Appendix A12.3: Detailed Survey Methods and Baseline Data

1.1 Introduction

1.1.1 This appendix provides detailed information on the survey baseline for the non-confidential biodiversity resources outlined in Chapter 12 (Biodiversity). Baseline data for badger, otter, bat roosts, freshwater pearl mussel (FWPM) and Schedule 1 bird species can be found in the Confidential Appendix A12.4 (Confidential Biodiversity Resources).

1.1.2 This appendix also presents the results of the online desk-based assessment for protected and notable species.

1.1.3 Additional details on the survey methods for all ecological receptors are presented in this appendix to complement information supplied in Chapter 12 (Biodiversity).

1.1.4 The outline of this appendix is as follows:

- Desk-based Assessment
- Detailed Survey Methodology
- Bats
- Breeding Birds
- Water Vole
- Red Squirrel and Pine Marten
- Reptiles
- Terrestrial Invertebrates
- Habitats
- Invasive Non Native Species
- Aquatic Biodiversity Resources

1.1.5 Data for species covered in this appendix come from a variety of surveys undertaken over a period of 10 years (2015-2025). The data presented are considered to be sufficient to inform a robust impact assessment. Pre-construction surveys will be undertaken to validate and update the ecological baseline prior to construction (refer to Chapter 12: Biodiversity and Chapter 22: Schedule of Environmental Commitments).

1.2 Desk-Based Assessment

1.2.1 National Biodiversity Network (NBN) Atlas data has been used, where appropriate, to assess the occurrence of ecological features within and up to 10km from the footprint of the proposed scheme. The data search of NBN (NBN Trust, 2024) omitted records pre-1994 as thirty years was considered a sufficient time period for records to inform the baseline.

1.2.2 The use of NBN data is governed by the terms and conditions of the network. The data providers, original recorders (where identified), and the NBN Trust bear no responsibility for the further analysis or interpretation of that material, data and/or information. NBN data providers are presented in Table A12.3-1.

Table A12.3-1: NBN data providers, recorders and dataset licence

Species	Data Provider	Recorder(s)	Licence	Date
Protected Species				
Adder (*Vipera berus*)	Amphibian and Reptile Conservation, and Biological Records Centre	Richard Smith; Matt Doogue; and Rachel Stroud.	CC-BY*	2018-2021
	Highland Biological Recording Group	Isobel Morrison	CC-BY	2019
	Scottish Wildlife Trust	Loch of Lowes (LOL) Staff and Volunteers	CC-BY	2001
Atlantic salmon (*Salmo salar*)	Biological Records Centre	Undisclosed	CC-BY	2002
	National Trust for Scotland	Ben Notley	CC-BY	2014
	Scottish Environment Protection Agency	Undisclosed	OGL**	2011
Badger (*Meles meles*)	Highland Biological Recording Group	Gilbert Dick	CC-BY	2011
	The Mammal Society, and Biological Records Centre	Pat Batty	CC-BY	2020
Barn owl (*Tyto alba*)	BTO	Withheld	OGL	2010
	Royal Society for the Protection of Birds	Withheld	CC-BY	2006
	Scottish Wildlife Trust	LOL Staff and Volunteers	CC-BY	2003
Beaver (*Castor fiber*)	The Mammal Society, and Biological Records Centre	Names not specified due to high number of recorders. Full list	CC-BY	2021

		available on the NBN website.		
	NatureScot	Names not specified due to high number of recorders. Full list available on the NBN website.	OGL	2021
	Scottish Natural Heritage	RCP and KW	OGL	2017
Black tern (*Chlidonias niger*)	SWT	LOL Staff and Volunteers	CC-BY	2010
Black-throated diver	RSPB	Undisclosed	CC-BY	1994
	SWT	LOL Staff and Volunteers	CC-BY	2010
Brambling (*Fringilla montifringilla)*	RSPB	Undisclosed	CC-BY	-
	SWT	LOL Staff and Volunteers	CC-BY	2010
	BTO	Withheld	OGL	2001
Brown hare (*Lepus europaeus*)	HBRG	Johnathan Groom	CC-BY	2012
	SWT	LOL Staff and Volunteers	CC-BY	2005
	Biological Records Centre	R E Youngman	CC-BY	1997
	BTO	Withheld	OGL	2020
	Argyll Biological Records Centre	Jonathan Groom	CC-BY	2012
	Highland Biological Recording Group	Jonathan Groom	CC-BY	2012
Brown long-eared bat (*Plecotus auritus)*	Bat Conservation Trust (BCT)	Undisclosed	CC-BY	2017
	NatureScot	NatureScot staff	OGL	2015
	SNH	SNH Staff	OGL	2004
Capercaillie (*Tetrao urogallus*)	RSPB	Undisclosed	CC-BY	2005
Common crossbill (*Loxia curvirostra*)	RSPB	Undisclosed	CC-BY	-
	SWT	LOL Staff and Volunteers	CC-BY	-
	BTO	Withheld	OGL	2010
Common	NatureScot	Sue Swift	OGL	2014

pipistrelle bat (*Pipistrellus pipistrellus*)	Biological Records Centre	NCC Printout (TMJ)	CC-BY	-
	SNH	SNH Staff	OGL	2004
Daubenton's bat (*Myotis daubentonii*	BCT	Undisclosed	CC-BY	2017
	SWT	LOL Staff and Volunteers	CC-BY	-
	NatureScot	NatureScot staff	OGL	1994
Natterer's bat (*Myotis nattereri*)	NatureScot	NatureScot staff	OGL	-
Soprano pipistrelle bat (*Pipistrellus pygmaeus*)	NatureScot	Emilie Wadsworth	OGL	2014
	SNH	SNH staff	OGL	2000
	Scottish Wildlife Trust	LOL Staff and Volunteers	CC-BY	2001
Common frog (*Rana temporaria*)	SWT	LOL Staff and Volunteers	CC-BY	-
	HBRG	Jonathan Groom	CC-BY	2012
	Amphibian and Reptile Conservation, and Biological Records Centre	James McMahon	CC-BY	2023
Common lizard (*Zootoca vivipara*)	HBRG	Jonathan Groom	CC-BY	2012
	SWT	LOL Staff and Volunteers	CC-BY	2010
	Amphibian and Reptile Conservation, and Biological Records Centre	Gareth Ventress	CC-BY	2020
Common toad (*Bufo bufo*)	SWT	LOL Staff and Volunteers	CC-BY	2010
	Amphibian and Reptile Conservation, and Biological Records Centre	James McMahon	CC-BY	2022
	Highland Biological Recording Group	Jonathan Groom	CC-BY	2013
Fieldfare (*Turdus pilaris*)	SWT	LOL Staff and Volunteers	CC-BY	2003
	RSPB	Undisclosed	CC-BY	-
	National Trust for Scotland	Ben Notley	CC-BY	-
Greenshank (*Tringa nebularia*)	SWT	LOL Staff and Volunteers	CC-BY	2010

	BTO	Withheld	OGL	2016
Hen harrier (*Circus cyaneus*)	SWT	LOL Staff and Volunteers	CC-BY	2010
	BTO	Withheld	OGL	2015
Honey buzzard (*Pernus apivorus*)	SWT	LOL Staff and Volunteers	CC-BY	2001
Kingfisher (*Alcedo atthis*)	SWT	LOL Staff and Volunteers, Reserve visitor	CC-BY	2016
	BTO	Withheld	OGL	2020
Lamprey (brook or river lamprey) (*Lampetra* sp.)	NatureScot	Undisclosed	OGL	-
	Scottish Natural Heritage	Undisclosed	OGL	2001
Long-tailed duck (*Clangula hyemalis*)	SWT	Reserve visitor	CC-BY	2003
	BTO	Withheld	OGL	2017
Merlin (*Falco columbarius*)	SWT	Reserve visitor	CC-BY	
	BTO	Withheld	OGL	2020
Osprey (*Pandion haliaetus*)	SWT	LOL Staff and Volunteers, Reserve visitor	CC-BY	2004
	BTO	Withheld	OGL	2021
Otter (*Lutra lutra*)	HBRG	Stefan Morrocco, Peter Nairne, Greg Fullarton, Neil Redgate, Scott Reilly, Owen Newton, Jonathan Groom, Scottish Mink Initiative	CC-BY	-
	SWT	LOL Staff and Volunteers	CC-BY	2013
	Unspecified	RG, JG	OGL	2008
	The Mammal Society, and Biological Records Centre	Bill Melville	CC-BY	2021
Palmate newt (*Lissotriton helveticus*)	SWT	LOL Staff and Volunteers	CC-BY	-
	HBRG	Jonathan Groom	CC-BY	2012
	Amphibian and Reptile	Paul Cromey	CC-BY	2021

	Conservation, and Biological Records Centre			
Peregrine (*Falco peregrinus*)	SWT	LOL Staff and Volunteers	CC-BY	2001
	BTO	Withheld	OGL	2001-2019
Pine marten (*Martes martes*)	SWT	LOL Staff and Volunteers	CC-BY	-
	Scottish Natural Heritage	Henry Schofield, David Balharry	OGL	2012
	NatureScot	Not disclosed	OGL	2008
	The Mammal Society, and Biological Records Centre	Jean Oudney	CC-BY	2021
Red kite (Milvus milvus)	SWT	LOL Staff and Volunteers	CC-BY	-
	BTO	Withheld	OGL	1997-2021
Red-throated diver (*Gavia stellata*)	SWT	LOL Staff and Volunteers, Reserve visitor	CC-BY	2001-2005
Red squirrel (*Sciurus vulgaris*)	SWT	Names not specified due to high number of recorders. Full list available on the NBN website.	CC-BY	1997-2023
	Argyll Biological Records Centre	Jonathan Groom	CC-BY	2010
	HBRG	Jonathan Groom, David McAllister, Willie Macdougal	CC-BY	2011-2015
	National Trust for Scotland	Hannah Patterson, Louise Medine	CC-BY	2017
	The Mammal Society, and Biological Records Centre	Nikki Murphy, Bill Melville,	CC-BY	2017 - 2023
Redwing (*Turdus iliacus*)	SWT	LOL Staff and Volunteers	CC-BY	2001
	RSPB	Undisclosed	CC-BY	-
	National Trust for Scotland	Ben Notley	CC-BY	-

Scaup (*Aythya marila*)	SWT	LOL Staff and Volunteers	CC-BY	2001
	BTO	Withheld	OGL	2015-2020
Scottish crossbill (*Loxia scotica*)	RSPB	Undisclosed	CC-BY	2006
Sea lamprey (*Petromyzon marinus*)	Biological Records Centre	Undisclosed	CC-BY	2001
	NatureScot	Undisclosed	OGL	2007
Slavonian grebe (*Podiceps auritus*)	SWT	LOL Staff and Volunteers	CC-BY	2000
	BTO	withheld	OGL	2013
Slow worm (*Anguis fragilis*)	Unspecified	Geraldine McGowan	CC-BY	-
White-tailed eagle (*Haliaeetus albicilla*)	RSPB	Undisclosed	CC-BY	1996
Whooper swan (*Cygnus cygnus*)	SWT	LOL Staff and Volunteers, Reserve visitor	CC-BY	-
	BTO	withheld	OGL	1999-2017
Wildcat (*Felis silvestris*)	SWT	LOL Staff and Volunteers	CC-BY	2008
	NatureScot	Undisclosed	OGL	2006
	Biological Records Centre	Easterbee et al. (Wildcat distribution)	CC-BY	-

* Creative Commons Attribution 4.0 International (https://creativecommons.org/licenses/by/4.0/).
** Open Government Licence Version 3 (http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/).

1.3 Detailed Survey Methodology

1.3.1 A summary of survey methods used for ecological features is presented in Table 12.2 of Chapter 12 (Biodiversity). Further detailed survey methods are presented below in Table A12.3-2.

Table A12.3-2 Detailed Survey Methodology

Survey Type	Guidance	Date Ranges	Zone of Influence	Methods
Terrestrial Resources				
Badger	Harris et al., 1989 Scottish Badgers, 2018 NatureScot, 2024a NatureScot, 2025	2015 January – October 2018 December 2020 February – March 2021 November – December 2024 October *In addition, data collected/validated during other surveys throughout 2022-2025.	250m	Badger presence/likely absence and use of habitats was recorded within and up to a minimum of 100m from the proposed scheme and maximum of 250m, except where an impassable barrier (e.g. a river ≥ 50m wide) constrained the survey extent. The grounds of residential properties (gardens of houses) were not surveyed directly; however, survey of all relevant properties was undertaken from adjacent ground where possible. Signs recorded: ▪ setts as defined by the Protection of Badgers Act 1992 (as amended for Scotland); ▪ structures that were possible setts, but that had no immediate evident signs of current use by badgers (NatureScot, 2025); and ▪ hairs, prints, mammal paths, foraging signs, dung pits and latrines. Data from surveys undertaken in 2015 and 2018 are only included in this assessment to provide background information to the potential movement of social groups in the area.
Bat roost surveys	Collins, 2016 Collins, 2023 Colins, 2024	2015 February – May 2016 – January - March 2018-2019 August – February 2019 December 2020 – January - February 2020 May 2021 January – February 2021-2022 June – February 2022-2023 May – February 2024 May – October	50m	All buildings, structures (bridges and culverts) and trees in and within 50m of the proposed scheme were subject to ground-based potential roost assessment (PRA) surveys at DMRB Stage 2 to determine their potential to support roosting bats. Following the best practice guidance in Collins (2016), individual buildings, structures and trees were assigned a roost potential of: ▪ negligible (no potential to support roosting bats); ▪ low (potential to be used by individual bats opportunistically); ▪ moderate (potential to support bats, but unlikely to be a roost of high conservation status); ▪ high (potential to support large numbers of bats); or ▪ roost (confirmed use by bats through evidence such as droppings, or the presence of live or dead bats). These data were used to inform the requirements for further survey work at DMRB Stage 3 and, where relevant, are reported in Section 1.4: Bats of this appendix. As part of DMRB Stage 3, further PRA and ground level tree assessments (GLTA) were undertaken following updated best practice guidance to assess roost suitability and record potential roost features. Dusk emergence or dawn re-entry roost surveys were undertaken to identify, and determine the conservation status of, any roosts under the footprint or within 30m of the proposed scheme, which could be impacted by the proposed scheme. These roosts surveys were undertaken during the optimal period (May to September) following best practice guidance (Collins, 2016, 2023 and 2024), where possible. One survey undertaken on a roost feature with low roost potential (or PRF-I[1]), two surveys on a roost feature with moderate roost potential, and three surveys on a roost feature with high roost potential (or PRF-M[2]) or which is a confirmed roost. In addition, PRF inspections, involving tree climbing, were undertaken in January to October 2024 on all trees within 30m of the proposed scheme that had been assessed as having PRF-M in previous surveys.

[1] PRF-I – PRF is only suitable for individual bats or vert small numbers of bats.
[2] PRF-M – PRF is suitable for multiple bats

Survey Type	Guidance	Date Ranges	Zone of Influence	Methods
				The potential for buildings and structures to support hibernating bats was assessed during the PRA surveys. Buildings and structures with moderate or high potential to support hibernating bats, in and within 30m of the proposed scheme and likely to be impacted by the proposed scheme, were subject to winter hibernation inspection surveys and passive monitoring (where appropriate) over winter months to determine use. Surveys and bat call analysis were carried out using standard call detection and recording equipment. Bat dropping samples collected during surveys were sent for eDNA analysis for species level identification.
Bat activity surveys	Collins, 2016 Berthinussen and Altringham (2015)	2018 July – August 2019 April – May 2020 August – October 2021 June – August	50m	Transects were conducted between 2018 and 2021. Four transect routes were designed to identify areas of high, and low, value habitats at varying proximities to the existing A9 and to determine bat activity and species richness (Collins, 2016; Berthinussen and Altringham, 2015). Each transect route was surveyed in July and August 2018, April and May 2019, September and October 2020, and in May, June, July and August 2021. Therefore the full complement of survey effort at each transect route was achieved over three seasons. To assess activity levels, passive monitoring bat detectors were deployed at three sites along each transect route between August and October 2020 and May to August 2021, with a minimum of 10 consecutive nights of data collected in each month. The data collected was analysed by ECOBAT (Ecobat, 2021) to evaluate the activity levels in respect to a national database. Bat commuting corridors that will be intersected by the proposed scheme were identified and monitored using crossing point surveys. These focused on existing structures, such as bridges or culverts, and features in close proximity to the proposed scheme, such as Dunkeld & Birnam Station. Identified crossing points were subject to two or three survey visits from 2018 to 2021 between April and September, inclusive, with surveyors recording bat activity, crossing locations and crossing flight height. Surveys and bat call analysis were undertaken using standard call detection and recording equipment.
Beaver	Campbell-Palmer et al., 2016	2018 September – December 2021 October - November 2022 July – August 2024 April 2024-2025 October – January *In addition, data collected/validated during other surveys throughout 2022-2025.	200m	Beaver presence/likely absence and use of habitats was recorded along watercourses, which were assessed by suitably experienced surveyors to have potential to support beaver, within and to a minimum of 100m from the proposed scheme and maximum of 200m, with surveys extending to 50m from watercourse banks. Eight suitable watercourses were surveyed (as identified at DMRB Stage 2) for beaver structures (burrows, dams and lodges) which were categorised and photographed. In addition, the following signs were recorded: ▪ prints, channels or other well-used paths to felled trees or to access points on the watercourse; ▪ food caches; ▪ felled trees; ▪ foraging; ▪ burrows; and ▪ structures (including dams and lodges). Short (up to 5m) stretches of steep, heavily vegetated or rocky banks could not be surveyed safely in some locations, but this did not preclude full assessment of beaver use of the survey area. Where appropriate, infra-red camera traps were also deployed to monitor known locations of beaver to gather further information.

