed as an Important Ecological Feature due to the identification of otter activity within and adjacent to the study area comprising historic records, sightings and abundant signs and potential for resting up along all three of the major watercourses and minor tributaries. Therefore, otter is considered as part of the assessment of ecological effects.

Water vole

8.5.62 No historical records of water vole were returned from the desk study.

8.5.63 Water voles are found on waterway edges in a range of habitats from upland burns to wide rivers[31]. They have a vegetarian diet, favouring lush bankside vegetation dominated by grasses and sedges for food and cover from predators. They create extensive burrow systems but avoid rocky banks due to difficulties posed by excavation.

8.5.64 No water vole field signs were identified during surveys and the study area +250m is considered unsuitable for water vole, due to the rocky or cobbled nature of the banks (refer to geomorphological comments within **Appendix 8.7** (crayfish report) and the CBEC geomorphology report within **Appendix 6.2**) and the lack of dense vegetation cover. In addition, American mink, an introduced and voracious predator of water vole, is known to be present in the area (a print was found a short distance outside the study area +250m buffer to the east of Comrie on the River Earn during surveys by Sweco ecologists) which further reduces the suitability for this species. Water vole is considered absent at the present time.

8.5.65 With the absence of historical records of water vole in the wider area, together with no evidence being found within the study area +250m buffer, lack of suitable habitat and presence of major predatory species American mink, this species is not assessed as an Important Ecological Feature and will not be considered further as part of the assessment of ecological effects.

Red squirrel

8.5.66 A single red squirrel was seen by surveyors (in 2018) in the grounds of Craigvannie (a short distance upstream of the Ross Bridge) within the 250m buffer of the study area and the landowner at the property reported seeing red squirrels regularly and watching them using an underpass beneath the road for commuting towards trees on the south side of the River Earn within the study area. No dreys were recorded within any of the trees surveyed (these were surveyed for both bats and dreys) and it is concluded that trees will occasionally be used for foraging and for commuting between woodland areas. The baseline arboreal habitat within the study area +250m buffer allows for red squirrel to move along the river bank at height (out of the

[31] Strachan, R., Moorhouse, T. & Gelling, M. 2011. Water Vole Conservation Handbook. Wildlife Conservation Research Unit, Great Britain.

reach of ground-based predators such as cats and foxes) along the length of the River Lednock and parts of the River Earn and Water of Ruchill, although gaps exist where small amenity trees and open gardens/grassland dominate in the centre of Comrie.

8.5.67 Red squirrel were not seen in the 2019 survey, nor were any signs of them (e.g. dray, foraging).

8.5.68 Red squirrels can be found in most woodland habitats including plantations and shelterbelts and the extent of use is influenced by the age of trees (which have to be old enough to produce seeds[32]). In the wider area, large areas of woodland including broadleaved, mixed and conifer plantation woodland are present, forming networks of interconnected forests across Strathearn, aiding dispersal.

8.5.69 The study area is situated within 10km north of a Forestry Commission Scotland (FCS) grant scheme in which the FCS supports targeted control of grey squirrel (*S. carolinensis*) in areas where they are a threat to the red squirrel[33]. Perthshire remains a stronghold of red squirrel populations.

8.5.70 Consultation and a desk study provided historical records of red squirrel for the search area and adult red squirrel was observed in the study area +250m buffer. This species is assessed as an Important Ecological Feature due to the presence of suitable habitat (i.e. mature woodland) within the study area. Consequently, this species is considered further as part of the assessment of ecological effects.

Aquatic ecology

8.5.71 The baseline aquatic ecology data were obtained from consultee responses (see **Appendix 8.6**) as follows:

8.5.72 Comrie Angling Club provided fishing returns for the years 2011 – 2017, the most recent year these data are available for. 2017 had the highest returns for Atlantic salmon (including grilse as a separate category) and sea trout out within that period.

8.5.73 The major watercourses within the site (River Earn, Water of Ruchill and Lednock Burn) all receive Moderate-High scores for Fish in their SEPA water classification and High scores for Macroinvertebrate ASPT where scores are given. A summary of ecological classifications for the relevant watercourses are shown in **Table 8.6**.

[32] Gurnell & Lurz (2012). Red squirrel chapter in publication UK BAP mammals: interim guidance for survey methodologies, impact assessment and mitigation.
[33] Source: https://map.environment.gov.scot/sewebmap/. Accessed 18/02/19.

Table 8.6 – SEPA Water Classification - 2017

Watercourse Name	ID	Overall Ecology	Macroinvertebrates ASPT	Fish
River Earn (Loch Earn to Water of Ruchill confluence)	6839	Moderate	High	Moderate
River Earn (Water of Ruchill to Ruthven Water confluences)	6838	Moderate	High	High
Lednock Burn	6815	Moderate	N/A	High
Water of Ruchill	6817	Good	High	High

8.5.74 Electrofishing and macroinvertebrate data provided by SEPA also indicates the ecological status of these watercourses. River Earn supports Atlantic salmon, brown trout, lamprey spp. and European eel populations. The Water of Ruchill also supports populations of Atlantic salmon, brown trout and European eel.

8.5.75 SEPA macroinvertebrate survey results show scores consistent with Excellent[34] status (BMWP ASPT >6.0) across the three major watercourses and the River Earn and Water of Ruchill have a SEPA water classification of High for macroinvertebrates. The desk study conducted did not return any records of notable freshwater macroinvertebrate species.

8.5.76 Consultation and a desk study provided historical records of Atlantic salmon, brown (sea) trout, lamprey spp. and European eel within the search area. In the absence of specific survey effort, freshwater and migratory fish are assessed as Important Ecological Features due to the presence of suitable habitat along the three main watercourses. Consequently, freshwater and migratory fish are considered further as part of the assessment of ecological effects.

Invasive non-native species (INNS)

8.5.77 Detailed survey information for INNS are included in **Appendix 8.7** and **Appendix 8.8**.

8.5.78 INNS plant species were ubiquitous throughout the study area +250m buffer in 2018. Along the river banks of all three main watercourses and Milton Burn the INNS flora is dominated by Himalayan balsam and Japanese knotweed with additional stands of variegated yellow archangel, montbretia and Rhododendron. Snowberry – another invasive species – was noted to be present in small clumps on the north bank of the River Earn but because this species is not included in Schedule 9 it is not considered further here. A programme of INNS treatment through chemical spraying commenced in summer 2019 by an experienced contractor and the extent to which the study area is still infested with these species will

[34] https://www.sepa.org.uk/media/38423/river-water-quality-classification-scheme.pdf

not be known until the 2020 growing season. As such, it is assumed that these invasive plant species will still persist in some areas.

8.5.79 INNS animal species were also recorded outwith the study area +250m buffer and these were American mink (a single print found in sandy substrate a short distance downstream of the Scottish Water WwTW to the east of Comrie) and American signal crayfish (SEPA reported this species to be present; Sweco ecologists found two dead crayfish near the fish farm upstream of Comrie to the west and additional crayfish signs were found in an otter spraint in the same stretch).

8.5.80 Signal crayfish have a significant negative impact on the biodiversity of water-courses and bank-side stability. Signal crayfish surveys were carried out by Practecology on the three main watercourses: the River Earn, Water of Ruchill and the River Lednock. Surveys included an initial habitat assessment, and instream aquatic survey and torchlight surveys. The instream survey followed methodology used for native white-clawed crayfish. Using these techniques, no crayfish were found within the areas surveyed.

8.5.81 The bankside geology and bed substrate were considered to be unsuitable for signal crayfish. There is a lack of suitable burrowing opportunities and the number of large consolidated boulders on the bed to shelter under is very limited. All of the rivers are subject to rapid changes in height and faster flows following periods of rainfall further limiting their suitability for crayfish. It was concluded that the crayfish population is restricted to Tullybannocher Burn (see **Appendix 8.7**).

8.5.82 Field surveys identified Himalayan balsam and Japanese knotweed within the study area +250m buffer, together with variegated yellow archangel, montbretia and Rhododendron. All of these species are listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended); as such it is an offence to cause these plants to grow in the wild at a place outwith their native range. These plant species are considered to be Important Ecological Features and are therefore considered further as part of the assessment of ecological effects.

8.6 Geographical context

8.6.1 This section, which has been undertaken in accordance with the methods described in **section 8.3** above establishes the geographical context of identified Important Ecological Features following the frame of reference recommended by CIEEM (2018). As part of the process, it is important to note that the geographical context is presented in order to contextualise the assessment of ecological effects and therefore should not be interpreted as a ‘value’ hierarchy. **Table 8.7** presents a justification and establishes the geographical context for each identified.

Table 8.7 – Geographical context

Ecological feature	Description	Geographical Context
Semi-natural broad-leaved woodland (A1.1.1) and Plantation broad-leaved woodland (A1.1.2)	The broad-leaved woodland on-site covers an area of approx. 18.85 ha). The semi-natural woodland represents 0.21% of the native woodland in Perth and Kinross. There are nearby areas of SSSI/SAC woodland with which the study area woodland is not directly connected. The SSSI/SAC woodlands are of higher ecological and conservation value than the broadleaved woodland within the study area, following an assessment of habitat quality parameters. This habitat is listed as a priority on the UK Biodiversity Action Plan (UKBAP), Scottish Biodiversity List (SBL), and Local Biodiversity Action Plan (LBAP).	District
Hedgerow with trees – species-poor (J2.3.2)	The hedgerows present on site are small (approx. 0.27 ha), defunct, and species-poor. This habitat is listed as a priority on UKBAP, SBL, and LBAP.	Local
Running Water (G2)	Within the study area, three major watercourses, the Lednock, the Earn, and Ruchill Water join. In addition, another minor watercourse, the Milton Burn also has its confluence on the eastern edge of the study area. These four watercourses form a major junction and an important linear habitat feature comprising approx. 9.76 ha in area. This habitat is listed as a priority on the SBL and LBAP.	District
Bat species	Five species of bat (Common pipistrelle, soprano pipistrelle, Daubenton's bat, Natterer's bat, and brown long-eared) were observed to be utilising features of this site for foraging and commuting. This is inclusive of the riparian fringe woodlands, and of the riverine habitats themselves. Additionally, five maternity roosts were confirmed including three pipistrelle roosts, a brown long-eared roost, and a Daubenton's roost. The species recorded are not considered to be particularly rare or threatened within Scotland. However, the habitats present on site are of high value for foraging, commuting and roosting behaviour. All bat species are offered protection in Scotland under schedule 2 of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). All species located within the Study area are listed on the SBL and LBAP.	District
European beaver	Both old and new foraging signs of beaver were recorded throughout the riparian fringes of the River Earn, Water of Ruchill, River Lednock and Milton Burn. Foraging signs were recorded on the Lednock in 2018, only. A single burrow within the +250m was recorded to the west of Comrie in 2018; this appears to have been flooded out in 2019. Beaver scat was found on the upper River Earn in 2019. Large numbers of records were received as part of the background data search and beaver have been known to exist here in comparatively large numbers in the last 5 years[35] European beaver is a European Protected Species, and as such is offered protection in Scotland under Schedule 2 of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).	District

[35] Trial re-introduction of the Eurasian beaver after an absence of 400 years to Scotland, UK. In Soorae, P. S. (ed.) (2016). Global Re-introduction Perspectives: 2016. Case-studies from around the globe. Gland, Switzerland: IUCN/SSC Reintroduction Specialist Group and Abu Dhabi, UAE: Environment AgencyAbu Dhabi. xiv + 276 pp.

Ecological feature	Description	Geographical Context
Breeding Birds	On the whole, the red and amber – listed Birds of Conservation Concern are widespread breeding birds within Scotland and the region. The one exception is kingfisher, which is a relatively localised but common breeding bird within a Scottish context. Red-kite, although Schedule I, is green-listed.	Local
European otter	Holts, couches, slides and potential resting places were noted across all three river systems during all surveys. Additionally, a number of spraints were observed within the river catchments and in 2018 three otters were incidentally noted at the confluence of the Earn and Ruchill. No breeding holts have been observed, likely due to disturbance. The three river systems within the study area provide high-quality foraging and commuting habitat as well as resting sites. Otter populations are believed to be at their carrying capacity within Tayside. Otters are offered protection by the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and are listed as a priority species on the LBAP and SBL.	District
Red Squirrel	A single red squirrel was observed just upstream of the Ross Bridge by the edge of the Earn in 2018. Local homeowners also reported regularly seeing squirrels. No signs of red squirrel were found in 2019. No dreys were recorded during either survey and there were no additional sightings though red squirrel likely utilises the site for foraging and commuting. Additionally, the majority of the records received during the background data search were of red squirrel. Red squirrels are offered protection in Scotland under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Additionally, they are listed on the LBAP and SBL.	Local
Aquatic Species	The major watercourses within the site (River Earn, Water of Ruchill and Lednock Water) all receive Moderate-High scores for Fish in their SEPA water classification and the River Earn supports Atlantic salmon, brown trout, lamprey ssp. and European eel populations. The Water of Ruchill also supports populations of Atlantic salmon, brown trout and European eel. SEPA macroinvertebrate survey results show scores consistent with Excellent[36] status (ASPT >6.0) across the three major watercourses and the River Earn and Water of Ruchill have a SEPA water classification of High for macroinvertebrates. No macroinvertebrate species of note are known to be present. The River Earn and Water of Ruchill have regional importance owing to their habitat quality, species presence and connectivity with the River Tay. The Lednock Water is of poorer quality and has District importance. Smaller watercourses are of local value. Atlantic salmon and lamprey species are listed on Schedule 3 of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). European eel and brown trout are also listed on the UKBAP.	Regional
Invasive Non-Native Species	Five species of invasive plant (Japanese knotweed, Himalayan balsam, rhododendron, variegated yellow archangel, and montbretia) and two species of invasive animal (American signal crayfish and American mink) were recorded within the study area and wider area.	Local

[36] https://www.sepa.org.uk/media/38423/river-water-quality-classification-scheme.pdf

Ecological feature	Description	Geographical Context
	All species here are listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) and as such it is an offence to release or cause to be released any of these species.	

8.7 Potential Effects

8.7.1 The construction and operation of developments results in a range of researched and well documented ecological effects. This section assesses the potential effects of the Scheme on the identified Ecologically Important Features arising from the construction and operation of the Scheme.

8.7.2 In accordance with CIEEM guidance (CIEEM, 2018) only those effects that are likely to be significant have been assessed and are detailed below. As outlined in **Section 8.3**, all potential effects described below would be considered significant in accordance with CIEEM (2018), which are all assessed to be adverse unless otherwise stated.

8.7.3 As part of the assessment, it is important to recognise that potential ecological impacts may interact; e.g. habitat loss during construction could potentially result in disturbance and habitat fragmentation, and the resulting combination of impacts may, through synergistic effects, increase the overall adverse effect of the Scheme.

Construction

8.7.4 The activities likely to cause impacts during the construction phase (see **Chapter 3: Scheme Description and Alternatives**) include:

- Site clearance including tree felling within the Scheme footprint, together with land required for construction and access including temporary lay-down areas;
- Vehicle, plant and personnel movements during construction;
- Construction activities associated with the installation of flood walls, embankments and erosion protection measures comprising coir roll walls; and
- Provision of areas of compensatory planting and mitigation measures on- and off-site.

8.7.5 The types of impacts resulting from such activities can include:

- Land-take leading to habitat loss or modification;
- Disturbance/damage to existing watercourse banks and bed;
- Physical damage to vegetation from smothering, damage to roots and changes in hydrology or soil chemistry;
- Pollution of habitats from run-off and chemical spillage;

- Impacts on species including killing and injury, loss of breeding and foraging habitat and disturbance; and
- Spread of invasive, non-native species (INNS) into the wild or outside their current distribution.

8.7.6 Construction is anticipated to be phased over a 2 to 3 year period, with works typically undertaken between 0700 to 1900 hrs Monday to Friday and 0800 to 1300 on a Saturday, if required.

8.7.7 The assessment of ecological effects has been informed based on the assumption that a temporary area will be required around the proposed Scheme in order to undertake and complete construction works (construction footprint) and areas for construction compounds. Reinstatement of these temporary areas will be undertaken following construction reducing the footprint of the built development to permanent areas of hard-standing and infrastructure. The assessment of habitat loss below assumes that the land-take, which is required to construct the Scheme, is in most circumstances, temporary and short term. It is expected that the majority of these areas will be reinstated to their former land-use at the end of the anticipated 3-year construction period. In comparison, habitat loss, which is associated with land-take required for the permanent footprint of the Scheme is a permanent impact, since these habitats are lost to the development.

Habitats (i.e. broadleaved woodland, hedgerows and rivers)

8.7.8 The construction area overlaps a range of habitat types, with two IEFs (broadleaved woodland and rivers) being directly affected. No hedgerows would be affected by the proposed works therefore there would be no impact on this IEF.

8.7.9 The construction area overlaps with broadleaved woodland habitat type and this would affect 4.6 ha in terms of area. This equates not only to the loss of around 530 trees (see **Chapter 5: Landscape and Visual Impact Assessment**) but also the loss of associated ground flora. Loss of broadleaved woodland habitat would be irreversible since the woodland habitat to be lost would be beneath the Scheme with ongoing management of woodland habitat within the construction footprint to ensure that a working area can be maintained adjacent to the Scheme. At the district scale this effect would be Minor (not significant) as the loss of woodland habitat forms a small part of the whole resource.

8.7.10 The characterisation and quantitative effects of Scheme construction on hydrology, flood risk and fluvial geomorphology are assessed separately in **Chapter 6: Water Environment & Fluvial Geomorphology** and are not repeated here. In terms of rivers as a habitat type, the key impacts would be disturbance/damage to watercourse bed and banks at those locations where flood defences are constructed and where bank protection is proposed. The potential for effects on river banks and the availability of

resting sites for protected species is addressed in the beaver and otter sections below and the potential for effects of silt-laden runoff on fish habitat is addressed in the aquatic ecology section.

8.7.11 As such, only habitat degradation in terms of water quality (pollution) is included in the assessment of effects for the Rivers habitat type. The following construction activities have the potential to cause pollution:

- Disturbance/mobilisation of contaminated soils from site clearance and ground preparation works;
- Bankside works in the vicinity of watercourses;
- Polluting activities including vehicle washing, cement mixing, refuelling and oil/fuels storage and operation of staff welfare facilities;
- Movement of construction vehicles and transport of potentially polluting materials around the site; and
- In-channel works associated with the construction of bank erosion protection measures.

8.7.12 Disturbance/mobilisation of contaminated soils (for example at the former gasworks) could temporarily affect water quality (see **Chapter 7: Hydrogeology and Contamination** for details).

8.7.13 Runoff from site compounds may contain pollutants and spillages of hydrocarbons, chemicals, fuels, oils and unset cement which can be toxic to aquatic species and affect water quality. Together with accidental leaks/spillages from plant and storage tanks and during transportation of hazardous substances around site, and uncontrolled release of plant/vehicle washings and concrete spills (which are highly alkaline) the risk of pollutants is predicted to result in an impact on all three main watercourses. Due to the heightened risk of pollution events associated with in-channel works in the River Earn, the risk is predicted to be higher here compared with the River Lednock and the Water of Ruchill.

8.7.14 Pollution impacts would be short term over the phased construction period. The three main watercourses have a high ability to dilute and disperse pollutants, as such the impact of pollution is considered to be significant, negative, medium-term but reversible at the district level. The effects would be measurable within the study area however the effect is unlikely to affect the conservation objectives of this feature.

Bats

8.7.15 It is estimated that around 530 trees would be lost during the clearance of the site for construction of the Scheme. Whilst no bat roosts were found within any of the trees proposed for felling, a number of trees assessed as having roost potential are present within the felling area. The details of these features are shown in **Table 8.8**.

Table 8.8 – Potential bat roosts in trees to be felled/ structure to be repaired

Tree reference [1]	Roost potential category	Location [2]	Reason for felling
T16, T11	Low	East bank of Water of Ruchill	root wad revetment
T13, T17, T23	Low	Woodland adjacent to Field of Refuge	WR04
T19	Low – moderate	Woodland adjacent to Field of Refuge	ER01
T21	Low	Woodland adjacent to Field of Refuge	ER01
T22	Moderate	Woodland adjacent to Field of Refuge	ER01
T29	High	Amenity tree adjacent to Dalginross Bridge	ER01
T34, T36	Low	Right bank of River Earn	ER03
T48, T49, T50	Low	Right bank of River Earn	ER03
T53	Moderate	Right bank of River Earn	ER03
T54, T55, T56	Low	Right bank of River Earn	ER03
T33, T35, T45	Low	Left bank of River Earn	EL03
T47	Moderate	Left bank of River Earn	EL04
T51	Low - Moderate	Left bank of River Earn	EL04 / EL05
T39	Moderate	Right bank of River Lednock	LR02
T40	Low	Right bank of River Lednock	LR02
T37	Low - Moderate	Right bank of River Lednock	LR02
T41, T42	Low	Left bank of River Lednock	LL01

[1] Tree reference relates to identification during bat survey

[2] Left and right banks are defined as those banks facing downstream

8.7.16 Should tree felling or structural work occur whilst bats are roosting inside direct mortality may occur, with consequent significant negative and irreversible (at individual level) / reversible (at population scale) effects. None of the trees/structure to be lost had been considered to be capable of supporting large numbers of bats at a sensitive time in their life cycle (i.e. maternity or hibernation roosts), instead, they were judged to provide opportunities for small numbers or individual bats to roost. As such, assuming the worst possible scenario, the effect of small numbers of bats would be Moderate (significant) as it would be measurable but not affect the distribution or abundance of the IEF at a population level or affect the conservation objectives of this species.

8.7.17 Construction works including vehicle movements, piling and installation of flood wall LR01 would be reasonably expected to result in disturbance to a known bat roost (Daubenton's bat and soprano pipistrelle mixed-species

maternity roost) at St Margaret's Church (S5[37]) if works were undertaken during the maternity roosting period of May-August inclusive. This, coupled with the clearance of trees from the river channel immediately adjacent to the church, would be expected to result in changes to the way that bats emerge from the roost to forage on the River Lednock and use the river corridor as a sheltered foraging and commuting corridor. Whilst the suitability of the building as a roost is unlikely to be compromised (as there are no changes to the roost itself) it is possible that the works may result in a change of suitability since the building would no longer be shaded by large trees and landscape cues would change. The effect of this would be Moderate (significant) as it would affect a number of Daubenton's and soprano pipistrelle bats at a vulnerable time of year with respect to their life cycle. The effect would be reversible with no long-term effects on the local population.

8.7.18 Vegetation clearance including tree felling would result in a reduction in available shelter and foraging habitat along sections of riverbank habitat at the River Earn and the River Lednock. The use of in-channel works in the River Earn would the use of artificial lighting on the river banks and in the in-channel works area on the River Earn would affect the suitability as a dark flyway affecting bats' use of this feature[38]. The worst-case scenario would be that the loss of shelterbelt habitat together with open areas becoming unsuitable for foraging/commuting would result in the effective temporary loss of approximately 600m of the River Earn, 400m of the River Lednock and 200m of the Water of Ruchill if works were undertaken during the bat activity period (April – September). In the long term, there is not anticipated to be any appreciable loss of foraging/commuting habitat as individuals become accustomed to the new layout and given that any lighting would be temporary. Overall the effect would be reversible and Minor at the District level.

Beaver

8.7.19 No beaver lodges, dams or burrows were recorded within the study area; the only burrow found was within the +250m buffer in 2018 and no signs of the burrow were found in the 2019 survey. This feature was outwith the areas required for construction activities therefore there would be no loss of resting habitat or areas which have been engineered by beavers to provide for family groups. The construction of the Scheme would require the clearance of broadleaved woodland and trees alongside the Water of Ruchill, the River Earn and the River Lednock which would result in a reduction in the availability of beaver foraging habitat. The number of trees/areas of broadleaved woodland vegetation affected in relation to the habitat available locally is considered to be irreversible (since the trees would not be able to grow back beneath the Scheme footprint) but

[37] Structure reference in preliminary roost assessment in bat study area (**Appendix 8.2**)
[38] Bat Conservation Trust and Institution of Lighting Professionals (2018). Guidance Nove 08/18: bats and artificial lighting in the UK. Bats and the Built Environment Series.

indiscernible at the district level resulting in Minor (not significant) effects on beaver.

8.7.20 Potential impacts from the use of in-channel work on the River Earn and from bank-side works on the Earn, the Ruchill and the Lednock may result in fragmentation of these watercourses used by beavers as a result of noise and vibration generated during construction. Although this impact would only be anticipated during the construction/reinstatement phase and limited to working hours, the additional disturbance may deter beavers from commuting and foraging along the Earn, Ruchill and Lednock. This may lead to further habitat fragmentation. Therefore, this disturbance is assessed as a significant, negative but a reversible effect at a local level.

8.7.21 Changes to the banks of the River Ruchill, River Lednock and River Earn have the potential to affect the availability of beaver burrowing habitat, however no burrows were found in proximity to the proposed Scheme and with the proximity of Comrie and assumed high levels of background anthropogenic disturbance the loss of limited burrowing habitat is considered to have a negligible (not significant) effect.

Breeding birds

8.7.22 There is potential for breeding birds to be killed, injured or disturbed during construction. The breeding bird season is typically from March to August inclusive and mitigation will be required if works occur within this period (those requiring vegetation removal or tree felling). There were no notable breeding/nesting bird species identified as an incidental part of the survey work on-site, with the location of the Scheme in relation to a built-up area affecting its suitability for rare birds. Clearance of vegetation and physical works to riverbank habitat during the phased construction period has the potential to result in destruction of active nests if undertaken during the breeding bird season. The effect is considered moderate (significant) as it would affect the distribution of the IEF and would contravene legislation protecting wild birds, however, the conservation objectives of the species are unlikely to be compromised.

Otter

8.7.23 A number of otter resting sites (i.e. holts and couches which had signs indicative of use by otter together with potential resting sites which had no evidence of use at the time of the survey) would be either directly affected by the construction of the Scheme or within close proximity to the construction site (this is defined as being within 30m of the works area) and would be at risk of being destroyed, damaged or disturbed as a result of installation of walls, embankments, scour protection or the laydown or access infrastructure required for these. The features affected are summarised in **Table 8.9**.

Table 8.9 – Otter resting sites and potential resting sites to be disturbed

Resting site reference	Description	Location	Reason for disturbance
OT9	Holt	Left bank of River Earn	EL02
OT12	Couch	Right bank of River Earn	ER03
OT13, OT14, OT15	Potential resting site	Right bank of River Earn	ER03

8.7.24 Potential impacts from the use of in-channel work on the River Earn and from bank-side works on the Earn, the Ruchill and the Lednock are likely to result in effective fragmentation of these watercourses used by otter as a result of noise and vibration generated during construction. Although this impact would only be anticipated during the construction/reinstatement phase and limited to working hours, the additional disturbance may deter otters from commuting along the Earn, Ruchill and Lednock, potentially leading to further habitat fragmentation. Disturbance is therefore assessed as a significant, negative but reversible effect at a local level. The effect is considered moderate (significant) as it would affect the distribution of the IEF however as the resting sites are not breeding sites the conservation objectives of the species are unlikely to be compromised.

Red squirrel

8.7.25 No red squirrel dreys were recorded within the study area +250m buffer however red squirrel is known to be present within the wider area and may use the trees for foraging and commuting. Despite this, no foraging signs were observed though, adult squirrels were observed being fed in the garden of a private residence south of the River Earn, west of the crossing to Ross. The proposed construction works would result in felling around 540 trees which would create gaps in the linear habitat along the downstream reach of the River Lednock and along the right (south) bank of the River Earn. The loss of trees alongside the river banks would result in fragmentation of habitats such that the arboreal structure red squirrels require for moving through the landscape would not exist and small pockets of woodland habitat may become effectively inaccessible. However, the existing availability of mature woodland across Comrie and the river banks is such that gaps already exist and further tree felling on the scale required for construction of the Scheme would not be expected to result in significant change to the availability of, or accessibility to, significant woodland habitat resource. As such habitat loss is assessed as minor (not significant) as it would not have a measurable effect on the distribution of red squirrel at the local level and its conservation objectives would not be compromised.

Aquatic ecology

8.7.26 Freshwater fish species including Atlantic salmon, trout, eel and lamprey species use the River Earn, the Water of Ruchill and the River Lednock for migration and spawning.

8.7.27 At this stage, in-channel construction utilising temporary sheet piles, in-channel platforms and/or a temporary dam in order to create a dry working area for construction is anticipated to be required on the River Earn on the right side of the channel between Dalginross Bridge and Lochay Drive. There is no in-channel construction anticipated on the River Lednock or the Water of Ruchill. In-channel works are likely to result in a temporary narrowing of the channel with changes in flow patterns and sediment transport in the River Earn, together with creation of physical barriers to fish movement including migratory salmonids.

8.7.28 Small fish such as smolt are vulnerable to noise and vibration[39]. Both salmon and lamprey hear in low and infrasound frequency levels which may result in behavioural responses to piling noise such as avoidance of the area which may result in temporary barriers to migration.

8.7.29 Construction activities close to the river banks and removal of bankside vegetation may result in increased scour of the bed and banks, and in volumes of sediment entering the watercourses which can result in filling-in of pools with accumulating sediment. Increases in silt-laden runoff and increased volumes of suspended sediment in the channel has the potential to affect the chemical and ecological quality of the watercourses (see effects of water quality above) and if undertaken during the sensitive time of year for salmon eggs and alevins (i.e. between November and May) in-channel works could result in the loss of salmonid spawning and brooding habitat.

8.7.30 Accidental release/spillage of oils, fuels and chemicals from mobile or stationary plant, such as the in-channel piling rig, and a localised increase in alkalinity from spillages of concrete or unset cement from activities involving concrete pumping and pouring could result in changes to the pH of the water. Aquatic species are very sensitive to changes in pH and could be adversely affected by such pollution events.

8.7.31 The effects of construction on fish and fish habitat would be anticipated to be temporary during the phased construction period. The effect would be negative, reversible and with long term effects which would not be expected to affect the conservation objectives of this IEF. The effect is considered Moderate (significant) at a species level as the effect may not be discernible at district/regional scale.

[39] E.g. Nedwell JR, Turnpenny AWH, Lovell JM, Edwards B (2006) An investigation into the effects of underwater piling noise on salmonids. Journal of the Acoustic Society of America 120:2550–2554; Hawkins AD, Johnstone ADF (1978) The hearing of the Atlantic salmon, *Salmo salar* . Journal of Fish Biology 13:655–673.

Invasive non-native species

8.7.32 The construction of the Scheme will require land to be cleared where INNS have been identified; these areas are focused along the banks of the Water of Ruchill and the River Earn, with large stands of INNS within woodland adjacent to the Field of Refuge. The species which have been identified within the construction area (but owing to their invasive nature may be found in all locations across the study area) are:

- Japanese knotweed – this species is present within the construction areas of WR02, WR03; WR04; EL02; EL03; ER01; ER02 and ER03. In addition, Japanese knotweed is present at the location of the root wad revetment along the Water of Ruchill;
- Variegated yellow archangel – this species is present in isolated stands within the construction areas of ER03.

8.7.33 Disturbance to the banks of the watercourses together with clearance of vegetation on land for the installation of flood walls, embankments and associated infrastructure may result in the mobilisation of contaminated soils. In the absence of control, natural, accidental and/or deliberate spread of seed and contaminated soil will take place, resulting in the expansion of these INNS species into new, previously uncontaminated areas. If left untreated their spread has potential to result in damage to structures throughout the Scheme as once this species has established under an engineered surface there are limited options for control.

8.7.34 The effect of dispersal of these species through site clearance for construction would be negative, long term and reversible at the local level. This is considered to be a Moderate (significant) effect as the uncontrolled spread of these species would affect a larger geographical scale than that of the Scheme footprint itself. The effect would increase the distribution and abundance of the IEF and thus compromise legal requirements.