Survey Type	Guidance	Date Ranges	Zone of Influence	Methods
Breeding birds: Modified Common Bird Census	Bibby et al., 2000 Gilbert et al., 2012	2019 April – June 2022 April – May	150m	Breeding bird surveys (an adapted Common Birds Census with some elements of the Breeding Bird Survey (BBS)) were undertaken in an area within and up to 150m from the mainline of the proposed scheme between April and June 2019, and April – May 2022, to gain an indication of the species assemblage present across all habitat types. All farmland, woodland, upland, copse and scrub boundaries, hedgerows, ditches, rivers, and streams were surveyed and the location, species and activity of every individual bird observed (by sight and/or sound) within or flying over the survey area was recorded using standard BTO conventions (Bibby et al., 2000). This approach also maximised the chances of seeing birds and so mitigated for reduction in ability to hear birds due to road noise.
Schedule 1 birds	Gilbert et al., 2012 Hardey et al., 2013 National Road Authority, 2009	2019 April – August 2019 December 2020 January – February 2020 March 2022 February 2022 March – August 2023 February, June, July 2024 February, June, July	500m	Targeted surveys were undertaken to record breeding by Schedule 1 bird species focusing on crossbills, kingfisher, barn owl and raptors (such as honey buzzard, goshawk, hen harrier, red kite, osprey, and peregrine). This involved walkover and vantage point surveys within and covering a 500m buffer around the proposed scheme. Walkover surveys involved two suitably experienced surveyors (including at least one specialist ornithologist) walking through suitable habitat in a zig-zag pattern, recording evidence e.g., visual and auditory evidence, active nests, pellets, and feathers. Walkover surveys also covered riparian habitats to assess potential breeding habitat for kingfisher. Vantage point surveys involved two surveyors at a fixed location (allowing a good view of the surrounding habitat) recording target species for three-hour periods. A separate targeted survey for barn owl was undertaken, surveying trees and structures assessed as suitable for breeding by this species. For both walkovers and vantage point surveys, surveyors used binoculars and a telescope as appropriate.
Otter	Chanin, 2003	2015 February – September 2016 February – March 2018 September – December 2019 February – September 2021 October – November 2024 April 2024-2025 October – January *In addition, data collected/validated during other surveys throughout 2022-2025.	200m	Otter presence/likely absence and use of habitats was recorded along watercourses, which were assessed by suitably experienced surveyors to have potential to support otter, within and to a minimum of 100m from the proposed scheme and a maximum of 200m, with surveys extending to 50m from watercourse banks. Eight suitable watercourses were surveyed (as identified at DMRB Stage 2) for otter shelters which were categorised and photographed. In addition, the following signs were recorded: ▪ spraints, prints, slides or other well-used access points to watercourses; ▪ feeding remains; and ▪ sightings (including Wildlife Vehicle Incidents (WVIs)). Where appropriate, infra-red camera traps were also deployed under licence from NatureScot (licence number: 54909 and 208062) to monitor otter resting sites to gather further information, such as to determine if any were natal holts. Short (up to 5m) stretches of steep, heavily vegetated or rocky banks could not be surveyed safely in some locations, but this did not preclude full assessment of otter use of the survey area. Surveys undertaken in 2021 were adapted due to restrictions on site visits from the measures put in place for the COVID-19 pandemic. For these surveys professional judgement and consultation was used to adapt the data collection to provide a baseline for the impact assessment. This included minimising survey extents in areas of less suitable habitat.
Water vole	Strachan et al., 2011 Dean et al., 2016 NatureScot, 2024c	2015 February – September 2016 February – March 2018 September – December	100m	Water vole presence/likely absence and use of habitats was recorded along watercourses within and up to 100m from the proposed scheme and extended to 2m from watercourse banks. Nine suitable watercourses were surveyed (as identified at DMRB Stage 2) where habitats were assessed by suitably experienced surveyors to have potential to support water vole. Field signs indicative of water vole presence were recorded, these included:

Survey Type	Guidance	Date Ranges	Zone of Influence	Methods
		2019 February – September 2021 October – November *In addition, data collected/validated during other surveys throughout 2022-2025.		▪ droppings and latrines; ▪ feeding signs of neat vegetation piles; ▪ covered runs through vegetation; and ▪ networks of bankside burrows. Where surveys did not identify habitat suitability or signs of water vole, only one survey was undertaken in each survey period. Additional water vole habitat suitability surveys were undertaken in 2021 to update and validate the initial baseline.
Red squirrel	Gurnell et al., 2009 NatureScot, 2024b	2018 September – October 2020 February - March *In addition, data collected/validated during other surveys throughout 2022-2025.	50m	Red squirrel presence/likely absence and likely use of habitats was recorded within and up to 50m from the proposed scheme, except where an impassable barrier (e.g. a river ≥ 50m wide) restricted the survey extent. The grounds of residential properties (gardens of houses) were not surveyed directly; however, survey of all relevant properties was undertaken from adjacent ground where possible. To increase detection rates of squirrel structures, surveys were carried out in winter when tree canopies had less foliage cover (NatureScot, 2024b). Indirect methods of surveying red squirrels were used, which included recording evidence of the below field signs: ▪ potential dreys or squirrel boxes; ▪ sightings; and ▪ feeding remains. Evidence of red squirrel was also recorded as incidental sightings/signs found during other habitat and species surveys. Grey squirrel are present within the study area; but as both species share dreys, all field signs were precautionarily recorded as red squirrel signs. Grey squirrel sightings were recorded during all surveys as incidentals.
Pine marten and wildcat	Croose et al., 2013 Birks et al., 2005 NatureScot, 2020a NatureScot, 2024d	2020 February – March *In addition, data collected/validated during other surveys throughout 2022-2025.	250m	Pine marten presence/likely absence and likely use of habitats was recorded within and up to 250m from the proposed scheme, except where an impassable barrier (e.g. a river ≥ 50m wide) restricted the survey extent. The grounds of residential properties (gardens of houses) were not surveyed directly; however, survey of all relevant properties was undertaken from adjacent ground where possible. Indirect methods of surveying for pine marten were undertaken by checking tracks, field boundaries and paths within the survey area for scats. Mature trees were also checked for use by pine marten as potential den sites from fur/print/scratching evidence. Evidence of pine marten was also recorded as incidental signs found during other habitat and species surveys. An assessment of habitat suitability for wildcat was undertaken based on desk based data as detailed in paragraph 12.2.17 of Chapter 12 (Biodiversity) and used in combination with incidental signs found during other habitat and species surveys.
Reptiles	Edgar et al., 2010 Sewell et al., 2013 Froglife, 1999 NatureScot, 2020b	2015 May – September 2018 August – October 2019 March – April 2023 September 2024 – April – October	Footprint of the proposed scheme	Suitable habitats for reptiles located under the footprint of the proposed scheme, and within 50m of the existing A9, were identified through examination of the A9 Dualling Programme route-wide Phase 1 habitat survey data (Transport Scotland, 2015), UKHab data (2021-2022) and walkover surveys. Visual search walkovers using artificial cover objects (ACO) were carried out in ten areas between 2015 and 2019. After a consultation with NatureScot, all sites were reassessed to determine suitability

Survey Type	Guidance	Date Ranges	Zone of Influence	Methods
				for reptile surveys based on changes in habitat and proposed scheme design, and the methodology was amended according to Sewell et al. (2013) in June 2023. Eleven sites were identified as having potentially suitable habitat for reptiles and were subject to six surveys each between April and October (inclusive) 2024 to determine presence, or likely absence, of reptiles with the use of ACOs. ACOs of 0.25m^2 basal-rubber carpet tiles and corrugated bitumen sheet (ratio 3:1) were deployed at all twelve survey sites at a density of a minimum of 30 ACOs per site as advised in Sewell at. (2013). ACOs were placed on sites in mid-March and sites were subject to six surveys. Additional site visits were not possible due to the high vegetation density preventing access to the survey areas from mid-July to late August. However, 4-5 survey visits are usually sufficient to detect 95% of occupied sites as stated in the guidance. The peak counts obtained from this site were included in the Key Reptile Site (KRS) assessment as the survey standard ACO deployment and survey methodology has been implemented. Survey results and incidental sightings were used to define the Reptile Site Status of each site surveyed for reptiles using criteria listed in Table A12.3-14 and Table A12.3-15.
UKHab	UKHab Ltd, 2023	2021 June – October 2022 May – June 2024 August 2024 October 2025 April – May	Footprint of the proposed scheme and 'off-site' areas at Muir of Thorn and Gelly Wood	UKHab surveys were undertaken in August-September 2020, June-October 2021, May-June 2022, and August and October 2024. All habitats in and within a 50m buffer of the scheme footprint were mapped. In addition, surveys were undertaken in April and May 2025 at the 'off-site' mitigation areas at Muir of Thorn an Gelly Wood. The minimum mapping unit (MMU) used was 400m^2 due to the large extent of habitat to be surveyed. The UK Habitat Classification Version 1.1 was used for surveys in 2021 and 2022; however, this has since been superseded by Version 2.0 (UKHab Ltd., 2023) and this updated guidance was used for surveys in 2024 and 2025. Changes between Version 1.1 and Version 2 have been reflected in the data retrospectively, where required, to ensure the most up-to-date guidance has been followed. Condition assessments were undertaken for habitats using Defra Condition Assessments versions 3.1 and Statutory Metric. Condition assessment was undertaken directly in the field where possible, and during post-survey analysis using detailed survey notes, photos and professional judgement where necessary. This is not considered to be a limitation to the survey or calculation of BNG (see Appendix A12.8: Positive Effects for Biodiversity and Biodiversity Net Gain). Habitats were recorded to at least Level 3 where possible in the field, however some habitat polygons were mapped to Level 2 only due to access restrictions.
Aquatic Resources				
Aquatic Habitat Visual Assessment (including fish habitat suitability and targeted redd surveys)	Scottish Fisheries Coordination Centre (SFCC), 2007 Hendry and Cragg-Hine, 2003 Maitland, 2007	2015 February 2015 September 2016 August 2018 August (Inchewan Burn only) October 2018 and January 2019 (redd surveys only) June 2021 (River Tay crossing only) 2024 April	Water features in and within 150m either side of the existing A9, and any additional areas with the potential to be impacted by the proposed scheme.	A visual assessment of the quality and suitability of aquatic habitat was undertaken in all areas where a potential impact pathway was identified. The surveys included water features in and within 150m, either side of the existing A9, and any additional areas with the potential to be impacted by the proposed scheme. A determination of habitat suitability for fish, freshwater pearl mussel (FWPM) and aquatic macroinvertebrates was made by assessing habitat connectivity, substrate composition, depth, flow types and suitability to support species of conservation interest. Water features that met the following criteria were scoped out of further assessment: ▪ a lack of resources to support sensitive ecological features; ▪ features that were representative of a number of similar watercourses of poor habitat quality (e.g. forestry drains), where a typical subset could be used for impact assessment. Habitat for different species and life stages of fish was assessed against the criteria in Table A12.3-24.

Survey Type	Guidance	Date Ranges	Zone of Influence	Methods
				An ecological value, used to inform the impact assessment, was assigned to each water feature using the results of the habitat assessment and the criteria outlined in Table A12.3-25. Targeted redd surveys were undertaken on the Inchewan Burn in October 2018 and January 2019, between the waterfall at NO 029 415 and the confluence with the River Tay. Habitat and flow types were assessed for their suitability to support salmonid spawning, and any evidence of spawning activities within the channel was recorded. A visual assessment was completed in April 2024 to update the aquatic habitat baseline at outfalls and crossings on watercourses within the proposed scheme.
Macroinvertebrates (aquatic)	Environment Agency, 2012 BS EN ISO 10870:2012	2021 June (All survey sites) 2021 November (All survey sites)	n/a	Macroinvertebrate kick-sampling was undertaken at seven locations on the River Tay, one location on the River Braan and one location on Inchewan Burn. All sites were surveyed once in June and once in November. All watercourses are under the footprint of the proposed scheme and the selected survey sites were considered broadly characteristic of all watercourse conditions in the area. Metrics calculated from the results of the macroinvertebrate surveys were used to give an indication of: ▪ Water Framework Directive (WFD) compliant macroinvertebrate classification; ▪ species of conservation importance (CCI Score); ▪ levels of organic pollution and habitat quality; ▪ flow; and, ▪ sedimentation. Further details of the metrics calculated from the samples are provided in paragraph 1.12.4 (Aquatic Assessment Methodology).
Freshwater Pearl Mussel	NatureScot, undated Skinner et al., 2003	2016 June (All crossings and outfalls) 2019 July (Updated outfall locations) 2020 September (Updated outfall locations)	600m reach adjacent to crossing points and proposed outfall locations on the River Tay and tributaries.	Surveys to identify FWPM presence and habitat suitability were undertaken at all accessible locations on the River Tay and River Braan. A minimum reach of 600m (100m upstream and 500m downstream) at each crossing point or indicative outfall location, with surveys extending further as required in the presence of FWPM (by 50m upstream/downstream), to comply with recommended survey methodology. Under the crossing point footprint, and when conditions permitted, the entire river width was surveyed. For all indicative outfall locations, the bank adjacent to the proposed location was surveyed. Where a live FWPM or a dead shell was found, a 50m x 1m transect was undertaken and all observed FWPM within the transect area were recorded, potentially extending the survey reach greater than 600m (by 50m upstream/downstream), as required. Surveys were undertaken by licenced surveyors under NatureScot licence numbers 17705, 102467 and 111078.
Juvenile lamprey habitat	Harvey and Cowx, 2003 Maitland, 2003	2022 May	River Tay and River Braan within 500m study area	A visual assessment of the quality and suitability of juvenile lamprey habitat was undertaken at all accessible locations from both banks of the River Tay and River Braan between the confluence with the River Tay and upstream end of the River Tay SAC. Habitat suitable for juvenile lamprey was categorised as either optimal or sub-optimal. Habitat suitability was assessed against the criteria in Table A12.3-24.

1.4 Bats

Desk Study

1.4.1 Five bat species were identified within 10km of the proposed scheme study area, including common and soprano pipistrelle, brown long-eared bat, Daubenton's bat, and Natterer's bat (Table A12.3-1).

1.4.2 There are no designated sites for bats in Scotland.

Roost Surveys

1.4.3 Bat roost surveys were carried out following best practice from August 2018 – May 2020, June 2021 - Feb 2022, May 2022– August 2022, and May to October 2024 (Collins, 2016, 2023, 2024).

1.4.4 All buildings, structures (bridges and culverts) and trees within 50m of the proposed scheme were subject to ground-based potential roost assessment (PRA) surveys at DMRB Stage 2 to determine their potential to support roosting bats. Following the best practice guidance in Collins (2016), individual buildings, structures and trees were assigned a roost potential of:

- negligible (no potential to support roosting bats);
- low (potential to be used by individual bats opportunistically);
- moderate (potential to support bats, but unlikely to be a roost of high conservation status);
- high (potential to support large numbers of bats); or
- roost (confirmed use by bats through evidence such as droppings, or the presence of live or dead bats).

1.4.5 As part of DMRB Stage 2, dusk emergence or dawn re-entry roost surveys were undertaken to identify, and determine the conservation status of, any roosts under the footprint or within 30m of the proposed scheme, which could be impacted by the proposed scheme.

1.4.6 These data were used to inform the requirements for further survey work at DMRB Stage 3.

1.4.7 These roost surveys were undertaken during the optimal period (May to September) following best practice guidance (Collins, 2016, 2023, 2024), where possible. Trees were re-assigned potential with low and moderate roost potential trees updated to PRF-I and high roost potential trees updated PRF-M. This aligned to the update in best practice guidance (Collins, 2024). PRF-I features are only suitable for individual bats or very small numbers due to their size or lack of surrounding habitats. PRF-M features are suitable for multiple bats and may therefore be used by a maternity colony (Collins, 2024). No further surveys were undertaken on a PRF-I roost feature and three surveys on PRF-M roost features or which is a confirmed roost.

1.4.8 Tree climbing surveys were undertaken in January to October 2024 on trees within 30m of the proposed scheme assessed as PRF-M roost feature. In the case where trees were unsafe to

climb, emergence surveys were undertaken on trees following best practice guidance (Collins, 2023, 2024).

1.4.9 The potential for buildings and structures to support hibernating bats was assessed during the PRA surveys. Buildings and structures with moderate or high potential to support hibernating bats, within 30m of the proposed scheme and likely to be impacted by the proposed scheme, were subject to winter hibernation inspection surveys and passive monitoring (where appropriate) over winter months to determine use.

1.4.10 Surveys and bat call analysis were carried out using standard call detection and recording equipment. Bat dropping samples collected during surveys were sent for eDNA analysis for species level identification.

Ground-Based Roost Assessments

1.4.11 Ground-based preliminary roost assessment data collected at DMRB Stage 2 was carried forward to inform the DMRB Stage 3 survey requirements and assessment. This data was updated following design changes at DMRB Stage 3.

1.4.12 The site surveys for the DMRB Stage 2 Assessment identified 184 trees, 44 buildings and eight structures with the potential to support roosts (classified as per Collins, 2016) in and within 50m of the proposed scheme; and an additional five buildings and one structure were confirmed as roosts.

1.4.13 Detailed ground-based preliminary roost assessments and ground level tree assessments were undertaken at DMRB Stage 3 at buildings, structures, and trees under the footprint of the proposed scheme and up to 30m from the edge of the scheme footprint. Due to changes in the design, some sites assessed are more than 30m from the current proposed scheme and have been excluded as a result (paragraphs 1.4.17 and 1.4.18).

1.4.14 The assessments were carried out using binoculars with a close focus, a high-powered torch, and an endoscope (Maplin Video Borescope) for directly inspecting cavities for signs of bats. Bat dropping samples, collected during surveys were sent for DNA analysis to The University of Warwick EcoWarwicker Ecological Forensics service and Nature Metrics to identify the bat species present.

1.4.15 Results of the ground-based roost assessments for buildings, structures and trees are presented in Tables A12.3-3, A12.3-4 and A12.3-5. Buildings and structures of negligible roost potential are excluded from Tables A12.3-3 and A12.3-4. Trees with negligible roost potential were not recorded.

1.4.16 Where summer emergence/re-entry surveys or further inspections, including aerial and ladder inspections, subsequently identified roosts within buildings, structures or trees, this is reflected in the tables (Tables A12.3-3, A12.3-4 and A12.3-5) to provide an overall summary of bat roosts within 30m of the proposed scheme. Further detailed data is provided in Appendix A12.4 (Confidential Biodiversity Resources).

1.4.17 Of the buildings surveyed, 47 are located within 30m of the footprint of the proposed scheme. Forty-two buildings were assessed as having summer bat roost potential, or as a confirmed

summer roost, within 30m of the footprint of the proposed scheme (Table A12.3-3). Forty buildings were assessed as having hibernation potential, or as a confirmed hibernation roost, within 30m of the footprint of the proposed scheme (Table A12.3-3). Five of the buildings surveyed had negligible summer roost potential while seven had negligible winter roost potential.

1.4.18 Of the structures surveyed, 23 are located within 30m of the footprint of the proposed scheme. Thirteen structures were assessed as having summer bat roost potential, or as a confirmed summer roost, within 30m of the footprint of the proposed scheme (Table A12.3-4). Ten structures were assessed as having hibernation potential, or as a confirmed hibernation roost, within 30m of the footprint of the proposed scheme (Table A12.3-4). Of the 23 structures surveyed, 10 had negligible summer roost potential and 13 had negligible winter roost potential.

1.4.19 Of the trees surveyed, 193 trees were assessed as having bat roost potential (PRF-I or PRF-M) or as confirmed roosts within 30m of the proposed scheme (Table A12.3-5).

1.4.20 The locations of these features are shown on Figure 12.6.

Table A12.3-3: Results of the bat building assessments for summer and winter roost potential

Distance from the proposed scheme	Building Summer Roost Potential					Building Winter Roost Potential				
	Confirmed Roost	High	Moderate	Low	Total	Confirmed Roost	High	Moderate	Low	Total
0m*	4	0	1	1	6	0	1	0	6	7
>0m to 10m	3	0	0	0	3	0	1	1	1	3
>10m to 30m	20	2	6	5	33	3	5	12	10	30
Total	27	2	7	6	**42**	3	7	13	17	**40**

* underneath the footprint of the proposed scheme.

Table A12.3-4: Results of the bat building assessments of structures for summer and winter roost potential

Distance from the proposed scheme	Structure Summer Roost Potential					Structure Winter Roost Potential				
	Confirmed Roost	High	Moderate	Low	Total	Confirmed Roost	High	Moderate	Low	Total
0m*	4	1	2	2	9	1	1	2	2	6
>0m to 10m	0	0	2	0	2	0	1	0	1	2
>10m to 30m	2	0	0	0	2	0	1	0	1	2
Total	0	1	3	2	**13**	1	3	2	4	**10**

* underneath the footprint of the proposed scheme.

Table A12.3-5: Results of the bat tree roost assessment

Distance from the proposed scheme	Tree Summer Roost Potential			
	Confirmed Roost	PRF-M	PRF-I	Total
0m*	3	8	57	68
>0m to 10m	0	7	44	51
>10m to 30m	3	6	65	74
Total	6	21	166	193
* underneath the footprint of the proposed scheme.				

Summer Emergence and Re-entry Surveys

1.4.21 Summer emergence and re-entry surveys of buildings and structures were conducted where roosts were found or they were deemed to have low, moderate or high suitability for summer roosting bats during the PRA surveys undertaken. Surveys at DMRB Stage 3 were carried out on buildings and structures under and up to 30m from the footprint of the scheme design.

1.4.22 Surveys were conducted using full spectrum bat detectors (Echo Meter Touch hardware with an iPad, Anabat Walkabout, Anabat Scout, and Anabat Swift), or frequency division bat detectors (Batbox Duet) with an MP3 recording device (Tascam DR-05 linear PCM recorders). Acoustic files were analysed using Kaleidoscope, Analook W V4.1z or Analook Insight version 21926.

1.4.23 The findings of the summer emergence and re-entry surveys are presented in Appendix A12.4 (Confidential Biodiversity Resources), and summaries are presented in Table A12.3-3 and Table A12.3-4 above.

Winter Hibernation Surveys

1.4.24 Where buildings or structures were assessed as having potential to be used by hibernating bats, inspection surveys were conducted and where appropriate static bat detectors (Anabat Express and Anabat Swift detectors) were deployed for a minimum of seven days over winter in January and February 2020 and for 14 days in December, January and February 2021/22 (adapted from Collins, 2016) to give an indication of bat presence over winter. The data was analysed using Analook W v4.1 and Anabat Insight software.

1.4.25 The results of these surveys identified four confirmed hibernation roosts (See Appendix A12.4: Confidential Biodiversity Resources) and three structures and seven buildings with high hibernation potential. Trees were not assessed for hibernation potential during these surveys, but were assessed during PRA/GLTA surveys (paragraphs 1.4.11 to 1.4.19).

1.4.26 Trees were not assessed for hibernation potential, however as a precaution, any tree with moderate or high suitability for roosting bats was considered likely to be sufficient for hibernation purposes and was given the same hibernation suitability as that of summer

roosting. Trees which received further surveys (ladder or aerial inspection) were then assessed to whether features were suitable for hibernating bats.

1.4.27 The findings of the hibernation inspections are presented in Appendix A12.4 (Confidential Biodiversity Resources), and summaries are presented in Table A12.3-3 and Table A12.3-4 above.

Activity Surveys

1.4.28 Bat flight lines (particularly road crossing points) and aspects of the landscape such as culverts and bridges were assessed at DMRB Stage 2 for their foraging/commuting potential, which was based on; professional judgement of the physical characteristics, quality of habitat and the presence of existing linear features leading to the structure. Those areas with moderate or high value for foraging/commuting were identified and were surveyed using static detectors and manual transects at DMRB Stage 3.

1.4.29 Surveys were carried out from July – August 2018, April – May 2019, August – October 2020, and June – August 2021.

Activity Surveys - Passive Monitoring Transect

1.4.30 Surveys at DMRB Stage 3 were carried out using static detectors (Anabat Express and Anabat Swift bat detectors). Detectors were deployed at three locations on each of the four transects, for a minimum of 10 nights over summer and autumn (August to October) in 2020 (Collins, 2016). Detectors were then deployed again in 2021 in the same locations for a minimum of 10 nights between May and August covering pre-maternity and maternity season. This spread of surveys in the months of August to October covers the post-maternity seasons. Data could not be collected during the pre-maternity and maternity season in 2020 due to COVID restrictions.

1.4.31 The acoustic sound files were analysed using Analook W v4.1 and Anabat Insight software.

1.4.32 The bat passes per night were entered into ECOBAT to enable a comparison between the sites surveyed and the wider area/region and enable mitigation to be designed.

1.4.33 To assess bat activity levels, the results of the static monitoring were entered into the ECOBAT database, an online tool run by The Mammal Society for the standardised, rigorous interpretation of bat activity data. The ECOBAT database compiles observations of bat activity (bat passes) at a national level. This is then compared to bat activity recorded at a focal site and contextualised against reference levels such as those recorded in the same region and at the same time of year. The 'reference range' is a stratified dataset by which percentile outputs are generated.

1.4.34 The percentiles provide a numerical indicator of the relative importance of a night's worth of bat activity. For example, activity data in the 70th percentile would indicate that the recorded data was in the top 30% of activity for the reference range.

1.4.35 The percentiles are categorised as follows:

- low activity: 0 to 20th percentiles;

- low to moderate activity: 21st to 40th percentiles;
- moderate activity: 41st to 60th percentiles;
- moderate to high activity: 61st to 80th percentiles; and
- high activity: 81st to 100th percentiles.

1.4.36 The reference range for analysing data on ECOBAT was stratified to include:

- only records from within 30 days of the survey data;
- only records from within 100km^2 of the survey locations (data was compared to between 3 and 832 nights of data (reference range) within 100km^2): and
- records using any make of bat detector.

1.4.37 The reference range is the number of nights for each species that that the data is compared to. For example, Myotis bat species that were recorded on the detectors were compared to 369-375 nights of data within 100km^2 in 2020.

1.4.38 Over the entire study area in 2020 and 2021, the maximum number of passes recorded in a single night was 857 passes, and seven species were recorded. Soprano pipistrelle, and common pipistrelle showed moderate or high levels of activity at most sites in both 2020 and 2021, whereas *Myotis* species showed low or moderate activity at most sites in 2020, with occasional high activity levels recorded in 2021. Brown long-eared bats, Nathusius' pipistrelle, and *Nyctalus* species showed low activity levels during both years.

1.4.39 In 2020, for common pipistrelle the mean median percentile was 24 and the mean maximum percentile was 68. For soprano pipistrelle the mean median percentile was 57 and the mean maximum percentile was 88. For *Myotis* species the mean median percentile was 11 and the mean maximum percentile was 32. For Brown long eared bats, the mean median percentile was 4 and the mean maximum percentile was 17.

1.4.40 The mean and maximum percentile and the activity levels for the passive monitoring locations are presented in Table A12.3-6 and the locations of these features are shown on Figure 12.7.

Table A12.3-6: Bat activity per night and ECOBAT Activity Level at the passive monitoring locations in 2020 and 2021.

Location	Year	Species/Species Group	Median Percentile	Activity Level on Median Percentile	Max Percentile	Activity Level on Max Percentile	Nights Recorded	Reference Range
TP 2.1-1	2020	Common pipistrelle	0	Low	86	High	3	648
	2021		80	Moderate-high	97	High	81	3032
	2020	Soprano pipistrelle	47	Moderate	91	High	6	771
	2021		71	Moderate-high	92	High	80	3205
	2021	*Pipistrellus* sp.	93	High	96	High	7	3847
	2021	*Myotis* sp.	0	Low	37	Low-moderate	17	1405
TP 2.1-2	2020	Common pipistrelle	82	High	94	High	43	648
	2021		80	Moderate-high	95	High	85	3032
	2020	Soprano pipistrelle	94	High	99	High	43	771
	2021		89	High	98	High	86	3205
	2020	*Pipistrellus* sp.	97	High	99	High	15	832
	2021		95	High	99	High	28	3847
	2020	*Myotis* sp.	0	Low	38	Low-Moderate	17	375
	2021		56	Moderate	78	Moderate-high	82	1405
	2020	Brown long-eared bat	0	Low	38	Low-Moderate	8	90
	2021		0	Low	25	Low-moderate	14	293
	2020	*Nyctalus* sp.	0	Low	0	Low	1	3
	2021		0	Low	0	Low	2	61
TP 2.1-3	2020	Common pipistrelle	35	Low-Moderate	87	High	6	648

Location	Year	Species/Species Group	Median Percentile	Activity Level on Median Percentile	Max Percentile	Activity Level on Max Percentile	Nights Recorded	Reference Range
	2020	Soprano pipistrelle	67	Moderate-High	88	High	25	771
	2020	*Pipistrellus* sp.	87	High	88	High	4	832
	2020	Brown long-eared bat	0	Low	0	Low	1	90
	2020	*Nyctalus* sp.	0	Low	0	Low	2	3
TP 2.2-1	2020	Common pipistrelle	0	Low	44	Moderate	6	648
	2021		87	High	98	High	55	3032
	2020	Soprano pipistrelle	44	Moderate	87	High	14	771
	2021		95	High	100	High	55	3032
	2021	*Pipistrellus* sp.	98	High	100	High	55	3847
	2021	Nathusius' pipistrelle	0	Low	37	Low-moderate	7	29
	2020	Myotis sp.	0	Low	26	Low-Moderate	5	375
	2021		85	High	99	High	55	1405
	2021	Brown long-eared bat	0	Low	0	Low	4	493
TP 2.2-2	2020	Common pipistrelle	37	Low-Moderate	94	High	24	611
			72	Moderate-high	99	High	89	3032
	2020	Soprano pipistrelle	97	High	100	High	35	732
			83	High	99	High	86	3205
	2020	*Pipistrellus* sp.	99	High	100	High	10	785
	2021		89	High	99	High	70	3847

Location	Year	Species/Species Group	Median Percentile	Activity Level on Median Percentile	Max Percentile	Activity Level on Max Percentile	Nights Recorded	Reference Range
	2020	*Myotis* sp.	25	Low-Moderate	51	Moderate	17	369
	2021		37	Low-moderate	73	Moderate-high	83	1405
TP 2.2-2	2021	Nathusius' pipistrelle	0	Low	0	Low	1	29
TP 2.2-2	2020	Brown long-eared bat	25	Low-Moderate	25	Low-Moderate	1	89
	2021		0	Low	0	Low	1	293
TP 2.2-2	2020	*Nyctalus* sp.	0	Low	0	Low	1	3
TP 2.2-3	2020	Common pipistrelle	37	Low-Moderate	77	Moderate-High	9	611
	2021		25	Low-moderate	70	Moderate-high	23	3032
	2020	Soprano Pipistrelle	25	Low-Moderate	78	Moderate-High	23	732
	2021		51	Moderate	87	High	46	3205
	2020	*Pipistrellus* sp.	42	Moderate	72	Moderate-High	3	785
	2021		63	Moderate-high	89	High	16	3847
	2020	*Myotis* sp.	19	Low	37	Low-Moderate	2	369
	2021		25	Low-moderate	59	Moderate	35	1405
	2020	Brown long-eared bat	0	Low	0	Low	1	89
	2021		0	Low	0	Low	5	293
TP 2.3-1	2020	Common pipistrelle	0	Low	44	Moderate	6	648
	2021		0	Low	85	High	14	3032
	2020	Soprano pipistrelle	26	Low-Moderate	84	High	24	771
	2021		56	Moderate	97	High	23	3205

Location	Year	Species/Species Group	Median Percentile	Activity Level on Median Percentile	Max Percentile	Activity Level on Max Percentile	Nights Recorded	Reference Range
	2020	*Pipistrellus* Sp.	44	Moderate	44	Moderate	3	832
	2021	*Myotis* sp.	0	Low	0	Low	1	1405
TP 2.3-2	2020	Common pipistrelle	38	Low-Moderate	89	High	25	648
	2021		73	Moderate-high	94	High	87	3032
	2020	Soprano pipistrelle	87	High	98	High	41	770
	2021		91	High	100	High	90	3205
	2021	Nathusius' pipistrelle	0	Low	0	Low	1	29
	2020	*Pipistrellus* sp.	89	High	89	High	1	832
	2021		97	High	100	High	70	3847
	2020	*Myotis* sp.	0	Low	44	Moderate	14	375
	2021		63	Moderate	94	High	89	1405
	2020	Brown long eared bat	0	Low	0	Low	1	90
	2021		25	Low-moderate	25	Low-moderate	1	293
TP 2.3-3	2020	Common Pipistrelle	0	Low	44	Moderate	6	648
	2021		0	Low	63	Moderate	23	3032
	2020	Soprano Pipistrelle	38	Low-Moderate	88	High	11	771
	2021		0	Low	37	Low-moderate	10	3205
	2021	*Pipistrellus* sp.	0	Low	0	Low	1	3847
	2020	*Myotis* sp.	26	Low-Moderate	44	Moderate	7	375

Location	Year	Species/Species Group	Median Percentile	Activity Level on Median Percentile	Max Percentile	Activity Level on Max Percentile	Nights Recorded	Reference Range
	2021		0	Low	0	Low	4	1405
	2021	Brown long-eared bat	0	Low	0	Low	1	293
	2021	*Nyctalus* sp.	0	Low	0	Low	1	61
TP 2.4-1	2020	Common pipistrelle	0	Low	25	Low-Moderate	16	611
	2021		65	Moderate	80	Moderate-high	41	3032
	2020	Soprano pipistrelle	67	Moderate-high	84	High	28	732
	2021		74	Moderate-high	95	High	41	3032
	2020	*Pipistrellus* sp.	78	Moderate-high	83	High	6	785
	2021		86	High	97	High	41	3847
	2020	*Myotis* sp.	0	Low	0	Low	2	369
	2020	Brown long-eared bat	0	Low	0	Low	2	89
	2020	*Nyctalus* sp.	0	Low	0	Low	1	3
TP 2.4-2	2020	Common pipistrelle	31	Low-Moderate	37	Low-Moderate	4	611
	2021		13	Low	25	Low-moderate	2	3032
	2020	Soprano pipistrelle	25	Low-moderate	77	Moderate-high	25	732
	2021		31	Low-moderate	74	Moderate-high	34	3205
	2020	*Myotis* sp.	25	Low-Moderate	47	Moderate	11	369
	2021		0	Low	0	Low	1	1405
	2020	Brown long-eared bat	0	Low	54	Moderate	16	89

Location	Year	Species/Species Group	Median Percentile	Activity Level on Median Percentile	Max Percentile	Activity Level on Max Percentile	Nights Recorded	Reference Range
TP 2.4-3	2020	Common pipistrelle	25	Low-Moderate	89	High	26	611
	2021		25	Low-moderate	92	High	30	3032
	2020	Soprano pipistrelle	64	Moderate-High	84	High	38	732
	2021		59	Moderate	96	High	34	3205
	2021	*Pipistrellus* sp.	72	Moderate-high	98	High	28	3847
	2020	*Myotis* sp.	0	Low	0	Low	12	369
			0	Low	0	Low	6	1405

Activity Surveys - Manual Bat Activity Transects

1.4.41 Four walked transect routes were undertaken to obtain a measure of bat activity and species richness in habitats along the proposed scheme and to help identify those areas of higher value to bats to allow mitigation to be designed if needed. The transect routes were designed to encompass a range of habitats at varying proximity to the A9, following BCT guidance (Hundt, 2012, Collins, 2016) (Figure 12.7).

1.4.42 Surveys at DMRB Stage 3 were carried out using hand-held full spectrum Echo Meter Touch hardware with iPads, or frequency division bat detectors (Batbox Duet) with Tascam DR-05 linear PCM recorders. Anabat Express, zero-crossing detectors, and Anabat Walkabout full spectrum detectors were also used. Hand held GPS units were used to record the position of each registration and observation.

1.4.43 Transects were conducted between 2018 and 2021. Each transect route was surveyed in July and August 2018, April and May 2019, September and October 2020, and in May, June, July and August 2021. Further surveys including peak maternity season surveys (June-August) were scheduled to take place in 2020, however, these could not be conducted due to COVID restrictions.

1.4.44 The acoustic sound files were analysed using Analook W v4.1 and Kaleidoscope v5.4.2 software.

1.4.45 Table A12.3-7 shows the percentage split by species of the total bat activity at each transect over all transects completed between 2018 and 2021.

Table A12.3-7 Percentage call abundance and bat activity for the walked transect routes between 2018 and 2021.