Operation

8.7.35 The activities likely to cause impacts during the operation phase (see **Chapter 3: Scheme Description and Alternatives**) include:

- Monitoring and maintenance of the Scheme throughout Scheme lifespan; and
- Habitat fragmentation through ongoing site clearance.

8.7.36 The risk of pollutants entering the watercourses from maintenance vehicles undertaking routine inspections of the flood defence measures is considered to be very low. The impact is predicted to be of negligible magnitude and Neutral significance in line with the impact assessment in **Chapter 6: Water Environment & Fluvial Geomorphology.**

8.7.37 Despite the implementation of INNS control including treatment and clearance prior to and during the construction phase it is anticipated that

some INNS may re-colonise and spread naturally across areas which are adjacent to the Scheme. The effect of dispersal of invasive non-native species from ongoing routine site maintenance would be negative, long term and reversible at local level. This is considered to be a Minor (not significant) effect as the scale of spread would not be considered to be large, however the spread into the wild would compromise legal requirements.

8.7.38 The effects of ongoing habitat clearance and fragmentation on species and habitats would not be predicted to be discernible following reinstatement after initial clearance for construction.

8.8 Mitigation Measures

8.8.1 This section presents an overview of mitigation measures proposed in order to ameliorate the ecological effects associated with the construction and operation of the Scheme. The objective of this section is to present measures that seek to prevent, reduce or offset potential impacts on ecological features.

Embedded Mitigation

8.8.2 The following embedded mitigation will be incorporated into the design of the Scheme to reduce significant effects on otter:

- An artificial otter holt will be incorporated into the design of erosion protection (root wad revetment) along the Water of Ruchill which will partly offset the loss of potential resting sites identified further downstream on the River Earn.

8.8.3 The following embedded mitigation will be incorporated into the construction phase to prevent the spread of INNS:

- The INNS management plan included in **Appendix 8.8** provides details of the management regime and control areas required for removal, treatment, storage and disposal of INNS species known to be present within the construction/works area. The management plan contains details of the methods to be used and biosecurity measures to be implemented across the site and across all phases of construction of the Scheme in order to prevent the uncontrolled spread of these species and contravention of legislation. The implementation of the management plan commenced with a treatment regime in summer 2019 and it is proposed that ongoing survey work and re-treatment will continue in accordance with this plan.

Construction

8.8.4 The following generic mitigation and best practice measures would be incorporated into the construction phase to prevent, reduce and offset effects on IEFs:

- Prior to construction, the Contractor will be required to prepare a Construction Environmental Management Plan (CEMP), which builds on the information laid out in the Outline CEMP, describing methods and techniques that will be employed during construction to ensure compliance with legislation, good practice and legally-binding mitigation measures identified within the EIAR. The CEMP will need to be approved by SEPA prior to construction.
- The Contractor will also prepare Construction Method Statements to plan and manage in-channel works and works on the bank, to be approved by SEPA prior to construction. This will include specific details of measures to reduce potential risks of sediment-release and pollution during the installation of erosion protection measures in the watercourses. The contractor will aim to limit the extent of river bed disturbance in the River Earn.
- Pre-construction surveys are required to ensure that construction activity avoids unlawful disturbance of protected species. This involves a Suitably Qualified Ecologist (SQE) undertaking surveys for European Protected Species (such as occupied otter holts) and nesting birds within the recommended minimum buffer areas for each species. Pre-construction surveys are aimed towards informing any additional mitigation measures that may be required and provide evidence for licence applications that may be required. The result of the pre-construction surveys will be communicated to the Contractor by the SQE and will be fed into the Construction Environmental Management Plan (CEMP). The recommendations will ensure compliance with the necessary wildlife legislation.
- An Environmental/Ecological Clerk of Works (ECoW) will be appointed to ensure compliance with the CEMP and the commitments made in this report, to provide advice in the event of any unforeseen protected species issues that arise during construction, and to oversee the implementation of mitigation measures (see below).
- Adherence to the Guidance for Prevention of Pollution (GPP)[40] in respect of working in and around watercourses and protection of watercourses through the adoption of measures outlined in **Chapter 6: Water Environment & Fluvial Geomorphology**. Adherence to SEPA and CIRIA good practice engineering guidance[41], specifically WAT-SG-23 (bank protection), WAT-SG-25 (river crossings), WAT-SG-26 (sediment management) and WAT-SG-29 (construction methods) will also ensure minimisation of disturbance and risk of pollution. The Contractor will implement sediment/pollution control measures to minimise the risk of silt-laden and polluted runoff.

[40] http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/.
[41] https://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/.

- Avoidance of unnecessary disturbance to habitats (including river bed habitat) by minimising the extent of ground clearance and other construction practices and restoration works following construction wherever reasonably practicable.
- All construction activity will be restricted to clearly defined working areas, keeping vegetation clearance to a minimum and limiting hardstanding to the minimum needed to reduce the need for additional drainage provision. Habitats which would be subject to temporary loss will be re-vegetated and reinstated as soon as possible after construction is complete.
- Typical working hours will be between the hours of 07.00 – 19.00 to avoid the need to work in dark/low light levels when protected species such as otters and bats are likely to be most active. If night works are unavoidable the need for artificial lighting will be kept to a minimum and directed away from sensitive habitats and species such as bat roosts and river corridors. The ECoW may make recommendations to revise the times of working hours at specific locations or times of the year as appropriate to avoid disturbance of sensitive receptors.

8.8.5 The following are specific mitigation measures which will prevent, reduce or offset significant effects identified above.

- The loss of broadleaved woodland habitat will be offset by compensatory tree planting. Further information on tree mix and planting areas can be found in **Chapter 5: Landscape and Visual Impact Assessment**.
- Direct mortality/injury of roosting bats using trees to be felled as roosts will be prevented by undertaking pre-construction surveys at all trees to be felled. Surveys should follow prevalent guidance[12] in terms of the timing, level of survey effort and the methods to be used. The results of the surveys will inform any required mitigation and provide detail for any licences required and be fed into the CEMP and Construction Method Statement. This will also ensure compliance with relevant wildlife legislation.
- The loss of mature trees with potential bat roost habitat cannot be replaced like-for-like in the short to medium term, given that the trees to be felled are considered to be permanently lost, and it will take time for trees to grow and develop similar roost features (see tree planting proposals above). Instead bat roost habitat will be provided in the form of bat boxes on mature trees to be retained along the Water of Ruchill/Field of Refuge and on the Lednock. Replacement bat roost, such as Schwegler bat boxes and low-maintenance roost features, are designed to last a number of years and will provide roosting opportunities in close proximity to the existing resource to be lost to the Scheme. All replacement roost habitat will be located outwith areas of potential disturbance including artificial lighting/noise and in accordance with bat box installation guidance in relation to height above ground and orientation.
- Tree felling, use of artificial lighting, piling and the use of heavy/vibrating machinery will be avoided within 50m up- and downstream of St Margaret's Church during the bat maternity

roosting period of May to August inclusive in order not to disturb any roosting bats at a vulnerable period of their life cycle.

- Direct mortality/injury/disturbance of nesting birds will be avoided by undertaking vegetation clearance/tree felling works outwith the sensitive nesting period of March-August inclusive. If site preparation works during this period are unavoidable the SQE or ECoW will undertake or commission to undertake pre-clearance checks and there is no alternative if nests (occupied nests or those in the process of being built) are found to works being delayed until any young have fledged.
- Otter resting places will be identified by the Ecological Clerk of Works (ECoW) and a 30m buffer demarked. No access will be taken within this area without the permission and presence of the ECoW.
- Prior to works, a European Protected Species derogation (licence) would be acquired for disturbance of the identified resting sites.
- Should any otter resting sites or beaver lodges or burrows be identified within 30m of any working areas during the pre-construction surveys or during Site activities, all works will cease until the ECoW is contacted and a licence is obtained from SNH.
- Construction will avoid periods of peak otter and beaver activity (where practicable) which are largely taken to include the hours between dusk and dawn. Where it is not possible to strictly comply with this requirement, construction activities will permit at least one night of undisturbed passage for every two day/nights of construction work subject at the discretion of the ECoW and additional pre-construction survey/monitoring as required to determine the level of use of the river banks.
- No obstacles/obstructions will be placed either in-channel or bankside that may impede the safe passage of otters or beavers, and potential resting places for both species will not be obstructed. If crossing features are required, any structure over the feature will allow safe passage underneath.
- In addition, it will be necessary to check exposed pipes and trenches each morning for any trapped animals (ECoW to be contacted in this event).
- In-channel works will be avoided during the period of November to May to avoid the sensitive spawning period for salmonids.

Operation

8.8.6 The following measure will be incorporated into the operation phase to ensure that INNS are not spread during routine maintenance and inspections:

- Contractors will be required to consider the risk of INNS being present, and to undertake or commission to undertake update surveys at an appropriate time of year to inform any INNS control, storage and management and biosecurity measures which may be required.

8.8.7 The following measure is considered to be an ecological enhancement:

- There is a disused railway bridge structure located on the west bank of the River Earn, which has the potential to be used for provision of artificial bat roosting habitat. The bridge was assessed as having low to moderate bat roost potential in the form of spalling mortar with minor cavities and does not currently provide any other functional use. The strategic position of the bridge near the confluence of two key watercourses (the Water of Ruchill and the River Earn), within commuting distance for pipistrelle and *Myotis* species of bat, which would be most significantly affected by clearance work for the Scheme and the fact that the bridge is surrounded by optimal foraging and commuting habitat combine to make this an ideal position to provide artificial bat roost habitat. Discussions have commenced between Perth & Kinross Council and the landowners to gain permission for the installation of bespoke artificial bat roost structures onto the railway bridge which will provide low- or no-maintenance (provided droppings are able to fall out of the base of the structure thus preventing them from building up or causing rot). The provision of multiple roost features e.g. on the south-facing spandrels, the east-facing abutment (over the River Earn) and north-facing spandrels would provide year-round roost opportunities or several independent roosts for individuals or small numbers of different species.

8.9 Residual Effects

8.9.1 An assessment of the residual ecological impacts and effects after the implementation of mitigation outlined above in **Section 8.8** is presented in **Table 8.10.**

8.9.2 There are not anticipated to be any effects on Important Ecological Features (IEFs) which are significant in EIA terms after the successful implementation of generic and specific mitigation measures and ecological enhancements.

8.9.3 This assessment of effects is considered for construction and operation of the Scheme as a whole, as per CIEEM guidance (2018).

Table 8.10 – Residual effects

IEF	Potential effect	Mitigation	Residual effect
Broadleaved woodland (District)	Construction – Habitat Loss Negative, irreversible	Generic mitigation Tree planting	**Minor** (not significant) Negative, short-term, irreversible
Rivers (District)	Construction – Pollution/habitat degradation Negative, reversible	Generic mitigation	**Minor** (not significant) Negative, short-term, reversible
Bats (District)	Construction – Direct mortality	Pre-construction surveys EPS licence and species protection plan	Negligible (not significant)
	Construction – Loss of roosting habitat (trees)	Artificial bat roost habitat provision i.e. bat boxes on trees to be removed	**Minor** (not significant) Negative, short-term, reversible
	Construction – Loss of roosting habitat (trees)	Provision of artificial roost habitat in disused railway bridge	**Minor** (not significant) Positive, medium-long term, reversible
	Construction – Disturbance (St Margaret's Church)	Avoidance of works during maternity roosting period	**Minor** (not significant) Negative, short-term, reversible
	Construction – loss of foraging/commuting habitat (vegetation removal and lighting)	Sensitive use of artificial lighting during bat activity period. Tree and other landscape planting	**Minor** (not significant) Negative, short-term, reversible
Beaver (District)	No significant effects anticipated	Generic mitigation including landscape tree planting which will be a future foraging resource.	Negligible (not significant)
	Construction – fragmentation/barrier effects	Maintain dark corridors and through-routes on all three watercourses No obstacles in channel/on banks	**Minor** (not significant) Negative, short-term, reversible

IEF	Potential effect	Mitigation	Residual effect
Breeding birds (Local)	Construction – Direct mortality/injury/loss of nests	Timing of tree felling/vegetation clearance works outwith nesting period (April – July inclusive). Pre-construction surveys	Negligible (not significant)
Red squirrel (Local)	No significant effects anticipated	Generic mitigation	Negligible (not significant)
Otter (District)	Construction – Loss of resting sites	Provision of artificial holt Pre-construction surveys EPS licence and species protection plan	**Minor** (not significant) Negative, long-term, irreversible
Otter (District)	Construction – fragmentation/barrier effects	Maintain dark corridors and through-routes on River Earn No obstacles in channel/on banks	**Minor** (not significant) Negative, short-term, reversible
Aquatic ecology (Regional)	Construction – habitat fragmentation during in-channel works	Avoid in-channel works during November – May period to protect salmonid spawning/brood areas	**Minor** (not significant) Negative, short-term, reversible
	Construction – Pollution and habitat degradation from siltation and contaminated runoff	Avoid in-channel works during November – May period to protect salmonid spawning/brood areas Generic mitigation	**Minor** (not significant) Negative, medium-term, reversible
Invasive, non-native species (Local)	Construction – spread of INNS into the wild	Implementation of INNS management plan and control/appropriate disposal of INNS and biosecurity plan	**Minor** (not significant) Negative, medium-term, reversible
	Operation – spread of INNS into the wild	Implementation of long-term INNS management plan*	**Minor** (not significant) Negative, medium-term, reversible

8.10 Cumulative Effects Summary

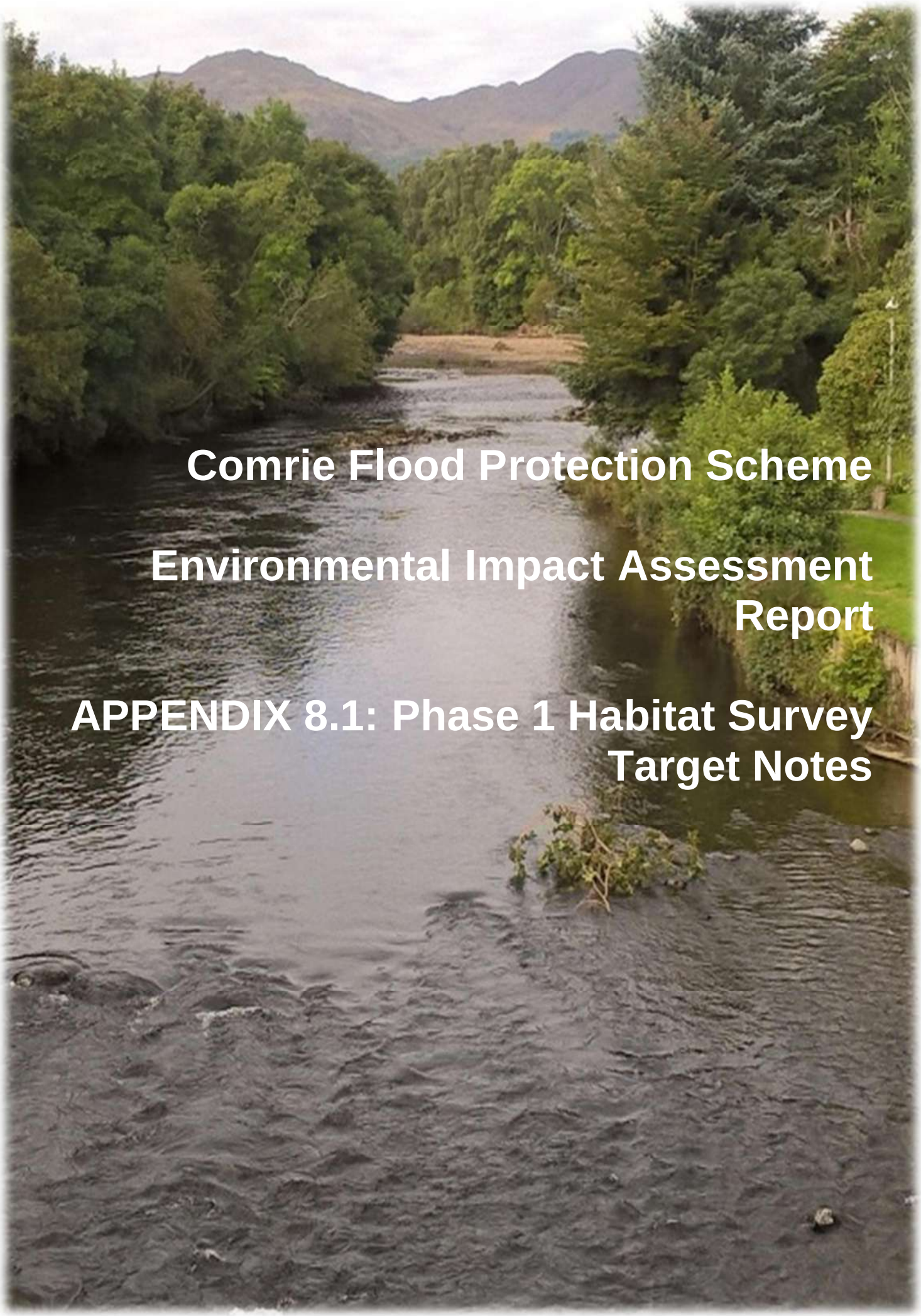
8.10.1 A study of the proposed planning applications using a buffer of 2km from the study area has been carried out. Please refer to **Chapter 11: Cumulative Environmental Assessment** for further information.

8.10.2 Comrie Holiday Park has also made an application to extend the park to the south of its current location, proposing 14 new units within grassland directly adjacent to the Scheme and approximately 60m from the River Earn. This development would not require the loss of any IEF habitats (only grassland plant communities would be affected). If the development were constructed at the same time as the Scheme there would be an increased risk of silt-laden and polluted runoff entering the River Earn from bare surfaces and from the higher intensities of potentially pollution-causing activities on site. This could have an increased impact on chemical and ecological quality of the Earn, as well as directly affecting aquatic species and habitats, however, with implementation of the mitigation measures identified above and

assuming best practice methods are adopted on both developments, no significant residual cumulative effects are predicted.

8.10.3 The Local Development Plan 2 identifies an area of proposed new housing at the southern edge of the study area. The land plot identifies space for approximately 30 units. This area – which is currently used for arable farmland – would not be anticipated to result in any cumulative effects on IEFs.

8.10.4 Collectively, there are not considered to be any impacts that are significant in EIA terms on the IEF habitats and species.



Comrie Flood Protection Scheme

Environmental Impact Assessment Report

APPENDIX 8.1: Phase 1 Habitat Survey Target Notes

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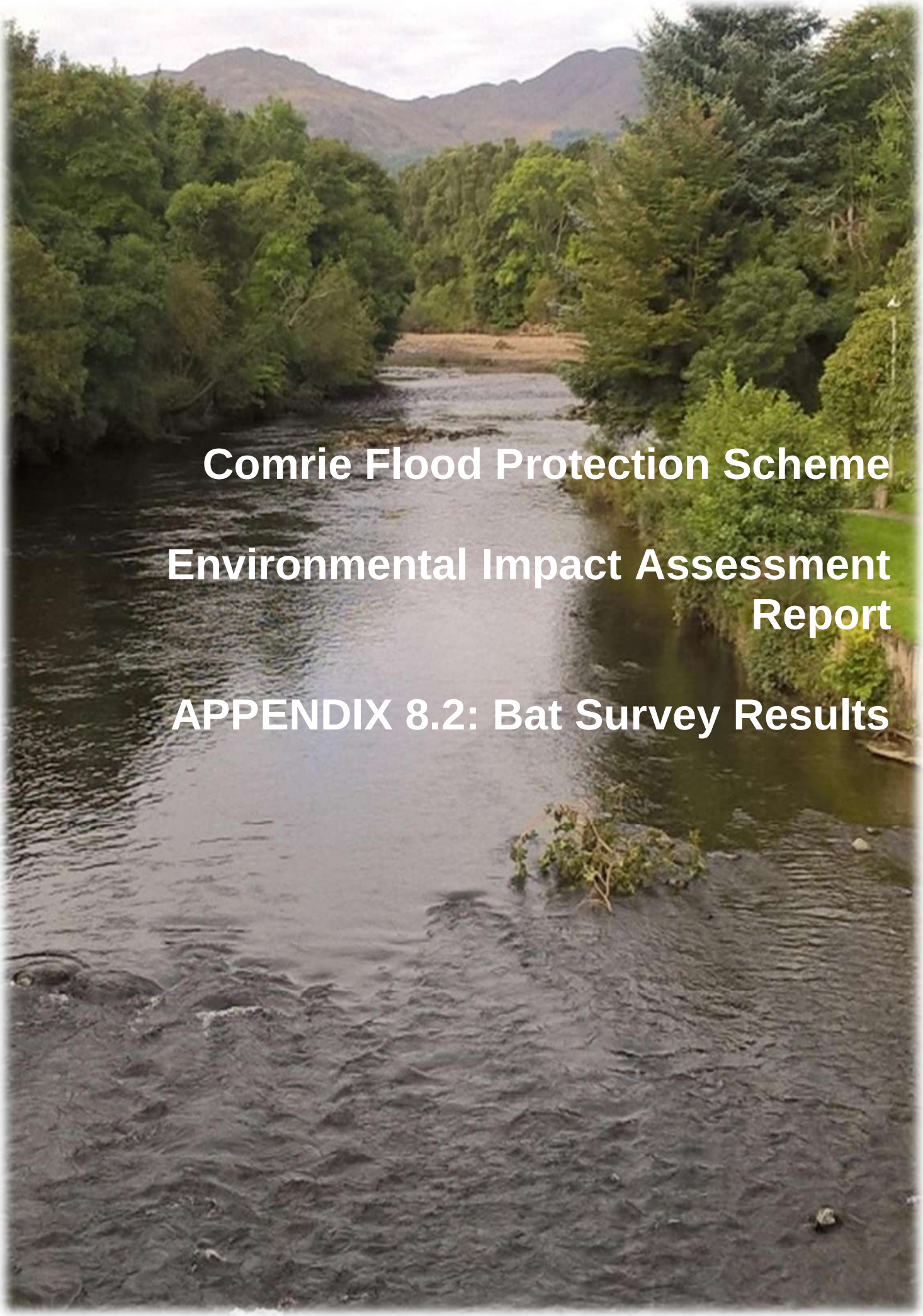
Appendix 8.1: Phase 1 Habitat Survey Target Notes

Table 1. Comrie FPS Phase 1 habitat survey target notes.

Target note	Description
1	Alder carr woodland on low-lying flat ground adjacent to the River Earn. River banks are reinforced with rip-rap banking along the inside of this area.
2	Mature broadleaved woodland comprising ash, sycamore and birch with occasional oak, alder and elm. Willow trees also exist on the woodland edges. Poorly-developed understorey and ground layer now dominated by Japanese knotweed stands. Woodland is used extensively for recreational purposes; an area of hard standing (gravel piles) exists inside adjacent to a track.
3	Existing flood embankment with range of flora including meadowsweet, common hawkweed, male fern, creeping thistle, yellow-rattle, bramble, greater stitchwort and occasional regenerating sycamore and willow saplings.
4	Braided river in state of constant flux; river banks are partly collapsing, and several mature trees lie on the shingle where these have been uprooted.
5	Gardens adjacent to properties on Dundas Street back onto the River via existing informal stone walls. Grassland and shrub dominated by garden escapes and invasive species together with occasional broad-leaved trees exist on the banks.
6	Amenity grassland managed by PKC gives way to mixed woodland of varying ages. Species include cherry, sycamore, holly, ash, beech and birch.
7	Stretch of river bank with scattered rowan, ash and sycamore trees. An informal path used for recreational purposes follows the bank. Several stands of Japanese knotweed also line the bank.
8	A line of mature trees flanks the south bank of the Earn with a well-used path. Tree species include sycamore, alder, ash and occasional hawthorn; ground flora is limited with occasional Japanese knotweed and stands of Variegated yellow archangel.
9	Mature garden around Glenbuckie House. Mostly laid to lawn (amenity grassland) with leylandii shrub hedgerows and mature trees (sycamore, beech and chestnut) present throughout the landscaped garden. Typical of much of the area.



Comrie Flood Protection Scheme

Environmental Impact Assessment Report

APPENDIX 8.2: Bat Survey Results

Document Control

Document title	Chapter 8, Appendix 8.2: Bat Survey Results
Originator	Erik Paterson
Checker	Claire Hopkins
Approver	Gail Currie
Authoriser	Rebecca McLean
Status	Final

Revision History

Document title	Date	Description	Author
0001	28/02/19	Initial draft	Erik Paterson
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Appendix 8.2: Bat Survey results

Table 1. Dusk backtracking around the Field of Refuge, EP & CH 11/06/18.

Date	11/06/18	**Survey type**	Dusk back-tracking
Sunrise/set Time	22:00	**Weather Conditions:**	21.3°C-18.8°C, moderate rain prior to start but dry during, 100% cloud, light breeze, and 66% humidity
Start Time	21:45	**End Time**	23:45
Survey results			
EP: Starting immediately to the east of where Ruchill Water meets the Earn, the first bat was a soprano pipistrelle at 22:01. CH: Starting within the field of refuge car park, the first bat was a common pipistrelle at 22:06. Bat foraging activity was noted throughout the survey, becoming quiet towards the end with activity restricted more to the River Earn. Common and soprano pipistrelle, as well as Myotis spp., were seen and heard. Bats were noted throughout the survey within the woodlands and surrounding urban areas and parkland. No roosts were located during this survey.			

Table 2. Dusk backtracking along the Earn south, EP & CH 14/06/18.

Date	14/06/18	**Survey type**	Dusk back-tracking
Sunrise/set Time	22:04	**Weather Conditions:**	15.5°C, dry, light breeze with moderate gusts, 100% cloud, and 53% humidity.
Start Time	21:45	**End Time**	23:05
Survey results			
EP: Started at Lochy Drive headed East, the first bat was a soprano pipistrelle at 21:59. CH: Started at Strowan Road headed east, the first bat was common and soprano pipistrelles at 22:08. Both surveyors walked separately back and forth along the south bank of the Earn between approximately Strowan Road and the field boundary at Garry Place. Common and soprano pipistrelles were noted as well as *Myotis* spp. throughout the survey with activity moving from south of the treeline to the river bank towards the end of the survey as the wind levels dropped. No roosts were located during this survey. However, CH noted bats commuting along the southern edge of the riparian trees over residential gardens and suspected that bats may have been emerging from a partially obscured building on Lochay Drive.			

Table 3. Dawn backtracking around the Field of Refuge, EP & CH 15/06/18.

Date	15/6/18	**Survey type**	Dawn back-tracking
Sunrise/set Time	04:26	**Weather Conditions:**	11.5°C, mild drizzle showers throughout, still within canopy but light breezes in edge and open areas, 100% cloud, and 70% humidity.
Start Time	02:32	**End Time**	04:40
Survey results			
EP starting immediately to the east of where Ruchill Water meets the Earn, the first bat was a soprano pipistrelle foraging at 02:33. CH starting within Field of Refuge car park, first bats were common and soprano pipistrelles at 03:47 foraging around the edge of the treeline and within the canopy to the north of the car park there. A mix of common and soprano pipistrelles as well as *Myotis* spp. bats were observed throughout this survey, with the final bats observed shortly after the last sound file was recorded at around 04:19, within the woodland area. No roosts were located during this survey.			

Table 4. Dusk Survey around Lednock southwest, EP, CH & CR, 23/07/18.

Date	23/07/18	**Survey type**	Dusk Survey
Sunrise/set Time	21:43	**Weather Conditions:**	17°C-16°C, 50% cloud, rain immediately prior but dry during, light breeze, and 96% humidity.
Start Time	21:25	**End Time**	23:25
Survey results			
EP: Positioned beneath mature beech on the western bank of the Lednock, the first bat was a soprano pipistrelle at 21:34. CR: Positioned within the clump of ivy-covered mixed-species trees north of the Earn, the first bat was a soprano pipistrelle at 21:40. CH: Mobile around the western bank of Lednock to the northern bank of Earn between Manse Lane and Ancroft Lane. Detector failure during survey resulted in no recordings of bats. First observation of pipistrelle sp. at 21.45. Common and soprano pipistrelle bats were noted to be foraging throughout the whole survey area during this survey. *Myotis spp*. bats were also noted, with probably Natterers observed foraging along the western bank of the Lednock, and probably Daubenton's foraging along the Lednock and Earn. No roosts were located during this survey.			

Table 5. Dusk survey around Lednock southeast, EP, CH & CR, 24/07/18.

Date	24/07/18	**Survey type**	Dusk Survey
Sunrise/set Time	21:41	**Weather Conditions:**	16.5°C-15.5°C, still, clear, dry, and 60% humidity.
Start Time	21:20	**End Time**	23:15
Survey results			
EP: Positioned within the mouth of the Lednock on shallow gravel, the first bat was a soprano pipistrelle at 21:51. CR: Positioned on the A85 bridge over the Lednock, the first bat was a *Myotis spp*. bat at 21:28. CH: Positioned along the eastern bank of the Lednock, the first bat was a soprano pipistrelle at 21:47. Bats were observed commuting from upstream of the Lednock towards the Earn at the start of the survey. Common and soprano pipistrelles as well as *Myotis* spp. (probably Daubenton's and natterers) were observed during this survey foraging along the riparian edges and within the treelines until the close of the survey. No roosts were located during this survey.			

Table 6. Dusk survey around Lednock north, EP, CH & CR, 25/07/18

Date	25/07/18	**Survey type**	Dusk Survey
Sunrise/set Time	21:40	**Weather Conditions:**	22.5°C-20.5°C, still, dry, 0% cloud, and 51% humidity.
Start Time	21:25	**End Time**	23:25
Survey results			
EP: to the east of the Lednock in the grounds of St. Serfs, the first bat was a soprano pipistrelle at 21:48. CR: to the west of the Lednock in the grounds of St. Margarets, the first bat was a soprano pipistrelle at 21:41. CH: on the pedestrian footbridge over the lednock to the north of the church grounds, the first bat was a soprano pipistrelle at 21:52. Common and soprano pipistrelles as well as *Myotis* spp. (probable Daubenton's) bats were observed at the beginning of the survey to be commuting from upstream on the Lednock, towards the Earn and foraging throughout the surrounding habitats throughout this survey. CR observed soprano pipistrelles emerging from St. Margarets church below the eaves on the southeastern edge, and a *Myotis* sp. (probable Daubenton's) maternity colony under the apex of the northern gable of St. Margaret's church.			

Table 7. Dusk Survey AROS Field West Trees, EP & MR 02/08/18.

Date	02/08/18	**Survey type**	Dusk survey
Sunrise/set Time	21:24	**Weather Conditions:**	17°C, light breeze, drizzle to light rain at repeated intervals during the survey, 80% cloud, and 100% humidity.
Start Time	20:48	**End Time**	22:32
Survey results			
EP: standing at an ash tree to the west of Aros Field West, the first bat was a soprano pipistrelle at 21:25. MR: standing at an oak tree to the southwest of Aros Field West, the first bat was a soprano pipistrelle at 21:28. Both common and soprano pipistrelles were abundant foraging along the field boundaries during this survey. No roosts were located during this survey. However, EP observed large numbers (between 10 and 15 bats) of soprano pipistrelles flying westwards and southwards from an old church building to the north of where he was standing and suspected there may be a roost colony there. MR observed a bat flying close by the oak tree at his position and was unclear whether it emerged from the tree.			

Table 8. Confirmed bat roosting locations around the Comrie flood protection scheme.

Roost Location	OS GRID	Species	Confirmation Method
St. Margarets Church (Apex of northern gable)	NN 77581 22278	*Myotis* sp. probably Daubenton's	Confirmed via back-tracking survey.
St. Margarets Church (southeastern soffits)	NN 77588 22264	Soprano pipistrelle	Confirmed via back-tracking survey.
Craigvannie	NN 76726 22035	Brown long-eared	Confirmed by photo from resident and loft inspection.
Mill of Ross	NN 75912 21802	Pipistrelle species. Maternity colony.	Confirmed by daytime assessment.
Mill of Ross	NN 75854 21825	Pipistrelle species.	Confirmed by resident.