Transect	Percentage Species Abundance						Total Bat Passes
	Myotis Sp.	Brown long eared bat	Common pipistrelle	Soprano pipistrelle	*Pipistrelle* sp.	*Nyctalus* sp.	
T2.1	1.9	1.3	46.5	48.1	2.3	0.0	310
T2.2	31.4	0.0	12.2	53.1	3.0	0.4	271
T2.3	2.9	0.0	41.9	52.3	2.9	0.0	375
T2.4	10.4	0.0	1.5	76.1	11.9	0.0	67

Activity Surveys-Crossing Point Surveys

1.4.46 Crossing point surveys were conducted at sites where bat commuting corridors intersected the A9. These included the crossings at the River Brann and Inchewan Burn and a large underpass/culvert at Inver. The Tay crossing was not assessed due to the height of the bridge above the commuting corridor (Figure 12.7).

1.4.47 One to two surveys were conducted in July-August 2018 and April 2019 to gauge how bats interacted with the A9 at these crossing points. Further surveys, including peak maternity season surveys, were scheduled to take place in 2020. However, these could not be conducted due to COVID restrictions. Crossing point surveys were conducted in 2021 between June and September as part of emergence and re-entry surveys.

1.4.48 Table A12.3-8 displays the bat passes per hour for different bat species. The results indicate that the majority of bats cross under the A9 at the underpass/culvert and Brann crossing and across the A9 at the Inchewan burn crossing.

Table A12.3-8: Bat activity per hour over or under the A9 at each crossing point.

Site ID	Date	Bat Passes per Hour															
		Myotis sp.		Brown long-eared bat		Common pipistrelle		Soprano pipistrelle		*Pipistrelle* sp.		*Nyctalus* sp.		Unidentified sp.		Total	
		Over A9	Under A9	Over A9	Under A9	Over A9	Under A9	Over A9	Under A9	Over A9	Under A9	Over A9	Under A9	Over A9	Under A9	Over A9	Under A9
Inver Culvert (BS 2.8)	07/08/2018	0	11.7	0	0	0	0.7	0	0	0	0	0	0	0	0.7	0	13.2
	24/07/2018	0	8.6	0	0	0	0	1.7	0	0	0	0	0	0	0	0	10.3
River Braan Crossing (BS 2.11/2.12)	25/07/2018	2.6	0	0	0	0	0.4	0.9	0	0	0	0	0	0.9	0	4.7	0
	02/08/2018	0	28.7	0	0	0	0	0.9	9	0	0	0	0	0	0	0.9	37.7
Dunkeld & Birnam Train Station (CP 2.1)	28/08/2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	17/09/2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	03/06/2021	0	0	0	0	0.42	0	0	0	0	0	0	0	0	0	0.42	0
Inchewan Burn Crossing (BS2.2)	18/04/2019	0	0	0	0	0	0	0.9	0	0	0	0	0	0.4	0	1.3	0

Cryptic/rare species

1.4.49 A small number of Nyctalus species of bats were observed during bat activity surveys and nine passes were recorded on the passive transect deployments between 2018, 2020 and 2021 (Table A12.3-9). These bats are most likely Noctules based on the sonogram characteristics and location. The study area is located to the north of the Noctule bat's range (JNCC, 2019) and this range has expanded over recent years. These bats are likely vagrants from larger populations to the south or part of a small local population.

Table A12.3-9: *Nyctalus* sightings/recordings

Year	Date	Location	Survey Type	Notes
2018	22/08/2018	302276 742165 (T 2.2)	Transect	Single bat pass
2019	17/04/2019	303254 741636 (BB 2.54)	Emergence/re-entry	Single/small numbers of passes
	18/04/2019	303041 741741 (BB 2.2)	Emergence/re-entry	Single/small numbers of passes
	17/07/2019	302374 742088 (BB 2.42a/2.42b)	Emergence/re-entry	Single/small numbers of passes
2020	24/08/2020 28/08/2020 09/09/2020 14/09/2020	300982 742388 (TP 2.2-2) 300216 742841 (TP 2.4-1) 303041 741775 (TP 2.1-2) 302984 741585 (TP 2.1-3)	Passive transect	Five passes total over four separate nights and sites
2021	15/06/2021 14/07/2021 19/07/2021	TP 2.3-3 303041 741775 (TP 2.1-2) 303041 741775 (TP 2.1-2)	Passive Transect	Three individual passes total over three separate nights at two sites.

1.5 Breeding Birds

Desk Study

1.5.1 Numerous records of birds were identified within 10km of the proposed scheme (Table A12.3-1). Several records are likely to pertain to wintering individuals (such as divers and some waterfowl), however the study area offers optimal breeding habitat for a range of birds.

1.5.2 Records from the British Trust for Ornithology (BTO) were obtained in June 2024 for a 500m and 2km buffer from the proposed scheme which comprised data from the BTO Bird Atlas and BirdTrack. These data were used to inform the baseline for breeding and wintering species within the study area (BTO, 2024a-b).

1.5.3 Bird Atlas 2007-11 indicates a total of 116 species with breeding evidence in the vicinity of the proposed scheme (within 2km and 10km tetrads), including 10 Schedule 1 species. In addition

one confidential species was recorded within the 50km tetrad for the site (the data is not provided in a smaller resolution due to the nature of the record).

1.5.4 BirdTrack data between 2020-2024 indicates 132 species in the vicinity of the proposed scheme (within 2km and 10km tetrads) during the breeding season including Schedule 1 species.

Field Survey

1.5.5 Transect surveys for breeding birds were designed as an adaptation of the BTO Common Birds Census, incorporating elements of the Breeding Bird Survey (BBS) designed by the BTO, the Joint Nature Conservation Committee, and the Royal Society for the Protection of Birds. A reconnaissance visit was undertaken in March 2019 to refine routes, followed by two survey visits to record bird activity, as per Bibby et al. (2000) and Gilbert et al. (1998). The first survey visit was undertaken in the week beginning 22 April 2019 and the second survey visit was undertaken in the week beginning 3 June 2019. Repeat surveys were conducted in 2022 with the first survey visit undertaken in the week beginning 11 April 2022 and the second survey visit undertaken in the week beginning 23 May 2022.

1.5.6 The survey area comprised all suitable habitat under the footprint of the proposed scheme plus a 150m buffer. The survey area was divided into four sections, each approximately 4km in length. Each survey team comprised two ecologists, including at least one specialist ornithologist. Survey work was undertaken between 15 minutes before sunrise and three hours after sunrise, to capture the period of maximum bird activity. The surveys were undertaken in suitable weather conditions (light winds, good visibility, and lack of persistent or heavy rain Gilbert et al. (1998).

1.5.7 Bird behaviour and other field signs were assessed to assign each species a likely breeding status. Table A12.3-10 defines the criteria for likely breeding status by observed breeding evidence.

Table A12.3-10: Criteria for breeding status

Breeding Status	Breeding Evidence
Confirmed	▪ active nest/colony; ▪ adult carrying food; ▪ family group; and/or ▪ recently fledged juvenile.
Probable	▪ pair in suitable nesting habitat; ▪ courtship and display; ▪ agitated behaviour; ▪ carrying nest material; and/or ▪ permanent territory (e.g. bird observed singing/acting territorially in the same area on more than one occasion).
Possible	▪ species observed in suitable nesting habitat.

Breeding Status	Breeding Evidence
Not considered to be breeding	▪ flyover; and/or ▪ observation of the species in unsuitable breeding habitat.

1.5.8 A complete list of species (excluding Schedule 1 species which are presented in Appendix A12.4 (Confidential Biodiversity Resources)) recorded during the breeding bird surveys is shown in Table A12.3-11. Species are highlighted red, amber, or green according to their classification in Birds of Conservation Concern (Stanbury et al., 2021). As non-native species, pheasant and red-legged partridge do not receive a conservation status in this list. The survey results are displayed in Figure 12.9.

1.5.9 In addition, incidental records of buzzard, kestrel and sparrowhawk were recorded during Schedule 1 VP surveys between April and July 2024.

Table A12.3-11: Species recorded during breeding bird surveys in 2019 and 2022 and likely breeding status

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Greenfinch (*Chloris chloris*)	9	6	4	2	Song	Probable	Peak of seven singing males, indicative of number of breeding pairs.	No	No
Hawfinch (*Coccothraustes coccothraustes*)	2	0	0	0	Pair in suitable nesting habitat	Probable	One pair likely to have bred.	Yes	No
House martin (*Delichon urbicum*)	5	30	0	1	Active nest	Confirmed	Three active nests recorded on houses in Birnam.	No	Yes
House sparrow (*Passer domesticus*)	60	58	3	14	Carrying food	Confirmed	Two confirmed breeding pairs; likely approximately 20 breeding pairs in survey area.	Yes	Yes
Lesser redpoll (*Acanthis cabaret*)	0	1	0	0	Observation	Not considered to be breeding	Single observation. Not considered to have bred within the survey area.	Yes	No
Mistle thrush (*Turdus viscivorus*)	0	0	3	0	Observation	Possible	Individuals observed; may breed in woodland within survey area.	No	No
Spotted flycatcher (*Muscicapa striata*)	0	3	0	1	Family group	Confirmed	One confirmed breeding pair; possibly one or two further pairs bred within the survey area.	Yes	Yes

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Starling (*Turdus vulgaris*)	5	7	2	6	Active nest	Confirmed	One confirmed breeding pair; possibly several more pairs bred within the survey area.	Yes	No
Swift (*Apus apus*)	0	40	0	0	Observation	Possible	Recorded in flight, feeding, but could breed in buildings within the survey area.	Yes	Yes
Tree sparrow (*Passer montanus*)	1	0	0	0	Observation	Possible	Single observation of one individual in suitable breeding habitat.	Yes	Yes
Woodcock (*Scolopax rusticola*)	0	1	2	0	Observation	Possible	Individuals observed; may breed in woodland within survey area.	Yes	No
Wood warbler (*Phylloscopus sibilatrix*)	0	0	0	2	Song	Possible	Two singing males recorded; may breed in woodland within survey area.	Yes	Yes
Yellowhammer (*Emberiza citrinella*)	1	0	0	0	Song	Possible	Single record of singing male.	Yes	Yes
Black-headed gull (*Chroicocephalus ridibundus*)	31	15	28	6	Observation	Possible	Individuals and small groups mainly recorded flying over the survey area.	Yes	No
Bullfinch (*Pyrrhula pyrrhula*)	1	0	3	7	Observation	Possible	Pairs observed. Small numbers may have bred within survey area.	Yes	Yes

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Common gull (*Larus canus*)	38	17	11	0	Observation	Possible	Individuals and small groups mainly recorded flying over the survey area.	No	No
Common sandpiper (*Actitis hypoleucos*)	17	12	4	7	Pair in suitable nesting habitat	Probable	Two or three pairs may have nested along the River Tay.	No	No
Dipper (*Cinclus cinclus*)	2	3	1	3	Juvenile	Confirmed	One confirmed breeding pair; possibly several pairs along watercourses.	No	No
Dunnock (*Prunella modularis*)	17	9	22	1	Family group	Confirmed	One pair confirmed breeding. Likely approximately 15 breeding pairs within the survey area.	Yes	No
Greylag goose (*Anser anser*)	0	60	0	6	Call	Not considered to be breeding	Flocks flying over the survey area.	No	Yes
Grey wagtail (*Motacilla cinerea*)	11	11	10	8	Call	Possible	Breeding not confirmed, but male and female birds observed in suitable breeding habitat. Possibly several breeding pairs	No	No
Lesser black-backed gull (*Larus fuscus*)	0	1	0	0	Observation	Not considered to be breeding	Single observation. Not considered to have bred within the survey area.	No	No

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Mallard (*Anus platyrhynchos*)	40	11	7	9	Family group	Confirmed	One confirmed breeding pair; possibly several more pairs bred within survey area.	No	No
Oystercatcher (*Haematopus ostralegus*)	17	30	8	11	Pair in suitable nesting habitat	Probable	Several pairs likely to have bred throughout the survey area.	No	Yes
Redshank (*Tringa totanus*)	0	0	1	0	Observation	Not considered to be breeding	Single observation. Not considered to have bred within the survey area	No	Yes
Rook (*Corvus frugilegus*)	1	2	1	0	Observation	Not considered to be breeding	Small number of individual birds recorded. No rookeries recorded within the survey area.	No	No
Song thrush (*Turdus philomelos*)	33	37	25	24	Juvenile	Confirmed	Three confirmed breeding pairs; peak of 28 singing males, indicative of number of breeding pairs.	Yes	Yes
Sparrowhawk (*Accipiter nisus*)	0	0	0	1	Observation	Possible	Single observation; may breed in woodland within survey area.	No	Yes
Whitethroat (*Sylvia communis*)	0	1	0	7	Song	Possible	Six singing males; may breed in suitable habitat within survey area.	No	No

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Willow warbler (*Phylloscopus trochilus*)	5	17	8	50	Song	Probable	Peak of 12 singing males, indicative of number of breeding pairs.	No	No
Woodpigeon (*Columba palumbus*)	167	174	65	94	Carrying nest material	Probable	Peak of 69 singing males, indicative of number of breeding pairs.	No	No
Wren (*Troglodytes troglodytes*)	78	113	67	98	Song	Probable	Common throughout. Peak of 111 singing males, indicative of number of breeding pairs.	No	No
Blackbird (*Turdus merula*)	58	108	25	56	Juvenile	Confirmed	Common throughout. Fifteen breeding pairs confirmed, numerous more pairs likely to have bred.	No	No
Blackcap (*Sylvia atricapilla*)	7	13	2	38	Pair in suitable nesting habitat	Probable	Twelve singing males recorded on Visit 2, indicative of number of breeding pairs.	No	No
Blue tit (*Cyanistes caeruleus*)	103	52	61	88	Pair in suitable nesting habitat	Probable	Common throughout woodland and gardens. Numerous pairs likely to have bred.	No	No

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Buzzard (common) (*Buteo buteo*)	5	3	3	1	Call	Possible	Breeding not confirmed within the survey area, but likely to have bred in the local area.	No	Yes
Carrion crow (*Corvus corone*)	67	71	20	11	Call	Possible	Breeding not confirmed within the survey area, but several pairs likely to have bred in the local area.	No	No
Chaffinch (*Fringilla coelebs*)	204	211	70	104	Carrying food	Confirmed	Common throughout. Potentially around 100 breeding pairs.	No	No
Chiffchaff (*Phylloscopus collybita*)	36	23	20	28	Song	Probable	Likely to be approximately 20 breeding pairs within the survey area.	No	No
Coal tit (*Periparus ater*)	61	28	90	37	Carrying food	Confirmed	Two pairs confirmed breeding, but likely to be approximately 50 pairs breeding within the survey area.	No	No
Collared dove (*Streptopelia decaocto*)	5	4	1	2	Pair in suitable nesting habitat	Probable	Likely to be three or four pairs nesting in the survey area.	No	No
Garden warbler (*Sylvia borin*)	1	7	0	3	Song	Probable	Seven singing males on Visit 2. Several pairs likely bred	No	No

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Goldcrest (*Regulus regulus*)	107	117	37	44	Pair in suitable nesting habitat	Probable	Common throughout. Likely approximately 100 pairs within the survey area.	No	No
Goldfinch (*Carduelis carduelis*)	22	19	3	4	Song	Probable	Peak of seven singing males indicative of number of breeding pairs.	No	Yes
Goosander (*Mergus merganser*)	2	16	0	4	Family group	Confirmed	One confirmed breeding pair with 15 young. Possibly young from two breeding pairs (creche).	No	Yes
Great spotted woodpecker (*Dendrocopos major*)	12	13	6	6	Song	Probable	Several pairs likely to have bred across survey area.	No	Yes
Great tit (*Parus major*)	80	61	50	52	Juvenile	Confirmed	Two pairs confirmed to have bred. Likely approximately 50 pairs bred within the survey area.	No	No
Grey heron (*Ardea cinerea*)	0	1	0	0	Observation	Not considered to be breeding	Single observation. Not considered to be breeding within the survey area.	No	Yes
Hooded crow (*Corvus cornix*)	0	0	1	0	Observation	Possible	Breeding not confirmed within the survey area, but likely to have bred in the local area.	No	No

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Jackdaw (*Corvus monedula*)	93	116	6	24	Active nest	Confirmed	Three confirmed breeding pairs; likely several more in survey area.	No	No
Jay (*Garrulus glandarius*)	11	6	26	5	Call	Possible	Small numbers may breed in mature woodland within the survey area.	No	No
Long-tailed tit (*Aegithalos caudatus*)	7	9	10	58	Alarm call	Possible	Small numbers may breed within the survey area.	No	No
Magpie (*Pica pica*)	0	0	2	0	Pair	Possible	Breeding not confirmed within the survey area, but likely to have bred in the local area.	No	No
Mute swan (*Cygnus olor*)	1	0	0	0	Observation	Not considered to be breeding	Single observation. Not considered to have bred within the survey area.	No	Yes
Nuthatch (*Sitta europaea*)	1	2	10	3	Active nest	Confirmed	One pair bred within the survey area.	No	No
Pied wagtail (*Moticilla alba*)	8	6	0	3	Pair in suitable nesting habitat	Probable	One pair observed plus several individuals. Several pairs may have bred.	No	No
Raven (*Corvus corax*)	0	0	2	0	Observation	Not considered to be breeding	Two individuals observed flying over survey area.	No	No

Species	Individuals Recorded 2019		Individuals Recorded 2022		Highest Breeding Evidence	Breeding Status	Summary	Species Listed on the Scottish Biodiversity List (SBL)	Species Listed on the Tayside Local Biodiversity Action Plan (LBAP)
	Visit 1	Visit 2	Visit 1	Visit 2					
Robin (*Erithacus rubecula*)	74	87	58	108	Juvenile	Confirmed	Nine confirmed breeding pairs. Common throughout; peak of 54 singing males, indicative of number of breeding pairs.	No	No
Sand martin (*Riparia riparia*)	4	12	0	1	Active colony	Confirmed	One colony (10 nesting holes) recorded.	No	Yes
Siskin (*Spinus spinus*)	69	41	47	42	Call	Probable	Peak of seven singing males, indicative of number of breeding pairs.	Yes	No
Swallow (*Hirundo rustica*)	5	17	2	10	Observation	Possible	Recorded in flight, feeding, but could breed in buildings within the survey area.	No	Yes
Treecreeper (*Certhia familiaris*)	3	4	5	10	Song	Possible	Only recorded in song once. Small numbers likely to breed within the survey area.	No	No
Pheasant (*Phasianus colchicus*)	25	12	12	2	Call	N/A	Introduced species. Occasional pair may have bred in the wild within the survey area.	No	No
Red-legged partridge (*Alectoris rufa*)	3	0	0	0	Call	N/A	Introduced species. Occasional pair may have bred in the wild within the survey area.	No	No

1.6 Water Vole

Desk Study

1.6.1 No records of water vole within the last 30 years were returned from the data search (NBN, 2024). A single historical record of water vole from 1960 was identified within a 10km radius of the study area (NBN, 2024).