Table 9. Preliminary roost assessment results for Structures within bat study area.

TN	Name	Description	BRP	x	y
S1	Craigvannie	Brown long-eared roost in attic of building.	Confirmed roost	276724.1	722033.4
S2	Bridge	Spalling mortar	Low to Moderate	277120.1	721935.7
S3	Dry Stone Wall	Dry stone wall with gaps suitable for breeding birds and roosting bats.	Low to Moderate	277289.2	721912
S4	Public Toilets	Public toilet building. Gaps under tiles and facia suitable for bat roosting.	Low to Moderate	277337.5	721943.3
S5	St. Margaret's Catholic Church	Roost in St Margaret's Catholic Church.	Confirmed roost	277584.1	722269.8

Table 10. Preliminary roost assessment results for trees within bat study area.

TN	Species	Tag No.	Feature Type	BRP	X	Y
T1	Willow		Hazard beam	Low to Moderate	277009.8	721903.4
T2	Ash		Wound	Low	277034.7	722003.1
T3	Ash		Knot holes in branches.	Low	277049.1	722030
T4	Alder		Flaking bark and snag ends	Low	277070.2	721417.7
T5	Hawthorn		Shallow grooves between plaited trunk	Low	277078.3	721428.8
T6	Birch	861	Small hole from dropped limb	Low	277118.2	721457.4
T7	Oak		Several holes, rotting heartwood and snag ends	Low to Moderate	277135.7	721341
T8	Beech		Small gap between rubbing branches	Low	277137.3	721345.6
T9	Sycamore		Hole in trunk	Low	277188.9	721765.2
T10	Ash		Rot hole from dropped branch	Low	277210.7	721794.4
T11	Ash	803	Hazard beam over water and snag end north-facing	Low	277237.2	721705.1
T12	Sycamore and Willow		Small risky cavity between two branches of sycamore and willow.	Low	277248.8	721802.7
T13	Willow	Adjacent to 0964	small crevices at ground to 1m.	Low	277254.6	721752.1
T14	Willow		Hazard beams	Low	277257	721821.1
T15	Ash		Double leader dead attached to live elbow wound at 2m west facing.	Low	277263.6	721821.8
T16	Willow		Hazard Beams	Low	277278.3	721645.2
T17	Sycamore and Ash		Small clump of immature trees covered with ivy.	Low	277278.6	721800.6

TN	Species	Tag No.	Feature Type	BRP	X	Y
T18	Birch		Standing deadwood with peeling bark and wounds.	Low	277283.6	721855.4
T19	Ash	944	Hollow trunk with entrance at c.2m, can't see top of cavity, 20cm+ in depth.	Low to Moderate	277284.1	721835.9
T20	Birch		Standing deadwood with peeling bark and minor wounds throughout.	Low	277284.1	721848.3
T21	Ash	943	West-facing tiny hole at 8m.	Low	277290.5	721838.5
T22	Ash	941	Dead fork and large hollow at c.5m, east facing.	Moderate	277294.7	721852.3
T23	Willow	955	Crack at c. 2.5m, west facing.	Low	277303.4	721819.5
T24	Unknown		Cracks in main trunk.	Low	277305.7	721885.5
T25	Sycamore	929	Hole at c. 10m, south-facing.	Low	277307.5	721877
T26	Cherry		Peeling bark.	Low	277310.9	721929.4
T27	Alder	919	Tiny, superficial holes at c.3-4m on mossy trunk.	Low	277330.9	721884.8
T28	Unknown	910	Standing deadwood with ivy cover.	Low	277335.1	721883.8
T29	Willow	799	Narrow gashes on east-facing aspect c.2-3m up. Rotting heartwood also present.	High	277357.1	721885.4
T30	Ash and Sycamore		Four trees with dense ivy cover.	Low	277358.8	721217.8
T31	Oak		Wound at c.5.5m with hazard beams slightly below and above this feature.	Moderate	277368.5	721129.4
T32	Beech		Hollows and snags throughout.	Low	277376.1	721052.8
T33	Beech	237	Intertwining branches.	Low	277521.9	722007.2
T34	Alder	333	Dying tree with small/superficial holes where branches have sloughed.	Low	277556.2	721955.9
T35	Multiple	2010, 2011, 2012	Tree ivy-covered trees.	Low	277584.8	722023.4

TN	Species	Tag No.	Feature Type	BRP	X	Y
T36	Ash	359	Large cavity at ground level, open at top.	Low	277595.4	721960.9
T37	Sycamore		Knot-hole at c.3m, north facing. Other holes present.	Low to Moderate	277597.2	722175.2
T38	Alder		Multiple trees with holes.	Low to Moderate	277599	722293.9
T39	Beech	454 & 456	Two large beech trees with holes.	Moderate	277606.2	722080.9
T40	Sycamore		Peeling bark.	Low	277606.3	722140.5
T41	Beech		Warped trunk with superficial cavities.	Low	277610.8	722243.7
T42	Sycamore		Hole in trunk.	Low	277612.9	722229.3
T43	Multiple	0001 to 0012	12 ivy-covered trees.	Low	277619.2	722156.2
T44	Sycamore	13	Rotting heartwood.	Moderate	277619.5	722145.7
T45	Ash		Cracks in deadwood. Located on confluence of Lednock with Earn.	Low	277622	722024.2
T46	Unknown	54	Small hole at c.2m, 8cm deep.	Low	277670.1	722038.7
T47	Ash	62	Shallow upwards cavity at c.1.5m, north facing.	Moderate	277681.8	722049.7
T48	Sycamore		Small hole at c.1.5m.	Low	277745.9	722019.1
T49	Ash and Hawthorn		Hawthorn entwinement and large cavity at c.0.5m.	Low	277758	722016
T50	Sycamore	398	Flaking bark.	Low	277762.2	722016.2
T51	Sycamore		Hollow dead trunk.	Low to Moderate	277772.6	722068.8
T52	Sycamore		Hollow trunk with holes, fissure forming.	Moderate	277853.5	722075.4
T53	Sycamore	431	Hole at c.2.5m facing south.	Moderate	277862.1	722027.6

TN	Species	Tag No.	Feature Type	BRP	X	Y
T54	Sycamore	744	Multiple small holes where branches have sloughed.	Low	277890.8	722031.3
T55	Alder	749	Double-leader at c.1.8m.	Low	277896.5	722038.2
T56	Sycamore	751	Hollow in trunk at c.3m.	Low	277899.4	722041.4
T57	Sycamore		Hole at c.0.8m, 15cm high, 5cm wide.	Low	278068.3	721996.3
T58	Unknown		Gaps within wounded tree.	Low	278099.2	722027.3
T59	Unknown		Hole of approx. 5cm width in limb.	Low	278114.1	721993.7
T60	Birch		Holes in tree plus dead trunk.	Low	278159.2	722049.2
T61	Sycamore		Sections of dead trunk with small holes.	Low	278160	722035.4
T62	Sycamore	462	Loose ivy covering and snag ends. Landowner noted tree was diseased and would be removed separate from the project.	Low	277595	722166
T63	Chestnut	505	Some dropped branches with gaps but do not appear large.	Low	277600	722141
T64	Sitka Spruce		Over-mature Sitka spruce with small snag ends.	Low	277604	722113

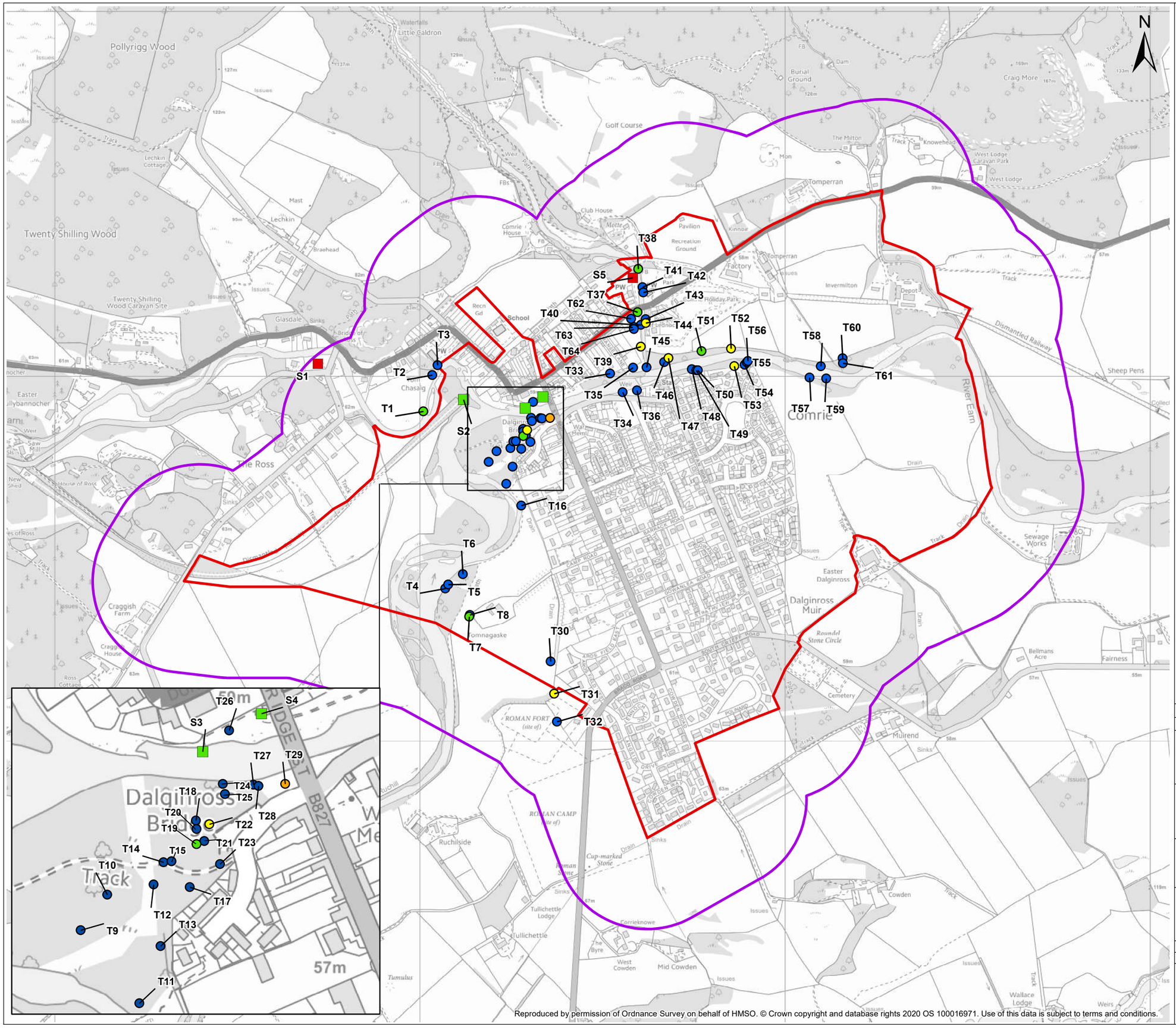
Figure 1. T19 – tree with rotting base leading to large cavity offering low to moderate bat roosting potential.

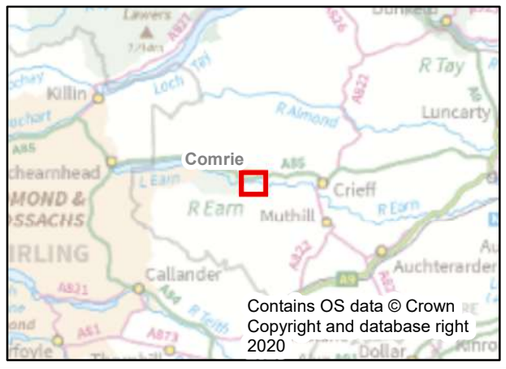
Figure 2. T44 – mature tree with rotting heartwood providing a cavity which gives moderate roosting suitability for bats.

Figure 3. T29 - Willow tree with high bat roosting potential, located to the northeast of the Field of Refuge car park.

Figure 4. S3 – Dry stone wall with gaps between brickwork presenting bat roosting opportunities.

Figure 5. S5 – St Margaret's Catholic Church showing the northern gable. Daubenton's maternity colony was observed at the apex of this gable end.





Legend

- EIA Study Area
- EIA Study Area - 250m Buffer

Bat Roost Potential

- Confirmed roost, Structure
- High, Tree
- Moderate, Structure
- Moderate, Tree
- Low to Moderate, Structure
- Low to Moderate, Tree
- Low, Tree

Rev.	Rev. Date	Drawing Suitability	Drawn	Appr'd
P01.1	04/02/2020	For Information	JB	RMcL

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Client

PERTH & KINROSS COUNCIL

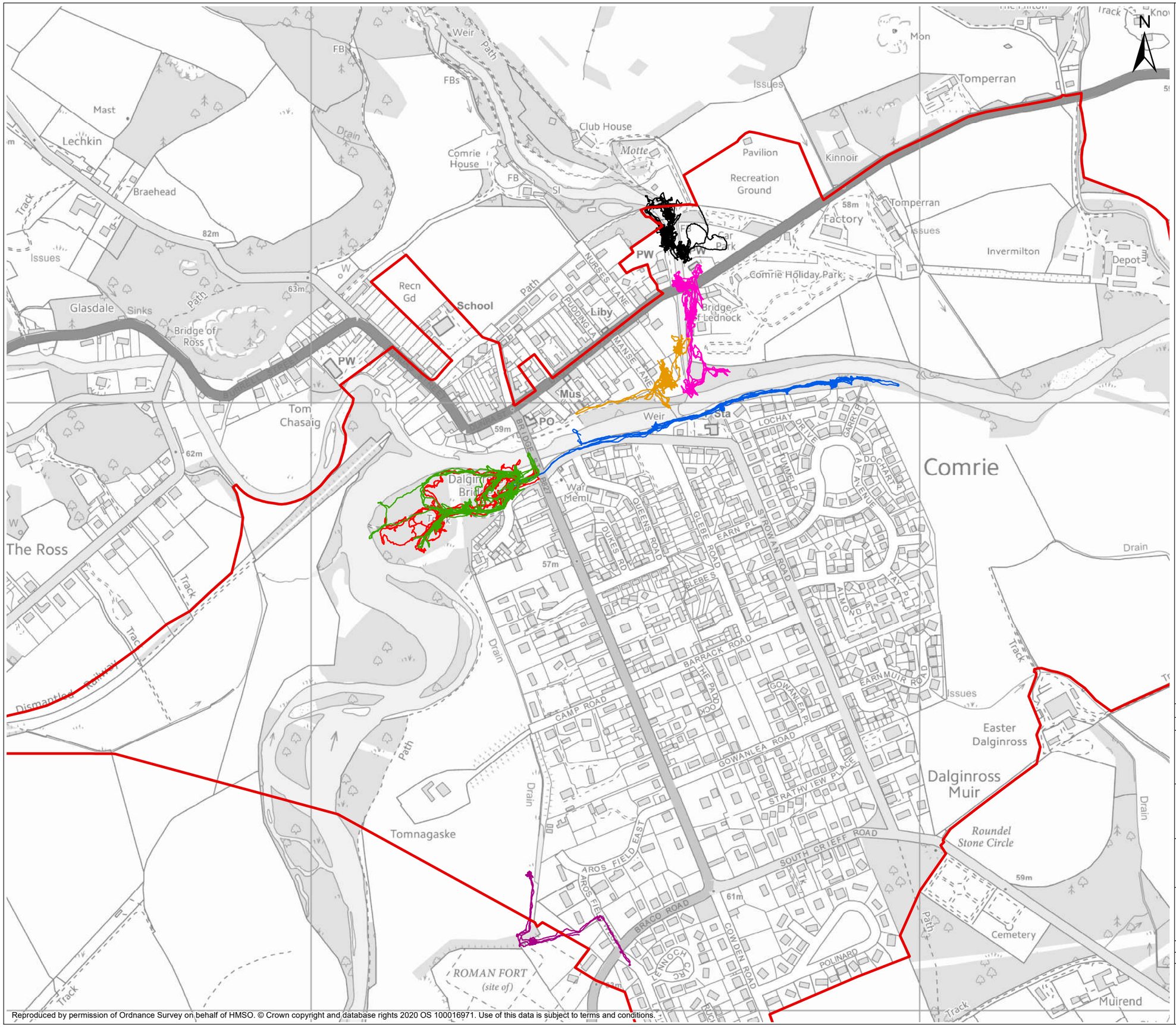
Project

Comrie Flood Protection Scheme 2020

Drawing Title

Figure 8.4a -
Bat Survey

Scale @ A3	1:10,000
Project No.	119702



Rev.	Rev. Date	Drawing Suitability	Drawn	Appr'd
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PERTH & KINROSS COUNCIL

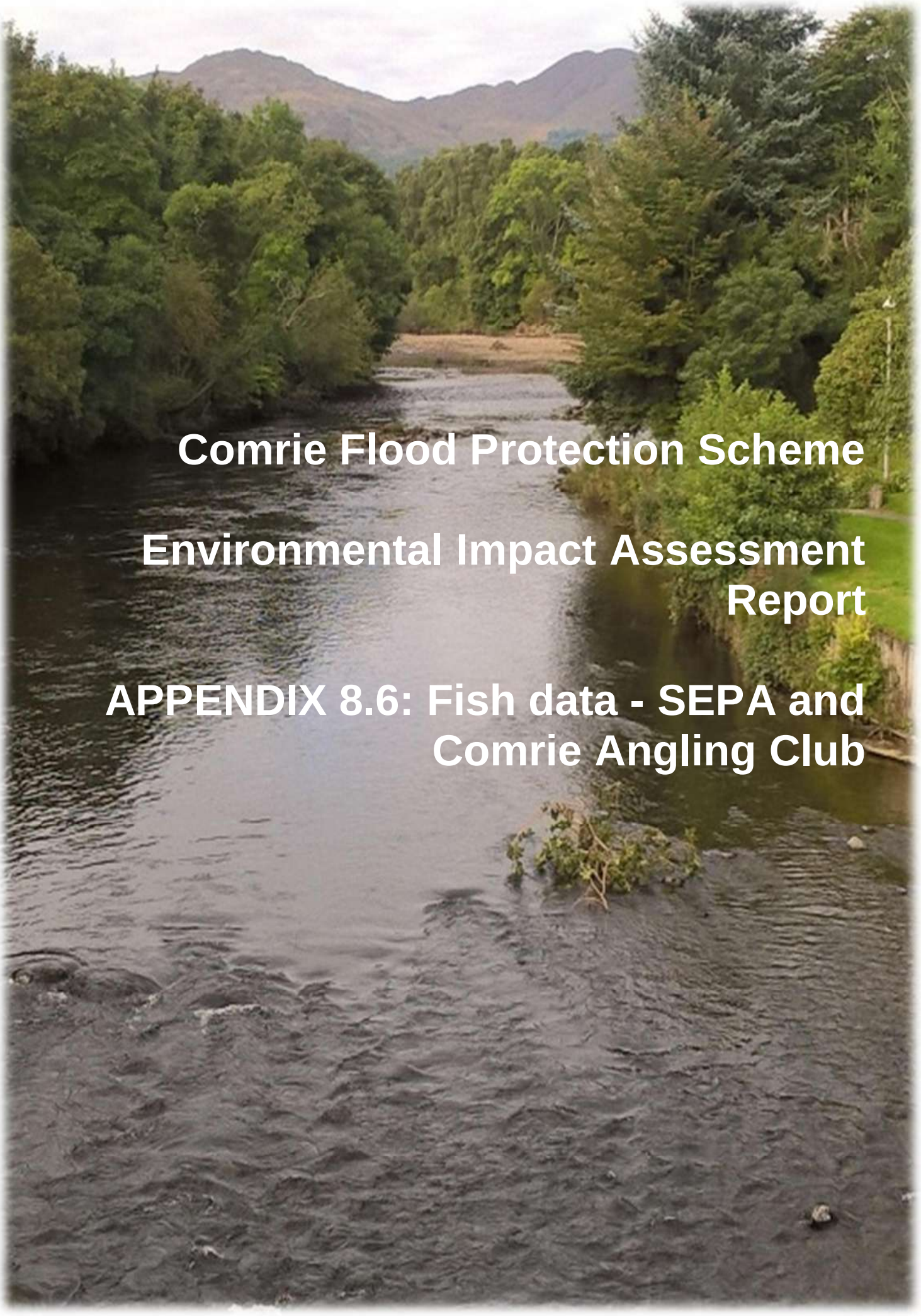
Project

Comrie Flood Protection Scheme 2020

Drawing Title

Figure 8.4b - Bat Survey Locations

Scale @ A3	1:6,000
Project No.	119702



Comrie Flood Protection Scheme

Environmental Impact Assessment Report

APPENDIX 8.6: Fish data - SEPA and Comrie Angling Club

Document Control

Document title	Chapter 8: Nature Conservation Appendix 8.6: Fish data (SEPA and Comrie Angling Club)
Originator	Kirsty Myron
Checker	Claire Hopkins
Approver	Gail Currie
Authoriser	Rebecca McLean
Status	Final

Revision History

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0001	23/01/2020	For Review	Kirsty Myron

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Appendix 8.6: Fish data - SEPA and Comrie Angling Club

SEPA - SFCC Electrofishing Event Report: River Earn

Easting: 274087	**Northing:** 722934	**Site code:** SEPA_374563	**Altitude:**
River: River Earn			
Site situation: Dalchonzie-top of site is 10m u/s bridge			
Access/permission: Robroy Homes			**Date:** 29/08/08

Type of fishing: Quantitative (1mm)	**Number of Fishing Runs:** 3
Instream Cover: Moderate	**Target Species:** Juvenile salmonid (Unspecified species) (-)

Dimensions

Wet Width Area (m²): 362.5	**Site Length (m):** 29.0
Bed Width Area (m²): 380.5	
Bank Width Area (m²):	

Point No.	Measured At (m)	Wet Width (m)	Bed Width (m)	Bank Width (m)
A-Upst	0.0	14.5	14.8	
B		12.4	13.5	
C		12.4	13.0	
D		11.8	12.3	
E-Downst		11.4	12.0	

Depth

< 10	11-20	21-30	31-40	41-50	> 50
5	10	40	25	10	10

Instream

Instream Vegetation (%): 0	**Silted:** Yes
Stable: Stable	**Compacted:** Compacted
Notes: Interstitial spaces infilled with fine material	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB	Substrate Total
0	5	10	20	20	30	15	0	0	100

Flow

Flow Speed (m/s):	
Notes:	

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO	Flow Total
2	5	10	20	40	20	3	0	100

Bank

	Left Bank	Right Bank
Total Fish Cover (%)	10	0
Bankface Veg.	Complex	Complex
Banktop Veg.	Uniform	Simple
Overhang Bough (%)	90	100
Canopy Cover (%)	90	
Notes	Overshaded	

Undercut UC		Draped DR		Bare BA		Marginal MA		Roots RT		Rocks RK		Other OTH		Bank Total	
LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB
10	0	0	0	90	100	10	0	0	0	0	0	0	0	110	100

Other

Team Leader:	A.Duguid/K.Birkeland
Number of Staff:	5
Survey Purpose:	Monitoring
Purpose Notes:	
Equipment Type:	Backpack
Volts:	350
Amps:	0.1
Smooth / Pulsed:	Smooth
Manufacturer:	
Model:	
No. of Anodes:	
Ring Diameter:	
Stop Net:	Both Boundaries
Capture Net:	Banner
Effective Fishing:	Yes
Conductivity:	51

Temperature:	14.30
Time:	09:40
Water Level:	Medium
Water Clarity:	Clear
Survey Notes:	Two teams of two
Salmon Access:	Regularly
Trout Access:	Yes
Pollution:	No
Access Notes:	No known issues for salmonids
Pollution Notes:	
Stocking:	No
Salmon Stocked:	No
Trout Stocked:	No
Stocking Notes:	Not thought to be stocked but need to check
Photos and IDs:	

Other Fish Species Count

Species	Count
European Eel (Anguilla anguilla)	18
Lamprey (Unspecified species) (-)	36
Common Minnow (Phoxinus phoxinus)	22

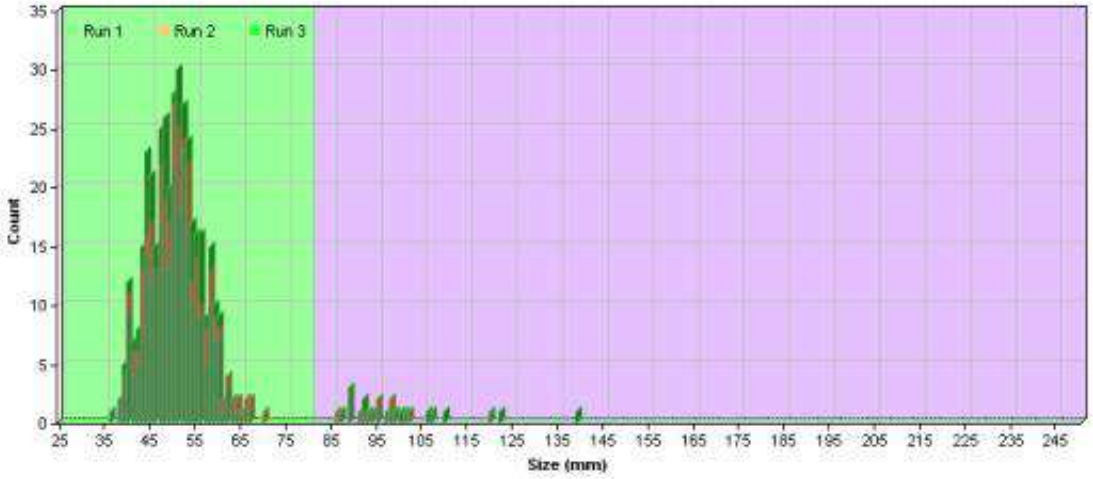
Atlantic Salmon Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	259	76	62	0	0	397	119.564	119.172	71.448	109.517	50	5.946	
1++	14	5	6	0	0	25	8.883	8.	3.862	6.897	99	12.386	
Total	273	81	68	0	0	422							
Salmon Missed (NaN)													

Zippin					
Age	Estimate	Confidence Levels			Probability
		Lower	Upper	95%	
0+	119.564	113.684	125.444	5.88	0.562
1++	8.883	4.548	13.218	4.335	0.393

Carle & Strub					
Age	Estimate	Confidence Levels			Probability
		Lower	Upper	95%	
0+	119.172	113.532	124.812	5.64	0.566
1++	8.	5.942	10.058	2.058	0.463



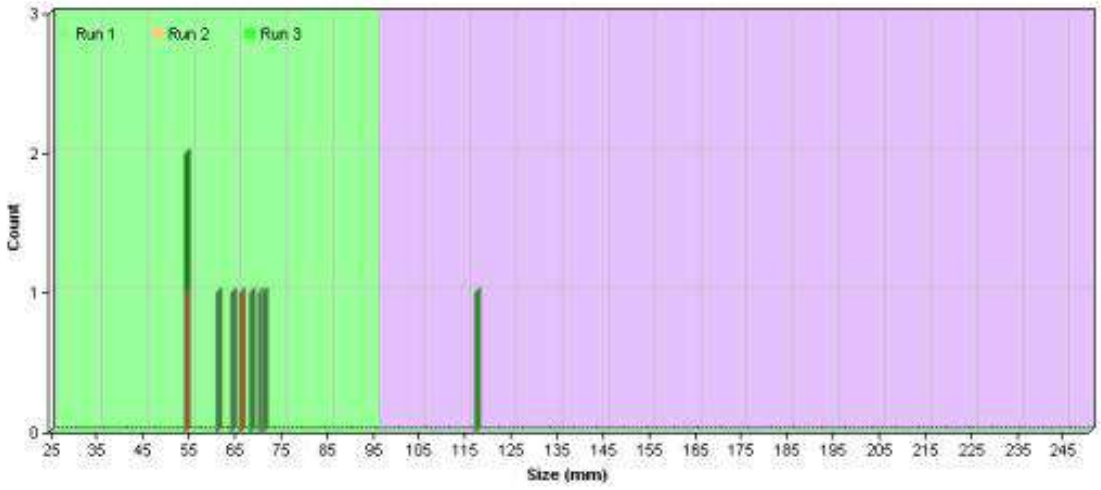
Brown Trout (Sea Trout) Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	5	2	1	0	0	8	2.405	2.207	1.379	2.207	63	6.676	
1++	1	0	0	0	0	1			0.276	0.276	117		
Total	6	2	1	0	0	9							
Trout Missed (NaN)													

Zippin					
Age	Estimate	Confidence Levels			Probability
		Lower	Upper	95%	
0+	2.405	1.586	3.224	0.819	0.565
1++					

Carle & Strub					
Age	Estimate	Confidence Levels			Probability
		Lower	Upper	95%	
0+	2.207	2.207	2.207	.	0.667
1++					



SEPA - SFCC Electrofishing Event Report: Ruchill Water

SFCC Electrofishing Event Report

Easting: 268094	**Northing:** 716889	**Site code:** SEPA_469056	**Altitude:**
River: Ruchill Water			
Site situation: Top of site 15m d/s RB trib			
Access/permission:			**Date:** 28/09/10

Type of fishing: Quantitative (1mm)	**Number of Fishing Runs:** 1
Instream Cover: Moderate	**Target Species:** Juvenile salmonid (Unspecified species) (-)

Dimensions

Wet Width Area (m²): 159.6	**Site Length (m):** 25.1
Bed Width Area (m²): 169.7	
Bank Width Area (m²):	

Point No.	Measured At (m)	Wet Width (m)	Bed Width (m)	Bank Width (m)
A-Upst	0.0	6.8	7.9	
B		5.8	6.5	
C		6.2	6.4	
D		6.0	6.0	
E-Downst		7.0	7.0	

Depth

< 10	11-20	21-30	31-40	41-50	> 50
10	10	20	30	20	10

Instream

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes:	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB	Substrate Total
0	0	2	8	10	10	20	50	0	100

Flow

Flow Speed (m/s):	
Notes:	

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO	Flow Total
5	0	5	10	10	60	10	0	100

Bank

	Left Bank	Right Bank
Total Fish Cover (%)	30	30
Bankface Veg.	Simple	Simple
Banktop Veg.	Simple	Simple
Overhang Bough (%)	0	0
Canopy Cover (%)	0	
Notes		

Undercut UC		Draped DR		Bare BA		Marginal MA		Roots RT		Rocks RK		Other OTH		Bank Total	
LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB
30	30	30	30	70	70	0	0	0	0	0	0	0	0	130	130

Other

Team Leader:	K.Birkeland
Number of Staff:	3
Survey Purpose:	Monitoring
Purpose Notes:	
Equipment Type:	Backpack
Volts:	350
Amps:	0.5
Smooth / Pulsed:	Smooth
Manufacturer:	Electracatch
Model:	
No. of Anodes:	1
Ring Diameter:	25.00
Stop Net:	None
Capture Net:	Combination
Effective Fishing:	Yes
Conductivity:	45

Temperature:	9.50
Time:	
Water Level:	Medium
Water Clarity:	Clear
Survey Notes:	
Salmon Access:	Regularly
Trout Access:	Yes
Pollution:	No
Access Notes:	
Pollution Notes:	Possibly acidified (operational site)
Stocking:	No
Salmon Stocked:	No
Trout Stocked:	No
Stocking Notes:	
Photos and IDs:	