Field Survey

1.6.2 Water vole presence/likely absence surveys were undertaken in line with survey guidance (Table A12.3-2).

1.6.3 The survey area included all suitable watercourses within and up to 100m from the proposed scheme and extended to 2m from watercourse banks.

1.6.4 No evidence of water vole presence was identified during site surveys within the main extent of the scheme. Small mammal holes were identified along a wet ditch within the 'off-site' mitigation area at Muir of Thorn in 2025 during habitat surveys; however no other signs were recorded to conclude evidence of water vole.

1.7 Red Squirrel and Pine Marten

Desk Study

1.7.1 The data search returned over 5000 records of red squirrel and 28 of pine marten within the study area.

Field Survey

1.7.2 Red squirrel and pine marten walkover surveys were undertaken in line with survey guidance set out by Gurnell et al. (2009) and Croose et al. (2013). Surveys were conducted over seven days, between 12 February 2020 and 5 March 2020. In addition, further evidence was recorded as incidental sightings/signs found during other habitat and species surveys throughout 2020, 2021, 2023, 2024 and 2025.

1.7.3 The survey area comprised all suitable habitat under the footprint of the proposed scheme plus a buffer of 50m for red squirrel, and 100m for pine marten.

1.7.4 Live sightings and other field signs were recorded for each species. Results are displayed in Table A12.3-12 for red squirrel, and Table A12.3-13 for pine marten. In addition, the following incidental sightings of red squirrel and pine marten were recorded during other species and habitat surveys, including camera trap monitoring for beaver/otter (see Appendix A12.4: Confidential Biodiversity Resources):

- Red squirrel
  - eleven live sightings, five feeding stations and three dreys found in 2020/2021;
  - four live sightings in December 2021;

- five live sightings in January/February 2023;
- four live sightings in April/May 2024; and
- live red sightings recorded on nine camera trap videos in October 2024;
- live red squirrel sightings on two camera trap videos in November 2024; and
- live red squirrel sighting on one camera trap video in December 2024.

- Pine marten
  - Live pine marten sighting recorded on six camera trap videos in October 2024;
  - live pine marten sighting recorded on two camera trap video in November 2024; and
  - four pine marten scats and one potential den site recorded during surveys in April-May 2025 at Muir of Thorn (see Figure 12.12).

1.7.5 Due to the volume of red squirrel data, Table A12.3-13 only displays live and dead red squirrel sightings, and the recorded dreys, including active, disused, and potential dreys. In addition to these displayed data, surveys recorded 39 incidences of feeding signs and 12 feeding stations. The majority of these feeding data was recorded within the Dalpowie Plantation, between ch400 and ch1300, and within the Inver Wood, between ch5500 and ch7500.

Table A12.3-12: DMRB Stage 3 red squirrel survey results

ID Number	Field Sign	Habitat	Description	OS Grid Reference
D1	Inactive drey	Mixed woodland	A drey found on the ground, having fallen out of the tree.	NO 05441 39329
D2	Potential drey	Coniferous woodland	Compact structure against the main stem of a larch 18m above ground level (AGL), facing north-east.	NO 05131 39727
D3	Potential drey	Coniferous woodland	Cluster of small branches near the crown of a larch 14m AGL, facing south-west.	NO 05100 39736
D4	Potential drey	Coniferous woodland	Potential drey in an exposed location on the main stem of a larch at 12m AGL, facing south-east.	NO 05203 39796
D5	Potential drey	Coniferous woodland	Small structure against the main stem of a Sitka spruce at 8m AGL, facing south-west. Copious	NO 05030 39874

ID Number	Field Sign	Habitat	Description	OS Grid Reference
			squirrel feeding signs at the base of the tree.	
D6	Active drey	Coniferous woodland	Small and compact structure against the main stem of a Norway spruce at 8m AGL, facing south.	NO 04796 39884
D7	Active drey	Coniferous woodland	Spherical structure near the crown of a spruce at 14m AGL, facing north-west. Squirrel feeding signs throughout the woodland.	NO 04955 39920
D8	Active drey	Coniferous woodland	Spherical structure against the main stem of an oak at 8m AGL, facing north-west.	NO 04660 40010
D9	Potential drey	Coniferous woodland	Potential drey nestled in the fork of a pine at 12m AGL, facing north-west.	NO 04653 40017
D10	Active drey	Coniferous woodland	Intact drey at 15m AGL in immature Scot's pine of 40cm DBH.	NO 04739 40275
D11	Active drey	Coniferous woodland	Spherical structure near the crown of a larch, against the main stem at 10m AGL, facing south-east.	NO 04674 40277
D12	Active drey	Coniferous woodland	Intact drey at 18m AGL in mature Scot's pine of 40cm DBH.	NO 04681 40330
D13	Active drey	Coniferous woodland	Spherical structure near the crown of a larch at 13m AGL, facing south-west.	NO 04600 40333
D14	Active drey	Coniferous woodland	Active drey nestled in the fork of a larch at 12m AGL, facing north-west.	NO 04584 40353

ID Number	Field Sign	Habitat	Description	OS Grid Reference
D15	Potential drey	Coniferous woodland	Potential drey on north-west side of larch, approx. 11m high.	NO 04559 40357
D16	Potential drey	Mixed woodland	Potential drey near the crown of a larch at 11m AGL, facing north-west.	NO 04540 40379
D17	Active drey	Mixed woodland	Spherical, compact structure against the stem of a silver birch at 7m AGL, facing north. Leaves identified within.	NO 04518 40388
D18	Inactive drey	Coniferous woodland	Inactive drey on the main stem of a larch at 18m AGL, facing south. The larch had a diameter breast height (DBH) of 30cm.	NO 04518 40429
D19	Active drey	Coniferous woodland	Potential drey on the main stem of a larch at 18m AGL, facing south.	NO 04532 40433
D20	Active drey	Coniferous woodland	Potential drey on the main stem of a silver birch at 20m AGL, facing west. The silver birch had a DBH of 40cm.	NO 04526 40464
D21	Active drey	Broadleaved woodland	Potential drey on the main stem of a silver birch at 20m AGL, facing west. The silver birch had a DBH of 25cm.	NO 04494 40504
D22	Active drey	Coniferous woodland	Potential drey on the main steam of a larch at 15m AGL, facing south-west. The larch had a DBH of 25cm.	NO 04226 40767
D23	Inactive drey	Coniferous woodland	Old, inactive drey in a larch at 15m AGL, facing north. The larch had a DBH of 25cm.	NO 04208 40821
D24	Potential drey	Broadleaved woodland	Two potential dreys in a beech tree at 15m AGL.	NO 03260 41471

ID Number	Field Sign	Habitat	Description	OS Grid Reference
D25	Inactive drey	Mixed woodland	Two old, inactive dreys at equal height, roughly 10cm apart in a larch.	NO 02961 41647
D26	Active drey	Mixed woodland	One intact drey adjacent to an inactive drey in a larch at 20m AGL, facing west. Squirrel feeding signs within 10m of the tree.	NO 02938 41658
D27	Active drey	Mixed woodland	Intact drey in larch at 17m AGL, facing south.	NO 02878 41722
D28	Potential drey	Coniferous woodland	Potential drey near the crown of a Norway spruce at 22m AGL, facing north-west.	NO 02646 41866
D29	Active drey	Mixed woodland	A cluster of pines with a drey near to the crown of one at 14m AGL, facing west.	NO 01989 42193
D30	Active drey	Mixed woodland	Drey near to the crown of a thin Scot's pine at 13m AGL, facing west.	NO 01961 42197
D31	Active drey	Coniferous woodland	Drey half-way up the main stem of a pine 11m AGL, facing east.	NO 00988 42242
D32	Potential drey	Coniferous woodland	Potential drey in a conifer at 13m AGL, facing west.	NO 00860 42247
D33	Potential drey	Coniferous woodland	Spherical structure of moss nestled in a fork from the main stem of a beech at 14m AGL, facing west.	NO 00787 42269
D34	Active drey	Coniferous woodland	Drey at 10m AGL, facing west, in a larch of 40cm DBH.	NO 00902 42281
D35	Active drey	Coniferous woodland	Drey at 20m AGL, facing east, in a larch of 35cm DBH.	NO 00640 42330

ID Number	Field Sign	Habitat	Description	OS Grid Reference
D36	Active drey	Coniferous woodland	Drey at 20m AGL, facing north, in a larch of 40cm DBH.	NO 00586 42341
D37	Active drey	Coniferous woodland	Intact drey at 25m AGL in Douglas fir of 50cm DBH.	NO 00565 42366
D38	Active drey	Coniferous woodland	Drey in a larch at 20m AGL, facing west.	NO 00554 42383
D39	Active drey	Coniferous woodland	Drey at 20m AGL, facing west, in a larch of 40cm DBH.	NO 00565 42410
D40	Potential drey	Mixed woodland	Potential drey in a spruce at 15m AGL, facing west.	NO 00749 42464
D41	Potential drey	Mixed woodland	Potential drey in a spruce at 10m AGL, facing north.	NO 00678 42524
D42	Inactive drey	Coniferous woodland	Inactive drey in a larch at 25m AGL, facing south-east.	NO 00250 42756
D43	Active drey	Mixed woodland	Small, compact structure against the main stem of a spruce at 13m AGL, facing north.	NO 00428 42843
D44	Inactive drey	Coniferous woodland	Inactive drey in a larch at 18m AGL, facing south-east.	NO 00218 43072
S1	Red squirrel sighting	Coniferous woodland	Live red squirrel observed in coniferous woodland near to the bunker structure.	NO 05127 39722
S2	Red squirrel sighting	Coniferous woodland	Live red squirrel observed along the edge of a coniferous woodland, moving away from the A9.	NO 04933 39995
S3	Red squirrel sighting	Coniferous woodland	Live red squirrel observed in coniferous woodland.	NO 04431 40510

ID Number	Field Sign	Habitat	Description	OS Grid Reference
S4	Red squirrel sighting	Broadleaved woodland	Live red squirrel observed in broadleaved woodland.	NO 04387 40573
S5	Red squirrel sighting	Coniferous woodland	Live red squirrel observed in larch plantation adjacent to the River Tay.	NO 04236 40741
S6	Red squirrel sighting	Mixed woodland	Live red squirrel observed in mixed woodland.	NO 04176 40796
S7	Red squirrel sighting	Broadleaved woodland	Live red squirrel observed in broadleaved woodland.	NO 03533 41386
S8	Red squirrel sighting	Coniferous woodland	Live red squirrel observed in coniferous woodland.	NO 02003 41445
S9	Red squirrel sighting	Coniferous woodland	Live red squirrel observed in coniferous woodland at the apex of a hill.	NO 00966 42216
S10	Red squirrel sighting	Coniferous woodland	Live red squirrel observed in coniferous woodland.	NO 01066 42265
S11	Red squirrel sighting	Coniferous woodland	Live red squirrel observed in a strip of coniferous woodland between the A9 and the Hermitage.	NO 01059 42270
S12	Red squirrel sighting	Mixed woodland	Live red squirrel observed in mixed woodland between the Highland Main Line railway and the River Tay on a steep hill.	NO 00672 42517
S13	Red squirrel sighting	Mixed woodland	Live red squirrel observed in mixed woodland between the Highland Main Line railway and the River Tay on a steep downhill slope.	NO 00639 42565

ID Number	Field Sign	Habitat	Description	OS Grid Reference
S14	Red squirrel sighting	Mixed woodland	Red squirrel sighting within mixed woodland	NO 01690 42197
S15	Red squirrel sighting	Mixed woodland	Red squirrel observed running around on forest floor	NO 03711 41212
S16	Red squirrel sighting	Mixed woodland	Red squirrel sighting.	NO 05201 39256
S17	Red squirrel sighting	Mixed woodland	Red squirrel sighting in garden of cottage	NO 05255 39131
S18	Red squirrel sighting	Mixed woodland	Red squirrel sighting.	NO 00463 43681
S19	Red squirrel sighting	Mixed woodland	Red squirrel sighting.	NO 00467 43668
W1	Red squirrel WVI	A9 Layby	Dead red squirrel recorded along the A9.	NO 00335 43109

Table A12.3-13: DMRB Stage 3 pine marten survey results

ID Number	Field Sign	Habitat	Description	OS Grid Reference
P1	Potential den site	Broadleaved riparian woodland	Veteran beech with numerous branch fractures and cavities, potentially suitable for pine marten and barn owl. Good connectivity under the A9 at the Tay Crossing to a large expanse of coniferous woodland.	NO 00462 44104

1.8 Reptiles

Desk Study

1.8.1 Three reptile species were recorded within 10km of the proposed scheme study area including adder, common lizard and slow worm (Table A12.3-1).

Field Survey

1.8.2 Suitable reptile habitats (Edgar et al., 2010) located under the footprint and within 50m of the mainline of the proposed scheme were identified using aerial photography, extended Phase 1 habitat data and UKHab survey data (Section 1.10) and targeted walkover surveys conducted by an experienced herpetologist in 2015 and 2023.

1.8.3 Surveys for the presence or likely absence of reptiles were undertaken in areas of suitable habitat by visual search walkovers, aided by the use of artificial cover objects (ACOs), in ten areas between 2015 and 2019 following Sewell et al. (2013) and Froglife (1999).

1.8.4 After a consultation with NatureScot, all sites were reassessed to determine change in habitat, and the methodology was amended according to Sewell at al. (2013) in June 2023. Eleven new sites were identified and taken forward for reptile surveys. These sites comprised suitable habitat to support breeding and hibernating reptiles, including foraging resources.

1.8.5 ACOs were deployed at each site identified as having suitable habitat and consisted of 0.25m^2 basal-rubber carpet tiles and corrugated bitumen sheet and were deployed at a density of at least 30 ACOs per hectare (Sewell et al., 2013).

1.8.6 Survey sites were checked seven times between April and October, with survey times focused between 08:30-11:00 and 16:00-18:30. Surveys were conducted during appropriate weather conditions as far as practicable, as per Froglife (1999), to maximise sightings, inclusive of juveniles.

1.8.7 Surveys identified a potential site (11) and confirmed the presence of common lizard and slow worm in ten areas (1, 2, 3, 4, 5, 6, 7, 8, 9, 10).

1.8.8 The presence of adder in survey area 10, previously identified as Key Reptile Site, was not confirmed during the surveys in 2024.

1.8.9 Results of the reptile surveys are presented in Table A12.3-16 and on Figure 12.13. Incidental records are presented in paragraph 1.8.2 (Incidental Records).

1.8.1 As detailed above, results obtained from reptile surveys and incidental sightings were used to determine a Reptile Site Status, as outlined in Tables A12.3-14 and A12.3-15.

Table A12.3-14: Reptile habitat importance criteria

Reptile Site Status	Criteria
Unsuitable*	▪ No confirmed reptile presence; and ▪ no desirable features in the habitat (Edgar et al., 2010).
Potential	▪ No confirmed reptile presence in the target habitat, but reptile presence confirmed in adjacent suitable habitat; or ▪ suitable habitat with desirable features present.
Presence	▪ Reptile presence confirmed with a minimum of one individual.
Key Reptile Site (KRS)	To qualify as a KRS, the site must meet at least one of the following criteria (Froglife, 1999) (population scores in Table A12.3-15): ▪ support three or more reptile species; ▪ support an exceptional population of one species; or ▪ support an assemblage of species scoring at least four.

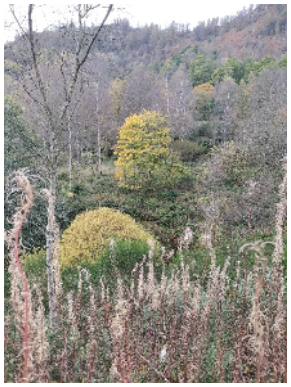
Reptile Site Status	Criteria
	Where a small area, or individual habitat, within a large reptile survey site was identified as a KRS, the entire reptile survey site was given a Reptile Site Status of Local KRS.

* Unsuitable habitat was screened out during habitat assessment.