Other Fish Species Count

Species	Count
European Eel (Anguilla anguilla)	4

Atlantic Salmon Density Report

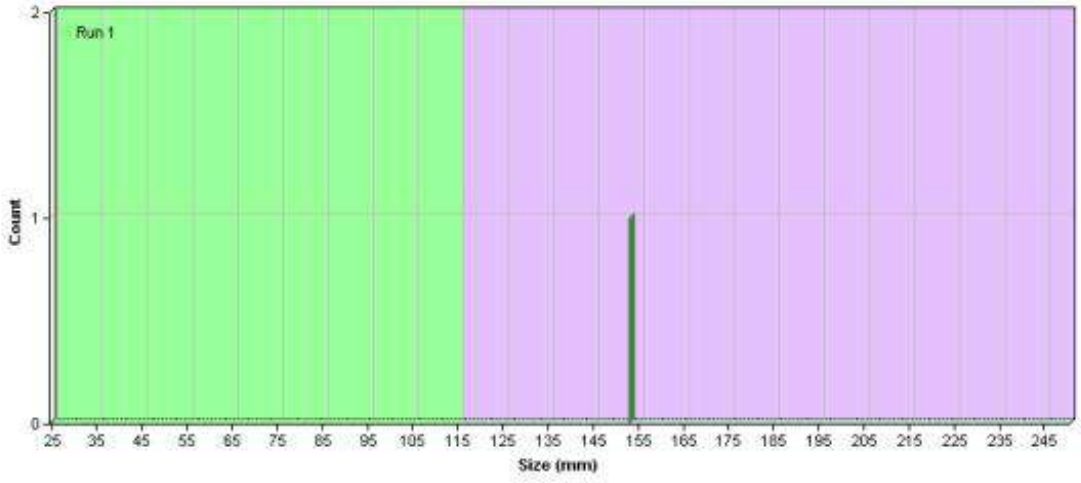
• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	0	0	0	0	0	0			0.000	0.000			
1++	1	0	0	0	0	1			0.626	0.626	153		
Total	1	0	0	0	0	1							

Salmon Missed (NaN)

Zippin					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					

Carle & Strub					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					



Brown Trout (Sea Trout) Density Report

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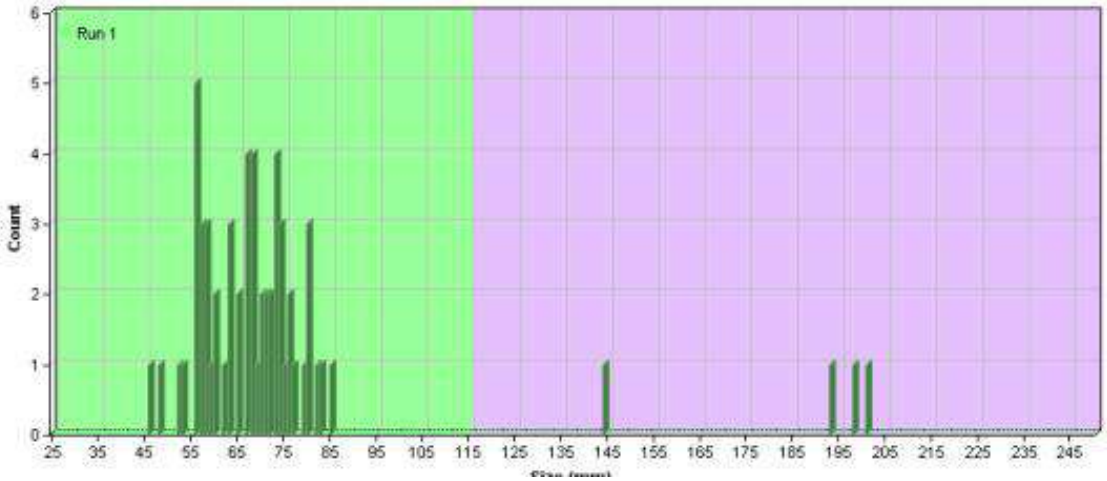
Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	57	0	0	0	0	57			35.705	35.705	66	9.251	
1++	4	0	0	0	0	4			2.506	2.506	184	26.870	
Total	61	0	0	0	0	61							

Trout Missed (NaN)

Zippin					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					

Carle & Strub					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					



SFCC Electrofishing Event Report

Easting: 267614	**Northing:** 714408	**Site code:** SEPA_469055	**Altitude:**
River: Ruchill Water			
Site situation: 29m d/s tributary on RB. Triangular boulder in middle of river			
Access/permission: Drummond estate			**Date:** 28/09/10

Type of fishing: Quantitative (1mm)	**Number of Fishing Runs:** 1
Instream Cover: Excellent	**Target Species:** Juvenile salmonid (Unspecified species) (-)

Dimensions

Wet Width Area (m²): 145.8	**Site Length (m):** 22.5
Bed Width Area (m²): 270.5	
Bank Width Area (m²):	

Point No.	Measured At (m)	Wet Width (m)	Bed Width (m)	Bank Width (m)
A-Upst	0.0	6.5	12.2	
B		7.3	14.3	
C		5.3	12.1	
D		6.3	11.0	
E-Downst		7.0	10.5	

Depth

< 10	11-20	21-30	31-40	41-50	> 50
5	5	10	20	10	50

Instream

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes:	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB	Substrate Total
0	0	2	3	5	30	60	0	0	100

Flow

Flow Speed (m/s):	
Notes:	

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO	Flow Total
10	0	0	0	0	30	40	20	100

Bank

	Left Bank	Right Bank
Total Fish Cover (%)	0	0
Bankface Veg.	Simple	Simple
Banktop Veg.	Simple	Simple
Overhang Bough (%)	0	0
Canopy Cover (%)	0	
Notes		

Undercut UC		Draped DR		Bare BA		Marginal MA		Roots RT		Rocks RK		Other OTH		Bank Total	
LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB
0	0	0	0	100	100	0	0	0	0	0	0	0	0	100	100

Other

Team Leader:	K.Birkeland
Number of Staff:	3
Survey Purpose:	Monitoring
Purpose Notes:	
Equipment Type:	Backpack
Volts:	400
Amps:	0.2
Smooth / Pulsed:	Smooth
Manufacturer:	Electracatch
Model:	
No. of Anodes:	1
Ring Diameter:	25.00
Stop Net:	None
Capture Net:	Combination
Effective Fishing:	Yes
Conductivity:	34

Temperature:	9.50
Time:	14:30
Water Level:	Medium
Water Clarity:	Clear
Survey Notes:	
Salmon Access:	Regularly
Trout Access:	Yes
Pollution:	No
Access Notes:	
Pollution Notes:	Possible acidification
Stocking:	No
Salmon Stocked:	No
Trout Stocked:	No
Stocking Notes:	
Photos and IDs:	

Other Fish Species Count

Species	Count

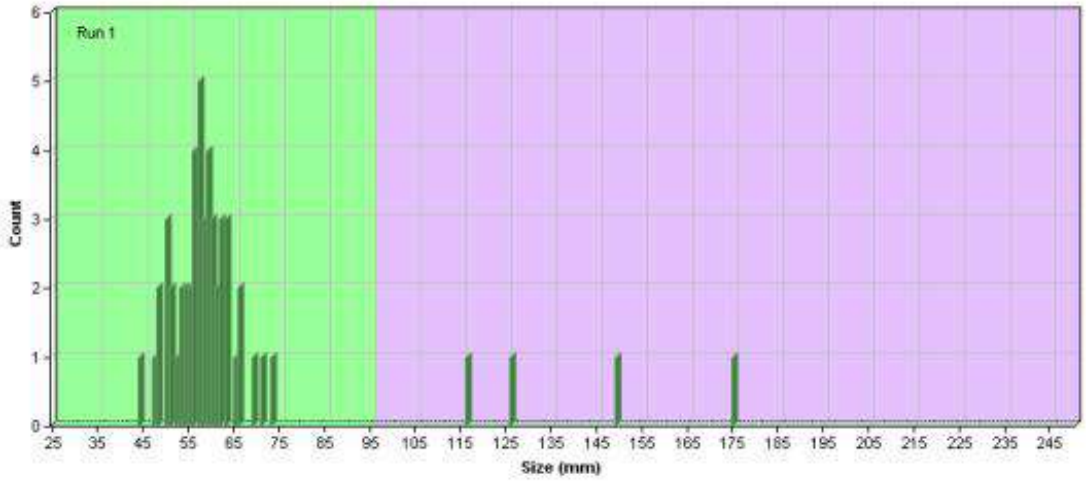
Atlantic Salmon Density Report

• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	49	0	0	0	0	49			33.608	33.608	57	6.131	
1++	4	0	0	0	0	4			2.743	2.743	141	26.262	
Total	53	0	0	0	0	53							
Salmon Missed (NaN)													

Zippin					
Age	Estimate	Confidence Levels		95%	Probability
		Lower	Upper		
0+					
1++					

Carle & Strub					
Age	Estimate	Confidence Levels		95%	Probability
		Lower	Upper		
0+					
1++					



Brown Trout (Sea Trout) Density Report

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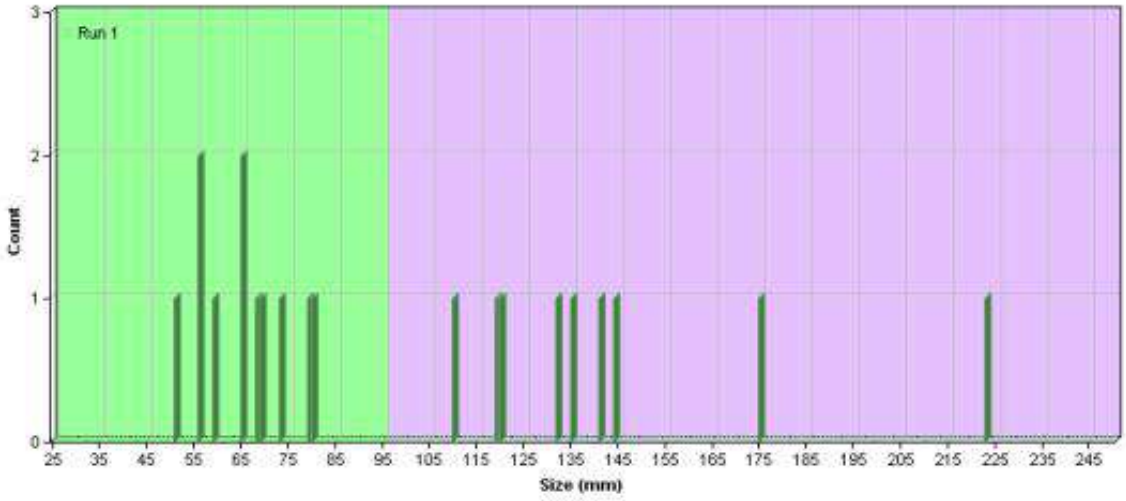
Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	11	0	0	0	0	11			7.545	7.545	65	9.491	
1++	9	0	0	0	0	9			6.173	6.173	144	34.986	
Total	20	0	0	0	0	20							
Trout Missed (NaN)													

Zippin						Carle & Strub					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability	Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+						0+					
1++						1++					



SFCC Electrofishing Event Report

Easting: 269658	**Northing:** 715589	**Site code:** SEPA_469054	**Altitude:**
River: Ruchill Water			
Site situation: D/S Pololines below bridge			
Access/permission: Drummond Estate			**Date:** 28/09/10

Type of fishing: Quantitative (1mm)	**Number of Fishing Runs:** 1
Instream Cover: Good	**Target Species:** Juvenile salmonid (Unspecified species) (-)

Dimensions

Wet Width Area (m²): 196.7	**Site Length (m):** 13.2
Bed Width Area (m²): 210.3	
Bank Width Area (m²):	

Point No.	Measured At (m)	Wet Width (m)	Bed Width (m)	Bank Width (m)
A-Upst	0.0	14.5	14.8	
B		14.8	16.9	
C-Downst		15.4	16.1	

Depth

< 10	11-20	21-30	31-40	41-50	> 50
8	20	35	25	10	2

Instream

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes:	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB	Substrate Total
0	0	5	15	20	20	40	0	0	100

Flow

Flow Speed (m/s):	
Notes:	

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO	Flow Total
2	10	8	5	5	40	30	0	100

Bank

	Left Bank	Right Bank
Total Fish Cover (%)	5	5
Bankface Veg.	Complex	Uniform
Banktop Veg.	Simple	Uniform
Overhang Bough (%)	50	5
Canopy Cover (%)	5	
Notes	LB very steep with BL and field at top	

Undercut UC		Draped DR		Bare BA		Marginal MA		Roots RT		Rocks RK		Other OTH		Bank Total	
LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB
0	0	0	0	95	95	5	5	0	0	0	0	0	0	100	100

Other

Team Leader:	A.Duguid
Number of Staff:	3
Survey Purpose:	
Purpose Notes:	
Equipment Type:	Backpack
Volts:	350
Amps:	0.4
Smooth / Pulsed:	Smooth
Manufacturer:	Electracatch
Model:	
No. of Anodes:	1
Ring Diameter:	25.00
Stop Net:	None
Capture Net:	Combination
Effective Fishing:	Yes
Conductivity:	57

Temperature:	10.10
Time:	16:15
Water Level:	Medium
Water Clarity:	Clear
Survey Notes:	
Salmon Access:	Regularly
Trout Access:	Yes
Pollution:	No
Access Notes:	
Pollution Notes:	
Stocking:	No
Salmon Stocked:	No
Trout Stocked:	No
Stocking Notes:	
Photos and IDs:	

Other Fish Species Count

Species	Count

Atlantic Salmon Density Report

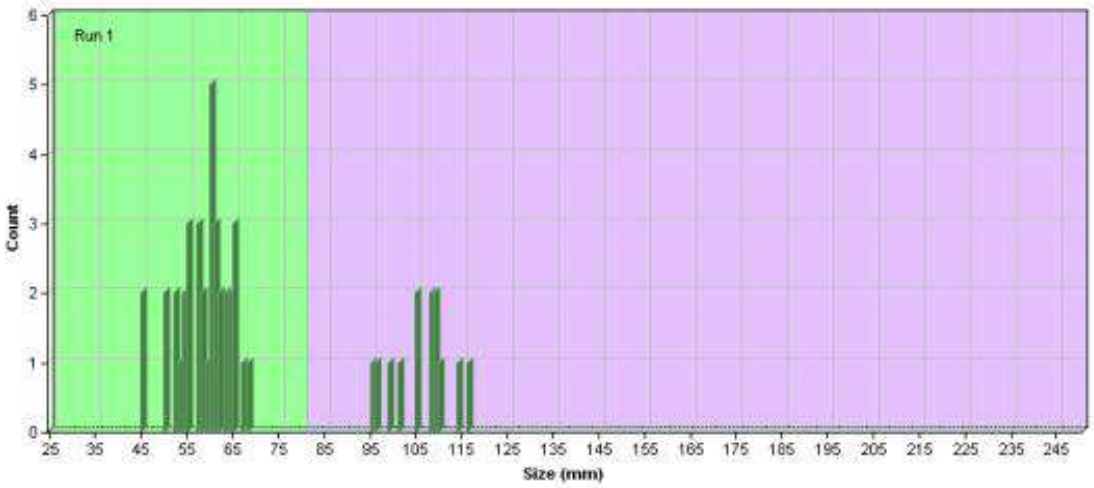
• The SFCC gratefully acknowledge the use of REMOVE software and its associated code, written by Professor Ralph Clarke, Centre for Conservation Ecology and Environmental Change, Bournemouth University, for the calculation of Zippin and Carle and Strub density estimates.

Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	37	0	0	0	0	37			18.812	18.812	58	5.656	
1++	13	0	0	0	0	13			6.610	6.610	105	6.470	
Total	50	0	0	0	0	50							

Salmon Missed (NaN)

Zippin					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					

Carle & Strub					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					



SFCC Electrofishing Event Report

Easting: 269658	**Northing:** 715589	**Site code:** SEPA_469054	**Altitude:**
River: Ruchill Water			
Site situation: D/S Pololines below bridge			
Access/permission: Drummond Estate			**Date:** 28/09/10

Type of fishing: Quantitative (1mm)	**Number of Fishing Runs:** 1
Instream Cover: Good	**Target Species:** Juvenile salmonid (Unspecified species) (-)

Dimensions

Wet Width Area (m²): 196.7	**Site Length (m):** 13.2
Bed Width Area (m²): 210.3	
Bank Width Area (m²):	

Point No.	Measured At (m)	Wet Width (m)	Bed Width (m)	Bank Width (m)
A-Upst	0.0	14.5	14.8	
B		14.8	16.9	
C-Downst		15.4	16.1	

Depth

< 10	11-20	21-30	31-40	41-50	> 50
8	20	35	25	10	2

Instream

Instream Vegetation (%): 0	**Silted:** No
Stable: Stable	**Compacted:** Uncompacted
Notes:	

High Organic HO	Silt SI	Sand SA	Gravel GR	Pebble PE	Cobble CO	Boulder BO	Bedrock BE	Obscured OB	Substrate Total
0	0	5	15	20	20	40	0	0	100

Flow

Flow Speed (m/s):	
Notes:	

Still Marginal SM	Deep Pool DP	Shallow Pool SP	Deep Glide DG	Shallow Glide SG	Run RU	Riffle RI	Torrent TO	Flow Total
2	10	8	5	5	40	30	0	100

Bank

	Left Bank	Right Bank
Total Fish Cover (%)	5	5
Bankface Veg.	Complex	Uniform
Banktop Veg.	Simple	Uniform
Overhang Bough (%)	50	5
Canopy Cover (%)	5	
Notes	LB very steep with BL and field at top	

Undercut UC		Draped DR		Bare BA		Marginal MA		Roots RT		Rocks RK		Other OTH		Bank Total	
LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB	LB	RB
0	0	0	0	95	95	5	5	0	0	0	0	0	0	100	100

Other

Team Leader:	A.Duguid
Number of Staff:	3
Survey Purpose:	
Purpose Notes:	
Equipment Type:	Backpack
Volts:	350
Amps:	0.4
Smooth / Pulsed:	Smooth
Manufacturer:	Electracatch
Model:	
No. of Anodes:	1
Ring Diameter:	25.00
Stop Net:	None
Capture Net:	Combination
Effective Fishing:	Yes
Conductivity:	57

Temperature:	10.10
Time:	16:15
Water Level:	Medium
Water Clarity:	Clear
Survey Notes:	
Salmon Access:	Regularly
Trout Access:	Yes
Pollution:	No
Access Notes:	
Pollution Notes:	
Stocking:	No
Salmon Stocked:	No
Trout Stocked:	No
Stocking Notes:	
Photos and IDs:	

Other Fish Species Count

Species	Count

Atlantic Salmon Density Report

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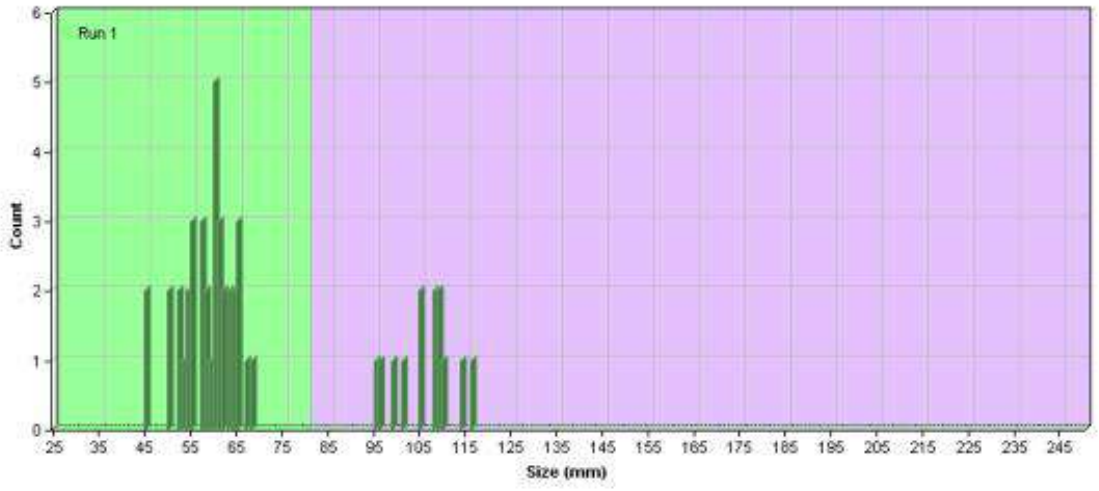
Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	37	0	0	0	0	37			18.812	18.812	58	5.656	
1++	13	0	0	0	0	13			6.610	6.610	105	6.470	
Total	50	0	0	0	0	50							
Salmon Missed (NaN)													

Zippin					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					

Carle & Strub					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					



Brown Trout (Sea Trout) Density Report

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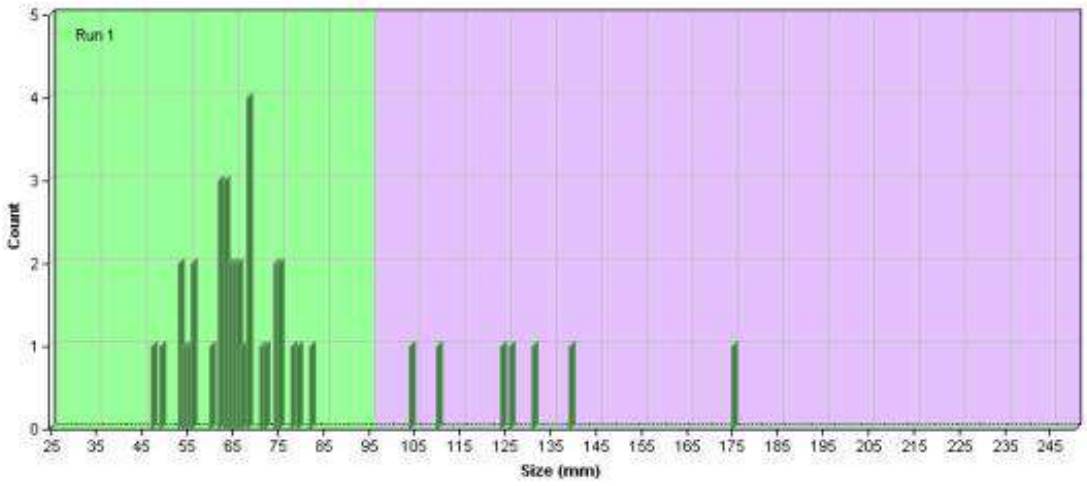
Age	Counts						Density Estimate (per 100m²)		Minimum Estimate (per 100m²)		Length		Scales Read?
	R1	R2	R3	R4	R5	Total	Zippin	Carle & Strub	1 Run	All Runs	Average	Std Dev	
0+	35	0	0	0	0	35			17.795	17.795	64	8.503	
1++	7	0	0	0	0	7			3.559	3.559	129	23.219	
Total	42	0	0	0	0	42							
Trout Missed (NaN)													

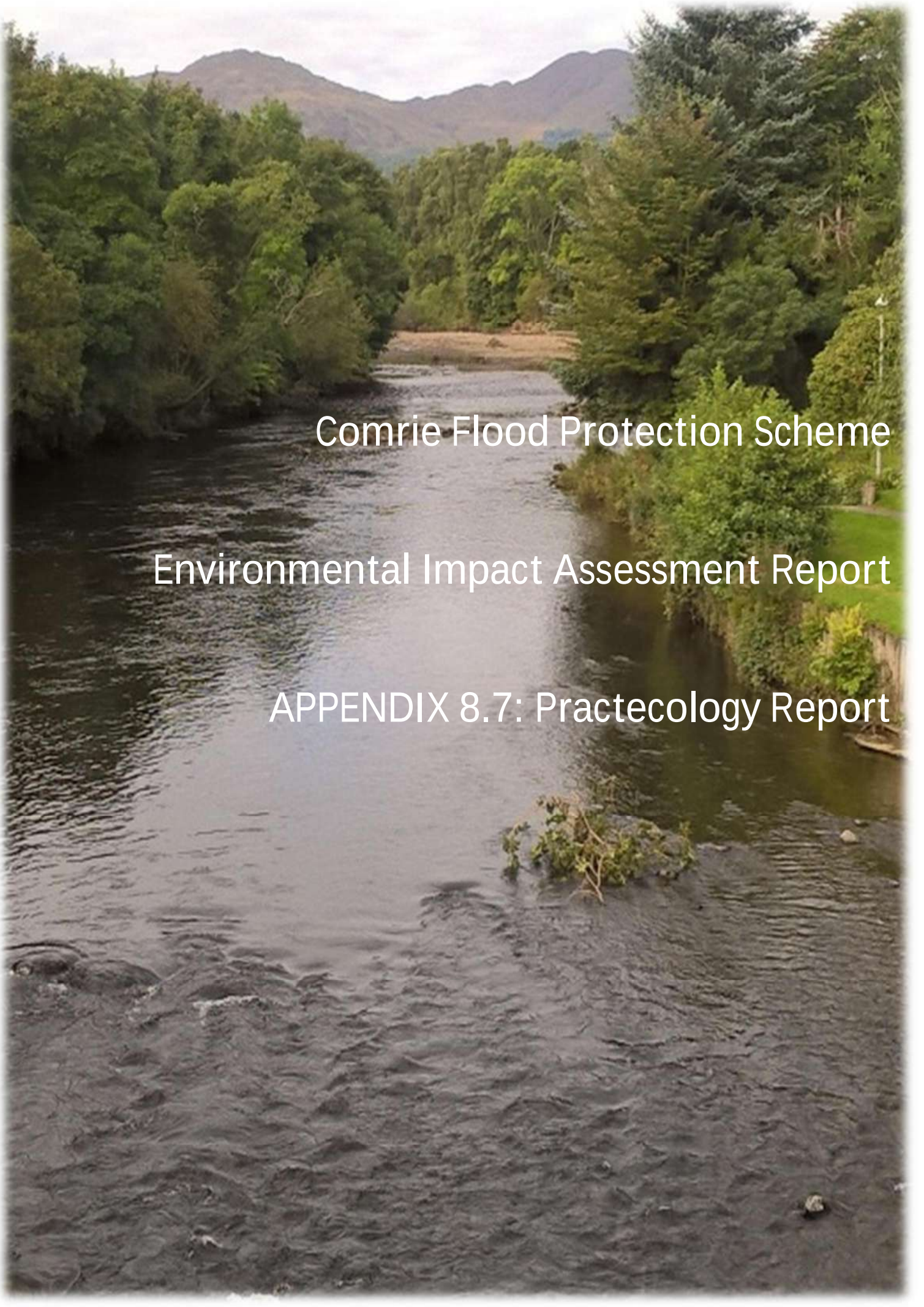
Zippin					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					

Carle & Strub					
Age	Estimate	Confidence Levels Lower	Upper	95%	Probability
0+					
1++					



Comrie Angling Club: Fish Returns

		Salmon				Grilse			Sea Trout				
		Wild		Farmed		Wild		Farmed		<0.5kg		>0.5kg	
		No.	Wt (Kg)	No.	Wt (Kg)	No.	Wt (Kg)	No.	Wt (Kg)	No.	Wt (Kg)	No.	Wt (Kg)
2017	Kept	10	37.77	0	0	4	8.93	0	0	0	0	10	16.44
	Returned	76	325.91	0	0	18	44.82	0	0	1	0.41	62	87.18
	Overall	86	363.68	0	0	22	53.75	0	0	1	0.41	72	103.62
2016	Kept	0	0	0	0	0	0	0	0	0	0	5	9.1
	Returned	72	276.6	0	0	16	28.7	0	0	0	0	26	36.19
	Overall	72	276.6	0	0	16	28.7	0	0	0	0	31	45.29
2015	Kept	9	35.06	0	0	4	9.05	0	0	1	0.5	14	22.99
	Returned	48	185.01	0	0	18	40.9	0	0	3	1.2	49	65.25
	Overall	57	220.07	0	0	22	49.95	0	0	4	1.7	63	88.24
2014	Kept	4	17.4	0	0	0	0	0	0	0	0	7	8.88
	Returned	17	67.72	0	0	3	7.09	0	0	0	0	35	45.28
	Overall	21	85.12	0	0	3	7.09	0	0	0	0	42	54.16
2013	Kept	11	41.68	0	0	5	14	0	0	0	0	5	5
	Returned	25	110.01	0	0	9	21.9	0	0	0	0	23	28.36
	Overall	36	151.69	0	0	14	35.9	0	0	0	0	28	33.36
2012	Kept	12	41.29	0	0	9	18.16	0	0	0	0	16	21.61
	Returned	37	143.98	0	0	23	42.77	0	0	0	0	54	68.47
	Overall	49	185.27	0	0	32	60.93	0	0	0	0	70	90.08
2011	Kept	23	95.74	0	0	9	16.9	0	0	2	1	21	25.1
	Returned	42	167.4	0	0	14	27.5	0	0	7	3.5	31	39
	Overall	65	263.14	0	0	23	44.4	0	0	9	4.5	52	64.1



Comrie Flood Protection Scheme

Environmental Impact Assessment Report

APPENDIX 8.7: Practecology Report

PRACTECOLOGY

PRACTICAL ECOLOGY SOLUTIONS

Comrie Flood Alleviation

American Signal Crayfish Survey

Document Control Sheet		
Version	Author	Issue Date
1.0: For Issue	Dr. Iain Adderton FLS, CEnv MCIEEM	21.11.18

Appendices

1. Executive Summary

1.1.1 As part of flood alleviation works at Comrie, Perthshire, protected species surveys were carried out by Sweco Ltd. During these surveys the remains of adult American signal crayfish where identified on the banks of the River Earn. In September 2018 Practecology Ltd. was commissioned to undertake targeted surveys for this species.

1.1.2 Signal crayfish are an invasive, non-native species which have a significant negative impact on the biodiversity of water-courses. This species also carries a bacteria, often referred to as crayfish plague, which kills infected native white-clawed crayfish which occur in England and Wales.

1.1.3 Signal crayfish surveys were carried out on three watercourses around Comrie: the River Earn, Water of Ruchill and the River Lednock. Surveys included an initial habitat assessment, and instream aquatic survey and torchlight surveys. The instream survey followed methodology used for native white-clawed crayfish.

1.1.4 A total of 73 habitat patches supporting 512 refuges were investigated with 9 patches being subject to a visual search only. Ten patches were surveyed by torchlight. No signal crayfish were found along any of the water-courses.

1.1.5 The bank side geology and bed substrate do not appear to be suitable for signal crayfish. There is a lack of suitable burrowing opportunities and the number of large consolidated boulders on the bed to shelter under is very limited. All of the rivers are subject to rapid changes in height and faster flows following periods of rainfall further limiting their suitability for crayfish.

1.1.6 The remains found on the River Earn may be from a small population occupying a water-course or pond with a more favourable flow regime and substrate. Anecdotal information obtained during the current survey suggests that crayfish may occupy the Tullybannocher Burn. This burn feeds into the River Earn approximately 0.5km further upstream from the extent of this survey. This population may have been unable to colonise the River Earn for the reasons above, or, a population does exist but below the density at which it could be detected.

1.1.7 It is recommended that targeted surveys are carried out along the Tullybannocher Burn and adjacent watercourses to determine whether crayfish are present. Ongoing consultation with SEPA, the fishery board, and anglers association should also be carried out.

2. Introduction

2.1 Terms of Reference

2.1.1 In September 2018 Practecology Ltd was commissioned by Sweco Ltd to conduct an American signal crayfish survey close to the village of Comrie (Grid reference: NN 77609; 21758), Perthshire, to inform proposed flood alleviation works. Comrie has suffered from several recent flooding events and the works are intended to reduce their frequency and occurrence. The need for the crayfish survey follows the discovery of crayfish remains on the banks of the River Earn by SEPA officials and more recent otter surveys done by Sweco staff.

2.1.2 Signal crayfish are an invasive, non-native species of crustacean which can have significant detrimental impact on a rivers biological diversity and bank-side stability. They are listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) making it an offence to cause it to spread in the wild. In 2007 the Scottish Government listed signal crayfish under the Species Action Framework (SAF) as an invasive species posing a significant threat to freshwater biodiversity.

2.1.3 Populations have been recorded in locations elsewhere in Scotland and it is estimated that they occupy up to 58km of river, as well as occupying standing waters such as lochs and rivers. They are more widespread in England and out-compete the native white-clawed crayfish. Signal crayfish are known to carry a disease, *Aphanomyces astaci*, which is also harmful to native crayfish resulting in the death of infected individuals. Once established in a river, signal crayfish populations can expand quickly due to the number of offspring produced by each female.

2.1.4 To determine whether signal crayfish present a constraint to the proposed works, specifically the likelihood that they may be spread, the current survey was commissioned. It was conducted on approximately 3km of watercourse including the River Earn, River Lednock and the Water of Ruchill.

3. Site Location and Description

3.1 Location

3.1.1 The village of Comrie is located in the county of Perthshire, approximately 35km west of the city of Perth (Figure 1) with the western end falling within the River Earn (Comrie to St Fillans) National Scenic Area.

3.1.2 Comrie sits on the confluence of three rivers with the Water of Ruchill and the River Lednock joining the main stem of the River Earn, which in turn enters the River Tay east of Perth and within the Tay estuary.

Figure 1: Location of Comrie, west of the city of Perth.

3.2 Site Description

3.2.1 All three rivers around Comrie where subject to survey with approximately 1.5km of the River Earn, 1km of the Water of Ruchill and 350m of the River Lednock included. The extent of the survey is shown in Figure 2.

3.2.2 The three rivers differ in size and character caused by their different catchment areas and surrounding topography. However, all three seem to respond rapidly to heavy rainfall before returning to previous levels quite quickly. During the survey all rivers were recorded by SEPA as being normal, albeit at the lower end of this classification. A description of each river is provided, with photographs shown in Appendix A.

Figure 2: The extent of the three rivers subject to signal crayfish surveys. The extent of each section is indicated in yellow.

River Earn

3.2.3 The River Earn is approximately 74km long and arises in Loch Earn which sits in the central highlands of Scotland only 10km upstream of Comrie. The river flows through the pastoral landscape of Strathearn which is bordered by rocky outcrops supporting native trees and plantation woodland.

3.2.4 Within the survey area the river generally has a fast flow with areas of run and glide most frequent. Rapids occur at a weir beside the River Lednock confluence and adjacent to Comrie Parish Church. The channel is generally stable (Photograph 1) although banks have often been reinforced with large boulders. Throughout the survey area the river is on average 13m wide and has a depth of 0.7m, although wider where the River Earn and Water of Ruchill combine.

3.2.5 There are a few very deep pools over 2.0m deep while much of the river has shallow margins characterised by water with little or no flow. The bed is highly mobile and predominantly loose cobble and boulder. Sand and gravel occurs close to the deep pools, behind large boulders, or in slow water on the inside of meanders.

Water of Ruchill

3.2.6 The Water of Ruchill is 16km long and arises in the Forest of Glenartney where moorland and heath dominate the upper reaches of the river.

3.2.7 Within the survey area the Water of Ruchill supports native trees and scrub. It has an obvious channel at its upstream end with areas of run and glide most dominant.

Across the survey area it has an average width of 12m and a depth of 0.6m, although towards the confluence with the River Earn the river bed is much wider, and characterised by exposed rocks which are submerged when river levels rise (Photograph 2).

3.2.8 Banks have been reinforced with large boulders and groynes (Photograph 3) have been installed at one meander to slow the rate of flow. Some standing water is present on the exposed bed and some braiding occurs at the downstream end.

3.2.9 Many parts of the banks have been eroded and undercut such that mature trees lie in the river with small deep pools up to one metre in depth around their base. These are generally the only deep pools on this water course. The bed is dominated by cobble while the lower section has a higher percentage of gravel and pebble. Boulders do occur on the bed but not to the same extent as on the River Earn.

3.2.10 Japanese knotweed is common along the banks at the downstream reaches close to the confluence with the River Earn.

River Lednock

3.2.11 The River Lednock rises in the Loch Lednock reservoir 10km north west of Comrie. It flows through moorland and heath, although some improved sheep pasture is present in places. Prior to arriving at Comrie the channel becomes more wooded with native and plantation woodland occurring extensively on both banks.

3.2.12 Within the survey area it has an average width and depth of 7.5m and 0.6m, respectively, and sits within a dense riparian corridor (Photograph 4). The river is in a pronounced channel with large boulders reinforcing the banks in many places. While there are areas of run and glide they are much smaller in scale than those on the Earn and Ruchill. Despite the short length of this water-course surveyed, parts of the Lednock are quite deep and over 0.8m in depth.

3.2.13 The bed is mainly cobble and boulder with sand and gravel occurring at the upstream area where the river is slightly wider, on the inside of a meander and adjacent to bridge supports. A small sand bar occurs where it joins with the River Earn.

4. Methodology

4.1 Habitat Assessments

4.1.1 Each of the three rivers was divided into sections approximately 500m in length. This gave three sections on the River Earn, two on the Water of Ruchill and one on the River Lednock. A suitable reference point was chosen to divide sections on the River Earn and Water of Ruchill. The section on the River Lednock was only 350m long in keeping with the Clients specification of survey extent.

4.1.2 While the standard methodology for surveying native white-clawed crayfish focussed on only a sub-sample of 500m sections across a whole catchment, the limited extent of this survey allowed all sections to be incorporated. The methodology also allowed targeted hand searching for crayfish in all suitable habitat rather than a sub-sample.

4.1.3 All water courses were subject to an initial assessment to identify suitable crayfish habitat. This included deep pools (Photograph 5) and slow moving water or where bank-side features may offer suitable refuges, for example groynes; boulders; reinforced banks, and; logs, trees (Photograph 6) or fallen branches. Banks were also investigated for the presence of burrows, made easier by the low water at the time of survey. Each suitable area of habitat was referred to as a “patch”.

4.1.4 A minimum of ten patches were identified for each 500m section. Patch size was maximised where possible to account for those which were much smaller but also where the availability of suitable habitats within the water-course was limited.

4.1.5 Habitat assessments were carried out on the 11th and 12th of October 2018.

4.2 Instream Surveys

4.2.1 Within each patch potential refuges which were deemed suitable for signal crayfish were inspected by ecologists wearing dry suits and equipped with snorkels. Visual searches were predominantly done using a face mask so that hands were kept free to move large rocks and boulders. In shallower water a bathyscope was used. The number and type of each refuge were recorded in each patch.

4.2.2 Kick sampling was undertaken where patches contained large amounts of leaf litter, twigs and branches. A pond net with head dimension 25cmx25cm and a 2mm mesh was held downstream of suitable patches which were then disturbed for 3 minutes by kicking the substrate and debris. Net contents were then inspected.

4.2.3 Trapping was not considered for this survey due to the risk of traps being washed away in high water. Further, trapping has been shown to be inconclusive and not as

effective as active methods. Active methods includes electrofishing, but this too has been shown to have limitations, and which may be exacerbated in fast flowing rivers.

4.2.4 Instream surveys were carried out between the 24th and 29th October 2018 during similar water levels recorded during the habitat assessments.

4.3 Torchlight Surveys

4.3.1 Torchlight surveys using a two million candlepower spotlight (Model: Cluson CB2 Clubman) were conducted at night where pools could be accessed from the bank top. This was to coincide with increased activity levels when crayfish were most likely to be feeding. Torchlight surveys were conducted on the 24th October.

4.4 Limitations

4.4.1 The availability of suitable patches on the three water courses was limited due to the unsuitable bank geology, bed substrate and flow regimes. Many of the large boulders within some of the deeper pools and large logs were not compacted into the bed substrate such that they would wash away in high water.

4.4.2 Habitat patches were also only considered as suitable at a specific snapshot in time and it is acknowledged that their value to crayfish may have altered depending on water height and flow regime.

4.4.3 Survey efficiency was reduced in deep pools over 1.7m in depth as moving boulders on the river bed was impossible. Shading on the River Lednock caused by riparian vegetation limited visibility of the river bed such that some crevices may have been overlooked.

4.4.4 Despite the limitations it is considered that the survey methods employed are sufficiently robust to give confidence in the results.

5. Results

5.1 Habitat Assessment

5.1.1 During the habitat assessment a total of 73 habitat patches were identified as being potentially suitable for signal crayfish across all three watercourses; 39 on the River Earn, 24 on the Water of Ruchill and 10 on the River Lednock. The majority of these habitats were located at the water's edge, within deep pools or areas of slow glide. Only two mid-stream patches were investigated which were formed by the exposure of bedrock in the main channel of the River Earn with two others on a vegetated braid of the Water of Ruchill.

5.1.2 Patches varied in dimension depending on the suitability of the substrate and flow regime, but also on the size of the feature. Patch size was limited where it was caused by fallen trees in the channel such that only slack water around the submerged root plate or branches could be surveyed. Conversely reinforced banks, groynes and deep pools gave rise to larger habitat patches.

5.1.3 No burrows were identified on the banks of any of the water courses. Banks were mostly comprised of cobbles and boulders and did not present suitable burrowing opportunities. Where banks had been reinforced with boulders then this too reduced their suitability for burrowing although crevices between the rocks did present suitable alternatives.

5.1.4 Earth banks which could have enabled burrowing were only present at 34 sites. However, at several of these locations the bank profile was too shallow and these areas were often used by anglers to access the river such that any burrows may have collapsed. On the Water of Ruchill, low water had exposed much of the river bed such that the banks were as much as 20m away from the wetted edge. This was particularly evident at its confluence with the River Earn.

5.1.5 Bank collapse was notable along the lower reaches of the Water of Ruchill prior to joining the River Earn. This included the collapse of whole sections which supported mature trees and which lay in the water. Some collapse was also evident at the mouth of the River Lednock where it joined the River Earn.

5.2 Instream Surveys

5.2.1 From the 73 habitat patches, 512 refuges were searched across the three water courses with eight habitat patches only assessed visually due to deep water. The number of refuges searched per water-course was as follows: River Earn, 264; Water of Ruchill, 227, and; River Lednock, 21.

5.2.2 As well as submerged root plates, other patches included submerged logs (Photograph 7), branches and leaf litter; effluent pipes; bridge foundations; reinforced banks, and; under and in crevices between boulders (Photograph 8). The latter two features were the most abundant type of refuge searched

5.2.3 No crayfish was recorded in any of the rivers including from sites subject to kick sampling.

5.3 Torchlight Surveys

5.3.1 Ten pools could be accessed safely to conduct torchlight surveys. No crayfish were identified.

6. Discussion

6.1 Habitat Assessment

6.1.1 The instream and bank-side habitat of all three rivers was generally unsuitable for signal crayfish. This was principally due to the absence of muddy banks in which they could burrow into, instead the banks were comprised mainly of boulders, including bedrock. At the lower reaches of the Water of Ruchill where it joins the River Earn much of the bank was exposed bare rock due to low water levels at the time of survey or was heavily eroded and showed signs of significant collapse. Any burrow excavated on these banks is unlikely to persist for long and may accelerate collapse.

6.1.2 While other habitats may become available during higher water levels, no burrows were identified on bank-tops more distant from the waters' edge. Further, even if bank-side structure was more favourable further away from the river, it may have been rendered unusable as higher flows may have led to unfavourable flow regimes. Additionally the bare rocks which would then form the river bed would be too small and uncompacted to provide a stable refuge.

6.1.3 There were deep pools and areas of standing water which could be suitable for crayfish on all three rivers, especially the River Earn and a small stretch of the River Lednock. However, these pools were only suitable when the river was at a low level and would be subject to faster flows when in flood. Faster flows may disturb material on the river bed, including rocks and large branches such that it is too unstable for crayfish to persist. Only where large stones occur on the bed could crayfish have a chance of survival.

6.1.4 During the habitat survey the river was at a low level, although still classed as normal according to SEPA data. Given the surrounding topography of steep sided valleys, especially the River Earn, and the size of each rivers catchment, each river is likely to undergo dramatic fluctuations in water level following periods of heavy rain or snow melt in winter. Such dramatic changes in flow, edge habitat and the dynamic nature of the bed is unlikely to be suitable for crayfish and may prevent any population from becoming established or ever reaching high numbers.

6.2 Instream and Torchlight Survey

6.2.1 Although 572 refuges were searched, the majority of them were unconsolidated boulders and debris which may be subsequently washed downstream during higher water levels and increased flows. This is also the case for the large trees and root plates which occupy the lower reaches of the Water of Ruchill.

6.2.2 The refuges chosen were the best available and which were deemed suitable for crayfish. Even in some patches, which were themselves limited in number and extent

on each watercourse, the number of refuges were limited to only a few boulders or crevices.

6.2.3 Torchlight surveys are a useful survey method but could only be carried out where deeper pools or slow water bordered areas of the bank that could be accessed safely at night. Nonetheless, the technique confirmed the presence of trout and minnows in water around 0.50m in depth such that they would have detected crayfish had they been present. Mobile sediment and leaf litter rendered spotlight surveys inefficient in deeper water.

6.2.4 The limited use of kick sampling and the avoidance of trapping and electrofishing in the current survey is unlikely to have contributed to the lack of crayfish records. Some of these methods are known to have limitations and it was reasoned that an active search of refuges would be overall more efficient.

7. Conclusion and Recommendations

7.1 Conclusion

7.1.1 The current survey suggests that a population of signal crayfish does not occupy any of the three water courses investigated. However, it is notoriously difficult to detect signal crayfish at low densities. Surveys by the Tay District Salmon Fishery Board on the River Earn in 2009 did not identify signal crayfish despite earlier records suggesting they were present.

7.1.2 Whilst alternative survey methods could have been deployed, for example electrofishing, extensive kick sampling or surber sampling, they each have their own limitations including time and expense to undertake. They would have been ineffectual in the River Earn and Water of Ruchill which are substantial in size and have many fast flowing sections.

7.1.3 The general unsuitability of the banks along all watercourses coupled to variable flow regimes and the dynamic nature of the instream substrate, which may become even more inhospitable during floods, may prevent a population of signal crayfish from becoming established. Even if one does become established it my only be able to exist at a very low density.

7.1.4 If a breeding population exists in a tributary or pond further upstream which has a preferable substrate and more steady flows then juveniles may eventually make their way downstream into the River Earn and other tributaries. These individuals may persist only as long as favourable flow conditions occur before perishing in high flows or being washed downstream to other habitats where they may later become established.

7.1.5 It is also possible that juvenile crayfish will be predated on by birds and fish with adults being targeted by otters, mink and herons. This may further reduce the likelihood of a small population of crayfish becoming established and increasing in number and distribution.

7.1.6 If anecdotal information is considered then a historic population may occur in the Tullybannocher Burn, approximately 0.5km upstream from the extent of the current survey, or have become established in the former fish farm on the southern bank of the River Earn close to the confluence of this burn with the river. This is supported by the recent discovery of adult crayfish remains on the banks of the River Earn in this location, but nowhere else during earlier protected species surveys.

7.1.7 Until the status of these potential populations is understood then there remains the possibility that signal crayfish could inhabit the River Earn and Water of Ruchill at a

later date and reach densities which may make them detectable. It should also be acknowledged that a population may not spread gradually along the water course as signal crayfish are able to move across land into neighbouring streams.

7.2 Recommendations

7.2.1 The only satisfactory way of determining whether signal crayfish present a risk to the flood alleviation works is to repeat the survey along the Tullybannocher Burn and at the former fish farm. These surveys may be able to make use of trapping in some of the ponds or electrofishing where the depth allows.

7.2.2 Ongoing Consultation with SEPA, the fisheries board, and anglers should be undertaken ahead of works such that should a crayfish be identified then action to prevent their spread can be immediately undertaken. This consultation would also determine whether surveys on completion of works are necessary.

8. References

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Non-native species secretariat: on line resource

Appendix A: Site Photographs

Photograph 1: The River Earn flowing through Comrie. Measures to stabilise the bank are visible in the left foreground.

Photograph 2: The confluence of the Water of Ruchill (background) and the River Earn (foreground) showing large areas of exposed bed and eroded banks.

Photograph 3: Groynes and bank-side reinforcement on the Water of Ruchill. Slow water downstream of the groynes, coupled to the crevices between the rocks, was considered to be suitable for crayfish.

Photograph 4: The River Lednock showing the dense riparian corridor and generally straight channel. Slow moving water offered suitable flow regimes although large boulders often reinforced the channel making the bank unsuitable for burrowing.

Photograph 5: A deep pool beside the right hand bank of the River Earn with slow flowing water and an earth bank which is suitable for signal crayfish.

Photograph 6: Submerged tree roots and boughs, coupled to slow moving water, may provide shelter for crayfish. The extent of the patch is centred on the woody debris.

Photograph 7: A submerged log which offers ideal habitat for crayfish to shelter under.

Photograph 8: Boulders were the commonest type of refuge although many of them were not consolidated into the bed and may have moved during flood events.

Appendix B: Details of Habitat Patches.

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77077;20941	*Conditions:*	Dry and bright
General description	Patch is the most upstream groyne and all the crevices on its upstream and downstream sides.		
Flow:	Patch is half glide and half static water in a back eddy of groyne.		
Substrate:	50% cobble; 50% boulder.		
Bank type:	Bank entirely comprised of boulder due to bank reinforcement.		
No. and/or type of refugia:	20 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77085;20941	*Conditions:*	Dry and bright
General description	Patch is reinforced bank between two groynes.		
Flow:	Patch is half glide and half static water in a back eddy of groyne.		
Substrate:	50% cobble; 50% boulder.		
Bank type:	Bank entirely comprised of boulder due to bank reinforcement.		
No. and/or type of refugia:	25 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77091;20959	*Conditions:*	Dry and bright
General description	Patch is both sides of the second downstream groyne		
Flow:	Patch is half glide and half static water in a back eddy of groyne.		
Substrate:	50% cobble; 50% boulder.		
Bank type:	Bank entirely comprised of boulder due to bank reinforcement.		
No. and/or type of refugia:	4 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77094;20975	*Conditions:*	Dry and bright
General description	Patch is reinforced bank between the second and third groyne.		
Flow:	Patch is half glide and half static water in a back eddy of groyne.		
Substrate:	50% cobble; 50% boulder.		
Bank type:	Bank entirely comprised of boulder due to bank reinforcement.		
No. and/or type of refugia:	27 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77095;20992	*Conditions:*	Dry and bright
General description	Patch is the third groyne. Much of the downstream edge is shallow with a large gravel bed.		
Flow:	Patch is half glide and half static water in a back eddy of groyne.		
Substrate:	70% gravel; 15% cobble; 15% boulder.		
Bank type:	Bank entirely comprised of boulder due to bank reinforcement.		
No. and/or type of refugia:	19 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77093;21001	*Conditions:*	Dry and bright
General description	Rock face between third and fourth groyne.		
Flow:	Patch is half glide and half static water in a back eddy of groyne.		
Substrate:	10% gravel; 20% pebble; 40% cobble; 30% boulder.		
Bank type:	Bank entirely comprised of boulder due to bank reinforcement.		
No. and/or type of refugia:	17 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77095;21008	*Conditions:*	Dry and bright
General description	Upstream and downstream edges of fourth groyne.		
Flow:	Patch is half glide and half static water in a back eddy of groyne.		
Substrate:	40% pebble; 40% cobble; 20% boulder.		
Bank type:	Bank entirely comprised of boulder due to bank reinforcement.		
No. and/or type of refugia:	13 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77092;21026	*Conditions:*	Dry and bright
General description	Downstream of bend and in the shelter of the 4 groyne. Still reinforced bank.		
Flow:	Patch entirely glide.		
Substrate:	20% pebble; 70% cobble; 10% boulder.		
Bank type:	Bank entirely comprised of boulder due to bank reinforcement.		
No. and/or type of refugia:	11 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77092;21040	*Conditions:*	Dry and bright
General description	Standing water by left hand bank. Number of refuges limited as the bed is uncompacted and only loose boulders atop cobble.		
Flow:	Patch entirely glide.		
Substrate:	30% gravel; 20% pebble; 40% cobble; 10% boulder.		
Bank type:	Bank has some earth but is mainly exposed boulder. No burrows.		
No. and/or type of refugia:	3 boulders	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77091;21208	*Conditions:*	Dry and bright
General description	Long gliding pool with exposed tree roots. Patch is entire river width and approximately 25m long.		
Flow:	Patch entirely glide.		
Substrate:	15% gravel; 50% cobble; 35% boulder.		
Bank type:	Bank is entirely boulder.		
No. and/or type of refugia:	60 boulders	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 76994;21393	*Conditions:*	Dry and bright
General description	Deep pool with evidence of bank-side collapse.		
Flow:	Patch entirely pool.		
Substrate:	5% gravel; 5% pebble; 30% cobble; 60% boulder.		
Bank type:	Bank is entirely boulder but is also subject to erosion.		
No. and/or type of refugia:	Visual inspection of bed.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 76992;21437	*Conditions:*	Dry and bright
General description	Deep pool.		
Flow:	Patch entirely glide.		
Substrate:	5% gravel; 5% pebble; 30% cobble; 60% boulder.		
Bank type:	Bank is earth but there are no burrows evident.		
No. and/or type of refugia:	Visual inspection of bed.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77155;21517	*Conditions:*	Dry and bright
General description	Slow water at the bank-side and quite shallow.		
Flow:	Patch entirely glide.		
Substrate:	20% pebble; 70% cobble; 10% boulder.		
Bank type:	Bank is a mix of earth and boulder and unstable.		
No. and/or type of refugia:	Visual inspection of bed.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77189;21505	*Conditions:*	Dry and bright
General description	Fallen tree at the bank-side with static water around branches lying instream.		
Flow:	Patch entirely glide.		
Substrate:	10% gravel; 10% pebble; 30% cobble; 50% boulder.		
Bank type:	Bank is a mix of earth and boulder.		
No. and/or type of refugia:	5 boulders and tree roots.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77226;21521	*Conditions:*	Dry and bright
General description	Two static water pools on braid.		
Flow:	Standing water outside of main channel.		
Substrate:	15% gravel; 15% pebble; 70% cobble		
Bank type:	Bank is a mix of earth and boulder.		
No. and/or type of refugia:	10 concrete blocks and leaf litter	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77248;21669	*Conditions:*	Dry and bright
General description	Back eddy at the end of a braid.		
Flow:	Entirely pool.		
Substrate:	5% sand; 15% gravel; 15% pebble; 20% cobble; 45% boulder		
Bank type:	Bank entirely boulder.		
No. and/or type of refugia:	2 boulders and a tree root	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77210;21732	*Conditions:*	Dry and bright
General description	Patch within the roots of a fallen ash tree on the outside of a meander. there is much bank-side collapse in the vicinity. Pool is very deep.		
Flow:	Entirely pool.		
Substrate:	20% cobble; 80% boulder		
Bank type:	Bank a mix of earth and boulder but unstable.		
No. and/or type of refugia:	Visual inspection.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77173;21755	*Conditions:*	Dry and bright
General description	Patch is around the roots and branches of a fallen maple tree. The pool is quite deep due to scour around the roots.		
Flow:	Entirely pool.		
Substrate:	5% silt; 10% sand; 5% pebble; 75% cobble; 5% boulder		
Bank type:	Bank a mix of earth and boulder but unstable.		
No. and/or type of refugia:	Visual inspection.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77151;21759	*Conditions:*	Dry and bright
General description	Patch is located around a fallen tree which has slow water around submerged boughs and large root plate.		
Flow:	Pool is partly glide but much of it is a back eddy.		
Substrate:	25% gravel; 50% pebble; 20% cobble; 5% boulder.		
Bank type:	Bank is completely earth but there are no burrows.		
No. and/or type of refugia:	1 under fallen bough	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77268;21592	*Conditions:*	Dry and bright
General description	Pool of standing water on vegetated braid.		
Flow:	Standing water outside of main channel.		
Substrate:	10% pebble; 70% cobble; 20% boulder		
Bank type:	Bank is a mix of earth and boulder.		
No. and/or type of refugia:	6 boulders	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77118;21759	*Conditions:*	Dry and bright
General description	Fallen ash tree by bank with static water around branches on downstream side.		
Flow:	Static water.		
Substrate:	5% sand; 10% pebble; 80% cobble; 5% boulder.		
Bank type:	Bank is completely earth but there are no burrows.		
No. and/or type of refugia:	Visual search as very shallow.	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77099;21766	*Conditions:*	Dry and bright
General description	Large maple tree lying instream. The root plate has caused scouring and created deep water. Patch was also torched.		
Flow:	Patch a mix of glide and eddy around tree.		
Substrate:	10% pebble; 30% cobble; 60% boulder.		
Bank type:	Bank is 100% boulder.		
No. and/or type of refugia:	1 bough	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77059;21793	*Conditions:*	Dry and bright
General description	Deep pool with lots of instream tree debris. Patch was also torched.		
Flow:	Deep pool.		
Substrate:	5% sand: 10% gravel; 60% cobble; 25% boulder.		
Bank type:	Bank is a mix of boulder and earth and notably unstable.		
No. and/or type of refugia:	1 root plate	*Crayfish (Y/N)*	No

Water Course	Water of Ruchill	*Survey Date:*	26/10/2018
Grid reference:	NN 77124;21877	*Conditions:*	Dry and bright
General description	Patch focussed on branches of fallen tree and undercut bank.		
Flow:	Slow glide.		
Substrate:	5% sand: 80% cobble; 15% boulder.		
Bank type:	Bank is all earth and unstable with some parts undercut. There are no burrows.		
No. and/or type of refugia:	1 root plate	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77558;22059	*Conditions:*	Dry, overcast
General description	A deep pool over 1.7m deep and adjacent to a retaining wall which has collapsed in places.		
Flow:	Deep pool with the edge of fast run closer to midstream.		
Substrate:	10% cobble; 90% boulder.		
Bank type:	Bank reinforced boulder but quite unstable.		
No. and/or type of refugia:	10 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 76604; 22052	*Conditions:*	Dry, overcast
General description	Back eddy on the inside of a meander forming a deep pool with an undercut bank.		
Flow:	Generally static.		
Substrate:	80% sand; 15% gravel; 5% boulder.		
Bank type:	All earth but undercut and no burrows present.		
No. and/or type of refugia:	Rocks and dead vegetation.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 76784; 22062	*Conditions:*	Dry, overcast
General description	Right hand bank of a meander downstream of Dalginross Bridge.		
Flow:	Gentle glide.		
Substrate:	10% sand; 10% pebble; 60% cobble; 20% boulder.		
Bank type:	All earth but no burrows.		
No. and/or type of refugia:	1 boulder.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 76799; 22033	*Conditions:*	Dry, overcast
General description	Banks of a deep pool.		
Flow:	Gentle glide		
Substrate:	40% sand; 30% pebble; 10% cobble; 20% boulder.		
Bank type:	Bank all earth.		
No. and/or type of refugia:	6 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 76824; 21967	*Conditions:*	Dry, overcast
General description	Pile of boulders and an old clay pipe adjacent to a private residence.		
Flow:	Standing water on the inside of a meander.		
Substrate:	40% sand; 30% cobble; 30% boulder.		
Bank type:	Bank a mix of earth and boulder but stable.		
No. and/or type of refugia:	9 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 76839; 21950	*Conditions:*	Dry, overcast
General description	Pile of boulders and an old clay pipe adjacent to a private residence.		
Flow:	A back eddy on inside of meander.		
Substrate:	10% sand; 20% cobble; 70% boulder.		
Bank type:	Bank a mix of earth and boulder but stable.		
No. and/or type of refugia:	12 boulders and some tree debris.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 76865; 21899	*Conditions:*	Dry, overcast
General description	Patch under a tree and bank-side vegetation. Part of the bank is slightly undercut.		
Flow:	Patch all slow glide.		
Substrate:	50% sand; 50% cobble.		
Bank type:	A stable earth bank.		
No. and/or type of refugia:	5 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 768783; 21882	*Conditions:*	Dry, overcast
General description	Shaded area under bank-side Japanese knotweed and Himalayan balsam.		
Flow:	Most of the patch is glide but there is substantial amounts of a back eddy.		
Substrate:	60% sand; 10% pebble; 25% cobble; 5% boulder.		
Bank type:	A stable earth bank.		
No. and/or type of refugia:	2 under a large log. Kick sample also taken.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 76933; 21843	*Conditions:*	Dry, overcast
General description	Boulders and instream tree roots.		
Flow:	Most of the pool is run but there are small amounts of eddy which has some potential to support crayfish.		
Substrate:	10% sand; 90% boulder.		
Bank type:	A stable bank comprised of boulders which have been placed as reinforcement.		
No. and/or type of refugia:	3 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77014; 21875	*Conditions:*	Dry, overcast
General description	Boulders and instream tree roots.		
Flow:	Most of the pool is run but there are small amounts of glide and eddy between and behind large bank-side boulders.		
Substrate:	100% boulder.		
Bank type:	A stable earth bank with many boulders as reinforcement.		
No. and/or type of refugia:	Crevices only but limited efficiency due to water current.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77031; 21940	*Conditions:*	Dry, overcast
General description	Left hand bank with tree roots and an undercut bank.		
Flow:	Patch all glide.		
Substrate:	20% cobble; 80% boulder.		
Bank type:	All boulders.		
No. and/or type of refugia:	3 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77049; 22006	*Conditions:*	Dry, overcast
General description	Immediate bank-side habitat under overhanging tree branches and submerged exposed roots.		
Flow:	Some quite glide at immediate edge of channel bit there is much run in close proximity.		
Substrate:	5% pebble; 80% cobble; 15% boulder.		
Bank type:	All boulders.		
No. and/or type of refugia:	5 boulders and old debris.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77127; 22005	*Conditions:*	Dry, overcast
General description	Large pool at the base of rapids.		
Flow:	Water is generally static as the patch is a large pool with a back eddy.		
Substrate:	30% cobble; 70% boulder.		
Bank type:	All boulders.		
No. and/or type of refugia:	20 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77124; 21994	*Conditions:*	Dry, overcast
General description	Area of glide downstream of rapids. There are limited suitable refuges here.		
Flow:	All glide as just downstream from pool formed by rapids.		
Substrate:	10% sand; 10% pebble; 80% cobble.		
Bank type:	All boulders.		
No. and/or type of refugia:	5 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77132; 21980	*Conditions:*	Dry, overcast
General description	Area of generally still water with some glide adjacent to a small braid.		
Flow:	A mix of glide and back eddy.		
Substrate:	10% sand; 10% pebble; 20% cobble; 60% boulder.		
Bank type:	Bank is generally all bedrock.		
No. and/or type of refugia:	8 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77184; 21923	*Conditions:*	Dry, overcast
General description	Patch is on left hand bank of R. Earn and beside the confluence with the Water of Ruchill. The river is very broad at this point.		
Flow:	Patch is entirely a back eddy.		
Substrate:	10% sand; 10% pebble; 20% cobble; 60% boulder.		
Bank type:	Bank is a mix of earth and boulders but no burrows are present.		
No. and/or type of refugia:	2 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77229; 21919	*Conditions:*	Dry, overcast
General description	Patch is on the downstream side of a large piece of exposed bedrock occurring mid-stream.		
Flow:	Patch is entirely a back eddy due to bedrock.		
Substrate:	10% cobble; 90% bedrock.		
Bank type:	Boulders on river bank but patch is entirely around bedrock.		
No. and/or type of refugia:	11 large cobbles.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77275; 21907	*Conditions:*	Dry, overcast
General description	Patch is on the downstream side of a large piece of exposed bedrock occurring mid-stream.		
Flow:	Patch is entirely a back eddy due to bedrock.		
Substrate:	100% bedrock.		
Bank type:	Boulders on river bank but patch is entirely around bedrock.		
No. and/or type of refugia:	2 boulders and leaf litter.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77299; 21909	*Conditions:*	Dry, overcast
General description	Patch is the margins of the left hand bank.		
Flow:	All back eddy.		
Substrate:	90% sand; 5% pebble; 5% cobble.		
Bank type:	Typically exposed bedrock.		
No. and/or type of refugia:	2 cobble piles.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77327; 21924	*Conditions:*	Dry, overcast
General description	Patch is the margins of the left hand bank with concrete reinforcements, posts and submerged vegetation.		
Flow:	All back eddy.		
Substrate:	90% sand; 5% pebble; 5% cobble.		
Bank type:	Concrete		
No. and/or type of refugia:	2 boulders in and around leaf litter.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77374; 21921	*Conditions:*	Dry, overcast
General description	Patch located around left hand bank bridge pier. There are large boulders with standing water amongst them.		
Flow:	All back eddy.		
Substrate:	70% sand; 20% pebble; 10% cobble.		
Bank type:	Mainly earth.		
No. and/or type of refugia:	3 cobble piles.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77374; 21921	*Conditions:*	Dry, overcast
General description	Patch located around right hand bank bridge pier. There are large boulders as reinforcement with some suitable crevices.		
Flow:	All back eddy.		
Substrate:	15% sand; 5% gravel; 10% cobble; 70% boulder.		
Bank type:	Boulders.		
No. and/or type of refugia:	8 boulders and crevices.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77399; 21927	*Conditions:*	Dry, overcast
General description	Slack water at the left hand margin. The bank is well vegetated and serves as access for fishermen.		
Flow:	All back eddy.		
Substrate:	5% gravel; 15% cobble; 80% boulder.		
Bank type:	Earth bank but no burrows.		
No. and/or type of refugia:	15 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77458; 21951	*Conditions:*	Dry, overcast
General description	Margins of left hand bank.		
Flow:	All back eddy.		
Substrate:	10% gravel; 10% cobble; 80% boulder.		
Bank type:	Earth bank but no burrows.		
No. and/or type of refugia:	14 boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	24/10/2018
Grid reference:	NN 77533; 21978	*Conditions:*	Dry, overcast
General description	Patch about 20m long adjacent to left hand bank.		
Flow:	All back eddy.		
Substrate:	5% gravel; 15% cobble; 80% boulder.		
Bank type:	Earth bank but no burrows.		
No. and/or type of refugia:	20 bricks, concrete blocks, cavities and boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77627; 21978	*Conditions:*	Dry, overcast
General description	At edge of right hand bank downstream of rapids and opposite the confluence with the River Lednock. Bed not inspected as unsafe to do so.		
Flow:	Deep pool.		
Substrate:	5% sand; 95% boulder.		
Bank type:	All boulder.		
No. and/or type of refugia:	3 cavities between boulders.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77672; 21996	*Conditions:*	Dry, overcast
General description	Deep pool at edge of right hand bank.		
Flow:	All pool.		
Substrate:	5% sand; 5% gravel; 5% cobble; 85% boulder.		
Bank type:	Mostly boulder but some earth. No burrows present.		
No. and/or type of refugia:	10 boulders, cavities and leaf litter.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77664;22032	*Conditions:*	Dry, overcast
General description	A deep pool at edge of right hand bank which contains some tree roots and branches.		
Flow:	All gentle glide.		
Substrate:	5% sand; 15% gravel; 80% boulder.		
Bank type:	All earth but burrows present.		
No. and/or type of refugia:	5 boulders and tree roots.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77678; 22038	*Conditions:*	Dry, overcast
General description	Overhanging branches in water and some tree roots.		
Flow:	All gentle glide.		
Substrate:	5% sand; 5% gravel; 80% cobble; 10% boulder.		
Bank type:	All earth with occasional boulders but burrows present.		
No. and/or type of refugia:	8 boulders and leaf litter.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77690; 22041	*Conditions:*	Dry, overcast
General description	Under large root of fallen tree.		
Flow:	All gentle glide.		
Substrate:	5% sand; 5% gravel; 5% pebble; 80% cobble; 5% boulder.		
Bank type:	All earth with evidence of erosion.		
No. and/or type of refugia:	3 boulders and aquatic vegetation	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77699; 22001	*Conditions:*	Dry, overcast
General description	Slow water at the edge of the right hand bank.		
Flow:	A limited area of glide which gives way to faster run mid-channel.		
Substrate:	5% sand; 5% gravel; 20% pebble; 70% boulder.		
Bank type:	All earth but no burrows present.		
No. and/or type of refugia:	17 boulders and aquatic vegetation	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77814; 22022	*Conditions:*	Dry, overcast
General description	Slow water in and around the branches of a fallen tree lying instream.		
Flow:	All back eddy.		
Substrate:	10% sand; 30% gravel; 60% cobble.		
Bank type:	Mostly earth but some boulder.		
No. and/or type of refugia:	7 cobbles and aquatic vegetation.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77909; 22047	*Conditions:*	Dry, overcast
General description	Located behind large logs lying in the water and branches of a sycamore tree.		
Flow:	All static water.		
Substrate:	5% sand; 10% gravel; 5% pebble; 75% cobble; 5% boulder.		
Bank type:	All earth but no burrows.		
No. and/or type of refugia:	12 boulders and under logs.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77972; 22026	*Conditions:*	Dry, overcast
General description	Patch centred on fallen tree trunks with slow water between boughs. Patch also torched.		
Flow:	All static water.		
Substrate:	5% silt; 15% sand; 20% gravel; 55% pebble; 5% boulder.		
Bank type:	All earth but no burrows.		
No. and/or type of refugia:	5 boulders, cobbles and leaf litter.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 77972; 22020	*Conditions:*	Dry, overcast
General description	Deep back eddy on left hand bank.		
Flow:	Back eddy.		
Substrate:	50% boulder; 50% bedrock.		
Bank type:	The majority is exposed bedrock but also several boulders.		
No. and/or type of refugia:	3 boulders and cavities.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 78008; 22014	*Conditions:*	Dry, overcast
General description	Slow water as part of deep pool. Edge of patch torched.		
Flow:	A mix of pool and glide.		
Substrate:	50% boulder; 50% bedrock.		
Bank type:	Mostly earth but some bedrock and boulders.		
No. and/or type of refugia:	8 large boulders and cavities.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 78008; 22014	*Conditions:*	Dry, overcast
General description	Slow water as part of deep pool. Patch also torched.		
Flow:	All pool.		
Substrate:	95% sand; 5% gravel.		
Bank type:	All earth but no burrows present.		
No. and/or type of refugia:	3 cavities under large limb of tree.	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 78177; 21979	*Conditions:*	Dry, overcast
General description	Slow water as part of deep pool. Patch also torched.		
Flow:	All back eddy after meander.		
Substrate:	80% silt; 20% sand.		
Bank type:	All earth but no burrows present.		
No. and/or type of refugia:	1 cavity	*Crayfish (Y/N)*	No