Table A12.3-15: Reptile populations density table (numbers refer to maximum number of adults seen in one survey in one hectare with a minimum of ten artificial cover objects) (Froglife, 1999)

Species	Low Population Score 1	Good Population Score 2	Exceptional Population Score 3
Adder	<5	5 – 10	>10
Slow worm	<5	5 – 20	>20
Common lizard	<5	5 – 20	>20

Table A12.3-16: Results of reptile habitat assessment and surveys from south to north

Site	Habitat Description	Central OS Grid Reference	Area (ha)	ACOs Deployed	Year Surveyed	Species Recorded and Peak Adult Count			Reptile Site Status	Photograph
						Adder	Common lizard	Slow worm		
1	Previously an area of coniferous woodland, which was felled in 2017. Dense scrub with broom (*Cytisus scoparius*) as dominant species with undulating ground, including large south-facing slope and bank with good deadwood refugia and continuous low scrub coverage of ferns and brambles.	NO 04164 40603	5.24	100*	2024	0	3	3	Presence	
2	Copse of broadleaved trees with a relatively open canopy in an area of lower ground. The understory is predominantly great wood-rush (*Luzula sylvatica*) with scattered scrub.	NO 04048 40783	0.88	100*	2024	0	2	3	Presence	

Site	Habitat Description	Central OS Grid Reference	Area (ha)	ACOs Deployed	Year Surveyed	Species Recorded and Peak Adult Count			Reptile Site Status	Photograph
						Adder	Common lizard	Slow worm		
3	Clear felled area of scattered broadleaved trees and dense brooms with patches of tussocks. A dry-stone wall runs along the west boundary on the edge with B867. Tree stumps and log piles are preset throughout the area.	NO 04355 40368	3.28	100*	2024	0	2	0	Presence	
4	Embankment of grassland with scattered scrub (broom, raspberry (*Rubus idaeus*)) cover to the east and tall ruderals to the west. Railway embankment facing southwest is at the southern section. Good basking areas.	NO 02148 42187	2.3	40	2024	0	1	1	Presence	

Site	Habitat Description	Central OS Grid Reference	Area (ha)	ACOs Deployed	Year Surveyed	Species Recorded and Peak Adult Count			Reptile Site Status	Photograph
						Adder	Common lizard	Slow worm		
5	North-facing embankment of A9 with a site of coniferous plantation felled in late 2017 and replanted with broadleaved saplings to the north.	NO 02163 42238	0.97	30	2024	0	1	6	Presence	
6	Site of coniferous plantation felled in 2013, surveyed in 2024 with tall ruderals of predominantly raspberry and rosebay willowherb (*Chamaenerion angustifolium*).	NO 02148 42187	1.02	30	2024	0	0	8	Presence	

Site	Habitat Description	Central OS Grid Reference	Area (ha)	ACOs Deployed	Year Surveyed	Species Recorded and Peak Adult Count			Reptile Site Status	Photograph
						Adder	Common lizard	Slow worm		
7	North-facing embankment of the A9, with dense fern coverage and scattered immature broadleaved trees.	NO 00738 42397	0.97	30	2024	0	0	2	Presence	
8	East-facing embankment of the A9 of semi-improved neutral grassland, scattered scrub and tall ruderals.	NO 00369 43255	0.85	30	2024	0	2	2	Presence	

Site	Habitat Description	Central OS Grid Reference	Area (ha)	ACOs Deployed	Year Surveyed	Species Recorded and Peak Adult Count			Reptile Site Status	Photograph
						Adder	Common lizard	Slow worm		
9	West-facing embankment of the A9 of semi-improved neutral grassland, scattered scrub and tall ruderals connecting to a south-facing neutral grassland of dense tussocks and bracken (*Pteridium aquilinum*) at the edge with coniferous plantation to the north.	NO 00344 43387	0.68	30	2024	0	3	5	Presence	
10	Large and steep west-facing embankment of the A9 comprising dense continuous scrub and bracken.	NO 00573 44394	2.74	40	2024	0	2	8	Presence	

Site	Habitat Description	Central OS Grid Reference	Area (ha)	ACOs Deployed	Year Surveyed	Species Recorded and Peak Adult Count			Reptile Site Status	Photograph
						Adder	Common lizard	Slow worm		
11	Inactive quarry with developing broom scrub and ruderal species. Tree seedlings of coniferous species.	NO 00196 43008	0.83	30	2024	0	0	0	Potential	

* Survey areas 1, 2, 3 were considered in their entirety during the survey design, being contiguous and having several natural refugia and basking opportunities, a higher level of survey effort would not be useful in increasing reptile sightings.

Incidental records

1.8.2 Outwith the reptile survey areas, an adult common lizard was observed on the verge near the parking off the B867 (NO 04100 40500) in March 2020. Six observations of common lizard were recorded within the 'off-site' mitigation areas at Muir of Thorn and Gelly Wood in 2025.

1.9 Terrestrial Invertebrates

Desk study

1.9.1 Records of five terrestrial invertebrates listed on the SBL were returned from the data search (NBN, 2024), as shown in Table A12.3-17 below. No records of terrestrial invertebrates were provided through consultation. Habitats within the study area, such as woodland sites (particularly ancient woodlands), grassland and scrub provide habitat for a range of terrestrial invertebrates.

Table A12.3-17. Terrestrial invertebrate records

Scientific name	Common name	Status	Licence	Data Provider	Recorder	Dates
Aricia artaxerxes	Northern brown argus	SBL	OGL	UK Butterfly Monitoring Scheme (UKBMS)	UKBMS	2013
Boloria selene	Small pearl-bordered fritillary	SBL	CC-BY	Highland Biological Records Group (HBRG)	Jonathan Groom	2012, 2013
			OGL	UKBMS	UKBMS	2010, 2011, 2013, 2016, 2018, 2019
Coenonympha pamphilus	Small heath	SBL	CC-BY	Highland Biological Records Group (HBRG)	HBRG	2012
			OGL	UKBMS	UKBMS	2010, 2011, 2013, 2016,

Scientific name	Common name	Status	Licence	Data Provider	Recorder	Dates
						2018, 2020
Coenonympha tullia	Large heath	SBL	CC-BY	HBRG	HBRG	2012, 2013
Euphydryas aurinia	Marsh fritillary	SBL	CC-BY	HBRG	HBRG	2021

Field survey

1.9.2 No surveys were undertaken for terrestrial invertebrates. A more general habitat based approach to terrestrial invertebrates was adopted and detailed habitat surveys were undertaken, as detailed in Section 1.10 below.

1.10 Habitats

Desk study

1.10.1 Plant records were provided by BSBI for the study area. A total of 47 species were recorded, including one WCA Schedule 8 species (bluebell *Hyacinthoides non-scripta*) and six species listed on the SBL (common juniper *Juniperus communis*, black-bindweed *Fallopia convolvulus*, wild pansy *Viola tricolor*, greater celandine *Chelidonium majus*, sun spurge *Euphorbia helioscopia* and heath cudweed *Omalotheca sylvatica*).

Field survey

1.10.2 Habitats within 150m of the existing A9 were recorded during the A9 Dualling Programme route-wide Phase 1 habitat survey (Transport Scotland, 2015). For DMRB Stage 3 a buffer of 50m from the proposed scheme footprint was applied and the Phase 1 habitat survey was further verified and updated, where relevant in 2019.

1.10.3 Further habitat surveys (and subsequent desk-based assessment and reviews) were undertaken in 2021, 2022, 2024 and 2025 to reflect further amendments to proposed scheme design and mitigation/compensation requirements and to collect further detailed data, including condition assessments, as required by UKHab survey methodology. These habitat surveys supersede the Phase 1 surveys and allow for use within the Statutory Biodiversity Metric to quantify biodiversity net gain (BNG) for the proposed scheme (Appendix A12.8: Positive Effects for Biodiversity and Biodiversity Net Gain).

1.10.4 The main ecosystems recorded within the study area are woodland and forest, grassland, urban, cropland, heathland and shrub, rivers and lakes and sparsely vegetated land.

1.10.5 Habitat types within the study area are shown on Figure 12.3. General descriptions for these habitats are provided below.

Woodland and forest

1.10.6 Table A12.3-18 provides a breakdown of woodland habitat types recorded in the study area.

1.10.7 Woodland comprises approximately 58% of the habitats within the study area. The majority of woodland within the study area is broadleaved and mixed woodland (w1f7, w1g, w1h and w1h5). Species present within these woodlands include a range of native and non-native species, including ash (*Fraxinus excelsior*), oak (*Quercus* sp.), elder (*Sambucus nigra*), sycamore (*Acer pseudoplatanus*) and beech (*Fagus sylvatica*) (Photograph 1). Coniferous woodland, including mixed woodland (mainly coniferous), (w1h6, w2b and w2c) is less frequent in the study area and these areas generally comprise Douglas fir (*Pseudotsuga menziesii*) and spruce (*Picea* sp.) with small areas of Scot's pine (*Pinus sylvestris*) (Photograph 2 and 3). None of the Scot's pine areas met the definition for w2a native pine woodlands. There are several sections along the River Tay bankside, where the slopes are steep enough that water drains away, which have beech (*Fagus* sp.) dominating the canopy in these areas. Additionally, multiple areas of bog woodland were identified in the 'off-site' mitigation areas at Muir of Thorn and Gelly Wood. These areas of bog woodland were dominated by downy birch (*Betula pubescens*) and the trees in wetter areas were rich in epiphytic flora.

Table A12.3-18: Woodland and forest habitats

UKHab Code	Habitat Name
w1c6	Beech forests on neutral to rich soils
w1d	Wet woodland
w1d6	Bog woodland
w1f7	Other lowland mixed deciduous woodland
w1g	Other broadleaved woodland
w1h	Other woodland; mixed
w1h5	Other woodland; mixed; mainly broadleaved
w1h6	Other woodland; mixed; mainly conifer
w2b	Other Scot's pine woodland
w2c	Other coniferous woodland

Photograph 1: Semi-natural broadleaved woodland (w1g), dominated by beech, within Murthly Estate.

Photograph 2: Other coniferous woodland (w2c), with some broad leaved species in Dalpowie Plantation.

Photograph 3: Area of coniferous plantation woodland (w2c) adjacent to the River Tay.

Grassland

1.10.8 Table A12.3-19 provides a breakdown of grassland habitat types recorded in the study area.

1.10.9 Grassland accounts for approximately 21% of the habitats in the study area. Neutral grassland (g3c, g3c5, g3c7 and g3c8) is the dominant grassland habitat type within study area closest to the proposed scheme. Other neutral grassland (g3c) is a type that is typically widespread in the lowlands, around farmland and built-up areas. The grassland comprised common and widespread grass species, but also stands of the tall herb species rosebay willowherb (*Chamaenerion angustifolium*). The 'off-site' mitigation areas at Muir of Thorn and Gelly Wood included areas of *Deschampsia* neutral grassland (g3c7) and *Holcus-Juncus* neutral grassland (g3c8) on seasonally waterlogged soils. An additional area of *Arrhenatherum* neutral grassland (g3c5) was also present in the 'off-site' mitigation area at Muir of Thorn.

Table A12.3-19: Grassland habitats

UKHab Code	Habitat Name
g1c	Bracken
g1d	Other lowland acid grassland
g3c	Other neutral grassland
g3c5	Arrhenatherum neutral grassland
g3c7	Deschampsia neutral grassland
g3c8	Holcus-Juncus neutral grassland
g4	Modified grassland

1.10.10 Acid grassland (g1d) made up much of the remainder of the mapped grassland and is mostly found in the 'off-site' mitigation areas at Muir of Thorn and Gelly Wood (see Figure 12.3). Dominant species such as wavy hair-grass (*Avenalla flexuosa*) and sheep's fescue (*Festuca*

ovina) and other indicator species such as broom (*Cytisus scoparius*) and heath bedstraw (*Galium saxatile*) present. Bracken (g1c) is recorded within the proximity of the proposed scheme and accounts for 18% of the grassland habitat recorded. Modified grassland (g4), which is that resulting from intensive agricultural production, is also present within the study area.

1.10.11 Most of the grassland was located within the A9 and railway corridor, such as on embankments, cuttings and visibility splays. Other areas included clearfell sites, wayleave areas and fields for horse grazing. Grassland is also present in the offsite areas (see Figure 12.3), including in areas of clearfell within these woodland areas.

Urban

1.10.12 Table A12.3-20 provides a breakdown of urban habitat types recorded in the study area.

1.10.13 The proposed scheme passes through settlements along the A9 including Birnam, Little Dunkeld and Inver. The majority of urban habitats recorded are associated with these areas (Figure 12.3) and the existing road network including the A9, and Highland Main Line railway.

Table A12.3-20: Urban habitats

UKHab Code	Habitat Name
u1b6	Other developed land
u1c	Artificial unvegetated, unsealed surface
u1d	Suburban mosaic of developed and natural surface
u1e	Built linear features

Cropland

1.10.14 Table A12.3-21 provides a breakdown of cropland habitat types recorded in the study area.

1.10.15 There were three locations where cropland was recorded within the study area (Figure 12.3). This habitat type accounts for approximately 4% of the total area surveyed. Cereal crops (c1c7) were recorded in a field to the east of Birnam and potato crop (c1d8) was recorded in a field south of the Tay Bridge. An area of temporary grass (c1b) comprising a timothy (*Phleum pratense*) crop was recorded adjacent to Inver Wood, south of the Tay Bridge.

Table A12.3-21: Cropland habitats

UKHab Code	Habitat Name
c1b	Temporary grass and clover leys
c1c7	Other cereal crops
c1d8	Arable fields pollen and nectar

Heathland and shrub

1.10.16 Table A12.3-22 provides a breakdown of heathland and shrub habitat types recorded in the study area.

1.10.17 Gorse scrub, mixed scrub (h3e, h3h) and wet heathland with cross-leaved heath (h1a7) are recorded within the study area. Heathland and shrub accounts for approximately 7% of the habitats within the study area. Two key areas of scrub are found on the southbound banks of the A9 north of the Tay Crossing and an area of felled AWI woodland between the B867 and A9 south of Birnam (Photograph 4). Small areas of wet heathland were recorded at the 'off-site' mitigation area at Muir of Thorn; heather (*Calluna vulgaris*) was dominant with cross-leaved heather (*Erica tetralix*) also present. Other wetland indicator species including common deergrass (*Trichophorum germanicum*) and bog mosses (*Sphagnum* spp.) were also recorded. Some purple moor-grass (*Molinia caerulea*) was a dominant species in some of these wet heathland areas at the Muir of Thorn suggesting poorer condition.

Table A12.3-22: Heathland and shrub habitats

UKHab Code	Habitat Name
h1a7	Wet heathland with cross-leaved heath
h3e	Gorse scrub
h3h	Mixed scrub

Photograph 4: Area of scrub on felled AWI

Wetland

1.10.18 Table A12.3-23 provides a breakdown of wetland habitat types recorded in the study area.

1.10.19 The only section of wetland habitat within the study area was found at the 'off-site' mitigation area at Muir of Thorn, the majority of which was either blanket bog (f1a5) or degraded blanket

bog (f1a6). These habitats comprise approximately 2% of the habitats within the study area. The main indicator species recorded in these areas of this habitat were bog mosses (*Sphagnum* spp.), though cotton-grass species (*Eriophorum* spp.) were also recorded. A single area of purple moor-grass and rush pasture (f2b) was also recorded in this area due to the abundance of sharp-flowered rush (*Juncus acutiflorus*) over the locally more dominant soft rush (*Juncus effusus*).

Table A12.3-23: Wetland habitats

UKHab Code	Habitat Name
f1a5	Blanket bog
f1a6	Degraded blanket bog
f2b	Purple moor-grass and rush pastures

Rivers and lakes

1.10.20 Table A12.3-24 provides a breakdown of rivers and lakes habitats and associated UKHab code recorded in the study area.

1.10.21 The River Tay is the main watercourse within the study area, running parallel to the existing A9 for the length of the proposed scheme. Five named watercourses are crossed by the A9 in the study area: Inchewan Burn, Birnam Burn, River Braan, Mill Stream and the River Tay. Nine smaller unnamed watercourses are also present within the study area and crossed by the A9, as detailed in Chapter 19 (Road Drainage and the Water Environment).

1.10.22 The River Tay is designated as an SAC and comprises a priority habitat (r2a). The River Braan falls partially within the SAC and is also classified as a priority habitat. Both these watercourses are WFD classified watercourses: River Tay (River Tummel to River Isla Confluences; ID: 6499) and River Braan (ID: 6576).

Table A12.3-24: River and lake habitats

UKHab Code	Habitat Name
r2a	Rivers priority habitat
r2b	Other rivers and streams

Photograph 6: River Tay at the Tay Crossing

Sparsely vegetated land

1.10.23 A small area of other inland rock (s1d) is present within the study area. This habitat describes the inactive quarry in Inver Wood. This area is being colonised by broom and ruderal species, with some larch and Douglas fir seedlings present.

1.11 Invasive Non-native Species

Desk Study

1.11.1 Rhododendron (*Rhododendron ponticum*), Himalayan balsam (*Impatiens glandulifera*), giant hogweed (*Heracleum mantegazzianum*) and Japanese knotweed (*Reynoutria japonica*) have been recorded within the study area (SEPA, 2024).

1.11.2 Ten invasive non-native species (INNS) plant species were recorded in the study area during the A9 Dualling Programme route-wide Phase 1 habitat survey (Transport Scotland, 2015)

Field Surveys

1.11.3 INNS plants were recorded incidentally during other species/habitat surveys. The following species have been recorded:

- rhododendron
- Himalayan balsam
- giant hogweed
- Japanese knotweed

1.11.4 Other non-native species that were recorded included: snowberry (*Symphoricarpos albus*); dame's-violet (*Hesperis matronalis*); pink purslane (*Claytonia sibirica*); sweet cicely (*Myrrhis*

odorata); yellow archangel (*Lamiastrum galeobdolon* ssp. *argentatum*) and Welsh poppy (*Papaver cambricum*).

1.12 Aquatic Biodiversity Resources

Desk Study

1.12.1 SEPA provided data for macroinvertebrates within the River Tay and River Braan within the study area for the proposed scheme (SEPA, 2024). 70 different taxon of macroinvertebrates were recorded.

1.12.2 SEPA provided results of electrofishing on the River Braan from 2011. Salmonid species, European eel and stone loach were recorded (SEPA, 2024)

1.12.3 The Marine Scotland salmonid distribution database indicates that Atlantic salmon are 'Present' on the River Tay within the study area (Marine Scotland, 2024)

1.12.4 In addition, records of Atlantic salmon and lamprey species were identified within 10km of the proposed scheme (Table A12.3-1)).

Aquatic Assessment Methodology

1.12.5 Aquatic habitat criteria are presented in Table A12.3-25 (based on Hendry and Cragg-Hine, 2003, Maitland, 2003, Maitland, 2007, SFCC, 2007) and Skinner et al., 2003), and water features were evaluated using the criteria in Table A12.3-26.

Table A12.3-25: Aquatic habitat criteria

Species	Life Stage	Habitat Requirements
Atlantic salmon	Spawning/egg	Channel width at least 3m, with 0.17-0.76m water depth. Glide or riffle flow at 0.35-0.80m/s. Golf ball-tennis ball sized substrate, 0.15-0.25m deep with less than 8% fine particles.
	Fry	Shallow (0.2m or less) fast flowing broken water. Golf ball – tennis ball sized substrate.
	Parr	Fast flowing broken water, 0.2-0.4m deep. Tennis ball–football sized substrate.
	Adult	Deep, at least 0.8m deep. Connectivity.
Lamprey	Adults/spawning	Gravel with some sand (around 0.1m deep substrate). Water flow through substrate, generally at the tail end of pools. Water velocities around 0.3–0.5m/s but can be as high as 4.0m/s. Water depth generally less than 0.4m.
	Ammocoetes (juveniles)	Mud, silt, sand substrate up to 0.3m deep with high organic content. Slow flowing water (less than 0.1m/s). Stable stream bed. Water depth 0.1–1m.