Water Course	River Earn	*Survey Date:*	25/10/2018
Grid reference:	NN 78242; 22000	*Conditions:*	Dry, overcast
General description	An area of slack water with large boulders on the bed.		
Flow:	A mix of pool and eddy.		
Substrate:	40% cobble; 60% boulder.		
Bank type:	All boulders.		
No. and/or type of refugia:	11 boulders.	*Crayfish (Y/N)*	No

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77558; 22316	*Conditions:*	Dry and bright
General description	Patch approximately 6sqm upstream of footbridge with lots of leaf litter on inside of meander.		
Flow:	All patch in area of glide.		
Substrate:	50% sand; 30% gravel; 20% pebble.		
Bank type:	Bank a mix of earth and boulders.		
No. and/or type of refugia:	In and around leaf litter.	*Crayfish (Y/N)*	No

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77609;22267	*Conditions:*	Dry and bright
General description	Patch is a group of boulders used to reinforce the left hand bank.		
Flow:	Patch is entirely pool.		
Substrate:	5% gravel; 95% boulder.		
Bank type:	Bank dominated by boulders used for reinforcement.		
No. and/or type of refugia:	4 crevices between large boulders.	*Crayfish (Y/N)*	No

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77613; 22244	*Conditions:*	Dry and bright
General description	Deep pool of slow moving water; quite deep and only possible to survey using bathyscope. Site also torched.		
Flow:	Patch is entirely pool.		
Substrate:	10% gravel; 90% boulder.		
Bank type:	Bank dominated by boulders used for reinforcement.		
No. and/or type of refugia:	Visual survey of bed only	*Crayfish (Y/N)*	No

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77611; 22227	*Conditions:*	Dry and bright
General description	Deep pool of slow moving water; again quite deep and only possible to survey using bathyscope. Site also torched.		
Flow:	Patch is entirely pool.		
Substrate:	5% gravel; 95% boulder.		
Bank type:	Bank comprised of earth but no evidence of burrowing.		
No. and/or type of refugia:	Visual survey of bed only	*Crayfish (Y/N)*	No

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77613; 22196	*Conditions:*	Dry and bright
General description	Slow moving water adjacent to a private garden which has reinforced sides at the wetted edge.		
Flow:	Patch is located in slow moving glide.		
Substrate:	10% gravel; 45% pebble; 30% cobble; 15% boulder.		
Bank type:	Bank comprised of earth but no evidence of burrowing.		
No. and/or type of refugia:	3 refuges under boulders.	*Crayfish (Y/N)*	No

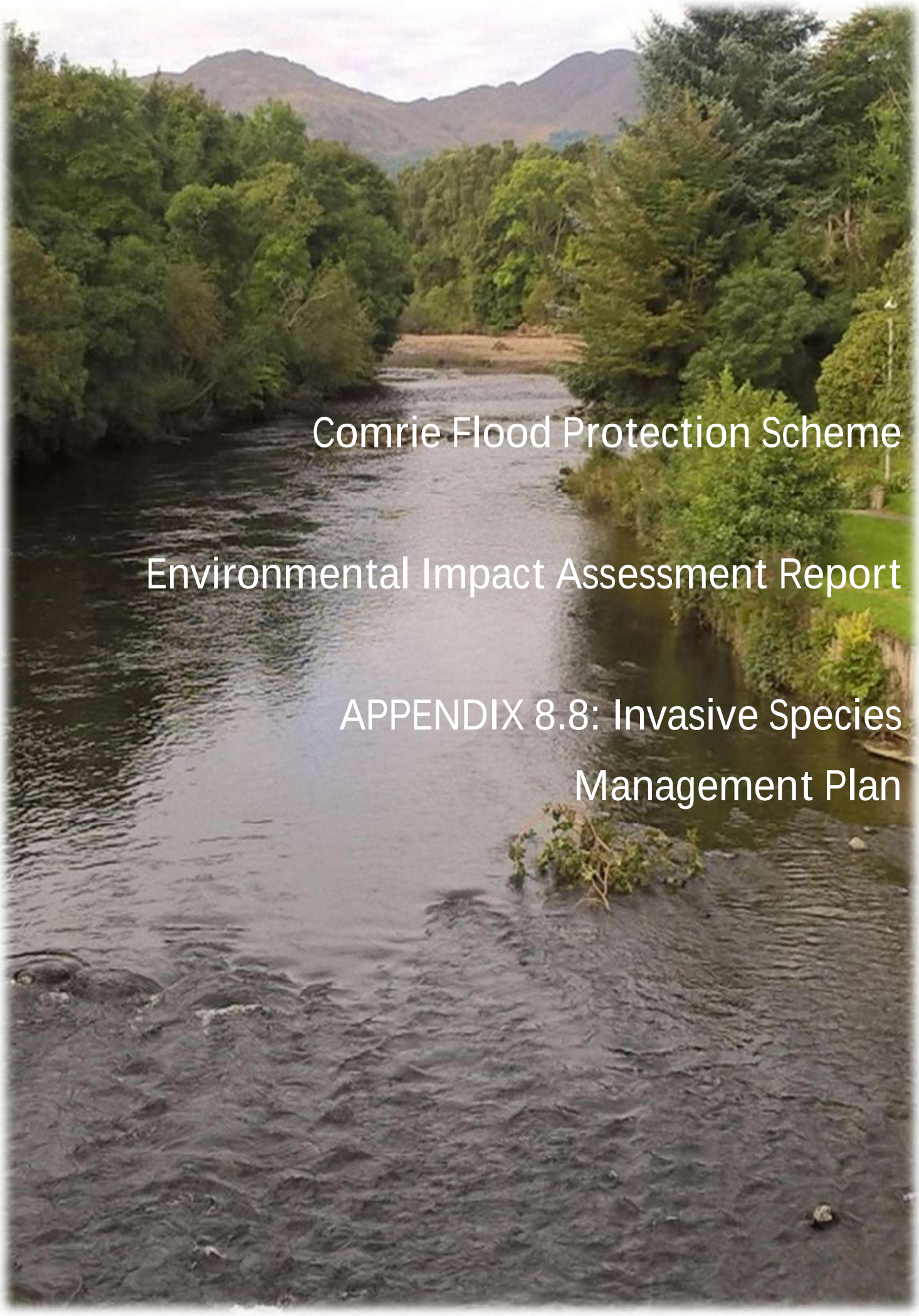
Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77613; 22175	*Conditions:*	Dry and bright
General description	Right hand bank around foundations of road bridge. Water quite shallow but some large boulders present. Site also torched.		
Flow:	Patch is located in slow moving glide.		
Substrate:	5% sand; 20% gravel; 40% pebble; 10% cobble; 25% boulder.		
Bank type:	Concrete bridge piers.		
No. and/or type of refugia:	4 refuges under boulders.	*Crayfish (Y/N)*	No

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77613; 22175	*Conditions:*	Dry and bright
General description	Left hand bank around foundations of road bridge. Water quite shallow but some large boulders present. Site also torched.		
Flow:	Patch is located in slow moving glide.		
Substrate:	10% gravel; 15% pebble; 35% cobble; 40% boulder.		
Bank type:	Concrete bridge piers.		

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77615; 22115	*Conditions:*	Dry and bright
General description	Area of glide by retaining wall and below access track beside white cottage. Patch approximately 4mx8m.		
Flow:	Most of flow is glide but turns into run mid-channel.		
Substrate:	5% gravel; 10% pebble; 45% cobble; 40% boulder.		
Bank type:	Earth bank but no burrows.		
No. and/or type of refugia:	3 refuges under boulders.	*Crayfish (Y/N)*	No

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77628; 22085	*Conditions:*	Dry and bright
General description	Water under dense canopy but right hand bank beside retaining wall better habitat potential. Subject to bathyscope survey.		
Flow:	Patch a mix of pool and glide.		
Substrate:	15% gravel; 30% pebble; 35% cobble; 20% boulder.		
Bank type:	Earth bank but also partly a retaining wall. No burrows.		
No. and/or type of refugia:	1 refuge under boulder.	*Crayfish (Y/N)*	No

Water Course	River Lednock	*Survey Date:*	29/10/2018
Grid reference:	NN 77623; 22021	*Conditions:*	Dry and bright
General description	Right hand bank upstream from confluence with Earn. Bank a bit under cut with instream debris.		
Flow:	Patch entirely pool.		
Substrate:	10% pebble; 30% cobble; 60% boulder.		
Bank type:	Earth bank but quite eroded and collapsed.		
No. and/or type of refugia:	1 refuge under submerged log.	*Crayfish (Y/N)*	No



Comrie Flood Protection Scheme

Environmental Impact Assessment Report

APPENDIX 8.8: Invasive Species Management Plan

Report

Invasive Species Management Plan

Comrie Flood Protection Scheme

Perth & Kinross Council

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Appendices

1 Introduction

Perth and Kinross Council are seeking to develop, promote and implement a flood protection scheme (the Scheme) for Comrie in order to reduce damage caused by flooding and manage the flood risk. The Scheme comprises a combination of flood defence walls, earth bunds and erosion protection measures on the River Earn, Water of Ruchill and River Lednock. Sweco are providing consultancy services relating to the development of the Scheme including environmental support.

Sweco ecologists surveyed the study area for invasive non-native species on behalf of Perth and Kinross Council. Additional specialist surveys were undertaken by Practecology (to investigate the distribution of American signal crayfish). Non-native species are those plants and animals which have been introduced – deliberately or accidentally – by humans into the wild. There are many non-native species in Scotland, but it is only those species which cause damage to the environment, economy or human health that are called invasive non-native species (INNS). It is the legal responsibility of all individuals to take all reasonable measures to prevent the spread of INNS.

A number of non-native species were found during surveys at Comrie, including aggressively invasive species. This document focuses only on INNS, detailing the species found and their distribution, legal considerations, management options and biosecurity measures required to ensure that construction activities take reasonable measures to prevent the spread of INNS during construction of the Scheme.

Prior to commencement of works, an update survey and targeted control by a specialist INNS contractor are advised. This report is aimed at guiding the tendering and procurement of these services.

This report has been divided to two parts;

Part One; Background information:

- Legislation and policy,
- Steps required for reasonable and lawful management of INNS
- Survey methods and results
- Description of INNS found in the survey area
- Description of permitted control and disposal methods

Part Two: Management Plan:

- Methods for control and disposal
- Site management and biosecurity

Part One:
Invasive non-native species: Background information

2 Invasive non-native species: Legislation and policy

An invasive species is defined as one which, if not under the control of any person, would likely have a significant adverse impact on:

- Biodiversity
- Other environmental interests or
- Social or economic interests

The sections below summarise the legislation around the prevention and control of INNS, with emphasis on the Scottish context.

2.1. Key legislation

2.1.1 Wildlife and Countryside Act 1981 (as amended): Schedule 9 species

The Wildlife and Countryside Act 1981 is the principle legislation for dealing with INNS. This legislation was enhanced by the Wildlife and Natural Environment (Scotland) Act 2011 which strengthened the offence relating to the release of species and added new measures on control of INNS.

Specifically, Section 14(1) of the WCA makes it illegal to release or allow to escape into the wild any animal which is not ordinarily resident in Great Britain and is not a regular visitor to Great Britain in a wild state. Schedule 9 comprises the list of species to which this law applies. There are 58 species/species groups listed on Schedule 9 for Scotland.

It should be noted that the illegal activity of allowing Schedule 9 species 'to grow in the wild' is extended to include causing a spread of these species, either intentionally or unintentionally, unless reasonable measures to prevent this have been undertaken.

Therefore, actions causing a plant to become present in the wild as a direct result of construction activities (for example spreading Japanese Knotweed by strimming next to a watercourse), may be deemed an offense, even though it was not deliberately planted or intended in any way.

It is important to note that the above offences are strict liability offences. This means that the prosecution does not need to prove any intention, knowledge, recklessness or negligence on the part of the accused. It is enough for the prosecution to prove that the offence took place – so if you are in any doubt regarding whether an animal or plant is native, don't release or plant. A person accused of an offence may successfully establish a defence if they can show they took all reasonable steps and exercised due diligence to avoid committing the offence.

The Scottish Government's Code of Practise, described below, provides clear guidance on what would be regarded as reasonable steps to avoid unlawful spread of INNS.

2.2. Key guidance: Scottish Government Code of Practise

The Scottish government have produced a Code of Practise[1] to help inform land managers of their legal responsibilities when dealing with non-native species. The Code of Practise came into effect in July 2012.

The Code of Practise specifies the Scottish Government's preferred approach to non-native species and is guided by an internationally-recognised three-stage hierarchy;

1. Prevention
2. Rapid response (eradication)
3. Control and containment

These three principles carry certain responsibilities, described in Table 1. How these apply to the Scheme is also summarised in **Table 1**.

Table 1: The Scottish Government's approach to INNS and the implications for the Scheme

Principle	Responsibility	Implications for Comrie FPS
Prevention	Preventing the introduction of INNS into an area where they are not present.	*The scheme shall not involve the handling of any INNS that are not already present on-site.* *There shall be no planting or release of INNS.* *The accidental introduction of new INNS shall be avoided by following biosecurity measures.*
Rapid response (eradication)	Swift eradication if prevention has failed. Ensure that non-native species is removed before becomes established.	*This shall only be required if it is identified that an INNS has arrived on-site because of the scheme.* *This shall be monitored, with appropriate advice given by an on-site ecologist.*

[1] Code of Practise on Non-native Species. Made by the Scottish Ministers under section 14C of the Wildlife and countryside Act 1981

Control and containment	For established invasive species, eradication is often not possible or cost-effective. Therefore, the responsibility is focussed on controlling the spread of INNS.	*There are several INNS already established within Comrie FPS work area.* *Efforts should be focussed on containing these species and ensuring that works activity does not lead to further spread of these species.*

Advice provided in this report seeks to ensure that **all appropriate and reasonable steps are taken to contain the INNS within the survey area and thus prevent further spread.** Eradication is not deemed feasible as this would require a catchment-wide approach.

2.3 Legislation and policy background

The requirements to control INNS are components of several legislative and policy frameworks, particularly those focused on environmental protection and nature conservation. In addition, the activities involved in the management and disposal of INNS are subject to regulatory control. The key legislation and regulations are summarised below, although this list is not exhaustive.

2.3.1 Environmental Protection Act 1990 c 43

This legislation sets out the legal framework within England, Scotland and Wales for environmental protection in relation to control of pollution waste, contaminated land, statutory nuisance and the control of genetically modified organisms.

2.3.2 Nature Conservation (Scotland) Act 2004 asp 6 – Biodiversity Duty.

This Act provides measures designed to conserve biodiversity and to protect and enhance Scotland's biological and geological natural heritage, including a new general duty on public bodies to further biodiversity in exercising their functions.

2.3.3 Plant Health (Scotland) Order (SSI 2005-613) and Plant Health (Forestry) Order (SSI 2005/2517)

The EU plant Health Directive 2000/29/EC and the Orders set out detailed requirements for many plant species and plant pests and diseases entering or moving within the community.

2.3.4 Environmental Liability (Scotland) Regulations (SI 2009/266)

This legislation sets out the mechanism by which bodies undertaking economic activity that carries a risk of damage to the environment are held responsible for preventing damage and provides that such bodies can be held liable for remedial measures.

2.3.5 Special Waste Regulations 1996 (as amended)

This legislation sets out procedures to be followed when disposing of, carrying or receiving special waste (defined as waste with hazardous properties which may render it hazardous to human health or the environment).

As part of the waste duty of care any waste produced by a business must be classified

- before it is collected, disposed of or recovered
- to identify the controls that apply to the movement of the waste
- to complete waste documents and records
- to identify suitably authorised waste management options
- to prevent harm to people and the environment

The Regulations contain provisions about the handling and movement of waste consignments. Material containing invasive species that have been treated with herbicide may be classified as hazardous waste.

If controlling non-native plants on land that you own or occupy, including land being used for development, maintenance you must comply with specific legal responsibilities including when;

- Spraying herbicides
- Cutting and burning invasive plants
- Burial of soil containing invasive plant material; and
- Off-site disposal of invasive plants and contaminated soil.

Further guidance on special waste is available from SEPA[2]. Guidance on Environmental Protection legislation in Scotland and Northern Ireland can be found on the NetRegs[3] website.

[2] https://www.sepa.org.uk/regulations/waste/special-waste/.
[3] http://www.netregs.org.uk/

2.4 Scottish Government priority invasive species list

Scottish Natural Heritage (SNH) have identified four invasive species that cause the most damage and two other species that have great potential to be invasive in certain habitats (**Table 2**). Two of these potentially invasive species are not currently listed on Schedule 9 of the Wildlife and Countryside Act.

Table 2: SNH Priority Invasive Species in Scotland

1) Four invasive species that cause the most damage in Scotland	
Rhododendron	*Rhododendron ponticum*
Japanese Knotweed	*Fallopia japonica*
Giant Hogweed	*Heracleum mantegazzianum*
Himalayan Balsam	*Impatiens glandulifera*
2) Species that have great potential to be invasive in certain habitats	
American Skunk-cabbage	*Lysichiton americanus*
Giant rhubarb	*Gunnera tinctoria*

3 Methods

3.1 Survey area

The survey area for INNS surveys included all areas within the EIA study area / red line boundary where proposed land take and access options were considered for the installation of the flood protection scheme, together with a 250m buffer. As such, the survey area extended along the River Earn from The Ross west of Comrie to the Scottish Water sewage works east of the village. On the River Lednock the survey area extended a short distance north of St Margaret's Church to the confluence with the River Earn. The survey area also included the Milton Burn from the A85 to its confluence with the River Earn. Along the Water of Ruchill and southwards of the River Earn the survey area extended as far as South Crieff and Braco Roads. The primary focus of surveys was the riparian edges themselves, and any areas where hard works were proposed to be taking place. Surveys for signal crayfish were conducted within the River Earn, Water of Ruchill, and River Lednock.

Earlier iterations of the proposed scheme included areas to the west of the survey area. Sweco undertook INNS surveys in these areas whilst they were part of the Scheme. Where relevant, INNS recorded in these areas are mentioned in the results section as the proximity makes it possible that these species may be found within the survey area in subsequent surveys or during construction.

3.2 Survey method

All non-native plant species encountered within the survey area were mapped using the ArcGIS Collector app. The species and extent were described, with INNS highlighted. A photograph was taken at each location where needed to show extent of cover. Surveys were undertaken between 08 May 2018 and 14 September 2018 by Sweco Principal Ecologist Claire Hopkins MCIEEM, Senior Ecologist Chris Rodger MCIEEM, Consultant Ecologist Erik Paterson ACIEEM and Consultant Ecologist Matthew Rea Grad CIEEM. All surveys were undertaken during the period when invasive plant species are most easily detected and identified.

3.3 Survey limitations

Many private gardens were not accessed during this survey and so there may be areas of invasive species which went without detection. However, management of INNS in private gardens is not the responsibility of the Developer/Contractor unless these areas fall within the sphere of influence of the Scheme.

As invasive species are, by definition, vigorous colonists, the distribution and extent of these species can increase rapidly if conditions allow. Therefore, the distribution and cover may change noticeably in future years. However, the conditions suitable for the dispersal and establishment of these species is likely to remain on and adjacent to watercourses.

4 Results

4.1. Wildlife and Countryside Act: Schedule 9 species present on-site

Four Schedule 9 plant species and one animal species (American mink) were recorded within the survey area.

Three additional Schedule 9 species were found to the west, but not within, the survey area during surveys undertaken to inform earlier iterations of the Scheme. These were American signal crayfish, Rhododendron and American skunk-cabbage. The locations where these species were observed is both very close and hydrologically connected to the current scheme boundary and as such the possibility that these species may be encountered during works is reasonably high.

The Schedule 9 plants are listed in **Table 3**, with the location of these records shown in **Figure 1**, **Appendix A**. The Schedule 9 animals are listed in **Table 4**.

Table 3: Schedule 9 plant species recorded at Comrie

Common Name	Scientific Name	Abundance/distribution
Japanese Knotweed[1]	*Fallopia japonica*	Widespread, particularly along riparian corridors (57 locations mapped)
Himalayan Balsam[1]	*Impatiens glandulifera*	Widespread, particularly along riparian corridors (29 locations mapped)
Variegated Yellow Archangel [A,1]	*Lamiastrum galeobdolon subsp. argentatum*	Localised, largely in small extent along riparian corridors. Never abundant or dominant. (5 locations mapped)
Montbretia[1]	*Crocosmia pottsii x aurea = C. x crocosmiiflora*	Recorded at single location. (1 location mapped)
Rhododendron[2]	*Rhododendron ponticum*	Widespread in understorey of mature forestry although never abundant or dominant

[A] Variegated yellow archangel is listed on Schedule 9 in England and Wales only
[1] Recorded in the current survey area (mapped in Appendix A)
[2] Recorded in the earlier red-line boundary, immediately east of current survey area

Table 4: Schedule 9 animal species recorded at Comrie

Common Name	Scientific Name	Abundance/distribution
American mink	*Neovison vison*	Prints found at one location (outside study area to the east of the Scottish Water WwTW)
Signal crayfish	*Pacifastacus leniusculus*	Predated remains found on bank side of River Earn (outside study area to the west of Dalginross)

4.2. Scottish Government priority invasive species in Scotland

Three of the six priority species were recorded within the survey area during the surveys, with a further species (rhododendron) recorded in the wider area. These are listed in the **Table 5**, with the location of these records shown in **Figure 1, Appendix A**.

Table 5: **Priority Invasive Species in Scotland (bold=present at Comrie)**

1) Four invasive species that cause the most damage in Scotland	
Rhododendron[1]	***Rhododendron ponticum***
Japanese Knotweed[1]	***Fallopia japonica***
Giant Hogweed	*Heracleum mantegazzianum*
Himalayan Balsam[1]	***Impatiens glandulifera***
2) Species that have great potential to be invasive in certain habitats	
American Skunk-cabbage[2]	***Lysichiton americanus***
Giant rhubarb	*Gunnera tinctoria*

[1]Recorded in the current survey area (mapped in Appendix A)
[2] Recorded in the earlier red-line boundary, immediately east of current survey area

4.3. Distribution of INNS encountered in the survey area

As can be seen from **Figure 1, Appendix A**, INNS were mainly encountered along the river corridors. This is quite typical of INNS, where river systems allow seed transport and availability of bare ground for recruitment (establishment of seed or root rhizome). River systems also provide nutrient-rich conditions suiting vigorous growth of INNS (often at the expense of other vegetation). Riparian edges are also often locations where pressure from grazing or human control are reduced, therefore less limiting to rapid establishment by INNS. Stands of invasive species were located throughout the scheme, on the River Earn, River Lednock, Water of Ruchil, and the Milton Burn (**Figure 1, Appendix A**). Japanese knotweed and Himalayan balsam were the most abundant INNS with stands located throughout the survey area. However, most of the stands were centred around the Earn and Ruchill, with smaller areas on the Milton Burn and around the sewage works. A single stand of Montbretia was observed on the southern bank of the Earn across from the confluence with the Milton Burn. Variegated yellow archangel was mostly noted along the River Earn from The Ross heading downstream as far as Garry Place, a single stand was observed on the Lednock just to the north of St. Margaret's Church. No giant hogweed was observed within the survey area and so is not considered further in this report.

5 INNS: Species accounts

Of the invasive or potentially invasive species described in Section 4, the species listed in **Table 6** have been selected for detailed discussion in the management plan. These are species which were encountered within the survey area and therefore likely to be encountered during construction – i.e. within the works area. For the purposes of this report and Management Plan which follows (see **Part Two**), the work area is defined as the footprint of all construction activity (including access tracks, temporary laydown areas, ancillary works etc) plus a 10-metre buffer.

Table 6: **INNS detailed in Management Plan**

Included	Reason
Japanese knotweed	Schedule 9 and Priority species, abundant in work area
Himalayan balsam	Schedule 9 and Priority species, abundant in work area
Montbretia	Schedule 9. Present in work area
Yellow archangel	Not schedule 9 in Scotland but widespread and found within work area at Comrie FPS. Potentially invasive

The species listed in **Table 7** are not included in the management plan as they are unlikely to require any conditions on working protocol. This is because they are either;

1) Only recorded outside the survey area and therefore unlikely to affect the proposed works.
2) Found in freshwater habitats and unlikely to be in direct contact with work activities (American signal crayfish); or
3) Mobile mammalian species, on which the proposed works will have negligible effect (American mink).

As described in **Section 4**, American skunk cabbage and rhododendron were found in the wider area during earlier surveys. Resultantly there is a chance that these species may be found or establish within the work area. Therefore, ecologists and project staff should be vigilant for these species during ongoing pre-construction and construction activities. If encountered, the Management Plan should be updated accordingly.

The management plan should be regarded as a live document, with the management of these species or any other INNS subsequently encountered to be added, should they subsequently be encountered within the works area.

Table 7: INNS not detailed in Management Plan

Excluded	Reason
Rhododendron	Schedule 9. not present in survey area. However, updated surveys should be vigilant for this species and advise accordingly.
American skunk cabbage	Not present within survey area. However, updated surveys should be vigilant for this species and advise accordingly.
American signal crayfish	Not found to be present within survey area. Proposed works unlikely to be impacted by this species.
American mink	Proposed works unlikely to be impacted by this species.

5.1 Japanese Knotweed

Japanese knotweed is an invasive plant species introduced in the early 19th century as an ornamental plant. The plant spreads rapidly and is now common and widespread throughout the UK. It is a tall herbaceous perennial with bamboo-like stems and often grows in dense thickets. The characteristic zig-zag stems and flat-based shield-like leaves are key identification features. In summer, whorls of white flowers are present on the plants along the stems. However, in the UK Japanese knotweed does not produce seed and spreads wholly by vegetative meant, either by fragments of rhizome or of stem material. This species out-competes native vegetation species, contributes to bank erosion, and can increase the likelihood of flooding. Knotweed can cause significant delays to development and structural damage as this species is capable of growing through asphalt and some other services. An identification sheet with photographs of the plant is provided in Error! Reference source not found.**D**.

5.2 Himalayan balsam

Himalayan balsam is a non-native plant that was introduced to Britain in 1839. Once Introduced, it escaped from gardens and rapidly colonised river banks and areas of damp ground. It is a tall, annual plant with pinkish-red hollow stems and is often jointed with shiny dark green leaves that are lance shaped. They have characteristic purplish-pink slipper shaped flowers, which appear from June to October. An identification sheet with photographs of the plant is provided in Error! Reference source not found.**D**.

Himalayan balsam is spread by seed and is capable of ejecting its seeds several metres upon disturbance. The seeds can be transported by water, remaining dormant for up to 2 years before germination and can remain viable for between 18 and 36 months. Any control must be carried out before the seed pods have formed to give long term benefit. Himalayan balsam colonises rapidly and smothers all native plants. It creates dense, monoculture stands predominantly on riverbanks and other areas of damp ground. The invasive nature of this plant is accelerated because it has no natural forms of control as it would in its native setting. The plant reduces biodiversity and drives out native species. When the Himalayan balsam dies back in winter the banks are left bare and liable to erosion.

5.3 Montbretia

This invasive plant species originates from South Africa and was first introduced to the UK in 1880. It is thought to have escaped in to the wild in 1911 and spread throughout the 20th century. With smooth, upright leaves approximately 3cm wide and extending to 60cm in height present from spring to autumn, this plant can grow in dense stands. The flowers are orange-red in colour and form clusters. This plant spreads predominantly by rhizomes though seeding can occur. Quick growth and growth via rhizomes can result in this plant quickly out-competing native species. An identification sheet with photographs of the plant is provided in **D**.

5.4 Variegated Yellow Archangel

Variegated yellow archangel is an invasive plant species which is thought to have escaped from gardens in the 1970's. It is an erect, hairy perennial with green variegated leaves that have characteristic and distinctive silvery patches and toothed edges. Leaves grow in opposing pairs to between 4 and 7 cm in length. Flowers are yellow in colour, lipped and hooded. These plants are self-fertile or cross pollinated by insects, producing up to 100 seeds. The plant can spread by seed and through long, creeping runners which can form roots at the nodes. Runners can smother other vegetation resulting in dense growths of this invasive species. An identification sheet with photographs of the plant is provided in Error! Reference source not found.**D**.

6 INNS: Method of control and disposal

The information provided in this section provides background and rationale underpinning the advice given in the INNS Management Plan (**Part 2**).

6.1. Exclusion and buffer zones

In order to avoid contamination of tools, machinery and clothing, it is essential that work is excluded within a certain distance of above ground, visible plants.

A buffer between the INNS patch and is required because seeds, and/or rhizomes may be encountered a distance from the above-ground plants. Therefore, the width of the minimum recommended buffer zone is dependent on the species concerned, as described in **Table 8**.

Table 8: Exclusion buffer distance for INNS

INNS	Notes	Width of exclusion buffer[1]
Japanese knotweed	Underground root rhizomes can be found at least 7m from parent plant at a depth of 3m or more. A plant can regenerate from very small pieces of rhizome.	10m
Himalayan balsam	Explosive seed dispersal. Ejected seeds can travel up to 7m.	10m
Other INNS present at Comrie	Based on review of available literature.	5m

[1]distance from visible extent of above-ground plant

6.2. Management of INNS

There are two main considerations when managing INNS:

1. Method of control
2. Method of disposal

To ensure that control is effective, it is important to use the correct method and timing for each species as described below.

In addition, if the wrong method for control and disposal is employed, there is a real risk of unlawful spread of the INNS.

Therefore, the following sections describe control and disposal methods on a species-by-species basis and it is important that management is appropriate for the species concerned.

6.2.1. Methods of control (clearance of INNS within work area)

There are four main methods for controlling INNS;

i. Mechanical (uprooting, cutting, dredging etc)
ii. Chemical (herbicides)
iii. Natural (using natural pests and diseases to weaken or kill INNS)
iv. Environmental (changing conditions so unfavourable for INNS)

For the purposes of the Management Plan, control via mechanical and chemical methods are described below. Whilst natural and environmental means are in many ways preferable (not requiring chemical input and often less labour-intensive) they are not realistic in the context of the Scheme in terms of localised and rapid management required at construction sites.

It is recommended that chemical treatment uses a bioactive formulation of glyphosate, approved for use in or near water, and in accordance with the agreed method detailed below. In addition, application should be undertaken in a manner which reduces the quantities used. Methods improving the efficiency (and efficacy) of treatment includes spraying when foliage surface is at maximum, using indicator dye, spraying both sides of the leaf and, particularly in sensitive areas, considering stem injection or use of a weed-wiper.

6.2.1.2. Japanese knotweed: method of control

The following methods can be considered for Japanese knotweed control[4]. Chemical control is advocated, and this is best undertaken when foliage is at maximum (August and September).

- *Chemical Control:* Japanese knotweed should only be sprayed in the growing season when green leaves are present. Chemical treatment is most effective in August and September, particularly if applying to mature, untreated plants. This is when leaves are at maximum surface area for contact with Glyphosate Only the approved range of Glyphosate based herbicides should be used in accordance with the Code of Practice[5]. Plants must be sprayed a minimum of two times in one growing season. More spraying may be needed and is allowed if the plant re-grows. SEPA must agree to the operation prior to spraying if this is undertaken within 10m of a watercourse.

- *Cutting/mowing/strimming:* **Cutting is not advocated for Japanese knotweed control.** This is because Japanese knotweed must not be cut using a method that produces fragments (strimming/flailing/mowing). Whilst it is possible to cut stems with a single, clean cut near the base, this is time consuming and carries risk that regenerative parts of the plant stem are spread by fragmentation. One highly regenerative part of the plant is the crown, which, despite its name, is found near the base of the stem. If plants are pulled-up, parts of the crown will remain attached and this remains highly regenerative, even when dried.

Therefore, cutting is not advocated for Japanese knotweed.

- *Digging out:* This method should only be used with consent from SEPA. If SEPA agree to digging out, then all leaf and stem material above ground alongside all roots and fibres within the ground and any soil or earth which contained the roots and fibres must be removed up to a diameter of 7m from the plant. Soil must be removed by a licensed haulier to a licensed or permitted landfill site. If any re-growth occurs following digging out, this must be sprayed.

Because of the risk of spreading root rhizomes, soil won from knotweed-infested areas should not be moved around site and used for bund construction or filling purposes.

Digging is not advocated near watercourses, as this presents significant risk that regenerative knotweed material will enter the watercourse.

Given the above constraints, digging-out would only be advisable if the soil is to be removed from site (as controlled waste), occurs where there is no risk of soil entering a watercourse and is undertaken with express consent from SEPA.

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[4] https://www2.gov.scot/Topics/farmingrural/SRDP/RuralPriorities/Options/Controlofinvasivenon-nati/Japaneseknotwood

[5] https://www2.gov.scot/Publications/2006/12/19110050/0.

6.2.1.1. Himalayan Balsam: method of control

It is very important to ensure that control is undertaken before the plant flowers in June. This is because the flowers mature to form explosive seed pods which explode and broadcast the seed when touched (scattering seed up to 7m).

The following methods can be considered for removal of Himalayan balsam:

- *Chemical control:* this must be undertaken during the growing season when there is green leafy material present and before the seed heads have developed. Only the approved range of Glyphosate-based herbicides may be used, and in accordance with the Code of Practice[6]. SEPA must agree to the operation prior to spraying if this is undertaken within 10m of a watercourse.

  This method is only applicable if undertaken annually and is therefore unlikely to be of use for pre-construction site clearance. Herbicide-treated material should be removed from site as hazardous waste.

- *Cutting/mowing/strimming:* this must only be undertaken before the plant reaches the flowering stage. Plants must be cut below the lowest node to prevent reflowering. It is important to ensure a cut below the lowest node to prevent reflowering. Incomplete cutting early in the growing season risks vigorous regrowth and higher flower and seed production (with greater risk of spread).

- *Pulling:* any germinating seedlings can be pulled up, and the roots must be pulled up with the plant.

6.2.1.3. Montbretia: method of control

The following methods can be considered for Montbretia control:

- *Chemical Control:* Montbretia should only be sprayed in the growing season when green leaves are present. Only the approved range of Glyphosate based herbicides should be used in accordance with the Code of Practice[9]. Plants must be sprayed a minimum of two times in one growing season. More spraying may be needed and is allowed if the plant re-grows, SEPA must agree to the operation prior to spraying if this is undertaken within 10m of a watercourse.
- *Digging out:* All leaf and stem material above ground alongside all roots, corms and fibres within the ground and any soil or earth which contained the roots and fibres must be removed up to a diameter of 4m from the plant. Soil must be removed by a licensed haulier to a licensed or permitted landfill site. If any re-growth occurs following digging out, this must be sprayed.

[6] https://www2.gov.scot/Publications/2006/12/19110050/0.

6.2.1.3. Variegated yellow archangel: method of control

The following methods can be considered for variegated yellow archangel control:

- *Chemical Control:* Variegated yellow archangel should only be sprayed in the growing season when leaves are present. Only the approved range of Glyphosate based herbicides should be used in accordance with the Code of Practice[9]. Plants must be sprayed in one growing season. More spraying may be needed and is allowed if the plant re-grows. SEPA must agree to the operation prior to spraying if this is undertaken within 10m of a watercourse.

- *Digging out:* All leaf and stem material above ground alongside all roots and fibres within the ground and any soil or earth which contained the roots and fibres must be removed up to a diameter of 4m from the plant. Soil must be removed by a licensed haulier to a licensed or permitted landfill site. If any re-growth occurs following digging out, this must be sprayed.

6.2.2 Methods of stockpiling prior to disposal

Cut plant material and contaminated topsoil can be stockpiled on-site prior to disposal. Material should be placed on an agreed area of hardstanding/root barrier membrane in piles not exceeding 2m in height and left undisturbed at least 10m from the proposed works. Access to these areas should be restricted and clearly marked as containing biological waste material. Piles should be covered with plastic sheeting to prevent any seeds from germinating, and piles should be demarcated.

6.2.3 Methods of disposal

There are four permitted methods of disposal available;

i. On-site burning
ii. On-site burial
iii. On-site composting (not recommended)
iv. Removal from site

These are described below on a method-by-method basis, as most are applicable to a range of INNS, with some exceptions.

Prior to disposal by any means, it is advised that the Contractors liaise with SEPA in order to ensure that the proposed method complies with legislation and all appropriate paperwork is in place.

6.2.3.1. Method of disposal: on-site burning

Note that burning plant material in the open is an activity where it is possible to secure a waste management license exemption. In order to do so, it is essential to meet the requirements detailed in the Waste Management Licensing (Scotland) Regulations 2011.

In order to secure exemption, it is essential to meet the requirements detailed in Regulation 17 of the Waste Management Licensing (Scotland) Regulations. To ensure

these are met and that the statutory controls to prevent pollution and harm to human health, it is strongly advocated that SEPA are contacted.

The statutory obligations are that on-site burning must not create excessive smoke or cause a nuisance. It must be undertaken using clean wood and avoid plastics or other synthetic materials (petrol as an accelerant is not permitted).

Himalayan balsam must not be burned if seeds are present.

6.2.3.2. Method of disposal: on-site burial

Burial on-site is often preferable to removal to landfill as the latter can accidently spread INNS to new areas and can be costly.

It is advised that the burial site should be at a location and depth where the material will not be subsequently exposed as the plants may remain viable for many years (e.g. giant hogweed seeds remain viable for 15 years and Japanese knotweed rhizomes for 20 years).

The recommended burial depths are:

Japanese knotweed; 5 metres;
Himalayan balsam, Montbretia and yellow archangel; 1m.

Buried material must be covered with a barrier membrane (e.g. Dendrobarrier or heavy-gauge polythene) and capped with clean soil.

Any material sprayed with a persistent herbicide must not be buried (glyphosate will break-down, and glyphosate-treated plant material can be buried).

Care must be taken to ensure that buried material does not interfere with groundwater movement.

Locations of buried material should be mapped and archived. Material must not be buried within 7m of a landowner boundary without consent.

6.2.3.3. Method of disposal: on-site composting (not recommended)

This method of disposal is not practical for construction sites as it requires long-term maintenance to ensure that the material does not represent a risk of further spread.

Composting is never any appropriate method of disposal for Japanese knotweed.

6.2.3.4. Method of disposal: removal from site

Invasive plant material and contaminated soils are types of controlled waste. Legally, such waste may only be disposed of at a licensed disposal site, licensed to receive that type of material, and the landfill operator must be informed of the nature of the waste so it can be disposed of appropriately within the site. SEPA and the waste disposal facility should be contacted one week prior to receiving the waste. Any waste taken off-site must

be taken by a licensed waste carrier. Waste Transfer Notes (WTNs) must be used for any material leaving site, listing any material that contains invasive plants or their seeds.

If the INNS has been treated with herbicides prior to off-site disposal then it is classed as hazardous waste and will require a consignment note in accordance with the Regulations and be taken to a site which is licensed to receive it. SEPA can advise on licensed disposal of waste.

7 INNS: Awareness and procedures during construction

7.1. Biosecurity Plan

The spread of INNS is perhaps best mitigated by ensuring that there is clear understanding amongst all staff and visitors of the procedures to follow to reduce risk of spreading INNS.

The Management Plan provides an example of a Biosecurity Plan. A similar, updated plan should be produced by the developer/contractor and provided all site staff and visitors as part of site induction.
This forms the foundations of a wider awareness and education programme, described below.

7.2. Education and awareness

An education and awareness programme should aim to ensure that all site personnel are;

i. Aware of the risks of spreading INNS;
ii. Informed of the legislative background;
iii. Understand the biosecurity measures they are expected to follow; and
iv. Can identify the INNS

This should be delivered as part of the site induction, undertaken by a suitably qualified individual. Staff and visitors should be provided with the most up to date version of the Biosecurity Plan, and the induction should ensure understanding of the of the following;

- Identification sheets for the INNS present on site (see **Appendix D** for examples). This should include leaves and shoots and in the case of Japanese knotweed, root rhizomes (that may be discovered during excavations)
- An up to date map of extent of INNS in the construction area
- Map clearly displaying exclusion zones
- Biosecurity measures, including guidance on tools and machinery, wash-down areas
- Protocol for any temporary lay-down/stockpile areas
- Guidance on paperwork and auditing requirements, where applicable
- For staff involved in control measures, provide detailed instructions on methodology, including Health and Safety, COSHH information etc

Following this induction, staff and visitors should sign that they have understood the INNS protocol and have been provided with the Biosecurity Plan.

An up-to-date copy of this Management Plan, Biosecurity Plan, maps showing areas of infestation, exclusion zones etc should be clearly displayed and available at the site office and staff canteen / welfare areas.

Part Two:
Invasive non-native species: Management Plan

8 Management plan

8.1 Aims and objectives

As described above, this Management Plan is intended to guide the project towards taking all reasonable steps to prevent the spread of INNS during the construction phase of the Scheme.

This task is made considerably easier by taking a proactive approach to the issue prior to works starting and as such, the Management Plan has been divided as follows:

1. Preparation for INNS control prior to construction
2. INNS control prior to construction
3. INNS control and management during construction

8.2 Preparation for INNS control prior to construction

The work area is defined as the footprint of all construction activity (including access tracks, temporary laydown areas, ancillary works etc) plus a 10-metre buffer.

8.2.1 Targeted control

Eradication of INNS at Comrie is not a cost effective and/or feasible objective. Consequently, INNS control will not be required throughout the entire survey area.

However, control of INNS will be required where they overlap core development and any ancillary works areas such temporary access tracks and laydown, storage or welfare areas. This is required to reduce the likelihood of contact and accidental spread of the species.

Therefore, the recommended approach is to undertake management of INNS within a clearly defined work area. This should entail demarking the entire work area with a visible barrier. Control of all INNS shall be undertaken within the defined area and a buffer area 10m wide outside of the work area. The 10m distance from above-ground (visible) plants covers the area in which it is likely that regenerating parts of the plants may be present in soil (seeds and root rhizomes). Methods of control and disposal are described in **Section 7.3**.

Access outside this boundary should be considered strictly out of bounds with a visible barrier and signs warning of the presence of INNS contamination. If access is required beyond this area, strict biosecurity protocol should be followed (see Section 7.4).

Figure 2 in **Appendix B** show the degree of overlap between INNS and work area/buffer. This shows that, at present, the number of locations where there is direct overlap between construction activity is 12. The breakdown of species is shown in **Table 9.**

Table 9: INNS locations within construction footprint

INNS	Number of locations within work area
Japanese knotweed	2
Himalayan balsam	1
Montbretia	0
Variegated yellow archangel	4

This assessment should at present be regarded as indicative; both the work area (such as access routes) and distribution/extent of INNS are likely to change before work is underway. Therefore, it is essential that an updated INNS survey is undertaken at near as practical to the onset of construction activities (at suitable time of year). The extent of all INNS within the control area shall be mapped, allowing costs and resource commitment to be calculated.

8.2.2 Exclusion zones

Potentially, some areas of INNS may be present within the work area in patches of such an extent that control is costly, particularly if access to the specific location is not required and so can be isolated with an exclusion zone.

The exclusion zone must include the entire extent of the visible INNS plus a 10-metre buffer. It must be clearly marked-out and signed as a strict exclusion zone due to invasive species.

8.3 Summary of control and disposal methods

Table 10 provides a summary of control and disposal methods for the INNS identified within the works area at the Scheme.

Further information on these methods can be found in Part One (**Section 6**).

SEPA must be consulted when location and control measures have been decided.

Table 10: Summary of control and disposal methods

INNS	Control Method			Disposal method		
	Cutting & pulling	Digging-out	Chemical	Burning on-site	Burial on-site	Removal from site
		All soil must be removed as controlled waste	Only the approved range of Glyphosate based herbicides. SEPA must agree to the operation prior to spraying if this is undertaken within 10m of a watercourse.	Statutory conditions must be met to secure waste management license exemption	Location & depth must not be disturbed. Cover with barrier membrane and clean soil.	Licensed waste carriers and landfill sites only.
Japanese knotweed	NO DO NOT CUT OR PULL PLANTS	YES All soil within 7m. Soil depth of 3m	YES Glyphosate. When plant in leaf. Most effective Aug/Sep	YES	YES To depth of 5m	YES
Himalayan balsam	YES Cutting & pulling before plant flowers (before June)	YES All soil within 10m.	YES Glyphosate. When plant in leaf, before seed heads developed	YES ONLY if no seeds present	YES To depth of 1m	YES
Montbretia	YES	YES All soil within 4m.	YES Glyphosate. When plant in leaf	YES	YES To depth of 1m	YES
Variegated yellow archangel	YES	YES All soil within 4m.	YES Glyphosate. When plant in leaf	YES	YES To depth of 1m	YES

Stockpiling prior to disposal: Piles on hardstanding/barrier membrane, <2m height, covered. Access restricted.

8.4 Sample Biosecurity Plan

A Biosecurity Plan is the best way to communicate the procedures that must be followed on-site. An example is provided below, although it should be noted that the approved contractor is expected to create their own plan, which should be updated regularly.

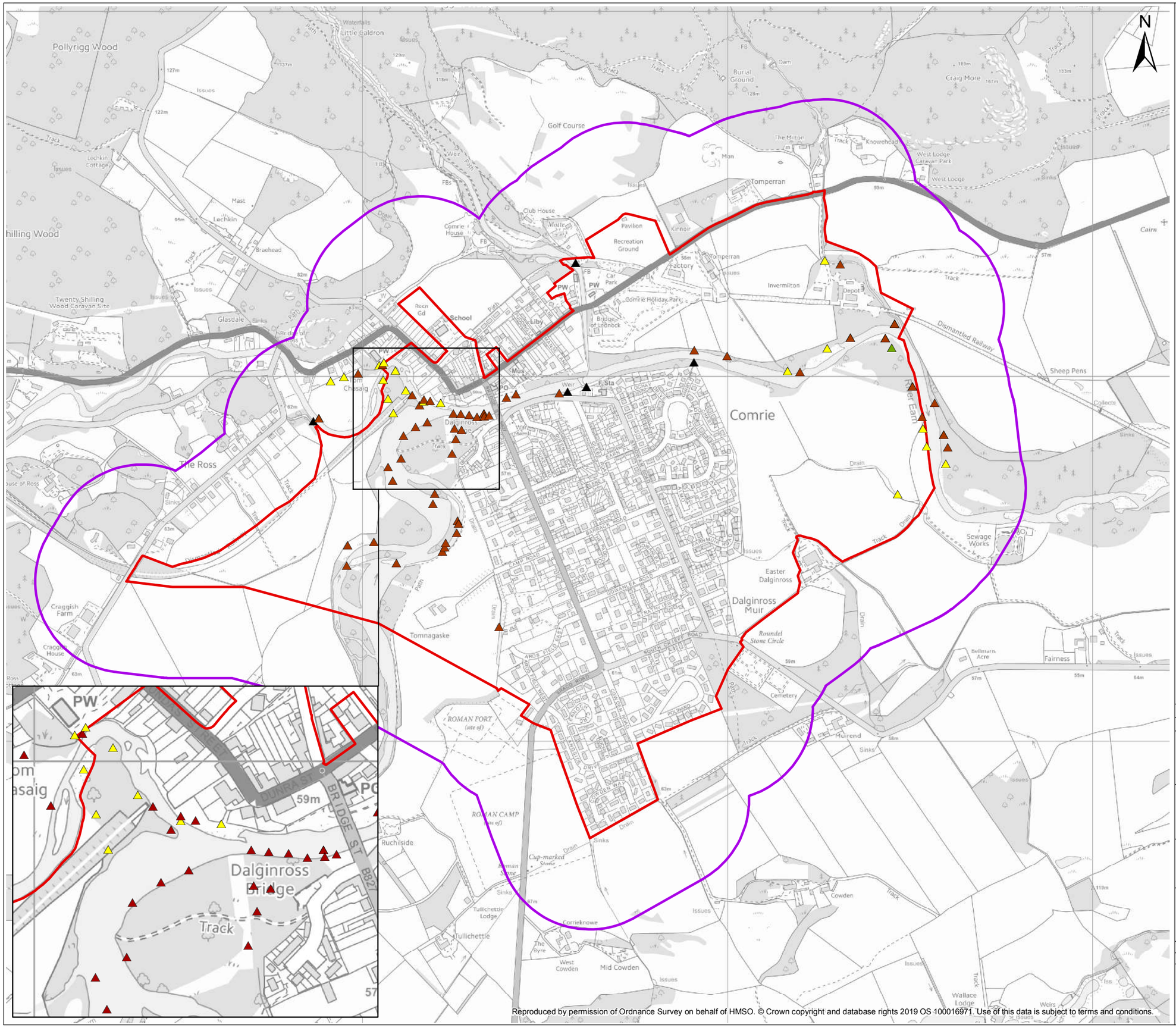
Ensure that all staff working on or visiting the site have been briefed on the biosecurity plan prior to the site visit. This is best delivered by a single designated individual.

Table 11: Biosecurity plan for working in area containing INNS

Impact	Action
Harm to human health	Prepare a risk assessment which considers potential risks to human health from exposure to herbicide sprays in accordance with COSHH.
Deliberate or inadvertent spread of INNS	All individuals must follow biosecurity measures implemented by this plan. An Ecological Clerk of Works (ECoW) or suitably qualified Contractor should oversee the INNS management outlined above including these biosecurity provisions for prevention of contamination. A toolbox talk should be given prior to any works within the identified areas of infestation. All parking must be either off site or on clean hard standing at an agreed location. Minimise the number of visits to and the number of workers in the infested areas where possible.
Establish an exclusion zone	Undertake an update survey of the working areas and update maps accordingly. Prior to any site clearance, a minimum 10m exclusion zone will be erected around all individual plants/stands of Himalayan balsam, 10m around Japanese knotweed, and 4m around and any other identified INNS. These areas will be clearly demarcated. Signs should warn people working within these areas that there is INNS contamination.
Stockpiles of cut material	Within the affected areas, any stockpiles of material including any stems or soil should be clearly demarcated and signed. Any material (vegetation or soil) that may contain seeds in these areas should be stored on an area of hard standing or an appropriate root barrier membrane.
Vehicles	Vehicles with caterpillar tracks should not be used within areas infested with INNS. Vehicles leaving the infested area should be pressure washed to remove any seeds or use routes protected by a root barrier membrane. Any material left after vehicles have been pressure washed must be collected and contained along with other INNS contaminated material.

	When transporting INNS material, make sure the vehicle is covered/sheeted so seeds and plant material cannot blow away.
Keep equipment and clothing clean	Ensure equipment, clothing and footwear does not contain seeds of INNS. Examine equipment, clothing and footwear for plant material before leaving the infested areas. Use a brush to scrub items clean of any plant debris or soil.

Appendix A – Figure 1: Invasive plants map



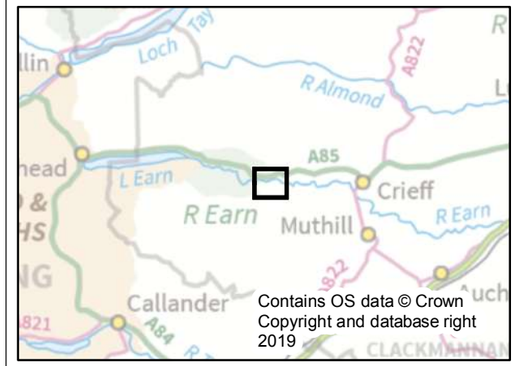
Legend

- Study Area
- Study Area - 250m Buffer

Invasive Non-Native Species

- INNS, Himalayan balsam
- INNS, Japanese knotweed
- INNS, Montbretia
- INNS, Variegated yellow archangel

0 125 250 500 Meters



Rev.	Rev. Date	Drawing Suitability	Drawn	Appr'd
P01.1	12/02/2019	Work In Progress	JB	CH

SWECO
Sweco UK Limited, 2nd Floor Quay 2, 139 Fountainbridge, Edinburgh, EH3 9QG
Tel: +44 131 550 6300

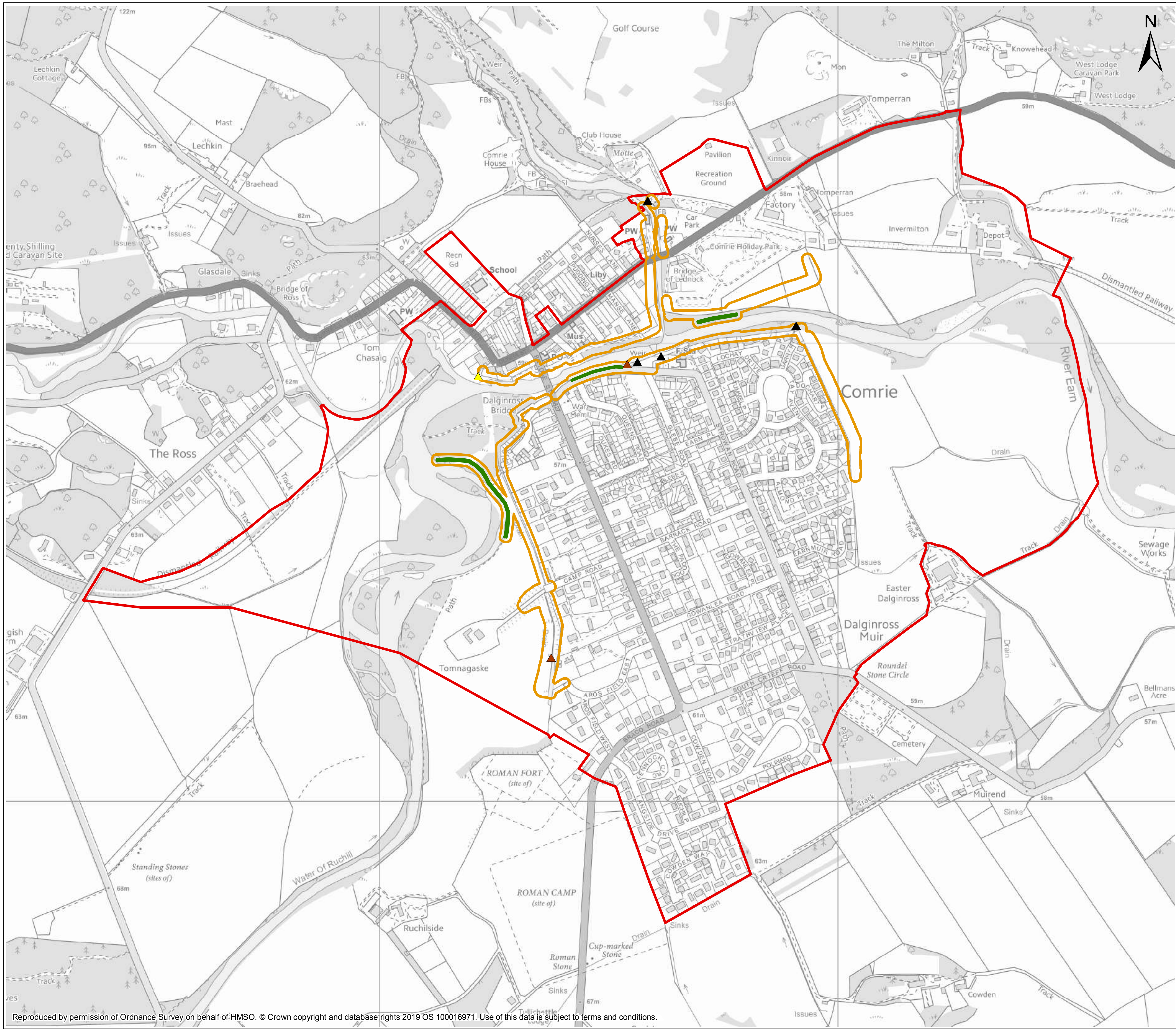
Client: PERTH & KINROSS COUNCIL

Project: Comrie Flood Protection Scheme

Drawing Title: Figure 1 - Invasive Plants

Scale @ A3	1:10,000
Project No.	119702

Appendix B – Figure 2: Invasive plants with Scheme design map



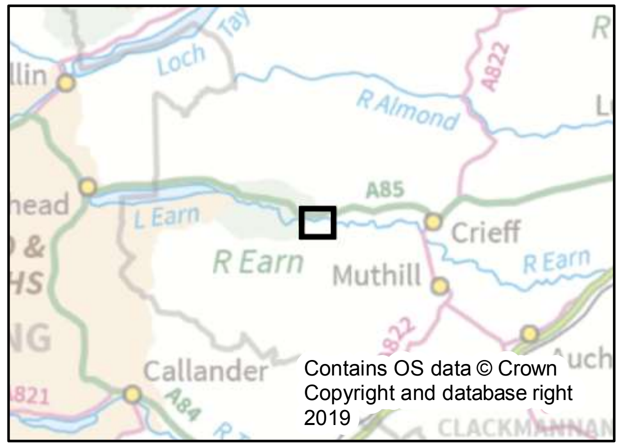
Legend

- Study Area
- Scheme Design - 10m Buffer
- Erosion / Scour Protection

Invasive Non-Native Species

- INNS, Himalayan balsam
- INNS, Japanese knotweed
- INNS, Variegated yellow archangel

0 125 250 500 Meters



P01.1	12/02/2019	Work In Progress	JB	CCR
Rev.	Rev. Date	Drawing Suitability	Drawn	Appr'd

SWECO

Sweco UK Limited, 2nd Floor Quay 2, 139 Fountainbridge, Edinburgh, EH3 9QG
Tel: +44 131 550 6300

Client

PERTH & KINROSS COUNCIL

Project

Comrie Flood Protection Scheme

Drawing Title

Figure 2 - Invasive Plants with Scheme Design

Scale @ A3	1:8,000
Project No.	119702

Appendix C – Site photos

Figure 1. Himalayan balsam in flower.

Figure 2. Himalayan balsam growing in the grounds of Comrie Parish Church.

Figure 3. Japanese knotweed growing early in the season on the banks of the Earn.

Figure 4. Large stand of Japanese knotweed growing on the Ruchill.

Figure 5. Montbretia growing on site.

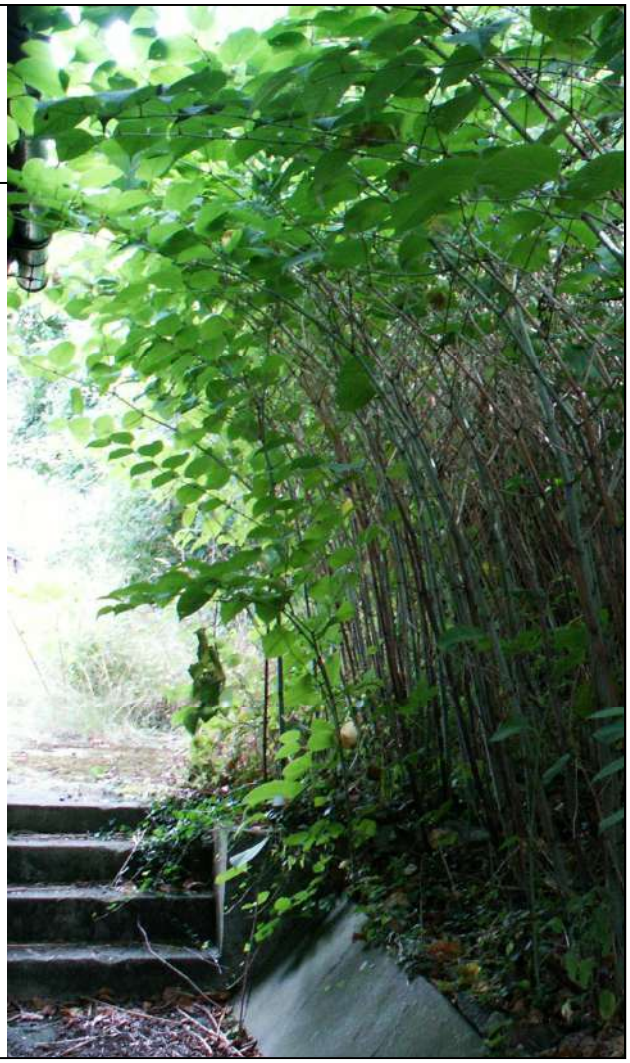
Figure 6. Variegated yellow archangel growing on site.

Appendix D – Species factsheets

www.nonnativespecies.org

Produced by Olaf Booy, Max Wade and Vicky White of RPS

Japanese Knotweed



Species Description

Scientific name: *Fallopia japonica*
AKA: Japanese Bamboo, Pysen saethwr (Welsh), *Polygonum cuspidatum*, *Reynoutria japonica*
Native to: Japan, Taiwan, northern China
Habitat: Common in urban areas, particularly on waste land, railways, road sides and river banks

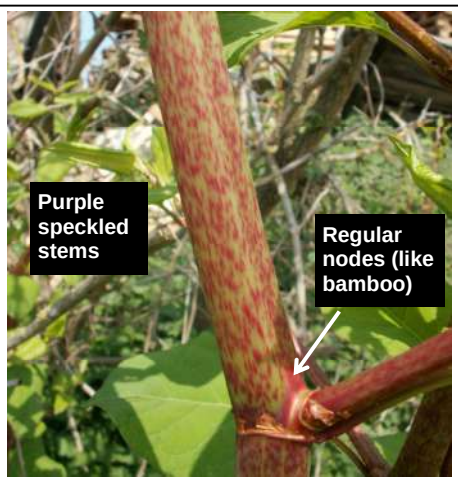
Tall herbaceous perennial with bamboo like stems. Often grows into dense thickets. Characteristic leaves and stems, persistence of last year's dead canes and distinctive rhizome (underground root-like stems) enables year round identification.

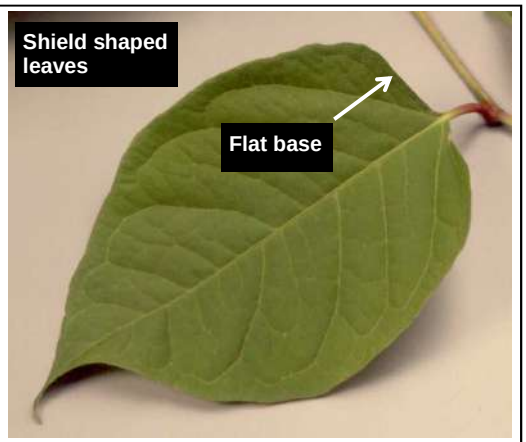
Introduced in the early 19th century as an ornamental plant. Now common and wide-spread across the UK. Spreads rapidly in the wild by natural means and as a result of spread by humans. Spread is solely by vegetative means, either fragments of rhizome or stem. Does not produce seed in the UK. Negative impacts include outcompeting native flora, contributing to river bank erosion and increasing the likelihood of flooding. Can also cause significant delays and cost to development as well as structural damage (it can grow through asphalt and some other surfaces).

Japanese Knotweed is listed under Schedule 9 to the Wildlife and Countryside Act 1981 with respect to England, Wales and Scotland. As such it is an offence to plant of other-wise cause Japanese knotweed to grow in the wild. Under the Environmental Protection Act 1990, Japanese Knotweed is classified as controlled waste.

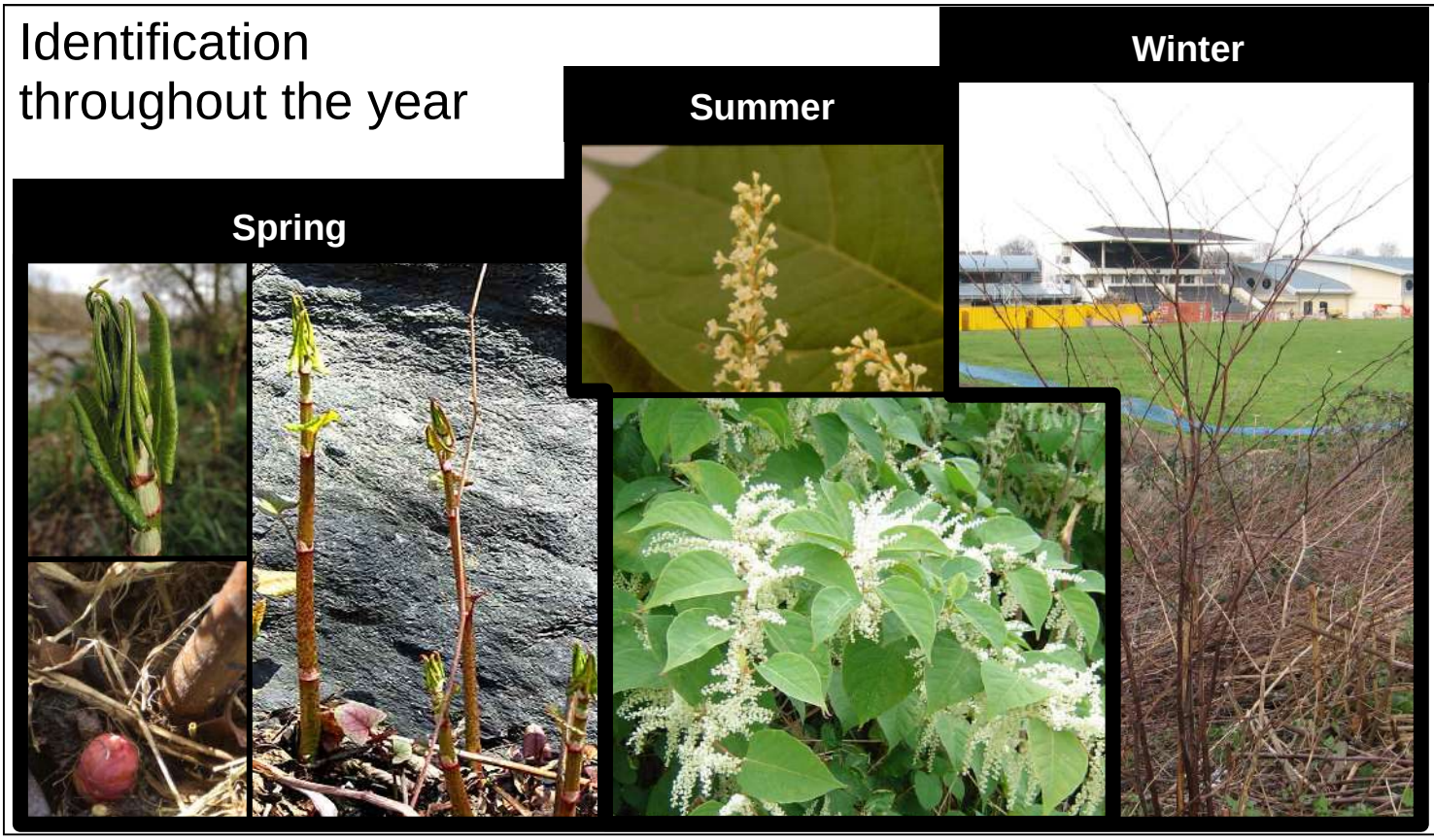
For details of legislation go to www.nonnativespecies.org/legislation.

Key ID Features



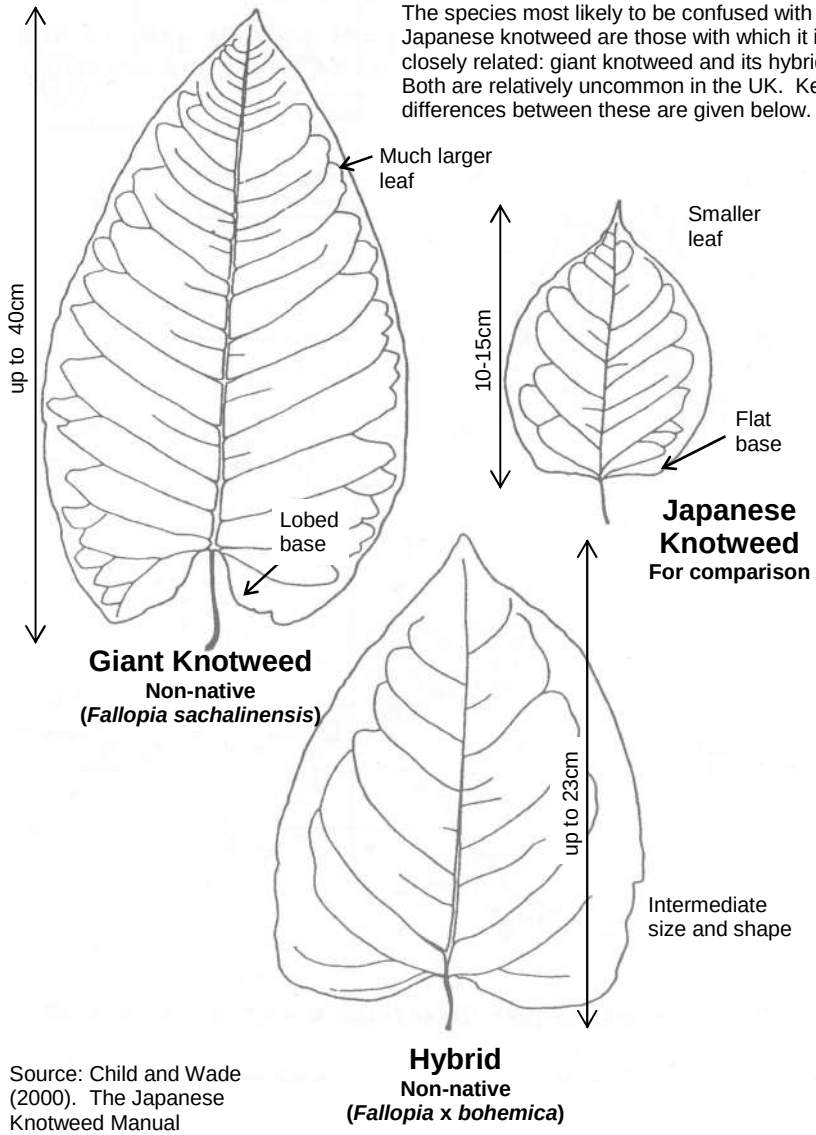


Identification throughout the year



Similar Species

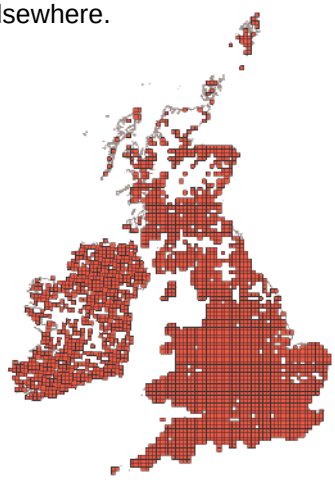
The species most likely to be confused with Japanese knotweed are those with which it is closely related: giant knotweed and its hybrid. Both are relatively uncommon in the UK. Key differences between these are given below.



Source: Child and Wade (2000). The Japanese Knotweed Manual

Distribution

Widespread and common across the UK. Notably extensive infestations are found in the south-west of England, south Wales and Greater London, however similarly extensive populations can also be found elsewhere.



Source: NBN Gateway. Check website for current distribution

References and further reading:

Blamey, M, Fitter, R and Fitter, A (2003) *"The Wild Flowers of Britain and Ireland. The Complete Guide to the British and Irish Flora."* A & C Black

Child, L E and Wade, P M (2000) "The Japanese Knotweed Manual". Packard

Environment Agency (2006) "*The Japanese Knotweed Code of Practice".* Environment Agency

Preston, C D, Pearman, D A and Dines, T A (editors) (2002) *"New Atlas of the British and Irish Flora".* Oxford University Press

Stace, C (1999) *"Field Flora of the British Isles".* Cambridge University Press

Photos from: Olaf Booy, Helen Parish, Max Wade, Vicky White

For more information visit **www.nonnativespecies.org**

Produced by Olaf Booy, Max Wade and Vicky White of RPS

Himalayan Balsam

Species Description

Scientific name: *Impatiens glandulifera*
AKA: Policeman's Helmet, Indian Balsam, Jac y Neidiwr (Welsh)
Native to: West and central Himalayas
Habitat: Found mostly on river banks and in damp woodland, can grow in other damp habitat

A tall, attractive, annual herb with explosive seed heads. Although easy to identify as a mature plant with its pink-purple flowers, fleshy stem and characteristic leaves, the seedlings and last year's dead stems of this annual are more difficult to spot.

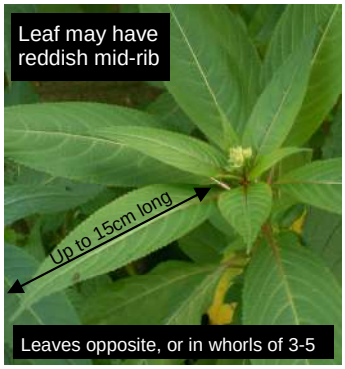
Introduced as a garden plant in the early 19th century and first recorded in the wild in 1855. Often favoured by the general public for its aesthetic appeal and is still deliberately planted on occasion. Now widespread in the UK, especially along urban rivers. Spreads solely by seeds, which are small and easily carried by wind or water.

Out-competes native species in ecologically sensitive areas, particularly river banks. Where it grows in dense stands along river banks it can impede flow at times of high rainfall, increasing the likelihood of flooding. Die back of extensive stands over winter can leave river banks bare and exposed to erosion.

Himalayan balsam is listed under Schedule 9 to the Wildlife and Countryside Act 1981 with respect to England and Wales. As such, it is an offence to plant or otherwise allow this species to grow in the wild.

For details of legislation go to www.nonnativespecies.org/legislation.

Key ID Features



Identification throughout the year

Can be identified at most times of the year: March-June by its seedlings, stem and leaf shape, from July to September by its stem, leaf shape and flowers. More difficult to identify over winter (October to February), look for hay like remains and distinctive root structure.

Similar Species

Orange Balsam
Non-Native
(*Impatiens capensis*)

Orange balsam is much less aggressive than Himalayan balsam, forming smaller less dense stands

Distribution

Widespread and common across the whole of the UK. Primarily on riverbanks and in other damp areas.

Source: NBN Gateway. Check website for current distribution

References and further reading:

Blamey, M, Fitter, R and Fitter, A (2003) *"The Wild Flowers of Britain and Ireland. The Complete Guide to the British and Irish Flora".* A & C Black

Preston, C D, Pearman, D A and Dines, T A (editors) (2002) *"New Atlas of the British and Irish Flora".* Oxford University Press

Stace, C (1999) *"Field Flora of the British Isles".* Cambridge University Press

Photos from: Olaf Booy, Mike Harris, Max Wade

For more information visit **www.nonnativespecies.org**

Produced by Olaf Booy, Max Wade and Vicky White of RPS

Montbretia

Species Description

Scientific name: *Crocosmia* x *crocosmifolia*
Hybrid of: *Crocosmia aurea* x *Crocosmia pottsii*
AKA: Coppertips, Falling Stars, Montbresia (Welsh)
Native to: Hybrid, parent species from South Africa
Habitat: Hedgerows, road verges, banks of lakes and rivers, beside woods and waste land, widely grown in gardens

Crocosmia species are easily recognised when in flower by the distinct shape and colour of their flower heads. All are non-native in the UK. The hybrid montbretia, with relatively short stems and orange flowers, is the main species to have escaped into the wild; however, a number of other ornamental *Crocosmia* species are grown in gardens and other landscaped areas. When not in flower, *Crocosmia* species are more difficult to identify. Look for rusty brown dead leaves and remains of previous years flowering heads.

Montbretia was originally created in France from parent plants of South African origin. Introduced to the UK in 1880 as a garden plant. It escaped by 1911 both naturally and through the disposal of garden waste, and spread rapidly across the UK in the latter part of the 20th century. Can completely dominate habitat where it grows, sometimes excluding native plant species. Spreads mainly by rhizomes, rarely by seed.

Montbretia is listed under Schedule 9 to the Wildlife and Countryside Act 1981 with respect to England and Wales. As such, it is an offence to plant or otherwise allow this species to grow in the wild.

For details of legislation go to www.nonnativespecies.org/legislation.

Key ID Features

Flowers orange and tubular in nodding clusters

Long stamens

Corm: a bulblike organ that provides the plant with energy

Grows to 60cm tall, usually found in clusters on road verges and in hedge-

Leaves less than 3cm wide, upright, flat, spear shaped and bright green

Flowers borne on long spikes

Identification throughout the year

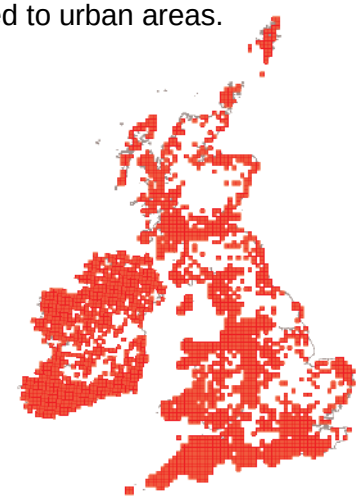
Montbretia is easily distinguished from other species when it is in flower between July and September. Identification outside of this period is more difficult. A key feature is the dense stands that it forms, which can spread to cover large areas. In addition, its smooth, upright, green leaves are relatively characteristic (although these can be confused with iris species). Green leaves are usually present from spring to autumn; dead brown leaves, dead flowering stems and seed heads are present are present throughout winter. Identification can also be checked year round by digging up the plant's corm.


Seed head


Dense stands present over winter

Distribution

Widespread, most common in western areas of England, Scotland, Wales and Ireland. Usually close to gardens. Not confined to urban areas.



Source: NBN Gateway. Check website for current distribution

Similar Species

Iris species
Native
(*various species - example shown is stinking iris*)

Iris flowers are distinctly different from montbretia

When not in flower iris (pictured) can be confused with montbretia

Similar shaped upright leaves with brown die back

Seed heads of iris differ from those of montbretia

Crocosmia species
Non-native
(*various species - example shown is 'Lucifer' variety*)

Other *Crocosmia* species are rarely found outside of the landscaped environment and rarely behave in an invasive manner. *Crocosmia* species in the wild that are invasive are most likely to be montbretia.

Flowers often different colour (this variety is a vivid red and taller than montbretia).

References and further reading:

Blamey, M, Fitter, R and Fitter, A (2003) *"The Wild Flowers of Britain and Ireland. The Complete Guide to the British and Irish Flora."* A & C Black

Preston, C D, Pearman, D A and Dines, T A (editors) (2002) *"New Atlas of the British and Irish Flora"*. Oxford University Press

Stace, C (1999) *"Field Flora of the British Isles"*. Cambridge University Press

Photos from: Olaf Booy, Joanne Denyer, Sue Hocking (Cornwall Wildlife Trust), Peter Llewellyn, Max Wade, Vicky White

Quick links

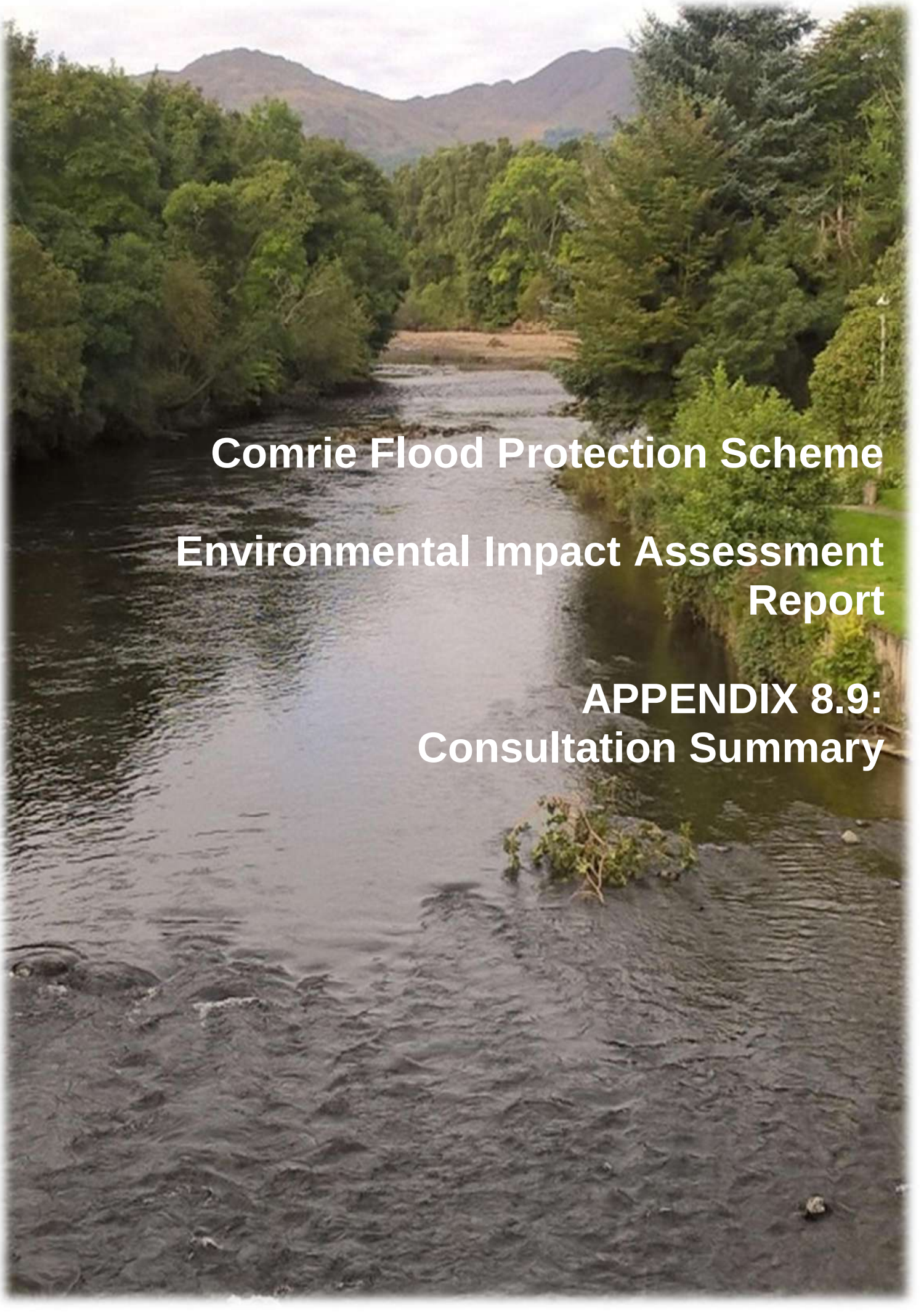
- Non-native species information portal
- Gallery
- ID sheets
- Action plans
- Risk analysis
- Species alerts

Variegated Yellow Archangel, (*Lamiastrum galeobdolon subsp. Argentatum*) images

To download an image please click on the thumbnail. Please click here for guidance on using the NNSS web gallery.

Search type: Species | Impacts / Management | Species A-Z: Scientific | Common

Species Name | Habitat all | Organism Type all | Search



Comrie Flood Protection Scheme

Environmental Impact Assessment Report

APPENDIX 8.9: Consultation Summary

Appendix 8.9: Consultation Summary

Consultee & date of consultation	Summary of consultation	Comment/Action taken
Bat Conservation Trust Email sent – 14/12/17	Data request for information. No response received.	No further action taken.
Comrie Angling Club Email sent – 03/04/18 Response received – 12/04/18	Information on any recreational uses of River Earn, Water of Ruchill and River Lednock. The Club fishes most of the stretches marked on your map, with the exceptions of the River Lednock, which we used to lease, but held as a Salmon reserve, (the bottom bit running past the caravan park is, I believe, leased by that park), and the stretch from the weir below Dalginross Bridge, on the South Bank, downwards, to where the Core Path and the Public Right of Way diverge - held by Crieff Angling Club. Request for data on fish catches. As the stretches concerned are parts of several different estates, the club doesn't have specific catch returns, but the Comrie Angling Club does provide a summary of the returns for the past few years for all the waters leased by the Club. Any other information for construction mitigation to protect water quality and aquatic species. Concerns over what will happen to vegetation along the south bank which provides shelter for fish also concerns about predatory birds impacts on juvenile fish. Also, raise issues of beavers encouraging bank erosion. Finally, mention the importance of pollution mitigation during construction.	Catch returns summary 2011 – 2017 included within Appendix 8.6/F (Volume 3 of the EIA).
Crieff Angling Club Email sent – 03/04/18	Request for fish data. No response received.	No further action taken
Forestry Commission Scotland Email sent – June 2009 Response received – 2009.	Data request for information. FCS provided a map showing the extent of Forestry Commission managed woodland.	No further action taken. Data on felling proposals since 2012 also taken from Scotland's Environment web portal for inclusion within the EIA Report.
Loch Lomond & the Trossachs National Park Email sent – 18/12/17 Response received – 19/12/17	Data request for information. Advised that they not consider any works related to the scheme to have any impacts on the National Park and so have no relevant data.	No further action taken

Consultee & date of consultation	Summary of consultation	Comment/Action taken
Perth Bat Group Contacted June 2009	Data request for information. No response received.	No further action taken
Perth & Kinross Red Squirrel Group Email sent – June 2009 Response received – 2009	Data request for information. Advised that the Comrie and Dalginross area supports both red and grey squirrels; the area lies within the main priority zone for red squirrel. Advised of guidelines relating to works potentially affecting red squirrels.	No further action taken
Royal Society for the Protection of Birds (RSPB) Letter sent – June 2009 Response received – 2009. Additional response received – June 2017.	Data request for information. Made reference to the new Flood Risk Management (Scotland) Bill and its framework for sustainable management of flood risk. Advised that more natural flood management solutions rather than hard engineering should be considered, incl. upland catchment restoration and floodplain/wetland storage. Advised that there are no known priority bird species or populations within the extent of the study area that would be affected by the proposal. Please note that through the Environmental Scoping Process PKC also received information from the RSPB regarding the location/presence of nesting sites for Red Kites in the works area.	RSPB confidential bird nest data included for consideration in EIA.
Scottish Badgers Email sent – 18/01/18 Response received – 23/01/18	Data request for information. No data available.	No further action taken
Scottish Bird Club Email sent – 18/12/17	Data request for information. No response received.	No further action taken
Scottish Natural Heritage Email received – 24/01/17; Email sent – 16/11/17 Response received – 17/11/17	Proposal for ecological study scope. Agree with the work outlined within Chapter 5: Ecology and Nature Conservation. Advised that work pertaining to great crested newt is unnecessary for this scheme as it falls outside of the current known range of this species. And welcome the inclusion of invasive non-native species as a factor for consideration. Inclusion of beaver within the proposed study scope. Pleased to see that beaver are covered within the proposed phase 2 work, citing that beavers are known to be present in the Earn. Noted that although beavers currently have no legal protection save that provided by animal welfare legislation, it was expected that they would become an EPS during early 2018. Noted that knowledge of beaver distribution in and around Comrie will allow for consideration when construction/implementation of the scheme begins. Stated that they expected a licensing scheme to be in place for beaver once legal protection is given and that any further information of advice can be sought from SNH. SNH confirmed that Habitats Regulations Appraisal (HRA) is not required for the proposed Scheme as there	GCN are scoped out. INNS are included in the chapter. Beaver is included in the assessment of ecological effects. HRA and assessment of effects on SSSI and Natura 2000 sites have been scoped out.

Consultee & date of consultation	Summary of consultation	Comment/Action taken
	are no SSSI or Natura 2000 sites (SAC, SPA, Ramsar) in the vicinity.	
Scottish Wildlife Trust Email sent – 18/12/17	Data request for information. *No response received.*	No further action taken
Scottish Environment Protection Agency (SEPA) Letter received – 02/02/2017	SEPA stated that they would be able to provide fish data relevant to the scheme and advised that the Tay District Salmon Fisheries Board have a statutory duty with respect to migratory fish in the River Earn and Ruchill Water and may also hold information on fish populations, migration periods and spawning areas. SEPA request measures to protect fish ecology are included in the ES. SEPA also state that invasive species (notably Japanese knotweed, Himalayan balsam and American signal crayfish) are present within the area and request that INNS are identified and that any biosecurity or mitigation required during construction are included in the ES.	Site visit with SEPA staff attended by Sweco ecologists in October 2018. Discussions about INNS held. Sweco shared results of INNS surveys with SEPA. SEPA fish data received and included in EIA.
Tayside Bat Group Email sent – 18/01/18 Response received – 23/01/18	Data request for information. No data available.	No further action taken
Tayside Biodiversity Partnership Email sent – 18/12/17	Data request for information. *No response received.*	No further action taken. The Tayside Local Biodiversity Action Plan 2016 – 2026 has been sourced publicly for use within the EIA.
Tay District Salmon Fisheries Board Email sent – 18/12/17 Response received – 30/03/18	Information on any recreational uses of River Earn, Water of Ruchill and River Lednock. Fishing in this area is administered by the Comrie Angling Club, who may lease their fishing from a number of different owners. No knowledge of owners boundaries but advises contacting Comrie Angling Club. Request for data on fish catches. No data available, advise contacting Comrie Angling Club Any other information for construction mitigation to protect water quality and aquatic species. TDSFB possess a few years of electrofishing data on juvenile salmon on a gravel bar on the Ruchill just upstream of the confluence – opposite the White Church. Reasonable numbers of salmon fry are found there, indicating the presence of spawning salmon. Indicate the importance of avoiding in-river works during the period November – May when salmon eggs and alevins are in the gravel.	Fishing returns summary from the Comrie Angling Club received in 2017 (see above) and fish/fish habitat is taken into consideration in the EIA.