Species	Life Stage	Habitat Requirements
Trout	Spawning/egg	Channel generally less than 3m wide. Glide or riffle flow at 0.15-0.75m/s. Pea – tennis ball sized substrate at least 0.15m deep with less than 12% fine particles.
	Fry	Shallow (0.2m or less) medium flowing water. Golf ball - tennis ball sized substrate. Marginal cover.
	Parr	Variety of substrates. Water depth 0.2–4m with slow-medium flows. Bankside cover (undercut banks/vegetation/tree roots).
	Adult	Deeper water (at least 0.4m) with slow sustained flow. Bankside/bed/canopy cover.
Eel	Adults/elvers (juveniles)	Occurs in all types of freshwaters that are accessible from the sea.
Fresh Water Pearl Mussel	Adults/juveniles	Boulder sheltered mussel beds containing small sand patches amongst large stones or boulders in fast flowing watercourses. In low gradient sections, well oxygenated silt-free riffle areas with mixtures of rocks, cobbles and sand.

Table A12.3-26: Scoring system for watercourse ecological evaluation

Feature	Scores		
	Yes	Partial	No
Accessible to Migratory Species	2	1	0
FWPM Habitat	2	1	0
Salmonid Spawning	2	1	0
Juvenile Salmonid Habitat	2	1	0
Adult Salmonid Habitat	2	1	0
Lamprey Habitat	2	1	0
Resources Supporting SAC	2	1	0
Overall Score/Ecological Value	10-14 = Excellent 5-9 = Good 2-4 = Moderate 0-1 = Poor		

Macroinvertebrates

1.12.6 The following macroinvertebrate metrics were calculated for each site: Whalley, Hawkes, Paisley and Trigg (WHPT) metrics; Average Score per Taxon (WHPT ASPT); Number of Taxa (WHPT NTAXA); Lotic Invertebrate Index for Flow Evaluation (LIFE); Proportion of Sediment-Sensitive Invertebrates (PSI) and Community Conservation Index (CCI). A detailed description

of these metrics and the WFD classification, which is based on WHPT ASPT and WHPT NTAXA scores, is provided below.

WFD Classification

1.12.7 An ecological status class of High, Good, Moderate, Poor or Bad is calculated for the macroinvertebrate biological quality element in surface waters using the WFD-compliant River Invertebrate Classification Tool (RICT) (WFD-UKTAG, 2014).

RICT uses environmental characteristics recorded during the field survey, including physical characteristics (width, depth, substrate composition), water chemistry, distance to source and altitude to assign each site to an end group of comparable reference sites (WFD-UKTAG, 2014). RICT reference sites are deemed to be as close as possible to pristine conditions and not impacted by environmental stressors such as pollution, habitat modification or flow.

RICT compares metrics calculated from the observed macroinvertebrate community are compared to that expected from a watercourse in reference condition and the variance between the observed and expected determines the ecological status. RICT uses WHPT ASPT (measure of macroinvertebrate tolerance to organic pollution) and WHPT NTAXA (measure of macroinvertebrate diversity), to classify sites (see below).

RICT is not suitable for use on ditches, artificial water bodies (e.g. canals), non-flowing watercourses or ephemeral water bodies as RICT does not contain reference sites for comparison. In addition, RICT sets minimum and maximum validation values and warning values for environmental and physical variables entered. RICT outputs provide suitability codes which denote the likelihood of the site being within the parameters of the end groups. Suitability codes are between 1-5, with 5 = very low probability of having suitable reference sites in the database.

Whalley, Hawkes, Paisley & Trigg (WHPT) Metric, Average Score Per Taxon (WHPT ASPT) and Number of Taxa (WHPT NTAXA)

1.12.8 The WHPT metric is the classification method for the assessment of macroinvertebrates in rivers in relation to general degradation, specifically organic pollution under the WFD (UKTAG, 2014). Scores are assigned to macroinvertebrate families based on tolerance to pollution with the final WHPT score taking into account the abundance of each of the families. WHPT ASPT Ecological Quality Ratio (EQR) scores are calculated by dividing the WHPT score by the number of scoring taxa (WHPT NTAXA) to give the average score per taxon. WHPT and WHPT ASPT scores are used as a measure of water quality; WHPT NTAXA is used as a measure of diversity.

Lotic Invertebrate Index for Flow Evaluation (LIFE)

1.12.9 Freshwater macroinvertebrates have precise requirements for flow conditions and can be used to determine not only predominant flow types (Extence et al., 1999) but also changes in flow. Each species (or family for family level classifications) within a sample is assigned to a flow group depending on their flow/velocity preference. Calculation of LIFE scores requires abundance data, as the effect of flow may lead to changes in abundance without the complete loss or gain of a taxon group.

1.12.10 Theoretically, LIFE scores range from 0 to 12, but typically vary between 5.5 and 8.5, with higher and lower scores indicating communities dominated by taxa with affinities with fast-flowing and drying habitats, respectively. Scores typically range between 8 for high gradient headwaters and 6 for slower flowing impounded stretches of water.

Proportion of Sediment-Sensitive Invertebrates (PSI)

1.12.11 The PSI scoring system is used to assess the impact of fine sediment accumulation on macroinvertebrate communities (Extence et al., 2011). Species are assigned a score based on their sensitivity to sediment. Calculation of the PSI score takes into account abundances of each scoring taxa. The resulting PSI scores indicate how sedimented the watercourse is; producing a numerical value to quantify a range from minimal sediment/unsedimented to heavily sedimented (Table A12.3-27).

Table A12.3-27: PSI Score Interpretation (Extence et al., 2011)

PSI Score	Riverbed Condition
81-100	Minimally sedimented/unsedimented
61-80	Slightly sedimented
41-60	Moderately sedimented
21-40	Sedimented
0-20	Heavily sedimented

Community Conservation Index (CCI)

1.12.12 The Community Conservation Index (Chadd and Extence, 2004) represents the national rarity and diversity of species identified within a site and designates a conservation value to the sampled community. A Conservation Score based upon each species' national rarity is applied to each species. The CCI is calculated from the sum of Conservation Scores (CS) divided by the number of contributing species to obtain the mean value. This is then multiplied by the Community Score (CoS), derived either from the rarest taxon present or the British Monitoring Working Party (BMWP) score (each macroinvertebrate family is assigned a score from 1 to 10 reflecting their tolerance to organic pollution which denotes the BMWP score). The CCI value tends to fall in a range of between 0 and 40 (Table A12.3-28).

Table A12.3-28: CCI score classifications (Chadd & Extence, 2004)

Conservation Class	Score	Description
Low	≤ 5.0	Sites supporting only common species and/or low taxon richness.
Moderate	< 5.0 to 10.0	Sites supporting at least one species with limited distribution and/or moderate taxon richness.
Fairly high	> 10.0 to 15.0	Sites supporting at least one uncommon species or several of limited distribution and/or higher taxon richness.

Conservation Class	Score	Description
High	> 15.0 to 20.0	Sites supporting several uncommon species, one of which may be nationally rare and/or highly taxon richness.
Very high	> 20.0	Site supporting several rare species and/or very high taxon richness.

Aquatic Survey Results

Aquatic Habitats

1.12.13 Relevant notes from the aquatic walkover surveys undertaken in 2015 and subsequent years by Jacobs are provided in Table A12.3-29.

Table A12.3-29: Aquatic Survey Walkover Results

Water Feature	Location	Description	Similar Water Features
River Tay (WF6A)	NO 04265 40762	The River Tay averages 60m wide and has depths greater than 1m (with many areas likely deeper). The flows are predominantly glide and run and substrates are dominated by cobble and boulder. Some pockets of gravel, sand and pebble are also found throughout, and the available habitat supports all life stages of protected fish species.	River Tay (WF6B) – NO 01710 42312 River Tay (WF6C) - NO 00443 43181 River Tay (WF6D) - NO 00425 43805 River Tay (WF6 02A) - NO 00425 43805
Inchewan Burn (WF8)	NO 02889 41552	The Inchewan Burn is approximately 2m wide and has a variable depth that ranges from 0.05m to 0.5m. The flows are predominantly cascade, with interspersed run, pools and glide throughout. Flow conditions and mixed boulder, cobble and pebble substrate provide supporting habitat for all life stages of protected fish species.	N/A
River Braan (WF11)	NO 01786 42062	The River Braan is approximately 20m wide with depths ranging from 0.1m to 2m. Flows are a mix of glide and run with cobble, boulder and gravel substrates	N/A

Water Feature	Location	Description	Similar Water Features
		providing habitat for mixed life stages of protected species.	
Mill Stream (WF12)	NO 01590 42134	The Mill Stream is a small watercourse, approximately 2m wide and 0.05m deep. The artificially straightened channel flows in a run throughout its full length, with cobble and boulder substrates throughout. The shallow conditions and habitat homogeneity reduce suitability for any species of conservation interest.	WF9 - NO 02514 42123 WF13 - NO 00213 43185 WF14 - NO 00211 43742
Unnamed watercourse (WF2)	NO 05421 39429	A narrow (0.1m) and shallow (0.05m) watercourse that is dry in places. Flows are a mix of run and riffle and the channel contains fine sand and gravel substrates. The shallow watercourse lacks connectivity due to areas of drying and, in conjunction with the lack of solid substrates, reduces habitat suitability for any species of conservation interest.	WF16 - NO 00678 44247 WF18 NO 00547 44601

Aquatic Habitat Evaluation (Including Fish Habitat Suitability)

1.12.14 Each watercourse surveyed was given an ecological value determined by the presence and accessibility of habitat and food resources for the qualifying fish species and FWPM of the River Tay SAC (Table A12.3-25 details criteria and Table A12.3-26 Scoring). These classifications are displayed on Figure 12.14. Six sites, five on the River Tay and one on the River Braan, were given an ecological value of excellent due to their connectivity with the wider catchment and the presence of optimal supporting habitat for fish species of conservation interest. The Inchewan Burn was classified as good, due to its connectivity to the main stem of the River Tay and the presence of some suitable supporting habitat. Watercourses WF13 and WF14 received a moderate classification and the minor watercourses WF2, WF9, WF16 and Mill Stream were classified as poor, due to reduced connectivity to the wider catchment and a lack of resources to support fish species of conservation interest.

1.12.15 The suitability of juvenile lamprey habitat was assessed along both banks of the River Tay and the River Braan from the confluence with the River Tay to the upstream end of the River Tay SAC during walkovers in May 2022. The results are present in Table A12.3-30.

Table A12.3-30: Lamprey ammocoete habitat survey results

Water Feature	Location	Habitat Description	Quality	Area (m^2)
River Tay Right Bank	NO 00402 43897	Small sandy patch observed from bank. Little silt or detritus.	Suboptimal	6
River Tay Right Bank	NO 00501 43270	Optimal sandy silt area extending at least 5m from the bank. Over 500mm silt depth in places. Lots of woody debris and detritus.	Optimal	375
River Tay Right Bank	NO 00741 42559	Suboptimal sandy area. 70% woody debris and detritus. Up to 300mm sand depth. Up to 0.5m water depth.	Suboptimal	15
River Tay Right Bank	NO 00346 44033	Sand and silt bed extending up to 3m from the bank. Extends upstream as narrow band along the bank. Over 300mm depth of sand/silt. Water depth ranging from 0.1 to 1m. Trout parr seen. Heavy tree cover with a small amount of woody debris and detritus. Undercut banks.	Suboptimal	90
River Tay Right Bank	NO 00680 42650	Large sandy backwater. Up to 300mm sand depth. 25% tree cover, 10% woody debris and detritus. Over 1m water depth in middle.	Suboptimal	150
River Tay Right Bank	NO 00752 42539	Sandy silty area. Only 100mm silt depth in places. 70% tree cover, 20% woody debris and detritus. Up to 0.5m water depth.	Suboptimal	25
River Tay Right Bank	NO 00628 43940	Band of sand/silt along bank. Quite consolidated. Less than 200mm silt depth. Up to 0.6m water depth. No tree cover. Small amount of woody debris and detritus.	Suboptimal	40
River Tay Right Bank	NO 00389 44221	Sand and silt patch. Only around 100mm sediment depth. Up to 0.3m water depth	Suboptimal	6
River Tay Right Bank	NO 00449 42890	Large backwater, but mostly boulder and cobble. Small area of silt, 90% cover of woody debris so unlikely to be used. Observed from bank.	Suboptimal	4

Water Feature	Location	Habitat Description	Quality	Area (m^2)
River Tay Right Bank	NO 00610 42804	Small sandy silt patch. Over 400mm silt depth	Suboptimal	4
River Tay Right Bank	NO 00437 43157	Sandy silt patch. More than 400mm silt depth. Heavy tree cover. 35% woody debris and detritus. Up to 1m water depth.	Optimal	6
River Tay Right Bank	NO 00463 43756	Sandy silt habitat. Tree cover, little woody debris or detritus. Over 1m deep. Over 300mm average silt depth but up to 500mm in places.	Optimal	100
River Tay Right Bank	NO 00362 44121	Sand and silt patch. Over 300mm silt depth. Up to 600mm water depth. Likely silt is input from arable field	Optimal	10
River Tay Right Bank	NO 02071 42362	Area of silty sand. Up to 300mm deep. 0-0.8m water depth. No woody debris or detritus. Area where dogs likely access the river.	Suboptimal	12
River Tay Right Bank	NO 01733 42334	Area of silt 100mm in depth overlying rock. Input likely from footpath.	Suboptimal	4
River Tay Right Bank	NO 01387 42384	Area of silty sand. Over 250mm silt depth. 0-1m water depth. 30% woody debris and detritus cover. 70% tree cover	Optimal	75
River Tay Right Bank	NO 01636 42356	Area of silt overlying cobble. Less than 100mm silt depth. 20% woody debris and detritus cover. 80% tree cover.	Suboptimal	20
River Tay Right Bank	NO 01370 42395	Area of sandy silt. Up to 400mm silt depth. No woody debris or detritus. 80% tree cover. Likely accessed by dogs.	Suboptimal	5
River Tay Right Bank	NO 03258 42190	Area of sandy silt in slow flowing margin. 150mm silt depth. Up to 0.4m water depth. 100% detritus cover for the first 1m from shore. Likely accessed by dogs.	Suboptimal	360
River Tay Right Bank	NO 02106 42356	Area of silty sand. 300mm sand depth. 0.4-0.6m water depth. 40% woody debris and detritus cover. 80% tree cover. Potentially susceptible to drying out during low flows	Suboptimal	60

Water Feature	Location	Habitat Description	Quality	Area (m^2)
River Tay Right Bank	NO 03454 42016	Area of silty sand. Sand up to 250mm deep. Slopes down to 0.8m water depth. 60% detritus and woody debris cover. 60% tree cover. Likely accessed by dogs.	Suboptimal	75
River Tay Right Bank	NO 04270 40840	Area of coarse sand up to 150mm deep where gillies bring boat in and out.	Suboptimal	20
River Tay Right Bank	NO 04293 40709	Area of silty sand. Over 300mm sand depth in places. 5% detritus and woody debris cover. 80% high tree cover.	Suboptimal	15
River Tay Right Bank	NO 05546 39721	Area of soft substrate in backwater. Substrate up to 170mm deep. 100% detritus and woody debris cover. Up to 1m water depth in centre. No tree cover.	Suboptimal	40
River Tay Right Bank	NO 00429 43818	Sand and silt bed in backwater. 300 mm silt depth on average. Water depth 150-200mm deep. Lots of woody debris and detritus.	Suboptimal	200
River Tay Left Bank	NO 04625 40510	Area of silty sand. Up to 200mm sand depth. 0.8m water depth. 90% woody debris cover. 10% tree cover.	Suboptimal	200
River Tay Left Bank	NO 01749 42388	Area of silty sand in slow river margin. 300mm sand depth, quite compact in areas. No detritus, woody debris or tree cover. One large, submerged tree.	Suboptimal	45
River Tay Left Bank	NO 04707 40451	Patch of silty sand between two trees. More than 300mm silt depth. Up to 0.6m water depth. Little detritus cover. 90% tree cover.	Suboptimal	8
River Tay Left Bank	NO 00590 42927	Area of sandy silt. Over 400mm silt depth. Quickly shelves off to over 1m water depth. 5% detritus and woody debris cover. No tree cover. Greater proportion of boulder and pebble towards edges of silt bed.	Suboptimal	125
River Tay Left Bank	NO 01787 42384	Area of silty sand. Greater than 300mm sand depth. Little detritus or woody debris. 5% tree cover. Silt is gathered behind manmade obstruction on bank.	Suboptimal	50
River Tay Left Bank	NO 00504 44531	Area of silty sand in slow flowing river margin. Over 500mm sand depth. Gradually slopes off to over 1m water	Suboptimal	200

Water Feature	Location	Habitat Description	Quality	Area (m^2)
		depth. 5% woody debris and detritus cover. 30% tree cover.		
River Tay Left Bank	NO 00571 43710	Area of silty sand. Up to 250mm sand depth. Gradual shelf down to 1m water depth. 10% detritus cover. No tree cover.	Suboptimal	24
River Tay Right Bank	NO 03258 42190	Area of sandy silt in slow flowing margin. 150mm silt depth. Up to 0.4m water depth. 100% detritus cover for the first 1m from shore. Likely accessed by dogs.	Suboptimal	360
River Tay Left Bank	NO 00492 44316	Area of sandy silt in slow flowing river margin. Over 300mm silt depth. Shelves down to 0.7m water depth. 5% detritus and woody debris cover. 90% tree cover.	Suboptimal	9
River Tay Left Bank	NO 01254 42518	Area of silty sand in slow flowing river margin. Over 300mm sand depth. Slopes down to over 1m water depth. 35% detritus and woody debris cover. 20% tree cover.	Suboptimal	175
River Tay Left Bank	NO 01812 42396	Area of silty sand. 300mm sand depth. Gradually slopes off to over 1m water depth. 20% debris and detritus cover. No tree cover. Access point to river so likely highly disturbed.	Suboptimal	20
River Tay Left Bank	NO 00475 44606	Area of silty sand. Over 300mm sand depth. Slopes down to 0.4m water depth. Some sand further upstream but likely to dry out in low flows.	Suboptimal	25
River Tay Left Bank	NO 00454 44198	Area of sandy silt in slow flowing river margin. Greater than 300mm silt depth. Quickly shelves off to more than 1m water depth. 10% detritus and woody debris cover. 80% tree cover.	Optimal	40
River Tay Left Bank	NO 01530 42462	Area of sandy silt observed from bank. Appears to be mainly silt overlying boulders. No debris or tree cover. One large, submerged tree.	Suboptimal	10
River Tay Left Bank	NO 00519 43169	Area of silty sand. Over 400mm sand depth. Up to 1m water depth. 50% detritus and woody debris cover, increasing to 90% cover at the upstream end. 90% tree cover	Suboptimal	75

Water Feature	Location	Habitat Description	Quality	Area (m^2)
River Braan	NO 02326 42366	Area of sandy silt on left bank at mouth of the River Braan. Up to 300mm silt depth. 10% detritus and woody debris cover. 5% tree cover.	Suboptimal	120
			Suboptimal	2,237
			Optimal	606
			Total Area	**2,843m^2**

Aquatic Macroinvertebrates

1.12.16 Aquatic macroinvertebrate surveys were conducted at ten sites on four watercourses (22-23 June 2021 and 16 November 2021). Invertebrate kick samples were taken at the same locations in April and November with the exception of Mill Stream. Due to flows being too low to undertake an invertebrate kick sample in this location in November, the River Tay at the confluence with Mill Stream was sampled instead. Field sampling, laboratory analysis and metric calculations were all in accordance with standard methodologies and published reports (paragraph 1.12.5, Aquatic Assessment Methodology).

1.12.17 WHPT NTAXA is a diversity index and does not reflect environmental pressures. Taxa numbers ranged from 9 to 25 across the sample sites and fluctuated between seasons. The lowest number of taxa was recorded at Inver Mill, with 9 taxa recorded. The highest number of taxa were recorded at outfalls A and B1in June, and outfalls B2 and C in November, with 25 taxa.

1.12.18 The WHPT ASPT scores for samples at outfalls B1, B2, C, D, F at River Tay and I, and the summer samples of outfalls A and H scored above 5.4, putting them in the Very good, unpolluted and unimpacted category. This indicates that macroinvertebrate species associated with good water quality are prevalent. The scores for the autumn samples of outfalls A, G and H, as well the Inver Mill site placed them into the Good, clean but slightly impacted category.

1.12.19 Life (sp) scores ranged from 7.56 to 8.68. LIFE values greater than 7.5 indicate macroinvertebrate communities dominated by taxa with affinities for fast-flowing water. This reflects the fast-flowing, riffle habitat the samples were taken in at each site.

1.12.20 PSI (sp) scores for samples at outfalls B1, C, D, the summer samples of outfalls A and F at Inver Mill, and the autumn sample of Outfall I were in the Minimally sedimented/unsedimented category. This indicates the sampled macroinvertebrate community is typical of habitat with minimal or no sedimentation. Scores for the samples at Outfall B2, the autumn sample of Outfall A and the summer samples of outfalls G, H and I were in the Slightly sedimented category, indicating macroinvertebrate communities typical of habitat with some sedimentation. The autumn River Tay Outfall F and outfalls G and H scored in the Moderately sedimented category.

1.12.21 CCI scores varied among the ten sites, ranging from High to Moderate conservation value. The one exception is the June sample collected from the River Tay (Outfall B2) which indicated a

Low conservation value. No species of conservation interest were collected from any of the sites in either of the sampling months.

1.12.22 RICT was performed on data collected from each site. Table A12.3-31 provides the EQRs and WFD Classifications. The suitability code for Inver Mill is 5, indicating a very low probability of having suitable reference sites in the database. Therefore, the EQRs and WFD classifications for this site have been excluded. The remaining sites all had suitability codes of 1.

1.12.23 Three of the eight sites met the overall WFD classification of Good or High. These sites were outfalls B1, C, D and I. This indicates there is little deviation in the macroinvertebrate community compared to reference conditions. The summer samples of outfalls A, G and H, and the autumn sample of Outfall B2, also met the WFD classification of Good. The autumn samples of outfalls A, G and H, as well as the summer sample of Outfall B2 failed to meet the WFD Classification of Good, with classifications of Poor, Poor, Moderate and Moderate respectively. The single sample at Outfall F also received a classification of Moderate. WFD classifications below Good indicate there is deviation in the observed macroinvertebrate communities with what is expected at reference conditions.

Table A12.3-31: EQR scores and WFD classifications for macroinvertebrate communities at each site

Site	Grid Reference	Survey Date	Index	EQR	Class	Overall WFD Classification
Outfall A	NO 05173 40121	Summer 2021	WHPT ASPT	0.95	Good	Good
			WHPT NTAXA	1.29	High	
		Autumn 2021	WHPT ASPT	0.70	Poor	Poor
			WHPT NTAXA	0.60	Moderate	
Outfall B1	NO 04286 40782	Summer 2021	WHPT ASPT	1.06	High	High
			WHPT NTAXA	1.30	High	
		Autumn 2021	WHPT ASPT	0.96	Good	Good
			WHPT NTAXA	0.99	High	
Outfall B2	NO 03965 41667	Summer 2021	WHPT ASPT	0.94	Good	Moderate
			WHPT NTAXA	0.68	Moderate	

Site	Grid Reference	Survey Date	Index	EQR	Class	Overall WFD Classification
		Autumn 2021	WHPT ASPT	0.89	Good	Good
			WHPT NTAXA	1.29	High	
Outfall C	NO 03078 41848	Summer 2021	WHPT ASPT	1.00	High	High
			WHPT NTAXA	1.36	High	
		Autumn 2021	WHPT ASPT	1.03	High	High
			WHPT NTAXA	1.47	High	
Outfall D	NO 02319 42231	Summer 2021	WHPT ASPT	1.07	High	High
			WHPT NTAXA	1.07	High	
		Autumn 2021	WHPT ASPT	1.05	High	High
			WHPT NTAXA	0.81	High	
Outfall F	NO 01699 42324	Summer 2021	WHPT ASPT	-	-	-
			WHPT NTAXA	-	-	
		Autumn 2021	WHPT ASPT	0.81	Moderate	Moderate
			WHPT NTAXA	0.93	High	
Outfall G	NO 00951 42407	Summer 2021	WHPT ASPT	0.92	Good	Good
			WHPT NTAXA	1.22	High	
		Autumn 2021	WHPT ASPT	0.70	Poor	Poor
			WHPT NTAXA	0.61	Moderate	
Outfall H	NO 00548 43350	Summer 2021	WHPT ASPT	0.87	Good	

Site	Grid Reference	Survey Date	Index	EQR	Class	Overall WFD Classification
			WHPT NTAXA	0.77	High	Good
		Autumn 2021	WHPT ASPT	0.72	Moderate	Moderate
			WHPT NTAXA	0.65	Moderate	
Outfall I	NO 00417 44072	Summer 2021	WHPT ASPT	0.93	Good	Good
			WHPT NTAXA	0.81	High	
		Autumn 2021	WHPT ASPT	0.86	Good	Good
			WHPT NTAXA	1.13	High	

Table A12.3-32: Summary of macroinvertebrate metrics calculated based on the June and November surveys (n/c = none collected).

Site Name	Month	Temperature (°C)	Dissolved Oxygen (%)	Conductivity (µs/cm)	WFD Class	WHPT	WHPT NTAXA	WHPT ASPT	LIFE (sp)	PSI (sp)	CCI Score	CCI Class	CCI Species of Conservation Interest (CS ≥ 6)
River Tay (Outfall A)	June	14.8	98.8	50	Good	163.7	25	6.55	8.38	83.64	13.30	Fairly High	n/c
	November	8.4	96.0	46.6	Poor	54.1	11	4.92	8.20	77.78	6.38	Moderate	n/c
River Tay (Outfall B1)	June	15.6	95.4	52	High	184.2	25	7.37	8.33	87.04	8.86	Moderate	n/c
	November	8.4	99.6	46.6	Good	131.1	19	6.90	8.39	83.72	11.39	Fairly High	n/c
River Tay (Outfall B2)	June	14.6	95.3	53.9	Moderate	78.4	12	6.53	8.18	77.78	4.09	Low	n/c
	November	8.4	97.7	45.6	Good	161.9	25	6.48	7.85	64.86	10.31	Fairly High	n/c
Inchewan Burn (Outfall C)	June	10.8	95.5	93.7	High	159.7	23	6.94	8.57	93.88	12.83	Fairly High	n/c
	November	7.6	102.4	52.6	High	192.8	25	7.71	8.68	90.91	16.63	High	n/c
River Braan (Outfall D)	June	15.2	100.5	80.9	High	160.7	22	7.30	8.58	85.71	11.84	Fairly High	n/c
	November	7.5	102.5	58.8	High	118.9	16	7.43	8.56	93.33	10.00	Moderate	n/c
Inver Mill (Outfall F)	June	12.4	94.4	80.8	n/a	48.3	9	5.37	8.50	88.24	6.00	Moderate	n/c
River Tay (Outfall F)	November	8.4	87.9	46.3	Moderate	103.6	18	5.76	7.63	58.62	12.86	Fairly High	n/c
River Tay (Outfall G)	June	15.4	102.1	50.8	Good	146.8	23	6.38	7.84	63.46	6.00	Moderate	n/c
	November	8.5	96.1	43.1	Poor	54.4	11	4.95	7.63	41.18	6.50	Moderate	n/c
River Tay (Outfall H)	June	18	104.5	48.4	Moderate	84	14	6.00	8.00	74.19	6.82	Moderate	n/c
	November	8.4	89.5	43.6	Poor	61.5	12	5.13	7.56	58.82	12.86	Fairly High	n/c
River Tay (Outfall I)	June	14.3	103.4	51.4	Good	97.1	15	6.47	8.33	78.79	10.91	Fairly High	n/c

Site Name	Month	Temperature (°C)	Dissolved Oxygen (%)	Conductivity (µs/cm)	WFD Class	WHPT	WHPT NTAXA	WHPT ASPT	LIFE (sp)	PSI (sp)	CCI Score	CCI Class	CCI Species of Conservation Interest (CS ≥ 6)
	November	8.4	97	39.3	Good	136.9	22	6.22	8.31	84.62	10.71	Fairly High	n/c

1.13 References

Berthinussen, A. and Altringham, J. (2016). Development Of A Cost Effective Method For Monitoring The Effectiveness Of Mitigation For Bats Crossing Linear Transport Infrastructure. University of Leeds/DEFRA.

Bibby, C., Burgess, N.D., Hill, D., and Mustoe, S. (2000). Bird Census Techniques. Second Edition, Academic Press, London, England.

Bidwells (2024). Muir of Thorn and Gelly Woods. Particulars. Online. Available at: https://assets.reapit.net/bid/live/pdf.php?p=RPE240054&t=S (Accessed March 2025).

Birks, J. D. S., Messenger, J. E. and Halliwell, E. C. (2005). Diversity of den sites used by pine martens *Martes martes*: a response to the scarcity of arboreal cavities? Mammal Review. 35: 313-320.

BTO (2024a). BTO Data Report. Pass of Birnam to Tay Crossing_500. Report prepared for Transport Scotland.

BTO (2024b). BTO Data Report. Pass of Birnam to Tay Crossing_2k. Report prepared for Transport Scotland.

Campbell-Palmer, R., Gow, D., Schwab, G., Halley, D., Gurnell, J., Girling, S., Lisle, S., Campbell, R., Dickinson, H., Jones, S., Parker, H., and Rosell F. (2016). The Eurasian Beaver Handbook: Ecology and Management of Castor fiber. Pelagic Publishing Ltd.

Chadd, R. and Extence, C. (2004). The conservation of freshwater macroinvertebrate populations: a community-based classification scheme. Aquatic Conservation: Marine and Freshwater Ecosystems, 14, 597-624.

Chanin, P. (2003). Ecology of the European Otter. Conserving Natura 2000 Rivers. Ecology SeriesNo.10. English Nature, Peterborough.

Clarke, R.T., Armitage, P.D., Hornby, D., Scarlett, P. and Davy-Bowker, J. (2003). Investigation of the relationship between the LIFE index and RIVPACS. R&D Technical Report W6-044/TR1.

Collins, J. (ed.) (2016). Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). The Bat Conservation Trust, London.ISBN-13 978-1-872745-96-1.

Collins, J. (ed.) (2023). Bat Surveys for Professional Ecologists: Good Practice Guidelines (4th Edition). The Bat Conservation Trust, London. ISBN-978-1-7395126-0-6.

Collins, J (ed). (2024). Bat Surveys for Professional Ecologists: Good Practice Guidelines (4th Edition) – Amendments and Q &A. The Bat Conservation Trust.

Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series). Eds Fiona Matthews and Paul Chanin. The Mammal Society, London.

Croose, E., Birks, J.D.S. and Schofield, H.W. (2013). Expansion zone survey of pine marten (Martes martes) distribution in Scotland. Scottish Natural Heritage Commissioned Report No. 520.

Edgar, P., Foster, J. and Baker, J. (2010). Reptile Habitat Management Handbook – Amphibian and Reptile Conservation, Bournemouth.

Environment Agency (2012). Freshwater macroinvertebrate sampling in rivers. Operational instruction. Document no. 018_08.

Extence, C.A., Balbi, D.M. and Chadd, R.P. (1999). River flow indexing using British benthic macroinvertebrates: A framework for setting hydroecological objectives. Regulated Rivers: Research and Management, 15, 543-574.

Extence, C.A., Chadd, R.P., England, J., Dunbar, M.J., Wood, P.J. and Taylor, E.D. (2011). The assessment of fine sediment accumulation in rivers using macroinvertebrate community response. River Research and Applications, 29, 17-55.

Froglife (1999). Reptile Survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation . Froglife Advice sheet 10. Froglife, Halesworth. https://www.wildcare.co.uk/media/wysiwyg/pdfs/froglife_advice_sheet_10_-_reptile_surveys.pdf (Accessed July 2023)

Gilbert, G., Gibbons, D.W. and Evans, J. (2012). Bird Monitoring Methods: a manual of techniques for key UK species. RSPB, Sandy.

Gurnell, J., Lurz, P., Macdonald, R. and Pepper, H. (2009). Practical techniques for surveying and monitoring squirrels. Forestry Commission Practice Note. Forestry Commission, Edinburgh.

Harris, S., Cresswell, P., and Jefferies, D. (1989). Surveying Badgers. An Occasional Publication of the Mammal Society – No. 9

Harvey J & Cowx I (2003). Monitoring the River, Brook and Sea Lamprey, Lampetra fluviatilis, L. planeri and Petromyzon marinus. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough

Hawkes, H.A. (1997). Origin and development of the Biological Monitoring Working Party score system. Water Research, 32(3), 964-968.

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

Maitland, P. (2003). Ecology of the river, brook and sea lamprey. Conserving Natura 2000 rivers. Ecology Series No.5. English Nature, Peterborough.

Maitland, P. (2007). Scotland's Freshwater Fish: Ecology, Conservation and Folklore. First edition. Trafford Publishing

Marine Scotland (2024). Species Distribution Database – Scottish Salmon Rivers. Online. Available at: https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=843 (Accessed March 2025)

NatureScot (2020a). Wildcat Survey Methods. Online. Available at: https://www.nature.scot/sites/default/files/2018-04/Guidance-Wildcat-Survey-Methods.pdf (Accessed December 2020).

NatureScot (2020b). Species Planning Advice - Reptiles (adder, slow worm & common lizard). Online. Available at: https://www.nature.scot/sites/default/files/2018-04/Guidance-Reptiles-Protected-species-advice-for-planners-adders-slow-worm-and-common-lizard.pdf (Accessed December 2020).

NatureScot (2024a). Species Planning Advice - Badger. Online. Available at: https://www.nature.scot/species-planning-advice-badger (Accessed October 2024).

NatureScot (2024b). Standing Advice for Planning Consultations – Protected Species: Red Squirrel. Online. Available at: https://www.nature.scot/doc/standing-advice-planning-consultations-red-squirrels (Accessed October 2024).

NatureScot (2024c). Species Planning Advice – Water Vole. Online. Available at: https://www.nature.scot/species-planning-advice-water-vole (Accessed October 2024).

NatureScot (2024d). Standing advice for planning consultations - Pine Martens. Online. Available at: https://www.nature.scot/doc/standing-advice-planning-consultations-pine-martens (Accessed October 2024).

NatureScot (2025). Guidance Licencing – Badgers - What is a badger sett? Online. Available at: https://www.nature.scot/doc/guidance-licensing-badgers-what-badger-sett (Accessed April 2025).

NatureScot (undated). Freshwater Pearl Mussel Survey Protocol – for use in site-specific projects. https://www.nature.scot/sites/default/files/2018-04/Freshwater-pearl-mussel-survey-protocol-for-use-in-site-specific-projects.pdf (Accessed October 2024).

National Roads Authority (2009). Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. National Roads Authority Guidelines for Assessment of Ecological Impacts of National Road Schemes. Transport Infrastructure Ireland.

NBN Trust (2024). The National Biodiversity Network (NBN) Atlas occurrence download at https://nbnatlas.org/ accessed on 09 July 2024.

Sewell, D., Griffiths, R.A., Beebee, T.J.C., Foster, J. and Wilkinson, J.W. (2013). Survey Protocols for the British Herpetofauna Version 1.0.

SEPA (2024). Request for information. Data provided to Jacobs UK Ltd.

Scottish Badgers (2018). Surveying for Badgers: Good Practice Guidelines. Version 1.

Scottish Fisheries Co-ordination Centre. (SFCC) (2007). Habitat Surveys Training Course Manual. pp. 1-64.

Skinner, A., Young, M. and Hastie, L. (2003). Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers Ecology Series No. 2 English Nature, Peterborough.

Stanbury, A., Eaton, M., Aebischer, N., Balmer, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D., and Win I. 2021. The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. British Birds 114: 723-747.

Strachan, R., Moorhouse, T. and Gelling, M. (2011). Water Vole Conservation Handbook – 3rd Edition, Wildlife Conservation Research Unit, Oxford.

Transport Scotland (2015). A9 Dualling Programme Strategic Study Report. Preliminary Ecological Appraisal, South Scheme, Tay Crossing to Glen Garry. Report to Transport Scotland, January 2015.

UKHab Ltd (2023). UK Habitat Classification Version 2.0. Online. Available at https://www.ukhab.org (Accessed October 2024).

WFD-UKTAG. (2014). River Assessment Method Benthic Invertebrate Fauna Invertebrates (General Degradation): Whalley, Hawkes, Paisley and Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT).