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Appendix A12.2: Baseline Data and Detailed Survey Methods

1 Purpose of Appendix

1.1.1 This appendix provides detailed information on the survey baseline for the ecological features outlined in Chapter 12 (Ecology and Nature Conservation). Additional details on the multiple survey methods for bats, breeding birds and aquatic surveys, as well as details of additional Phase 1 and Phase 2 habitat surveys, are presented in this appendix to complement the information supplied in Chapter 12. Baseline information for badger, otter, freshwater pearl mussel (FWPM) and Schedule 1 bird species can be found in the Appendix A12.3 (Confidential Ecology Features).

2 Online Data

2.1.1 National Biodiversity Network (NBN)[1] data has been used, where appropriate, to assess the occurrence of ecological features within the study area as indicated within Section 12.2 of Chapter 12. The data search of NBN omitted records pre-1986 as thirty years was considered a sufficient time period for records to inform the baseline for all species. Although historically recorded in the area, no records of water vole were available post-1960.

2.1.2 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 1.

Table 1: NBN data providers, recorders and dataset licence

Ecological Receptor	Data Provider	Recorder(s)	Licence
Badger	Highland Biological Recording Group (HBRG)	Unidentified	CC-BY*
Bats	Scottish Natural Heritage (SNH)	Unidentified	OGL**
	Bat Conservation Trust (BCT)	Unidentified	CC-BY*
	National Trust for Scotland	Anna Jennings Diane Megias	CC-BY*
Otter	SNH	Unidentified	OGL**
	HBRG	Neil Redgate Greg Fullarton Owen Newton Jonathan Groom Peter Nairne Scott Reilly Stefan Morrocco Unknown to HBRG	CC-BY*
	Joint Nature Conservation Committee (JNCC)	Unidentified	OGL**
Pine marten	Biological Records Centre	R.E. Youngman	CC-BY*
	SNH	Unidentified Henry Schofield	OGL**
Red squirrel	HBRG	Jonathan Groom Willie MacDougal Unknown to HBRG	CC-BY*
	Scottish Wildlife Trust (SWT)	Names not specified due to high number of recorders. Full list available on the NBN website.	CC-BY*
	Lorn Natural History Group	Johnathan Groom	CC-BY*
	Natural Trust for Scotland	Louise Medine	CC-BY*

1 NBN Atlas replaced NBN Gateway in April 2017. Data searches were undertaken using NBN in 2016.

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Ecological Receptor	Data Provider	Recorder(s)	Licence
Scottish wildcat	SNH	Alan Ross Peter Ferns Rob Coupe	OGL**
Common lizard	HRBG	Johnathan Groom Unknown to HBRG	CC-BY*
	Amphibian and Reptile Conservation	N-LW	CC-BY*
	SWT	Loch of the Lowes (LOL) Staff and volunteers	OGL**
Northern damselfly	Dragonfly Recording Network	Pat Batty R.E. Youngman M. Thompson Tricia Thompson Lynette Borradaile Jonathon Groom Polly Freeman Andy Riches Jonathon Wilet Norman Elkins Nigel Slater R. Perkins Tim G. Beynon H. Addlesee Audrey Edgar R.J. Penson B. Smith David Pryce Graham Sherwin E.M. Smith Susan and Keith Futter Stephen Place Nigel Muddiman David Clarke R.W.J. Smith Betty and Bob Smith C.D. Lowmass Steve M. Hewitt John R.G. Turner G. and Tel Hinchon Mark G. Telfer Eric and Leslie McCabe Mike Thurner John Paul Rosalind A.H. Smith	CC-BY*
	HBRG	Jonathan Groom	CC-BY*
Roe Deer	SWT	LOL staff and volunteers	CC-BY*
	HBRG	Roger Cottis	CC-BY*
	National Trust for Scotland	Louise Medine	CC-BY*
	BRC	H.I. Leitch Unidentified	CC-BY*
Beaver	SNH	Dr Ruaraidh Campbell	OGL**

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** Open Government Licence Version 3 (http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/)

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3 Bats

3.1.1 Survey methods are summarised in Table 12.1 of Chapter 12 (Ecology and Nature Conservation). Further details of the survey and analysis methods are provided in the following sections.

Desk-study Data

3.1.2 As part of the ecological constraints surveys for the preliminary and detailed Ground Investigation (GI) contracts, trees with bat roost potential were identified and subject to climbed inspections in October 2016 and February/March 2017. Nineteen trees were identified as having high/moderate bat roost potential, of which sixteen were located within 50m of the design extent (HEL, 2017). These are in addition to the trees identified during the ground-based roost assessments detailed below.

Roost Surveys – Ground-based Roost Assessments

3.1.3 Ground-based roost assessment data collected at DMRB Stage 2 were carried forward to inform the DMRB Stage 3 survey requirements and assessment. This data was updated following design changes at DMRB Stage 3 and is presented in Tables 2 to 4.

3.1.4 Detailed ground-based roost assessments were undertaken on buildings, structures and trees under the footprint of the proposed scheme (including up to 50m from the proposed earthworks, for trees and structures, as specified in the Outline Approach to Consistency paper (Transport Scotland, 2015a)). These 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.

3.1.5 Liaison with landowners identified bat presence in four buildings outwith the footprint, but within 50m of the proposed scheme. These were subject to a similar level of survey effort as buildings under the proposed footprint. A further two buildings were also surveyed, one of which (Guay farmhouse, BB3.12) falls under the proposed footprint, and another which now is located outwith 50m of the proposed scheme footprint, following changes to the side road design.

3.1.6 The remainder of the buildings assessed (33 in total), where access was not available, were assessed at a preliminary ecological appraisal level (Collins, 2016) whereby their roosting potential was assessed from a distance in combination with the buildings proximity to high, moderate and low quality habitat.

3.1.7 Results of the ground-based roost assessments are presented in Tables 2 to 4. Where activity surveys subsequently identified roosts, this is reflected in the data provided. Of the 39 structures surveyed, 23 had negligible summer roost potential and 27 had negligible winter roost potential. One of the 39 buildings had negligible winter roost potential. Buildings and structures of negligible roost potential are excluded from Tables 2 and 3. The locations of these features are shown on Figure 12.5.

Table 2: Results of the bat buildings assessments for summer and winter roost potential

Distance from Scheme	Building Summer Roost Potential					Building Winter Roost Potential				
	Confirmed Roost	High	Moderate	Low	Total	Confirmed Roost	High	Moderate	Low	Total
0m	1	0	0	0	1	1	0	0	0	1
0m+ to 10m	0	0	0	1	1	0	0	0	0	0
10m+ to 30m	3	2	2	1	8	0	5	1	2	8
30m+ to 50m	2	5	0	2	9	0	2	4	3	9
50m+	1	3	13	3	20	0	0	12	8	20

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Distance from Scheme	Building Summer Roost Potential					Building Winter Roost Potential				
	Confirmed Roost	High	Moderate	Low	Total	Confirmed Roost	High	Moderate	Low	Total
Total	7	10	15	7	39	1	7	17	13	38

Table 3: Results of the bat structures assessments for summer and winter roost potential

Distance from Scheme	Structure Summer Roost Potential					Structure Winter Roost Potential				
	Confirmed Roost	High	Moderate	Low	Total	Confirmed Roost	High	Moderate	Low	Total
0m	1	1	2	2	6	0	2	0	3	5
0m+ to 10m	0	0	0	1	1	0	0	0	1	1
10m+ to 30m	0	0	1	0	1	0	0	0	1	1
30m+ to 50m	0	0	1	1	2	0	0	0	2	2
50m+	1	0	1	4	6	0	1	0	2	3
Total	2	1	5	8	16	0	3	0	9	12

Table 4: Results of the bat trees roost assessment for significant bat roosts (roosts and high potential/1* category trees)

Distance from Scheme	Number of Roost Trees	Number of High Potential Trees	Grand Total
0m	2[1]	7	9
0m+ to 10m	1	10	11
10m+ to 30m	0	10	10
30m+ to 50m	1	9	10
50m+	0	11	11
Total	4	47	52

[1] BT 3.8 was subsequently identified as a roost by Heritage Environmental Ltd, (HEL) as part of surveys prior to ground investigation works.

Roost Surveys - Summer Emergence and Re-entry Surveys

3.1.8　Surveys at DMRB Stage 3 were carried out using hand-held frequency division bat detectors (Batbox Duet) with Creative Zen, Transcend Mp330 or Tascam DR-05 linear PCM recorders, and complemented by Anabat Express and Anabat SD1 zero-crossing detectors, and Anabat Walkabout and Echo Meter Touch full spectrum detectors. Acoustic files were analysed using BatSound 4.2, Analook W V4.1z or Analook Insight version 21926.

3.1.9　Nine roosts were confirmed through summer emergence and re-entry surveys. Detailed results of these surveys are presented in Table 5 and the location of these features are shown on Figure 12.5.

Roost Surveys - Mist Netting Surveys

3.1.10　Mist netting was conducted at BB 3.12 to confirm the species of *Myotis* bat roosting in the building, and to ascertain the status of the roost as a maternity colony. Mist netting was conducted following consultation with SNH. Two mist netting sessions were conducted by suitably licensed bat ecologists with the permission to take bats by mist netting, in June and July 2017 following the method agreed by SNH in an email dated 08 June 2017 (SNH, 2017).

3.1.11　Mist nets of various lengths (12, 9, 6 and 3m) with a mesh size of 14mm, were deployed to the north of the property where the *Myotis* bats were thought to be roosting. The nets were positioned so that chances of capturing bats emerging (dusk surveys) or re-entering (dawn surveys) the building were maximised. For dawn surveys, nets were deployed two hours before sunrise and closed at sunrise.

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For dusk surveys nets were deployed immediately before sunset and closed 2.5 hours after sunset. A constant presence at the nets was maintained throughout the surveys so caught bats could be examined and released immediately.

3.1.12 Bats were extracted from the nets, identified and measured and their reproductive status was assessed. Once examined, they were released. Extraction, processing and handling was prioritised for pregnant females over males and was kept to a minimum to reduce stress.

3.1.13 Three species of bat were caught during the surveys namely; brown long-eared bat, Natterer's bat and soprano pipistrelle. Full results of the mist netting surveys at BB3.12 are presented in Table 5.

Roost Surveys - Winter Hibernation Surveys

3.1.14 Where buildings, structures or trees were assessed as having potential to be used by hibernating bats, inspection surveys were conducted and static bat detectors (Anabat Express and Anabat SD1 bat detectors) were deployed for a minimum of ten days over winter (January-February) (adapted from Hundt, 2012) to give an indication of bat presence over winter. The data have been analysed using Analook W v4.1 software.

3.1.15 The results of these surveys identified one confirmed hibernation roost (BB 3.12), three structures with high hibernation potential (BS 2.22, BS 3.7, BS 3.31) and one tree with high hibernation potential (BT 3.29). All features (except BS 2.22) are confirmed summer roosts also.

3.1.16 The findings of the hibernation inspections are detailed in Table 5 below. Note that only features with confirmed roosts have been presented.

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Confirmed Roost Summary

Table 5: DMRB Stage 3 survey results of all confirmed bat roosts found during all types of roost surveys

Reference	Distance From Scheme	Survey Dates	Survey Type	Roosting Species	Roost Type	Details	Figure Reference
BT 3.34	30m+ to 50m	02.06.2015	Ground-based assessment	Common pipistrelle	Likely summer roost of a common species.	Droppings found at base of tree were DNA tested and found to be that of common pipistrelle.	12.5b
BT 3.29	0m	02.05.2015	Ground-based assessment	Brown long-eared bat (BLE)	Likely transitory roost of an uncommon species.	Droppings found on butt rot during woodland assessment in February and March 2015. Sample DNA tested and found to be that of brown long-eared species.
No bat emergence or re-entry was observed during surveys.
No bats observed during hibernation inspection.	12.5c
		17.08.2015 25.08.2015 18.09.2015	Emergence/ re-entry surveys				
		04.03.2016	Hibernation survey				
		17.08.2015 to 25.08.2015	Passive monitoring				
BT 3.26	10m+ to 30m+	02.05.2015	Ground-based assessment	Unknown bat species	Likely summer roost of a common species.	Two potential droppings found at woodland assessment.	12.5d
BT 3.8	0m	02.04.2015	Ground-based assessment	Pipistrelle species	Likely hibernation/ transitory roost.	Identified as a high potential bat roost tree during ground-based assessments and subsequently identified as a hibernation/ transitory roost by HEL as part of ecological constraints surveys prior to ground investigation works.	12.5c
		17.03 2017	Endoscope inspection by HEL				
BS 3.7	0m	03.02.2015	Ground-based assessment	*Myotis* species, possible BLE	Summer roost for small numbers of two uncommon species. Not maternity roosts.	During an inspection on the first emergence survey a bat, thought to be a BLE, was observed in a crack on the underside of the span, and later emerged. On the second survey two to three Myotis species bats may have emerged and one Myotis species bat was observed swarming but not re-entering under the span – pipistrelle species, Myotis and BLE were active throughout the survey. No emergence or re-entry was seen on the third survey.
No bats observed during hibernation inspection.
No bats recorded during hibernation passive monitoring.	12.5b
		12.05.2015 07.07.2015	Emergence surveys				
		05.08.2015	Re-entry survey				
		28.01.2016 04.03.2016	Hibernation survey				

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Reference	Distance From Scheme	Survey Dates	Survey Type	Roosting Species	Roost Type	Details	Figure Reference
BS 3.31	50m+	04.03.2015	Ground-based assessment	*Myotis* species, pipistrelle and unknown bat species	Likely summer roosts for an uncommon species (Daubenton's bat) and a likely common species (pipistrelle species). Possible mating and hibernation roost for *Myotis* (likely Daubenton's) bats.	On the second survey four *Myotis* species bats, one unknown bat and one pipistrelle species bat may have emerged from the structure. Two *Myotis* bats (likely Daubenton's) were observed swarming under the span - this was potentially mating swarming activity and indicates a high likelihood of the site being used for hibernation by *Myotis* species bats. Droppings collected during a ground assessment survey were identified as Daubenton's bat by DNA analysis. No bats observed during hibernation inspection. No bats recorded during hibernation passive monitoring.	12.5d
		25.08.2015	Emergence survey				
		07.08.2015 04.09.2015	Re-entry surveys				
		14.01.2016 26.01.2016	Hibernation surveys				
BB 3.29	50m+	30.04.2015 14.10.2015	Ground-based assessment	Soprano pipistrelle	Possible maternity roost of a common species.	An internal inspection of the attic was conducted during the ground assessment in October 2015. Bat droppings were collected from the attic and window sill. DNA test confirmed soprano pipistrelle.	12.5c
BB 3.6	0m+ to 10m	03.03.2015	Ground-based assessment	Soprano pipistrelle	Possible maternity roost of a common species.	No bats seen during re-entry surveys in August 2015. However, ten to fourteen soprano pipistrelles observed re-entering near a window on the building during a transect survey in October 2015.	12.5c
		10.08.2015	Re-entry survey				
BB 3.5	10m+ to 30m	10.08.2016	Re-entry survey	BLE and soprano pipistrelle	Likely maternity roost of an uncommon species (BLE) and non-breeding summer roost of a common species (soprano pipistrelle).	Twelve BLE and three soprano pipistrelles (confirmed by dropping DNA analysis) entered at two roost locations on a single survey.	12.5c
BB 3.1a	30m+ to 50m	02.03.2015	Ground-based assessment	Common and soprano pipistrelle, BLE.	Likely maternity roost of a common species (soprano pipistrelle). Likely summer roosts for small numbers of a common species (common pipistrelle) and a rarer species (BLE). Likely transitory roost of a common species (pipistrelle species).	Eighty-two soprano pipistrelles (species confirmed by dropping DNA analysis) emerged from four main roost points at the first of three surveys. Three BLE and three soprano pipistrelles emerged from two further locations. One soprano pipistrelle emerged on the second survey. On the third survey, eight pipistrelle species bats and one common pipistrelle emerged from two locations.	12.5c
		13.08.2015 01.09.2015 09.08.2016	Emergence surveys				
BB 3.1b	10m+ to 30m	02.03.2015	Ground-based assessment	Common and soprano pipistrelle	Likely non-breeding summer roosts of two	Three soprano pipistrelles emerged from two locations on the first survey. On the second survey one soprano	12.5c

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Reference	Distance From Scheme	Survey Dates	Survey Type	Roosting Species	Roost Type	Details	Figure Reference
		13.08.2015 01.09.2015 09.08.2016	Emergence surveys		common species.	pipistrelle emerged. On the third survey one common and one soprano pipistrelle emerged from two roost locations.	
BB 3.12 Guay Farmhouse (Range and Wing)	0m	03.03.2015	Ground-based assessment	Common pipistrelle, soprano pipistrelle and *Myotis* species, (Natterer's bat) and BLE	Maternity roost of a common species (common pipistrelle) and of rarer species (BLE, Natterer's bat). Summer roost for small numbers of a common species (common and soprano pipistrelle). Hibernation roost for a common species (pipistrelle bat)	Approximately 55 common pipistrelles, 12 individuals of *Myotis* species bats and two possible BLE emerged on the first survey undertaken in July 2015. DNA test on droppings found at this survey were found to be BLE. On the second survey approximately seven BLE re-entered near a chimney of the Range and approximately six *Myotis* species bats re-entered the Wing. Two pipistrelle species bats entered the Wing at the same point. During the survey in May 2017 approximately ten BLE re-entered the roof of the Range along with 25 common pipistrelle bats. Approximately seven *Myotis* species bats re-entered the Wing. Furthermore, two soprano pipistrelle bats entered the Range during the dawn survey. DNA tests on droppings found at this survey (May 2017) were found to be BLE bat, common pipistrelle and Natterer's bat. During the June 2017 survey, approximately 73 common pipistrelle and five BLE bats re-entered at the Range. One *Myotis* bat also emerged to the roof of the Range. Four common pipistrelle and five *Myotis* species bats re-entered the Wing. During the July survey, activity was low and only two BLE and two common pipistrelle bats were observed re-entering the Wing. During the August survey two *Myotis* bats emerged from the Wing and 14 from the Range, with the majority using the same emergence point as the common pipistrelle maternity colony. Two soprano pipistrelle bats also emerged from the Range.	12.5d
		22.07.15	Emergence survey				
		09.08.2016	Re-entry survey				
		17.05.2017 15.06.2017 29.08.2017	Emergence survey				
		16.06.2017 18.05.2017 11.07.2017	Re-entry survey				
		24.02.2016 04.03.2016 18.12.2017	Hibernation Surveys				

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Reference	Distance From Scheme	Survey Dates	Survey Type	Roosting Species	Roost Type	Details	Figure Reference
		15.06.2017 16.06.2017 10.07.2017	Mist Netting			During hibernation surveys in 2016, BLE bats and three pipistrelle species bats (likely common pipistrelle) observed roosting in an alcove lintel in the Wing. Droppings collected were DNA tested and found to be that of BLE bat. Common pipistrelle, BLE and potential Myotis bats calls were recorded on a passive detector. During hibernation surveys in 2017, seven pipistrelle species bats (likely common pipistrelle) were observed roosting in an alcove lintel in the Wing. The June mist netting survey at dusk (15.06.2017) caught: • five BLE bats, two males and three pregnant females. • one soprano pipistrelle bat (pregnant female). The June mist netting survey at dawn (16.06.2017) caught: • five BLE bats, one male and four pregnant females. • one Natterer's bat (pregnant female). The July mist netting survey at dusk (10.07.2017) caught: • two Natterer's bats (lactating female and non-breeding female). • three soprano pipistrelle bats (lactating female and two males).	
BB 3.13	30m+ to 50m	03.03.2015	Ground-based assessment	Common and soprano pipistrelles and unknown bat species.	Likely summer roosts for small numbers of a common species (soprano and common pipistrelles) and a likely common species (pipistrelle species and unknown species).	Five soprano pipistrelle bats, four common pipistrelle bats (species confirmed by dropping DNA analysis) and three unknown bat species emerged from six roost locations on the first survey. On the second survey two soprano pipistrelles bats, three pipistrelle species bats and one bat of unknown species emerged from two roost locations.	12.5d
		03.09.2015 08.08.2016	Emergence surveys				

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Activity Surveys

3.1.17   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 as potential bat flight lines and were surveyed using static detectors at DMRB Stage 3.

Passive Monitoring at Bridges and Culverts

3.1.18   Surveys at DMRB Stage 3 were carried out using static detectors (Anabat Express and Anabat SD1 bat detectors). Detectors were deployed for a minimum of fourteen nights over spring, summer and autumn (adapted from Hundt, 2012). This spread, throughout May to September, covers the periods when bats would be expected to be most active; during the pre-maternity, maternity, and post-maternity seasons, respectively.

3.1.19   The acoustic sound files were analysed using Analook W v4.1 software.

3.1.20   In the absence of guidance on criteria for transforming the number of echolocation calls detected into relative activity levels, a method was developed, with reference to Dowse et al., (2015), to enable a comparison between the sites surveyed and enabled mitigation to be designed.

3.1.21   This valuation was based on:

- overall activity levels (recorded as bat passes per night for all species);
- species richness; and
- presence of rare species (as defined in Wray et al., 2010).

3.1.22   To create the activity index for structures, the interquartile range (IQR) was calculated. The IQR is a measure of variability, which is based on a rank-ordered dataset being divided into four equal parts, called quartiles (Q). The thresholds are Q1, Q2 and Q3, and the IQR is the range Q3 minus Q1, which accounts for 50% of data points.

3.1.23   The activity data, measured as the bat passes per night (BPpN), was combined for all species across the Southern Section Projects of the A9 Dualling Programme. Using this combined dataset made the interquartile ranges more robust.

3.1.24   Across the four Southern Section Projects (Projects 02 to 05: Pass of Birnam to Glen Garry), passive monitoring was undertaken at 36 locations. Results from two sites were identified as being outliers, and were removed from the calculation of the IQR to avoid distorting the calculation and potentially undervaluing other locations. Quartiles 1 and 3 were then calculated using the remaining 34 sites, which in this instance was 6.95 to 162.8 BPpN.

3.1.25   This provided three categories, which were used to assign High, Moderate or Low activity to each structure:

- High activity: BPpN above the third quartile (>162.8 BPpN);
- Moderate activity: BPpN between the first and third quartiles (6.95 to 162.8 BPpN); and
- Low activity: BPpN below the first quartile (<6.95 BPpN).

3.1.26   Species richness was determined by the number of each species recorded at each location. Where species were unknown, or pipistrelle species could not be discerned, these records were excluded from the species richness. Categories of species richness were assigned according to the following:

- High species richness: four species or more;
- Moderate species richness: two or three species; and

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- Low species richness: one species.

3.1.27   An index value for rarity was calculated using the same approach as above, calculating the IQR of BPpN across the Southern Section Projects, but only including Myotis species and BLE, which were taken as being rarer species (Wray et al., 2010). Values of High, Moderate and Low were assigned to the quartile ranges, with the following data thresholds:

- High rarity: rare species BPpN above the third quartile (>1.09 BPpN);

- Moderate rarity: rare species BPpN between the first and third quartiles (0.25 to 1.09 BPpN); and

- Low rarity: rare species BPpN below the first quartile (<0.25 BPpN).

3.1.28   An overall value of each passive monitoring location was calculated by assigning three points to each result of High, two points for Moderate and one point for Low. The total points for each feature then equated to an overall value as follows:

- High value for total scores of eight and nine;

- Moderate value for total scores of five, six and seven; and

- Low value for total scores of three and four.

3.1.29   The overall values of the passive monitoring locations are presented in Table 6 and the locations of these features are shown on Figure 12.6. Table 7 provides the percentage split by species of the total bat activity.

Table 6: Index values for activity, species richness, and rarity for passive monitoring locations, and overall scores

Structure	Activity	Species Richness	Rarity	Overall Score	Overall Value
BS 3.20	High	High	High	9	High
BS 3.22	Moderate	High	Moderate	7	Moderate
BS 3.29	Moderate	High	Moderate	7	Moderate
BS 3.30	Moderate	High	Moderate	7	Moderate

Table 7: Percentage call abundance and bat activity per night at passive monitoring locations

Structure	Percentage Species Call Abundance						Total BPpN
	Myotis Species	BLE	Pipistrelle Species	Common Pipistrelle	Soprano Pipistrelle	Unknown	
BS 3.20	2.61	0.44	0.44	0.52	95.66	0.32	249
BS 3.22	4.07	2.44	1.63	49.59	40.65	1.63	7.412
BS 3.29	0.94	5.66	0.00	35.85	33.96	23.58	12.4
BS 3.30	2.94	0.59	0.00	71.18	25.29	0.00	19.44

Manual Bat Activity Transects

3.1.30   Five 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).

3.1.31   Surveys at DMRB Stage 3 were carried out using hand-held frequency division bat detectors (Batbox Duet) with Creative Zen, Transcend Mp330 or Tascam DR-05 linear PCM recorders. Trimble Juno T41/5 and the Apple iPad mini 4 (Apple A8, iOS, Wi-Fi and cellular) hand held GPS units were used to record the position of each registration and observation.

3.1.32   The acoustic sound files were analysed using Analook W v4.1 software.

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3.1.33 Activity was measured in bat passes per hour (BPpH). IQR were created as for passive monitoring (overall activity, species richness and rare species activity) and an overall index value was then created for each transect using the following data ranges:

Activity index:

- High activity: BPpH above the third quartile (>19.10 BPpH);

- Moderate activity: BPpH between the first and third quartiles (7.22 to 19.10 BPpH); and

- Low activity: BPpH below the first quartile (<7.22 BPpH).

Species richness:

- High: four species or more;

- Moderate: between two and three species; and

- Low: fewer than two species.

Rarity:

- High rarity: rare species BPpH above the third quartile (>0.19 BPpH);

- Moderate rarity: rare species BPpH between the first and third quartiles (0.01 to 0.19 BPpH); and

- Low rarity: rare species BPpH below the first quartile (<0.01 BPpH).

3.1.34 An overall value of each transect was calculated by assigning three points to each result of High, two points for Moderate and one point for Low. The total points for each feature then equated to an overall value as follows:

- High value for total scores of seven and eight;

- Moderate value for total scores of five and six; and

- Low value for total scores of three and four.

3.1.35 Where species were unknown, or pipistrelle species could not be discerned, these records were excluded from species richness.

3.1.36 The overall values of the transects are presented in Table 8 and the locations of these features are shown on Figure 12.6. Table 9 provides the percentage split by species of the total bat activity.

Table 8: Index values for activity, species richness, and rarity for transects, and overall scores

Structure	Activity	Species richness	Rarity	Overall Score	Overall Value
T 3.1	Moderate	Low	Low	4	Low
T 3.2	Low	Low	Low	3	Low
T 3.3	Moderate	Moderate	High	7	Moderate
T 3.4	Moderate	Low	Low	4	Low
T 3.5	Low	Low	Low	3	Low

Table 9: Percentage call abundance and bat activity per hour of the walked transect route

Transect	Percentage Species Abundance				Total BPpH
	Myotis Species	Pipistrelle Species	Common Pipistrelle	Soprano Pipistrelle	
T 3.1	0.0	5.2	3.4	91.4	11.07
T 3.2	0.0	10.0	50.0	40.0	6.61
T 3.3	1.8	3.0	1.8	93.5	18.46
T 3.4	0.0	38.7	35.5	25.8	12.70
T 3.5	0.0	16.7	16.7	66.7	0.99

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Rare and Cryptic Species Monitoring

3.1.37 Where data search, survey or habitat assessment had shown the presence or potential presence of rare or rarer, and/or cryptic species within 300m of the mainline of the proposed scheme (Wray et al., 2010) additional passive monitoring was conducted. The results were used to help identify those areas of higher value to rare or rarer, and/or cryptic species of bats to allow mitigation to be designed if needed. Cryptic species are defined here as those with similarities in echolocation to other bat species, or those species with echolocation calls which are more difficult to detect.

3.1.38 Surveys at DMRB Stage 3 were carried out using static detectors (Anabat Express and Anabat SD1 bat detectors) deployed at ten locations for a minimum of four nights over mid-summer. See Figure 12.6 for the monitoring locations.

3.1.39 The acoustic sound files were analysed using Analook W v4.1 software. The data were used to determine the presence of these species that had not been picked up during previous surveys, and to determine the importance of the area being monitored for these species.

3.1.40 Cryptic species data were measured in bat passes per night (BPpN) of rare species. The IQR was calculated for rare species (Myotis species and BLE) across the Southern Section Projects. This range was used to assign High, Moderate or Low value to the monitoring location according to the following (Table 10). Where no rare species were recorded, an overall activity value of none was assigned:

- High activity: BPpN above the third quartile (>3.06 BPpN);

- Moderate activity: BPpN between the first and third quartiles (1.11 to 3.06 BPpN);

- Low activity: BPpN below the first quartile (<1.11 BPpN); and

- None: No rare species recorded.

Table 10: Number of rare bat passes and the overall activity value

Cryptic Species Monitoring (CSM) Location Name	*Myotis* Species Calls	BLE Calls	Nights of Recording	BPpN	Overall Activity Value
CSM Guay	40	4	18	2.44	Moderate
CSM GuayVP mid	10	2	11	1.09	Low
CSM GuayVP N	1	0	8	0.13	Low
CSM Guay 1	8	5	11	1.18	Moderate
CSM Guay 2	37	12	15	3.27	High
CSM Guay 3	1	0	4	0.25	Low
CSM Guay 4	76	7	12	6.92	High
CSM Ledpetty Lodge	549	1	22	25	High
CSM BT 3.29	14	1	7	2.14	Moderate
CSM Kindallachan	32	3	19	1.84	Moderate

4   Breeding Birds

4.1.1 An adapted Breeding Bird Survey (BBS), designed by the BTO, JNCC and RSPB (Bibby et al., 2000), was utilised. The standard BBS methodology (Bibby et al., 2000) recommends multiple survey visits spread across the breeding bird season (March-August inclusive). Due to the large survey area, the methodology was adapted to survey the total area once in July 2015. It is considered that by surveying the total area, the data provide a suitable indication of the species assemblage present across all habitat types within 150m from the mainline of the proposed scheme.

4.1.2 The survey area was divided into survey sectors that were 1km to 1.5km in length. Each survey team comprised two ecologists, including at least one specialist ornithologist. Survey work was undertaken each morning between dawn and 12:00 British Summer Time (BST) in optimum weather conditions for survey (light winds, good visibility and lack of persistent or heavy rain).

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4.1.3   A total of 1113 breeding records (birds recorded nesting, singing, acting territorially or in family groups) were logged during the breeding bird surveys. A total of 56 species (excluding Schedule 1 species) were recorded during the site surveys (including incidental data), of which 48 species were confirmed to have bred.

4.1.4   Two Schedule 1 species, barn owl and osprey, were recorded during the site surveys (details provided in Appendix A12.3: Confidential Ecology Features). A complete list of bird species recorded as breeding within the study area is shown in Table 11 where species are highlighted (red, amber or green) according to their classification as birds of conservation concern (Eaton et al., 2015). The locations of recordings are shown on Figure 12.7.

Table 11: Breeding bird records within the study area, their protection and conservation status

Species	Breeding Records	Species listed on SBL	Species listed on Tayside LBAP
Grey wagtail	3	No	No
Herring gull	1	Yes	Yes
House sparrow	9	Yes	Yes
Lapwing	2	Yes	Yes
Linnet	1	Yes	Yes
Mistle thrush	6	No	No
Song thrush	19	Yes	Yes
Starling	2	Yes	No
Wood warbler	2	Yes	Yes
Yellowhammer	12	Yes	Yes
Bullfinch	2	Yes	Yes
Common sandpiper	6	No	No
Dunnock	18	No	No
Mallard	10	No	No
Meadow pipit	5	No	No
Oystercatcher	10	No	Yes
Swift	3	Yes	Yes
Tawny owl	1	No	Yes
Willow warbler	62	No	No
Blackbird	37	No	No
Blackcap	12	No	No
Blue Tit	121	No	No
Buzzard	4	No	Yes
Carrion crow	4	No	No
Chaffinch	169	No	No
Chiffchaff	11	No	No
Coal tit	114	No	No
Collared dove	1	No	No
Garden warbler	3	No	No
Goldcrest	78	No	No
Goldfinch	8	No	Yes
Goosander	1	No	Yes
Great spotted woodpecker	1	No	Yes
Great tit	49	No	No
Greenfinch	1	No	No
Jackdaw	5	No	No
Jay	6	No	No
Long-tailed tit	11	No	No

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Species	Breeding Records	Species listed on SBL	Species listed on Tayside LBAP
Pied wagtail	6	No	No
Robin	112	No	No
Rook	3	No	No
Siskin	8	Yes	No
Swallow	5	No	Yes
Treecreeper	11	No	No
Wheatear	1	No	Yes
Whitethroat	1	No	No
Woodpigeon	27	No	No
Wren	129	No	No

5 Red Squirrel, Pine Marten and Wildcat

5.1.1 Incidental evidence of red squirrel and pine marten are detailed below in Table 12 and are shown in Figure 12.9. No incidental evidence of wildcat was observed.

Table 12: Incidental records of red squirrel and pine marten.

Species	Evidence	OS Grid Reference	Description of Incidental	Figure Reference
Red squirrel	Sighting	NO 00646 44275	Red squirrel sighting.	12.9a
Red squirrel	Potential drey	NO 00540 45639	Potential squirrel drey in fork of a tree near Warren Lodge.	12.9a-b
Red squirrel	Drey	NO 00545 45644	Active drey recorded during walkovers for GI works.	12.9a-b
Red squirrel	Sighting	NO 00518 45980	Red squirrel observed on tree in woodland east of General Wade's Military Road.	12.9b
Red squirrel	Sighting	NO 00429 46297	Red squirrel observed east of General Wade's Military Road.	12.9b
Red squirrel	Feeding signs	NO 00260 46703	One pine cone chewed by a squirrel in woodland east of the existing A9.	12.9b
Red squirrel	Potential drey	NO 00303 46995	Two possible squirrel dreys in a tree at a height of approximately 6m above ground level, west of Rotmell Cottages.	12.9b
Red squirrel	Sighting	NO 00157 48131	Red squirrel observed running across the slope behind Dowally Craft Centre.	12.9c
Red squirrel	Sighting	NO 00127 48297	Red squirrel observed in woodland north of Dowally.	12.9c
Red squirrel	Sighting	NO 00059 48334	Red squirrel observed crossing road to woodland east of existing A9.	12.9c
Red squirrel	Feeding signs	NO 00051 48511	Pine cones chewed by a squirrel in woodland east of the existing A9.	12.9c
Red squirrel	Feeding signs	NO 00037 49082	Pine cones chewed by a squirrel in woodland at Guay.	12.9c
Red squirrel	Sighting	NN 99979 49345	Red squirrel observed during walkovers for GI works.	12.9c
Red squirrel	Sighting	NN 99541 49785	Red squirrel observed in woodland at Kindallachan.	12.9c
Red squirrel	Feeding signs	NN 99212 50782	Pine cones chewed by a squirrel in woodland east of the existing A9.	12.9d
Red squirrel	Feeding signs	NN 98815 51134	Feeding station under large larch on west facing slope.	12.9d
Red squirrel	Sighting	NN 98783 51303	Red squirrel observed in trees east of the existing A9.	12.9d
Red squirrel	Sighting	NN 98899 51360	Red squirrel observed during walkovers for GI works.	12.9d
Red squirrel	Feeding signs	NN 98745 51719	Pine cones chewed by a squirrel in woodland east of the existing A9.	12.9d
Red squirrel	Drey	NN 98458 51744	Tree with structure against trunk at a height of approximately 12m from the ground. Chewed cones were recorded on the ground in the vicinity.	12.9d

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Species	Evidence	OS Grid Reference	Description of Incidental	Figure Reference
Red squirrel	Sighting	NN 98341 51815	Red squirrel observed east of General Wade's Military Road.	12.9d
Pine marten	Sighting	NO 00362 46100	Pine marten dead on the road.	12.9b
Pine marten	Sighting	NN 99807 49126	Pine marten observed on rafter of building.	12.9c

6 Beaver

6.1.1 Incidental evidence of beaver is detailed below in Table 13 and is shown on Figure 12.9.

Table 13: Incidental records of beaver

Evidence	OS Grid Reference	Description of Incidental	Figure Reference
Foraging*	NO 00507 44408	Beaver gnawing.	12.9a
Foraging*	NO 00509 44345	Beaver gnawing.	12.9a
Felling*	NO 00490 44304	Felled tree.	12.9a
Foraging*	NO 00486 44262	Beaver gnawing.	12.9a
Felling*	NO 00437 44079	Felled trees.	12.9a
Felling*	NO 00441 44059	Felled tree, gnawing evident.	12.9a
Felling*	NO 00404 44269	Felled trees along west bank.	12.9a
Felling	NO 00437 45599	Reasonably fresh signs of beaver tree felling on edge of bank.	12.9a
Foraging	NO 00425 45579	Beaver foraging activity.	12.9a
Felling	NO 00419 45521	Beaver felling on small willow and alder covered island in River Tay. Markings in muddy ground indicate recent beaver presence.	12.9a
Foraging	NO 00418 45509	Beaver foraging activity.	12.9a
Foraging	NO 00416 45419	Signs of old and fresh beaver gnawing on edge of River Tay.	12.9a
Foraging	NO 00392 45343	Beaver feeding station. Fresh gnawing on multiple branches leaning over water. Food cache in water.	12.9a
Burrow	NO 00334 45205	Steep tunnel in bank of River Tay (30cm wide x 40cm high). Markings on muddy slope indicate recent beaver presence. Unable to inspect hole properly.	12.9a
Print	NO 00329 45191	Beaver print and potential channel or blown out tunnel (50cm wide x 50cm high) on bank of River Tay. Old beaver gnawing on trees in vicinity.	12.9a
Print	NO 00429 44820	Beaver prints on sandy bank next to island.	12.9a
Burrow	NO 00439 44810	One hole (40cm x 25cm) under forked beech tree in centre of sandy inlet. Drystone wall at top of bank next to track. Identified as a mammal hole on 13/03/15. Roof obstructed by gnawed branch, sloped tunnel. Beaver gnawing in general vicinity and prints recorded (16/03/16). No signs of recent activity on 19/06/17.	12.9a
Burrow	NO 00425 44796	Two holes (south 40cm x 40cm, north 40cm x 20cm) in root cavity (3m w x 0.75m h x 1.5m d) at south end of sandy alcove across from island. Small gnawed branches within cavity and around entrance.	12.9a
Burrow	NO 00446 44779	One hole (35cm x 40cm) on water's edge 5m south of fence line. Tunnel wide for at least 5m then splits north and south. Sand on floor patted down. Two gnawed branches at entrance.	12.9a
Felling	NO 00405 44270	Signs of beaver tree felling.	12.9a
Foraging	NO 00404 44269	Multiple high density foraging and feeding sites along the west bank of the River Tay by the Tay Crossing.	12.9a
Felling	NO 00163 46918	Gnawed felled tree.	12.9b
Foraging	NN 99011 50086	Gnawed old tree.	12.9c
Foraging	NN 99003 50080	Foraging site. Six felled young ash and alder.	12.9c
Felling	NN 99003 50080	Signs of beaver felling.	12.9c

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Evidence	OS Grid Reference	Description of Incidental	Figure Reference
Foraging	NN 98744 50381	Beaver gnawed branches.	12.9c-d
Foraging	NN 97765 51244	Beaver gnawing.	12.9d

* denotes records that overlap with Project 2: Pass of Birnam to Tay Crossing

7 Reptiles

7.1.1 Results of the reptile surveys are presented in Table 14 and on Figure 12.10. Incidental records are presented in the subsection following Table 14.

Table 14: Results of reptile habitat assessment and surveys from south to north

Site	Habitat Description	Central Grid Reference	Area (ha)	ACOs Deployed	Species Recorded and Peak Adult Count			Current Reptile Habitat Status	Figure reference
					Adder	Common lizard	Slow worm		
1*	South-facing bank of low shrub coverage (H&S hazard late summer).	NO 00573 44394	3.70	40	1	4	2	Key Reptile Site	12.10a
2	South-facing bank of rough grassland and low shrub coverage.	NO 00285 46394	0.60	16	0	4	4	Key Reptile Site	12.10b
3*	South-facing bank of clearfell (H&S hazard late summer).	NO 00384 46604	0.55	8	0	1	3	Presence	12.10b
4*	South-facing bank of old clearfell with ruderals (H&S hazard late summer).	NO 00220 47720	0.46	8	0	1	3	Presence	12.10c
5	Tussock rough grassland with sparse low shrub and log piles.	NN 99502 50134	1.00	13	0	6	10	Key Reptile Site	12.10d
6	South-facing bank of rough grassland and low shrub coverage.	NN 99019 50835	1.00	15	0	5	13	Key Reptile Site	12.10d-e
7	Tussock rough grassland with sparse low shrub and log piles.	NN 98561 51658	0.60	8	0	1	2	Presence	12.10e

* Survey sites not subject to full eight visits.

Incidental Records

7.1.2 An adult female slow worm was observed on the Kindallachan cycle track at NN 99211 50547 in June 2017 (Figure 12.10d).

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8 Water Vole

8.1.1 No field signs or suitable habitat was recorded during the DMRB Stage 3 site surveys.

9 Phase 1 Habitat Survey

9.1.1 Target notes, detailing habitats and plant species, from the A9 Dualling Programme route-wide Phase 1 habitat survey (Transport Scotland, 2015b) are provided in Table 15. Target notes relating to Wildlife Vehicle Incidents (WVI) have been included also. It is assumed that the target notes were subject to appropriate quality assurance before being provided for use in this document.

9.1.2 Of note, the data from the A9 Dualling Programme route-wide Phase 1 habitat survey (Transport Scotland, 2015b) have been used solely to provide the baseline for habitats present within the study area. DMRB Stage 3 surveys provide a robust baseline for protected species within the study area. There were no protected species identified during the A9 Dualling Programme route-wide Phase 1 habitat survey that were not also recorded at DMRB Stage 3.

Table 15: A9 Dualling Programme route-wide Phase 1 habitat survey target notes

Target Note Reference	Grid Reference	Description	Figure Reference
TN06	NO 00471 45734	Large area of Japanese knotweed approx. 2m x 4m and 2m tall.	12.2b
TN07	NO 00487 45564	Coniferous woodland with a broadleaved edge. Block of mature Douglas fir with a suppressed ground flora. To the north of this along the burn is semi-natural woodland, a mix of ash, sycamore, beech and oak, with an understorey of wych elm; typical ground flora species include male-fern, bracken, tufted hair-grass, wood avens, common nettle, false brome and herb-Robert. North of this there is a small block of mature beech plantation with a very sparse ground flora, beside which there is a small patch of neutral grassland with common bent, false oat-grass, wood sage and raspberry. On the east side of the B road in this vicinity, below the extensive coniferous plantation, there is a narrow strip of broadleaved plantation of mature/semi-mature sycamore, beech and birch with rhododendron dominant underneath, and a sparse ground flora.	12.2a
TN08	NO 00515 45430	A stream/spring runs from the adjacent field under and down the side of the track.	12.2a
TN09	NO 00187 46416	Woodland is wet in places with ancient woodland indicators and series of ditches. Himalayan balsam in edges of woodland nearest to river. Semi-mature mixed plantation with a few larch but mainly sycamore and birch all of a similar age. There is red fescue and wavy hair-grass with abundant dog's mercury, occasional violet and rare bluebell.	12.2b
TN10	NO 00386 46217	Large stands of Japanese knotweed found along the bottom of the embankment. Some sections of Japanese knotweed had been strimmed.	12.2b
TN11	NO 00213 46609	Drain outlet and rock slope from forest and road above. Surrounded by broom and gorse scrub with young sycamore. Semi-mature conifers near roads edge. Valley bottom looks to be a storage lagoon (currently dry). Drains to facilitate flood water/snow melt – alder present. Japanese knotweed 1.5m to 2m tall about 3m x 1.5m in area close by. Damp un-mown strip below bank of dense gorse by A9. The grassland here is much better than the normal mown strip that runs in varying width along most of the A9. It is dominated by common bent and red fescue with frequent white clover, germander speedwell and tufted vetch. There is occasional ribwort plantain and common dog-violet, and more notably occasional prickly sedge and scattered marsh-orchids (most likely northern marsh-orchid: at least 15 spikes); cow parsley is rare.	12.2b
TN12a	NO 00372 46108	Dead deer on verge.	12.2b
TN12b	NO 00242 46677	Dead deer on verge.	12.2b
TN13	NO 00350 45943	Drain from Tay into plain/grassland below woodland. This area is formed of a channel/ditch containing water mint, northern bedstraw and crane's-gill with acidic species on the east side including a small amount of cross-leaved heath. To the west of the channel lies neutral mixed herb rich grassland with patchy	12.2b

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Target Note Reference	Grid Reference	Description	Figure Reference
		scrub of young willow, broom and alder towards the Tay.	
TN14	NO 00248 46867	Amenity grassland with some semi-improved behind with common knapweed, Yorkshire-fog, wood sage, lesser stitchwort. Slightly further along in a bowl near a wetland feature is a stand of Japanese knotweed and Himalayan balsam.	12.2b
TN17	NO 00253 47559	Sedges and rushes (compact rush and soft-rush) within the woodland and alder in the wetter areas where a drain runs through the woodland. A narrow dry ditch is present alongside much of the footpath.	12.2b-c
TN18	NO 00213 47184	Japanese knotweed and Himalayan balsam present on verge and edge of woodland. Woodland now broadleaved with silver birch, hazel, ash and sycamore. Part of the verge is stone and behind this are fairly large areas of rose. The Japanese knotweed here is quite extensive running down the slope through the woodland.	12.2b
TN19	NO 00167 47831	Amenity grassland, path and herb rich bank: cow parsley, hogweed, rosebay willowherb, red campion, false oat-grass, Yorkshire-fog, common ragwort, common bird's-foot-trefoil. Over the bank is a grazing meadow; perennial rye-grass, Yorkshire-fog, forget-me-not, selfheal and thistle.	12.2c
TN21	NO 00066 48157	Dowally Burn passes under the A9. Vegetation along the river bank consists of alder sapling, young ash and willow sp. on the field side. Road side consists of ground elder, willow, rosebay willowherb and common bird's-foot-trefoil.	12.2c
TN23	NO 00107 47736	A substantial section of bank has collapsed.	12.2c
TN24	NO 00055 47981	An area of rush pasture at the end of the field with soft-rush dominant.	12.2c
TN25	NO 00104 48284	Old coniferous plantation with some deciduous species, particularly at the edges. Ancient indicators present include bluebell, enchanter's-nightshade, dog's mercury and wood sorrel. Mature woodland dominated by sycamore, oak and common lime is rare. Young sycamore is abundant by the road and there is abundant hedge woundwort and male-fern. There is a gap through the woodland, which has abundant young sycamore. There is a dense spruce plantation. Dog's mercury is abundant by the road and there is frequent male-fern and hedge woundwort and bluebell is occasional.	12.2c
TN27	NN 99984 48796	Mixed woodland: sycamore, oak and conifer with common nettle, dog's mercury, wood sorrel, bluebell, willowherb, enchanter's-nightshade, cleavers, meadow-grasses, pignut bracken and honeysuckle. Mammal hole under tree near road. Mixed plantation in vicinity of disused quarry. Dominated by sycamore and Douglas fir with a generally very sparse flora. However, at the quarry there are several mature oaks growing amongst young, tall sycamore. The ground flora at the quarry includes herb-Robert, dog's-mercury, male-fern, common nettle; sycamore seedlings are frequent, and very locally lady-fern is abundant.	12.2c
TN29	NN 99618 49345	Amenity grassland on top of bank with a mix of young trees and scattered scrub.	12.2c-d
TN30	NN 99488 49715	Nearby arable field is bordered by tall herb and ruderal with herbs and grasses indicative of semi-improved neutral grassland.	12.2d
TN31	NN 99509 49853	Amenity gardens – domestic plants and shrubs with rowan, wild cherry and blackthorn.	12.2d
TN33	NN 99300 50163	Pond: Approximately 25m x 15m, although no clear dimension and spreads out into marshland around – fed by drain. 90% emergent vegetation, largely dominated by flowering rush with some bottle sedge and reed; shade = 40% at edge; damselflies seen; no water fowl noted but potential; fish potential low; probably fairly shallow. Suitable for amphibians.	12.2d
TN34	NN 99312 50280	A channel (currently dry) appears to separate the two ponds although due to marsh and deep mud this could not be inspected. The lower pond is located within woodland and is more of a flooded depression with little in the way of aquatic vegetation. 100% shaded at edges, quite shallow.	12.2d
TN35	NN 99223 50500	Road verge is banked here with common knapweed, ferns, hogweed, broom, ribwort plantain, fescues, and false oat-grass. Woodland in this section is broadleaved with sycamore, beech, elm, copper beech with grass and herb in between. Sward: false oat-grass, lesser stitchwort, musk-mallow and broom. This semi-natural woodland extends down a steep bank on to a flat area by the A9, which is an old meander and is still very wet with areas of standing water.	12.2d

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Target Note Reference	Grid Reference	Description	Figure Reference
		The steep bank is dominated by sycamore, alder and birch. Bird cherry is frequent and there are several mature common lime along the path. The ground flora consists of abundant ground-elder, frequent herb-Robert and common dog-violet, and occasional wild strawberry and wood avens. Red fescue and wavy hair-grass are abundant on the bank. There is scattered bracken and locally abundant dog's mercury. The area by the old meander is very wet with large pools of standing water, especially at the north end, where the woodland is dominated by grey willow and alder, with some ash and downy birch. The ground flora here has abundant water forget-me-not, water mint and creeping buttercup making a dense cover on the woodland floor. Other species present include tufted hair-grass, common marsh-bedstraw, creeping-jenny, ground-ivy, bugle and male-fern. By the standing pools of water there is what appears to be, frequent bladder-sedge. The old meander becomes wider at the south end where there is open water without a tree canopy. This open water supports abundant water-starwort and frequent water horsetail/bladder-sedge. There is also frequent bittersweet suggesting the water levels were higher than normal at the time of survey. Of more note is the rare occurrence of water-plantain. Grey willow and alder dominate around the edges of the open water, with smaller amounts of ash and sycamore. Between the wet woodland/old meander and the A9 is a crescent of rather rank semi -improved neutral grassland dominated by common bent/Yorkshire-fog, but with abundant common nettle and frequent creeping thistle and false oat-grass. Other species include bramble, red fescue, cow parsley and rarely reed canary-grass. There are scattered young alder at the north end, and along the edge of the wet woodland is a row of mature sycamore.	
TN36	NN 99246 50128	Pond is elliptical 40m x 30m - 90% shaded; weed in the pond 80% coverage. No emergent vegetation only some of the surrounding trees fallen or submerged into the water. Pond is fed by a drain.	12.2d

10   Further Habitat Surveys

Additional Phase 1 Data

10.1.1   An additional Phase 1 habitat survey was undertaken in 2016 to update the A9 Dualling Programme route-wide Phase 1 habitat survey where necessary. Target notes from these surveys are presented in Table 16 (for example J-TN01) and on Figure 12.15.

10.1.2   Furthermore, following development of the proposed scheme design at DMRB Stage 3, analysis was undertaken to provide an assessment of the habitats present at locations in which the proposed scheme overlapped with designated sites, specifically the River Tay SAC. This desk-analysis involved the review of Blom (2014) aerial imagery, photographic data and field notes, collected during DMRB Stage 3 surveys. Target notes from this study are provided in Table 16 (for example P3-SAC-01) and on Figure 12.15.

Phase 2 Habitat Survey

10.1.3   Areas identified during the A9 Dualling Programme route-wide Phase 1 habitat survey as being of greater botanical importance, which were likely to be impacted by the proposed scheme at DMRB Stage 2, were revisited in 2016, to collate more detailed information where needed. Target notes from these Phase 2 surveys are shown in Table 17, which follows directly from Table 16, and the updated habitat map is presented in Figure 12.15.

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Table 16: Additional Phase 1 Target Notes

Target Note Number	Grid Reference and Chainages	Target Notes	Photographs	Figure Reference
P3-SAC-01	NO 00445 44124 ch150	The area within the River Tay SAC where the proposed Outfall A is located comprises shingle bank (as shown to the right of the photograph). The River Tay SAC boundary lies along the river bank, and adjacent terrestrial habitats are outwith the designation, although may offer potential for otter which is a qualifying feature of the SAC. At this location, the River Tay is lined with broadleaved woodland, consisting of predominantly birch and is classified as native woodland (wet woodland) on the Native Woodland Survey of Scotland (NWSS).		12.15a
P3-SAC-02	NO 00447 44696 ch600-800	The area that falls within the SAC comprises broadleaved woodland containing a mix of silver birch amongst other species. This woodland is classified on the NWSS as native woodland (wet woodland) being contiguous with woodland described in P3-SAC-01. Within an area of open canopy, there is a patch of bracken covering approximately 0.11ha, of which 0.05ha falls under the footprint of the proposed SuDS detention basin (see Figure 12.2). A small shingle bank is evident within the footprint of the proposed outfall from the SuDS detention basin at this chainage. This shingle bank is directly adjacent to broadleaved woodland to the east (see photograph).		12.15a
P3-SAC-03	NO 00407 44921 ch920-1200	The River Tay SAC between ch900 and ch1200 inlcudes a wide shingle bank, approximately 45m in width at its widest point. The wide shingle bank grades into a narrow strip of gorse dominated scrub and then a band of bracken. Adjacent to this is a parcel of mature broadleaved woodland, of which c.2ha falls within the SAC designation, including willow and birch species. This woodland is classified on the NWSS as native woodland (wet woodland) being contiguous with woodland P3-SAC-01 and P3-SAC-02. The proposed side road at this location extends <5m in to the woodland (0.01ha lost under the footprint) (Figure 12.2); however, the majority of the footprint falls on the existing road..	None taken	12.15a

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Target Note Number	Grid Reference and Chainages	Target Notes	Photographs	Figure Reference
P3-SAC-04 (see TN13 in Table 15 above)	NO 00325 45985 ch2000	The vegetation in this area of the River Tay SAC comprises an amalgam of young woodland, scrub, rough grassland and indeterminate habitats. This includes the 'herb-rich' grassland as indicated in TN13 from A9 Dualling Programme route-wide Phase 1 habitat survey (Table 15), but this is only a small element of the habitats present at this location. The woodland partially aligns along a dry drainage ditch (apparently for road run-off). This woodland comprises sycamore, willow, birch (dominating in some extents) and alder. Himalayan balsam was very common in some areas under the trees, but elsewhere the ground flora was sparse (see first photograph). The woodland was not listed on either the AWI or the NWSS. In the more open areas, rough grassland and gorse scrub dominated. Tufted hair-grass and Yorkshire-fog were sometimes very common together with cock's-foot and false oat-grass. The thin gravelly substrates of the existing ditch (see second photograph) provided opportunities for grass/heath vegetation and ephemeral species, including bell heather and perforate St John's wort. Tansy was occasional to locally frequent and giant bellflower was rare. A total of 0.12ha of the River Tay SAC terrestrial habitat lies under the footprint of the proposed scheme.	 	12.15b

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Target Note Number	Grid Reference and Chainages	Target Notes	Photographs	Figure Reference
P3-SAC-05	NO 00121 47744 ch3850	The left bank of the River Tay is generally wooded, however at this location the canopy is considerably more open, with some wind thrown or fallen trees evident on the bank (see photographs). The woodland comprises a mixed woodland strip including non-native coniferous species (spruce species). It is not listed on either the AWI or the NWSS. The river bank at this chainage is disturbed, and ruderal species, including rosebay willowherb, are present. Adjacent to this woodland, outside the SAC boundary is a parcel of poor-semi improved grassland (Figure 12.2), in which the proposed SuDS detention basin is to be constructed. Approximately 0.02ha of the terrestrial habitat within the River Tay SAC falls under the footprint of the proposed scheme.		12.15c

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Target Note Number	Grid Reference and Chainages	Target Notes	Photographs	Figure Reference
P3-SAC-06	NN 99602 48747 ch4900	The River Tay SAC extends from the river to the top of the river bank here. Only a small margin of terrestrial habitat is included within the SAC between chainages ch4300 to ch5300. Scattered gorse is present along the banks of the River Tay at this location. The left river bank is generally dominated by semi-improved neutral grassland, on a shallow slope toward the water. The toe of the slope comprises a narrow margin of large cobbles and small boulders. An informal grassy track is present on the top of the slope which follows the line of the river. On the east side of the track (outwith the SAC designation), sheep grazed agriculturally improved grassland is present. Approximately 0.01ha of terrestrial habitat within the River Tay SAC falls under the footprint of the proposed scheme.		12.15c

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Target Note Number	Grid Reference and Chainages	Target Notes	Photographs	Figure Reference
P3-SAC-07	NN 99501 49247 ch5500	The River Tay SAC in this location comprises improved/poor semi-improved grassland for livestock grazing, an access track and a grassy verge along the river bank. The improved/semi-improved grassland within the SAC extends up to the historical flood bank. Exposed sandy substrate and rock is evident along the river bank at this location (see photograph) and there are clusters of broadleaved trees (willow species) present upstream of the proposed outfall. Approximately 0.06ha of the River Tay SAC, of which 0.04ha comprises the grazed grassland, falls under the footprint of the proposed scheme.		12.15c-d
J-TN01	NO 00349 46430 ch2500	Mainly Douglas fir and spruce 30m+ in height. Scattered herbs in a generally species-poor ground flora (bluebell, climbing corydalis, foxglove, herb-Robert, wood sorrel). Himalayan balsam scattered throughout the woodland and especially along the road boundaries. 5-10m wide verge of scrub and tall ruderal adjacent to General Wade's Military Road.	None taken.	12.15b
J-TN02	NO 00284 47055 ch3150	Broadleaved woodland/coniferous plantation woodland. Oak/beech woodland with some silver birch and sweet chestnut. Stands of spruce and Douglas fir. Bluebell (locally abundant), dog's mercury and wood sorrel present. Large patches of Himalayan balsam scattered along the roadside.	None taken.	12.15b
J-TN03	NO 00264 47684 ch3700	Felled woodland now dominated by tall ruderal, scrub and rank grassland. Patches of bare ground and large amounts of dead wood. Broom, rosebay willowherb and raspberry locally dominant with scattered small trees and shrubs naturally regenerating, such as sliver birch. Herb species few: bluebell (Locally Frequent (LF)), common mouse-ear (Occasional (O)), foxglove (LF), heath bedstraw (O), sheep's sorrel, Yorkshire-fog (Locally Abundant (LA)) and wood sage (O). Small scattered amounts of fescue spp. and bent spp.		12.15b-c

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Target Note Number	Grid Reference and Chainages	Target Notes	Photographs	Figure Reference
J-TN04	NN 99228 49966 ch6200	Large pond with swamp vegetation including large patches of spike-rush, horsetail, bottle sedge and flowering rush surrounded by trees and scrub. Himalayan balsam is scattered around the pond. Numerous damselflies also observed including azure damselfly.		12.15d
J-TN05	NN 98944 51000 ch7310	Broad-leaved woodland of mainly beech and sycamore (with beech dominant). Trees up to 25-30m in height and 1m diameter at chest height. Spruce was scattered throughout. Further north, the woodland became more species rich with pedunculate oak, scots pine and sliver birch becoming more frequent. The ground flora was very poor. Climbing corydalis was present. Under the sycamore, the canopy was more open and bluebell, common dog-violet, germander speedwell and wood-sorrel were recorded. In the more species rich woodland, the ground flora was grassier with sweet vernal grass frequent, together with bracken, foxglove, raspberry and wood sage all prominent.	None taken.	12.15d-e
J-TN06	NN 99804 49225 ch5350	Large amounts of pink purslane, a non-native species, present.	None taken.	12.15c-d

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Table 17: Phase 2 Target Notes

Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
Ph2-TN-01	NO00597 44534 ch500-600	This area consists of a west-facing slope above and to the east of the existing A9, adjacent to but outwith the footprint of the proposed scheme. Within this area, the upper slope is designated as AWI woodland (category 2b). This upper slope was dominated by a mature Douglas fir plantation with some infiltration of birch sp. mainly higher on the slope. Most of the mature conifers occupied the mid-slope. Ground flora was poorly developed beneath the canopy and was mainly bare, with brash/needles carpeting ground layer. This are did not match well with NVC woodland categories. The lower slopes, which are not listed on the AWI, were dominated by broom and bracken, with some characteristics of W23 *Ulex europaeus – Rubus fruticosus* agg. scrub, but with an impoverished understorey. Where present, the understorey included sparse dog-rose and bramble somewhat characteristic of W25 *Rubus fruticosus* agg. – *Pteridium aquilinum* underscrub sub-community, and indicative of the woodland having been previously cleared or disturbed. The ground layer was also sparse, mainly absent within coniferous plantation, but where present on lower slopes was dominated by *Sphagnum* communities (*S. fallax* and *S. palustre*) with mosaics of *Polytrichum commune* also fairly widespread. Common bent and red fescue were present in a patchy distribution, with occasional heather. A localised depression in the slope towards ch600 was dominated by downy birch of uniform age class (trunk diameter c.10-15cm), with a bracken-dominated understorey.		12.15a
Ph2-TN-02	NO00368 45001 ch500-1400	Except for 0.1ha to the south, this area lies within the River Tay SAC. Approximately 0.22ha lies under the footprint of the proposed scheme. This area occupies a section of the east bank of the River Tay, consisting of steep wooded slopes at southern end descending northwards to meet with large area of floodplain adjacent to the river. At the north end of the area, around ch1400, the river banks rise again to a steep incline. Between ch500 and ch1200 the woodland displayed some characteristics of W4 *Betula pubescens – Molinia caerulea* woodland, with a canopy layer dominated by downy birch although scattered rowan, silver birch, wild cherry, pedunculate oak and non-native sycamore were also present. There was also some evidence of management in the form of planted immature beech. Purple moor-grass was present but patchy, and bracken tended to dominate many areas of the understorey, with scattered broom, bramble and hawthorn also present. The shrub layer included white dead-nettle, foxglove, primrose, bluebell, snowdrop sp. and daffodil. In localised damper areas (e.g. adjacent to existing A9 culverts), scattered patches of soft-rush were recorded, with associated mosaics of *Sphagnum* species (*S. fallax* and *S. fimbriatum*) composing the ground layer. Around ch1400 a small European larch plantation with bracken dominated understorey, was perched on the upper slopes of the river bank. The shingle banks along the River Tay SAC were mainly barren, exhibiting some colonisation of the upper parts with broom, gorse sp., common ragwort and hawthorn shrubs. There was patchy heather near the upper edges of shingle, but it was mainly dead.		12.15a

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
Ph2-TN-03	NO00482 45596 ch1550-1750	This area consists of a west-facing slope overlooking and to the east of the existing A9, which falls almost entirely under the footprint of the proposed scheme. The upper extent is dominated by coniferous plantation; this part of the site extends into an area designated as AWI (category 1a) and NWSS (PAWS). The boundaries of the AWI and NWSS sites are broadly overlapping within this area. Planting was dense and the understorey was poor or absent, likely due to brash/needles, the lack of light penetration to the understory and/or space. Species included Douglas fir, Sitka spruce and European larch. Lower parts of the slope down to the existing A9 consisted of a mosaic of acid grasses dominated by mat-grass with some wavy hair-grass also present. Stands of gorse sp., broom and bracken were recorded across the slope, some stands were quite dense. The slope's floral assemblage displayed some characteristics of both W23 *Ulex europaeus – Rubus fruticosus* agg. scrub and W25 *Rubus fruticosus* agg. – *Pteridium aquilinum* underscrub communities, though field and ground layers appear impoverished (likely due to management). Scattered trees (birch sp.) are distributed throughout lower reaches of slope, densest at the north where a small patch of birch woodland was forming.	No photos	12.15a
Ph2-TN-04	NO 00620 45617 ch1600-1700	An area to the east of the A9 between chainages ch1500-ch1700 designated as AWI, comprising category 3 (ch1500-1600) and category 1a (ch1600-1700); approximately 0.3ha of AWI woodland falls under the proposed scheme footprint. The AWI area is also recorded on the NWSS. The category 3 area is dense Douglas fir plantation (30m+ in height) on a steep slope above the existing A9. The ground flora was very poorly developed with bluebell, foxglove and wood sorrel being only very occasionally recorded. Broadleaved tree species were present around the edge, including ash, sycamore, silver birch, beech and oak, and also within the category 1a area, along the small watercourse and on some of the very steep slopes. Also within the category 1a area was a block of beech plantation. To the south of the site was an unwooded area of approximately 0.7ha. This was predominantly tall ruderal vegetation with large stands of rosebay willowherb and raspberry, with common nettle and bracken. On the NWSS, the AWI category 1a area was classified as Plantations on Ancient Woodland Sites (PAWS) (non-native) with a 70% naturalness and 35% nativeness. The AWI category 3 and open area were not recorded on the NWSS. Douglas fir plantation has no NVC equivalent. Semi-natural beech woodland is largely confined to England, especially southern England, and the beech plantation recorded at this location would not represent a typical example of these types. The nearest equivalent, outside the beech plantation itself, could be W15 *Fagus sylvatica-Deschampsia flexuosa* woodland. The open AWI area contained a number of patches of different NVC types including W25 *Pteridium aquilinum-Rubus fruticosus* scrub and OV27 *Chamerion angustifolium* community. Both communities often occur where woodland has been cleared or disturbed.		12.15a

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
Ph2-TN-05	NO00249 46255 ch1600-3000	This area, was predominantly situated on low-lying floodplain to the west of the existing A9. The majority of the area lies outwith the footprint of the proposed scheme, except a strip between ch1600 and ch2200, and a small area at ch2700 to ch2820. The area lies entirely within the River Tay SAC. It was characteristic of W4 *Betula pubescens – Molinia caerulea* woodland with downy birch dominates large areas of the lowest lying parts. Small mosaics of W5 *Alnus glutinosa – Carex paniculata* woodland were also present, though less widespread and mainly associated with wetter, flushy southern parts near the river. The trees here were less well grown with irregular shaped crowns. Bracken was the dominant understorey species in many areas, though where wetter, purple moor-grass tends to dominate, with scattered stands of soft-rush where conditions are wettest. Abundant crack-willow was recorded near the river banks, with scattered elder and occasional hawthorn and beech present in the drier areas. Higher on the verge slopes where conditions were drier there was a mix of downy birch and silver birch, with a more developed understorey/shrub layer, with bramble, common nettle, bluebells, silvery crocus, dog-rose, cow parsley, broom and gorse were found to be present, but relatively sparse. There was a patchy distribution of broom and gorse along the shoreline, which showed signs of regular management for use by the nearby angling club (mowing of banks, impoverished sward, patches of rock armour). Several large stands of common rhododendron were recorded next to the access track entrance to the fishery at the northern end of the area. None of the woodland within this area is designated on the AWI, however areas between ch1950-2100 and ch2250 to ch3000 are categorised on the NWSS as native woodland.		12.15b
Ph2-TN-06	NO 00403 45998 ch1900-2050	An area designated as AWI category 1a of which approximately 0.89ha falls under the footprint of the proposed scheme at this location. The location comprises dense Douglas fir plantation woodland (30m+ in height) with little or no ground flora, although wood-sorrel and bluebells were occasionally recorded in open areas, and foxglove was rarely present. Steep slopes down to the A9 were characteristic of the area.	None taken.	12.15b

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
		At approximately ch2000, adjacent to the old road, was an area (300-400m^2) of apparently naturally regenerated broadleaved woodland. This had been mapped as built-up on the original Phase 1 survey. Species present included elm, sycamore, ash and birch. Scrub, tall ruderal species and dense grasses were also present within the area, including bramble, raspberry, rosebay willowherb, creeping thistle and Yorkshire-fog. On the NWSS, the area is classified as PAWS (non-native) with a 0% naturalness and 0% nativeness. Douglas fir plantation has no NVC equivalent and due to the disturbed and rapidly developing nature of the broadleaved woodland area, it did not match an NVC category.		
Ph2-TN-07	NO00211 47448 ch3050-3950	This area is a long narrow area of woodland between the west side of the existing A9 and immediately east of the River Tay. Between ch3050-3450, the woodland is listed on the NWSS as native woodland. The area features a steep slope with west-southwest aspect, descending steeply to the river banks. There was widespread evidence of fly tipping along the existing A9 roadside. The woodland was in places characteristic of W4 *Betula pubescens – Molinia caerulea* woodland with downy birch dominating large areas, and occasional silver birch where conditions are drier. Occasional beech, pedunculate oak, hawthorn, wild cherry, crack-willow and non-native sycamore were also recorded. Purple moor-grass component of W4 *Betula pubescens – Molinia caerulea* was present, but forming a relatively scarce part of the field layer, which was generally impoverished or absent. Localised patches of soft-rush were also recorded in wetter conditions. The ground layer in these areas tended to be largely absent due to leaf fall or Japanese knotweed stands, but where present it is dominated by *Sphagnum* species, including *S. fallax* and *S. pallustre, P. commune* was also recorded, though sparse. A small mixed plantation composed mainly of European larch was located at northern end of this area, with some hazel and Sitka spruce also present. Occasional mosaics of bracken-dominated W25 *Rubus fruticosus* agg. – *Pteridium aquilinum* underscrub occurred along the slope where gaps in the canopy allow, particularly to the north end on the upper part of the slope. Occasional broom occurs on steep slopes down to river in this area. Japanese knotweed was widespread within the woodland at NO002470, NO002472, NO002473 and NO002475 totalling approximately 825sqm. Many mature Japanese knotweed plants dominated the shrub layer in infested areas, with field and ground layers beneath these largely absent due to dead stems.		12.5b

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
Ph2-TN-08	NO00247 47657 ch3600-3800	This is a west-facing area overlooking the existing A9 and was a poor match with any distinct NVC categories, though the bracken-dominated lower slope is suggestive of W25 *Rubus fruticosus* agg. – *Pteridium aquilinum* underscrub sub-community. The area was characteristic of many of the embankments adjacent to this section of the existing A9. The area was mainly dominated by bracken, with some scattered broom, scarce bramble and established patches of common rhododendron directly adjacent to the existing A9. A small stand of downy birch, hawthorn and sycamore, all of a similar age class, occupy central part of the area, around ch3700. The understorey was poorly developed or absent. Where present, *Sphagnum* communities formed the ground layer, and included *S.fallax* and *S. pallustre. P. commune* was also recorded, though sparse.		12.15b, c
Ph2-TN-09	NN99484 48026 ch4100-4200	This area comprised a 0.4ha section of floodplain directly adjacent to Clachan railway bridge (bridge directly south). The area was dominated by grasses typifying acidic conditions, predominantly purple moor-grass with some mat-grass and very occasional clumps of couch grass. Grasses form a mosaic with stunted gorse sp. and broom, evidently damaged by periodic flooding of this area, due to its location within the floodplain of the River Tay. Canopy layer was absent, however a line of stunted pedunculate oak, crack-willow, birch sp. and common hazel follows the river bank. The ground and field layer includes fairly abundant common ragwort, common nettle, occasional creeping thistle and cow parsley, and scarce stands of hogweed. Patchy stands of common reed were also recorded near the water's edge. Ground layer includes an extensive mosaic of *Sphagnum* communities, including *S. fallax* and *S. palustre.* Occasional stands of soft-rush were also present. This area falls within the River Tay SAC; however, it is outwith the proposed scheme's footprint.		12.15c

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
Ph2-TN-10	NN00044 48553 ch4200-5000	The southern end of this area consisted of a band of mixed broadleaved species bordering the roadside, with coniferous plantation further upslope from the road. This woodland parcel is designated as AWI woodland (category 1a), of which approximately 2.42ha falls under the footprint of the proposed scheme. The band of broadleaved species included pedunculate oak, downy birch, silver birch, occasional beech and ash. Some less mature examples of elder were found close to road, and widespread non-native sycamore (the latter was very evident at firebreaks in this area, where the species has colonised gaps in coniferous canopy). Understorey shrub layer in many areas was dominated by gorse sp. and broom scrub, and stands of bracken, with more occasional bramble and dog-rose. These areas had some characteristics of W23 *Ulex europaeus – Rubus fruticosus* agg. scrub and W25 *Rubus fruticosus* agg. – *Pteridium aquilinum* underscrub communities. The field layer was generally quite impoverished in plantation areas, and more developed in broadleaf patches, where common nettle, primrose, foxglove, and daffodil were relatively widespread, with more occasional ramsons, cow parsley and scarce corn mint. The woodland to the east of Guay becomes more dominated by coniferous plantation woodland, composed mainly of Scots pine and Sitka spruce with occasional European larch also being present.		12.15c
Ph2-TN-11	NN 99958 48718 ch4300-4950	The full stretch between ch4300-4950 comprises a mixture of woodland parcels mapped mainly as mixed semi-natural woodland. However, all areas are listed on the AWI as category 1a. Within this chainage, approximately 2.27ha of woodland falls under the footprint of the proposed scheme. The lower part of the area (ch4300 onwards) comprises coniferous plantation woodland (spruce) with an overhead powerline wayleave strip at ch4400 dominated by bracken. Around ch4900 broadleaved species including ash, pedunculate oak, birch and sycamore are present around the edge, with the main part of the woodland mainly comprising coniferous plantation including European larch, spruce, Douglas fir and cypress. Some Scots pine is present and ground flora is absent or sparse. Towards the northern end of this area, the woodland becomes more mixed and semi-natural although coniferous trees remain dominant (within the area of the scheme footprint). Dog's mercury also becomes more prominent towards the northern part of the AWI parcel. Elsewhere within the woodland area, in open glades, wood anemone, wood avens, wood-sorrel, greater stitchwort, bluebell, climbing corydalis and pignut are present. There are also large patches of bracken. Broadleaved trees are notably colonising open areas within the coniferous woodland, mainly sycamore and birch. At ch4800 towards the eastern extent of the woodland parcel, there is a large open glade within the coniferous woodland. A ground flora of abundant bluebell with some male fern and bracken is present. Sycamore, oak and scots pine regenerating, and also hazel (rare) are present here, with trees <15m in height. Along the old road to the east of this woodland patch are 25-30 mature trees (horse chestnut, lime and sycamore). The larger trees are up to 60cm in diameter. On the NWSS, the woodland is classified as PAWS (non-native) with a 0% naturalness and a 10% nativeness (up to approximately ch4600) and a 30% naturalness and 25%		12.15c

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		nativeness up to ch4950. The main coniferous woodland plantation areas (European larch, spruce, Douglas fir and cypress) have no NVC equivalent. In the open and more broadleaved areas, where a more semi-natural ground flora had developed, the vegetation had characteristics of W11 *Quercus petraea-Betula pubescens-Oxalis acetosella* woodland. The presence of dog's mercury, especially in the northern part of the AWI woodland, would indicate affinities with W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland. The dense bracken areas would be classed as W25 *Pteridium aquilinum-Rubus fruticosus* underscrub.		
Ph2-TN-12	NN99615 49172 ch4300-6100	This area is within the River Tay SAC and the access track between ch4900 and ch6100 falls will comprise construction access for the proposed scheme. This area comprises a continuation of that described in Ph2-TN-09, consisting of a narrow stretch of river bank within the floodplain of the River Tay, which show indications of periodic inundation, including stunted shrub growth along the river bank. The field layer was dominated by relatively species-poor acid grassland consisting of mat-grass and purple moor-grass, indicative of the location on the edge of agricultural land. The canopy layer was absent, however a line of stunted pedunculate oak, crack-willow, birch sp., hawthorn and hazel follows the shoreline, interspersed with occasional stands of stunted gorse sp. and broom scrub. Further north these stands of broom and gorse became denser and more well established, with trees less widely distributed along the river bank. Occasional stands of wild teasel was evident along banks. The wider, northern section of this area, between ch5500 and ch6100, widened out to encompass a large area of semi-improved acid grassland, dominated by mat-grass and purple moor-grass. Occasional forb species (which are common within the study area) were present, but scarce. Common ragwort was noticeably widespread across this area, some creeping buttercup was also evident, although scarce. Occasional mature trees including pedunculate oak, birch sp. and ash are scattered across the grassland.		12.15c

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
Ph2-TN-13	NN99859 49318 ch5400-5500	To the east of the existing A9, north of Guay a coniferous plantation dominated the slope. This woodland is designated as AWI (category 1a) and on the NWSS as nearly-native woodland. The woodland edge is west-facing, and mainly consisted of European larch and Scots pine, with some Sitka spruce and scattered Douglas fir also evident. Broadleaf species present next to the road included young pedunculate oak and elder, with occasional beech. The shrub layer was mainly dominated by bracken where present, but it was mostly absent beneath the coniferous plantation. The field layer included scattered broad-leaved dock, common nettle, creeping thistle, and snowdrop. The ground layer, where not dominated by bracken, included *Sphagnum* mosaics composed of *S.fallax* and *S. pallustre. P. commune* was also recorded, though sparse. Occasional English stonecrop patches were also recorded in the wetter areas. There was a short section of verge opposite the woodland, which bordered a small agricultural field on the edge of the existing A9. The verge included occasional scattered young pedunculate oak and sycamore, though the latter show signs of recent management (cutting). The shrub layer was generally absent due to management (mowing), though there were occasional patches of tall ruderal species including common nettle and rosebay willowherb, with cow parsley, colt's-foot and herb-Robert recorded in the field layer.		12.15c, d
Ph2-TN-14	NN99577 49669 ch5800-5950	This area is a narrow sliver of mixed woodland running parallel to coniferous plantation woodland, covering a southwest-facing slope. The coniferous species included mainly European larch with Scots pine, Sitka spruce and scattered Douglas fir, the latter of which was concentrated away from the road on higher parts of slope. Broadleaved species lining the road edge included frequent mature pedunculate oak and sycamore, with some well-established elder and hawthorn, and occasional beech. The scrub layer included occasional immature hawthorn, with widespread bramble and patches of bracken in more open areas of canopy which displayed some characteristics of the W25 *Rubus fruticosus* agg. – *Pteridium aquilinum* underscrub community. The field layer within the broadleaf section, where not dominated by W25, included foxglove, daffodil, rosebay willowherb and common nettle, with occasional stands of purple moor-grass and scarce mat-grass. The understorey is much more impoverished in coniferous parts due to canopy density and a blanket of needles covering the ground. The ground layer in the broadleaf edge is fairly poor, often bare but with occasional *Sphagnum* mosaics of mainly *S.fallax,* with less widespread *S. pallustre.*		12.15d

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
Ph2-TN-15	NN98933 50195 ch6100-6750	This is an open area encompassing a section of the east bank of the River Tay and within the SAC. This area falls under access tracks for the proposed scheme. An area listed on the NWSS is present within the site. Plant communities are comparatively impoverished along either side of the access track which follows the contours of the river. Banks appeared to be regularly maintained (mowed) with a short, even sward of semi-improved species-poor acid grassland. The ward composition was predominantly mat-grass with scattered clumps of purple moor-grass. The sward composition on the landward side was even more species-poor, showed signs of recent and extensive high intensity grazing (likely sheep, due to short evenly grazed sward). Other field layer species were mainly absent from this area, although occasional stands of broad-leaved dock, common nettle, common ragwort were present. Occasional pedunculate oak, Scots pine, birch sp. and European larch were scattered along the bank, with occasional stunted stands of gorse sp. or broom scrub, or mixed stands of birch sp. scrub. Bramble scrub was also recorded, though scarce. Much of the river bank in this between ch6100 and ch6750 has been reinforced with rock armour, creating a uniform bank height and structure but with the expected reduction in habitat and floral species diversity. A shingle bar was also located within the River Tay adjacent.		12.15d
Ph2-TN-16	NN99251 50488 ch6500-7000	This woodland along the existing A9 between ch6500 and ch7000 falls under the proposed scheme. The northern extent of this area, between ch6800 and ch700 is designated as AWI (categories 1a and 3). Along the roadside footpath, between ch6500 and ch6800, there were mixed broadleaved species on either side of the footpath, mainly comprised of birch sp. with occasional pedunculate oak, beech, ash and widespread sycamore. Between ch6800 and ch6950 an open section of slope which has been colonised mainly by gorse and bramble scrub, was somewhat characteristic of the W23 *Ulex europaeus – Rubus fruticosus* agg. scrub community. Above this scrubby area the coniferous plantation dominated the top of the slope. Coniferous species present included mainly Douglas fir, Scots pine, Sitka spruce with occasional European larch. The northern extent, between ch6950 and ch7200, was more mixed in woodland character, with colonisation of roadside gaps in the canopy by birch sp., pedunculate oak, crack-willow and sycamore.		12.15d

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
Ph2-TN-17	NN98845 51117 ch6950-8200	This long narrow area runs parallel or close to the west side of the existing A9 and sections of General Wade's Military Road, and falls under the footprint of the proposed scheme. Towards the northern extent of the area (between ch8000 to the end of the scheme), the habitat was comprised of mixed broadleaved woodland along the road edge, which included birch sp., scattered beech and occasional pedunculate oak. This habitat extended to the top of the west-facing slope overlooking the road. The canopy was quite open, and the understorey was dominated by W25 *Rubus fruticosus* agg. - *Pteridium aquilinum* underscrub, with a relatively diverse ground flora compared to other woodland within the study area. The shrub layer also included raspberry, salmonberry, dog-rose, and occasional gorse. The field layer included foxglove, *Ranunculus* sp., broad-leaved dock, primrose and creeping thistle and widespread along the roadside were greater plantain, pineappleweed and herb-Robert. Sycamore was fairly well established nearest the edge of General Wade's Military Road between. Moving southwards along the A9 from the access road to Ballachan at approximately ch7800, broadleaved species became less well established, with mature coniferous plantation species included Douglas fir, Sitka spruce and European larch dominating right up to the edge of General Wade's Military Road. The understorey here was impoverished or absent. A narrow strip of woodland with dense coniferous plantation, comprising species including Sitka spruce, Douglas fir and European larch, was present along the existing A9 between, ch7600 to ch8000, bordering a gravel footpath. The western edge of the path adjacent to the existing A9 was lined with mature broadleaved species including pedunculate oak (dominant) with some beech, and occasional elder, hawthorn and birch sp. The understorey between trees was impoverished, with signs of management evident (mowing/strimming), and dominated mainly by purple moor-grass. Some bracken, bramble and occasional sycamore saplings were also present. The southern extent of the area between ch7200 and ch7600 was mainly open slope, with a west facing aspect, dominated by gorse sp. scrub. The slope beneath was mainly semi-improved acid grassland with a mosaic of *Sphagnum* communities fairly widespread in distribution, but simple in composition including *S.fallax* and *S. pallustre. P. commune* was also recorded on this slope, though very sparse. The verge separating the footpath from A9 was species-poor, and impoverished due to regular management (mowing/strimming), with some acid grasses present amongst the sward.	 	12.15e
Ph2-TN-18	NN 98816 51224 ch7400-8100	Area of category 2b AWI woodland comprising mainly coniferous plantation woodland. Approximately 0.89ha of the woodland falls under the footprint of the proposed scheme. The plantation woodland is largely Douglas fir and larch with some broadleaved species at the edge, especially adjacent to the existing A9. Species present here included ash, elm, pedunculate oak, silver birch and sycamore. Hawthorn, raspberry and bracken	None taken.	12.15d-e

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Target ID	Grid Reference and Chainages	Target Notes and Photographs	Photographs	Figure Reference
		comprise the scrub layer whilst the ground flora included broad-leaved willowherb, greater stitchwort, hedge woundwort, herb-Robert, hogweed, wood avens and wood sage.		
		South of ch7700 broadleaved woodland was present comprising ash, oak and lime, with oak the most abundant species.		
		The AWI woodland at ch7400-7750 was not listed on the NWSS. Between ch7750 and ch8100 a strip as narrow as 12m was listed and was classified as 'upland mixed ashwood' with a 100% naturalness and an 80% nativeness.		
		The majority of the woodland falling under the footprint of the proposed scheme was broadleaved woodland. The predominance of oak suggested W11 *Quercus petraea-Betula pubescens-Oxalis acetosella* woodland. On some steep slopes, the woodland showed some characteristics of W17 *Quercus petraea-Betula pubescens-Dicranum majus* woodland.		

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11 Invasive Non-native Species

11.1.1 Six invasive non-native species (INNS) were recorded in the study area (Table 18). The locations of INNS are presented on Figure 12.9.

Table 18: INNS recorded within the study area

Species	Grid Reference	Description	Figure Reference
Common rhododendron	NO 00057 48152	On the west side of the bridge near Dowally Craft Centre.	12.9c
Giant hogweed	NN 99272 50259	On A9 southbound verge by layby 30.	12.9d
Himalayan balsam	NO 00209 46877	Road verge at layby 23. Large patch.	12.9b
	NO 00409 45099	Found on northbound roadside verge and also at edge of alder woodland (SAC), at bottom of the verge. Scattered across embankments in low density.	12.9b
	NN 992587 50371	Two plants located in swampy ground amongst immature birch trees.	12.9c-d
	NO 00417 45924	Adjacent to A9 east at culvert of WF26.	12.9b
	NO 00327 46374	At culvert of WF30.	12.9b
	NN 99031 50037	On riverbank. Small stand 2mx2m.	12.9c-d
	NN 99743 49062	Found along Sloggan Burn to the west of the railway.	12.9c
	NN 99246 49804	Area of Himalayan balsam found adjacent to the pond.	12.9c
Japanese knotweed	NO 00325 46209	On verge and bank to the west of the A9.	12.9a
	NO 00300 47100	Opposite the old A9 road end on west side of A9. Untreated.	12.9b
	NO 00302 46246	Along watercourse WF28 parallel to A9 along west. Large stands of Japanese knotweed.	12.9b
	NO 00325 46209	On WF28, west A9.	12.9b
Pink purslane	NN 99804 49225	Located near Guay, adjacent to an arable field.	12.9c
Variegated yellow archangel	NN 99451 49873	On north side of Kindallachan Burn.	12.9c

12 Aquatic Analysis Methods

Watercourse Condition

12.1.1 The Water Framework Directive (WFD) classification does not place a value (or importance) on the watercourses as such, rather qualifies a deviation from reference or pristine condition due to environmental stress. That means a minor watercourse that is exceeding its predicted quality (based upon a suite of physically and biologically similar reference sites) can be classified at High status, without supporting habitat or species of importance. Whilst the minor watercourse may be an excellent example of that watercourse type, the classification/status does not infer any environmental value other than the absence of environmental stress.

12.1.2 It should be noted that watercourses classified as Highly Modified are given an Ecological Potential rather than an Ecological Status.

Macroinvertebrates

12.1.3 The following macroinvertebrate metrics were calculated for each site: WFD classification; Whalley, Hawkes, Paisley and Trigg (WHPT) metrics; Biological Monitoring Working Party (BMWP); Number of Scoring Taxa (NTAXA); Average Score Per Taxon (ASPT); Lotic Invertebrate Index for Flow Evaluation (LIFE); Proportion of Sediment-Sensitive Invertebrates (PSI); and Community Conservation Index (CCI). Descriptions of these metrics are given below.

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<u>WFD Classification</u>

12.1.4 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, 2014a). Environmental characteristics recorded during the field survey, macroinvertebrate metric data and other site data including water chemistry, distance to source and altitude are used to assign each site to a class (WFD-UKTAG, 2014a). The observed macroinvertebrate community is compared to that expected from a watercourse in reference condition and the variance between the observed and expected determines the ecological status. RICT was used to calculate macroinvertebrate metrics using the WHPT method which replaces the formerly used BMWP method (WFD-UKTAG, 2014a). These metrics; WHPT score, WHPT ASPT (measure of macro-invertebrate tolerance to organic pollution) and WHPT NTAXA (measure of macro-invertebrate diversity) were used to classify the site. The metrics calculated by RICT are not appropriate for artificial water bodies, non-flowing or ephemeral water bodies (such as ditches) or sites located within 2.5km of their source.

<u>BMWP and Derived Metrics</u>

12.1.5 BMWP score and its derived metrics are no longer used for WFD classification, but are still valid measures of the impact of organic pollution and general degradation on macroinvertebrate communities, the purpose for which the system was originally developed and has been used since the early 1980's (Hawkes, 1997). Calculating the metrics enables comparison with pre-2015 invertebrate samples and reports. To calculate the score, each macroinvertebrate family present in a sample is assigned a score from one to ten depending on their tolerance to pollution (low scores are given to pollution-tolerant taxa). The BMWP score is the sum of all the scoring families present in a given sample. The BMWP score is divided by the number of macroinvertebrate families present in the sample (NTAXA) to give the average score per taxon (ASPT). Higher BMWP and ASPT scores indicate increased sensitivity to pollution. ASPT is considered a more stable and reliable measure of pollution than BMWP because it describes the tolerance of the families collected in each individual sample whereas BMWP scores can be low at sites with low NTAXA, even if the taxa collected all belonged to pollution-intolerant families. No formal interpretations exist for these metrics, but BMWP scores greater than 100 and ASPT scores greater than 6.0 are considered to represent good quality macroinvertebrate communities.

<u>LIFE</u>

12.1.6 Freshwater macroinvertebrates have specific requirements for flow conditions and can be used to determine not only predominant flow types (Extence et al., 1999) but also changes in flow character. The LIFE metric uses abundance data to assign a flow preference score to macroinvertebrate families present in a sample and an overall score for the site can be interpreted as an abundance-weighted average-score-per-taxon metric. The family-level LIFE score is also calculated in RICT as is an O/E ratio (observed/expected at reference sites) for the sample. The metrics calculated by RICT are not appropriate for artificial water bodies, non-flowing or ephemeral water bodies (such as ditches), so O/E scores were not calculated for these sites (WFD-UKTAG, 2014a). A LIFE O/E score of 0.93 or greater suggests that a site is not subject to flow-related stress (Clarke et al., 2003).

<u>PSI</u>

12.1.7 The PSI metric aims to act as a proxy for the quantity of fine sediment at a site (Extence et al., 2011). Macroinvertebrate species are assigned a fine sediment sensitivity rating that ranges from highly insensitive to highly sensitive to fine sediment. The PSI score is calculated as the percentage of sensitive taxa in the sample (as shown in Table 19).

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Table 19: Interpretation of PSI scores.

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

CCI

12.1.8 The CCI metric represents the national rarity and diversity of species identified within a site and designates a conservation value to the sampled community (Chadd & Extence, 2004). A conservation score (CS) based upon each species' national rarity is applied to each species. The CCI is calculated from the sum of conservation scores 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 BMWP score. CCI scores are assigned into conservation classes, the class boundaries and descriptions are given in Table 20. CCI scores and classes can be adjusted to take into account local conditions. For example, a species may be nationally scarce but relatively common in a particular location, and vice versa.

Table 20: 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	Site supporting at least one uncommon species or several of limited distribution and/or high taxon richness.
High	>15.0 to 20.0	Site supporting several uncommon species, one of which may be nationally rare and/or high taxon richness.
Very High	>20.0	Site supporting several rare species and/or very high taxon richness.

Macrophytes

12.1.9 Macrophytes are the larger photosynthetic organisms that can be seen with the naked eye. This definition includes vascular plants, bryophytes, stoneworts and macro-algae (WFD-UKTAG, 2014b). Macrophyte assessment involved compiling macrophyte species lists and taxon cover values (TCVs, Table 21) from a 100m reach of the watercourse. During these surveys, field data detailing the physical characteristics of each sample site were collected including location, width, depth, substrate, habitats (for example pools and riffles), shading, water clarity and bed stability. The overall coverage of macrophytes and algae was also recorded. The hydrophyte (i.e. truly aquatic) macrophyte species collected were assigned a value according to their tolerance to nutrients and were assigned to one of 23 functional groups. These data were used to calculate the following metrics:

- River Macrophyte Nutrient Index (RMNI): measure of nutrient enrichment at the site. Values range from 1 to 10, with high scores assigned to nutrient-tolerant taxa (Wilby et al., 2012).

- Number of macrophyte taxa (NTAXA): number of truly aquatic taxa observed in the survey.

- Number of functional groups (NFG): measures the functional diversity at the site.

- Cover of green filamentous algae (ALG): percentage cover of green filamentous algae observed over the whole of the survey reach.

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Table 21: Taxon cover values

TCV	Percentage Cover
1	<0.1%
2	0.1 to 1%
3	1 to 2.5%
4	2.5% to 5%
5	5 to 10%
6	10 to 25%
7	25 to 50%
8	50 to 75%
9	>75%

12.1.10 The standard WFD assessment tool, LEAFPACS2, uses macrophyte and environmental data to assess the condition of flowing watercourses according to WFD requirements (WFD-UKTAG, 2014b). LEAFPACS2 can also be used to indicate eutrophication of a watercourse as the analysis method targets the extent and impact of elevated levels of nutrients. An ecological quality ratio (EQR) was calculated for each of the above metrics as well as for the site as a whole. The EQR is the ratio of the observed conditions at the site to those expected in reference (i.e. high quality or pristine) conditions. The EQR ranges from zero to one, with one indicating that the observed conditions were equal to reference conditions. A WFD classification of High, Good, Moderate, Poor or Bad was also assigned to the site, as well as a measure of the confidence of the classification.

Predictive SYstem for Multimetrics (PSYM)

12.1.11 The PSYM method compares the results for a pond against expected values based on the physical characteristics. Metrics used to compare with expected values in order to obtain final score are, for macrophytes: number of submerged and marginal plant species; number of uncommon plant species; and Trophic Ranking Score (TRS), and for macroinvertebrates: ASPT as described in paragraph 12.1.5 number of Odonata and Megoloptera Families (OM); and number of Coleoptera families (CO). Ecological Quality Indices (EQI), the ratio between the observed and expected values, are calculated for each metric as a measure of how close they are to the minimally impacted baseline condition.

12.1.12 The pond scores an Index of Biotic Integrity (IBI) based on the macrophyte and macroinvertebrate data which was used to determine the PSYM quality category. The following IBI ranges were used: IBI >75%=Good, 51-75%= Moderate, 25-50%=Poor and <25%=Very Poor.

12.1.13 Of note, PSYM was developed for assessing pond habitat quality of English and Welsh ponds; no Scottish ponds are included within the reference database. As such it is acknowledged that ponds at higher latitudes may not be appropriately referenced within the model. The limitations regarding a lack of reference ponds in the model database are acknowledged. However, professional judgement in this instance identifies PSYM as appropriate as the use of a standardised method provides a strong basis for interpretation of pond habitat/quality.

13   Aquatic Survey Results

Aquatic Habitats

13.1.1 Relevant Notes from the aquatic walkover surveys undertaken in 2015 by Jacobs are provided in Table 22.

Table 22: Watercourse descriptions

Water Feature	Location	Description	Similar Water Features
River Tay	NO 00418 45537	The River Tay averages 80m wide and up to 4m	River Tay (WF6G) - NO 00159

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Water Feature	Location	Description	Similar Water Features
(WF6E)		deep (although likely deeper in some areas). The flows are predominantly glide and run and along with the mixed substrate provide habitat for various life stages of protected species.	46871
WF24	NO 00463 45772	Small stream around 1m wide and 10cm deep flowing down steep wooded hillside directly into the River Tay. Mostly cobble and gravel substrate, not accessible to migratory fish. Characteristic of several other watercourses in the area.	WF16 - NO 00494 44269 WF20 - NO 00422 44856 WF23 - NO 00428 45555 WF25 - NO 00435 45916 WF30 - NO 00323 46374 WF31 - NO 00257 46650 WF32 - NO 00198 47118 WF33 - NO 00209 47224 WF35 - NO 00240 47587
WF28	NO 00318 46209	Heavily modified small stream around 0.5m wide and very little water, flowing down steep wooded hillside. Mostly silt/organic and artificial substrate. Section of artificial scree between General Wade's Military Road and A9. Not accessible or suitable for fish.	WF29 - NO 00385 46293
WF6F	NO 00179 46843	Small section of ephemeral sandy ditch seeping into the ground on the bank of the River Tay. Potentially road drainage as no upstream source is obvious.	n/a
Dowally Burn (WF36)	NO 00015 48157	Relatively shallow watercourse, averaging 25cm deep and 2-3m wide, crossed by the A9. Mainly cobble substrate with small amounts of gravel, pebble and boulder. A debris dam is present downstream of the culvert and a field drain joins the burn in the downstream section.	n/a
WF38	NN 99966 48514	Small stream up to 1.25m wide and 40cm deep flowing through steep woodland upstream of the A9 and flat pasture downstream of the A9 before flowing into the Dowally Burn. Cobble and gravel substrate upstream of the A9 and finer silt substrate downstream of the A9 provide habitat for invertebrate species but limited habitat for fish. Characteristic of several watercourses throughout the area.	WF37 - NO 00052 48301 WF38A - NO 00085 48497 WF50 - NN 98913 50901 WF52/52A - NN 98612 51440
Sloggan Burn (WF39)	NN 99765 49081	Small watercourse, crossed by the A9 and rail line, averaging 1m wide and 20cm deep. Downstream of the rail line the watercourse is directed into a corrugated pipe culvert over 50m long under a field and into the Tay. Upstream of the A9 the burn is redirected round a farm yard, but upstream of this there is a more natural series of cascades with cobble and boulder substrate.	n/a
Kindallachan Burn (WF40)	NN 99438 49851	Watercourse 5m wide and 20cm deep, on average, crossed by the A9 and rail line. Mixed substrate and flow types provide habitat for protected species. In the downstream section of this watercourse there is a large ponded area with large amounts of silt and organic matter.	n/a
WF43	NN 99246 50204	Small watercourse with little or no flow. Characteristic of several similar roadside channels in the survey area. Connected to ponds. Silt substrate with large amounts of organic matter.	WF44 - NN 99277 50163 WF55 - NN 97998 51832
WF42	NN 99321 50233	Series of interconnected ponds crossed by the A9. Heavily shaded with silt substrate and lots of organic matter. Fed by two small feeder ditches flowing down steep wooded hillside on the east of the ponds. Receive run-off from A9 and litter from lay-by at top of embankment. Provide a resource for wildfowl.	WF42A - NN 99223 50306 WF41 - NN 99261 50112 WF41A – NN 99229 49980

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Water Feature	Location	Description	Similar Water Features
WF46	NN 99370 50260	Small stream, less than 0.5m wide and containing very little water. Flowing down steep wooded hillside and into complex of ponds. Boulder and cobble substrate. Not suitable or accessible for fish.	n/a
WF49	NN 99120 50677	Small watercourse, less than 1m wide and 20cm deep. Upstream of A9 the watercourse flows down a steep wooded hillside but downstream of the A9 is an artificial roadside channel. Flows into complex of ponds. Not suitable or accessible for fish.	WF47 - NN 99199 50633 WF53 - NN 98368 51763
WF54	NN 98341 51739	SuDS pond. Ephemeral.	n/a
WF55A	NN 98095 51541	Pond at end of WF55. Approximately 20m x 50m with 50cm water depth. Tree-lined with extensive cover of terrestrial grasses.	n/a

Aquatic Habitat Evaluation (Including Fish Habitat Suitability)

13.1.2   Each water feature, with the exception of the ponds, was given an ecological value determined by the presence and accessibility of habitat and food resources for the qualifying fish species of the River Tay SAC (See Table 12.5 for criteria). These classifications are displayed on Figure 12.11. Three sites, two on the River Tay and one on Kindallachan Burn, were given an ecological value of excellent due to being accessible and having good habitat for fish species. Dowally Burn was given an ecological value of good due to having habitat suitable for juvenile salmonids and some potential spawning habitat. An ecological value of moderate was assigned to four unnamed watercourses and Sloggan Burn due to provision of resources to the SAC, but being only partially accessible or entirely inaccessible and containing little suitable fish habitat. The remaining 21 sites were given an ecological value of poor due to being inaccessible and providing no suitable habitat for fish of conservation interest.

Aquatic Macroinvertebrates

13.1.3   Aquatic macroinvertebrate surveys were conducted on seven sites on six watercourses (14-16 April 2015 and 20 November 2015). All sites were surveyed in April, but the two River Tay sites could not be sampled again in November due to high flows. Field sampling, laboratory analysis and metric calculations were all in accordance with standard methodologies and published reports (see Section 12: Aquatic Analysis Methods).

13.1.4   WHPT NTAXA scores indicated that the two River Tay sites displayed poor species diversity, this can be attributed to the homogeneous habitat recorded. The remaining six sites show good species diversity, which is reflected in the heterogeneous substrate recorded.

13.1.5   WHPT ASPT scores suggest that Sites 6E and 6G on the River Tay are being negatively impacted by water quality pressures and is reflected in the absence of pollution sensitive species from the macroinvertebrate communities recorded. All other sites displayed good WHPT ASPT scores, which is evidenced by macroinvertebrate communities comprising a range of pollution sensitive species.

13.1.6   Similar interpretations can be made from the BMWP and ASPT scores which indicated that the River Tay supported a poor macroinvertebrate community and was likely affected by organic pollution, but the other streams supported macroinvertebrate communities composed of many pollution-intolerant families (Table 23).

13.1.7   The LIFE O/E scores for the five tributaries to the River Tay exceeded 0.93, indicating that flow is not a pressure. The LIFE O/E for the River Tay sites were low and indicated flow stress. This may reflect the fact that safe sampling locations for the river were located at the edge of the river, where flows tend to be slower.

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13.1.8   The PSI score at Site 6E on the River Tay indicated a moderate level of sedimentation (Table 23). This sample was collected from the edge of the River Tay in a slower water section where fine sediment are more likely to accumulate than in an area closer to the middle of the river. The PSI scores at the remaining six sites indicated that they were only slightly or minimally sedimented.

13.1.9   CCI scores varied among the seven sites. Two samples, from WF25 in November and the River Tay (6G) in April, indicated Moderate conservation value and the remaining samples all indicated Fairly High to Very High conservation value. Regionally Notable or Notable species were collected from at least one of the samples from five of the seven sites (Table 23) however, none of these species were listed in either the Tayside Local Biodiversity Action Plan (Tayside Biodiversity Partnership, 2016) or the IUCN Invertebrate Red Data Book (Wells et al., 1983).

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Table 23: Summary of macroinvertebrate metrics calculated based on the April and November surveys (n/c = none collected).

Site Name	Month	Temperature (°C)	Dissolved Oxygen (%)	Conductivity (µs)	WFD Class	WHPT	WHPT NTAXA	WHPT ASPT	BMWP	NTAXA	ASPT	LIFE (O/E)	PSI Score	CCI Score	CCI Class	CCI Species of Conservation Interest (CS ≥ 6)
River Tay (6E)	April	7.3	115	42	Poor	68.8	13	5.29	72	13	5.54	0.82	55.0	12.80	Fairly High	*Protonemura meyeri*
Unnamed (WF25)	April	5.1	109	95	n/a	125.3	20	6.27	97	16	6.06	n/a	80.0	10.90	Fairly High	n/c
	November	5.9	99	103	n/a	126.5	19	6.66	98	16	6.13	n/a	85.7	7.50	Moderate	n/c
River Tay (6G)	April	7.5	108	37	Poor	46.6	9	5.18	49	9	5.44	0.92	75.0	9.40	Moderate	n/c
Dowally Burn	April	10.7	113	53	Good	157.7	21	7.51	127	20	6.35	0.95	86.4	10.30	Fairly High	*Protonemura meyeri*
	November	6.1	100	65	Good	114.2	16	7.14	105	16	6.56	0.96	100.0	11.40	Fairly High	*Protonemura meyeri*
Unnamed (WF38)	April	11.6	102	86	n/a	131.8	21	6.28	115	19	6.05	n/a	66.7	20.50	Very High	*Potamophylax rotundipennis, Capnia vidua vidua*
	November	7.0	99	91	n/a	132.3	21	6.3	109	19	5.74	n/a	84.6	15.80	High	*Hydraena nigrita*
Kindallachan Burn	April	5.4	116	100	Good	128.2	17	7.54	106	17	6.24	1.02	88.6	12.50	Fairly High	*Potamophylax rotundipennis, Protonemura meyeri*
	November	5.5	101	91	Good	125.6	19	6.61	106	18	5.89	0.96	95.0	11.80	Fairly High	*Leuctra moselyi, Protonemura meyeri*
Unnamed (WF49)	April	5.7	96	120	n/a	126.1	18	7.01	106	17	6.24	n/a	85.7	10.40	Fairly High	n/c
	November	5.6	97	126	n/a	184.3	26	7.09	147	23	6.39	n/a	77.6	11.60	Fairly High	*Potamophylax rotundipennis*

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Macrophytes

13.1.10   The metrics calculated from the macrophyte surveys are given in Table 24.

Table 24: Summary of macrophyte data. Taxon cover values are reported for all species collected

Metric	Dowally Burn (WF36)	Unnamed (WF38)	Kindallachan Burn (WF40)
River Macrophyte Nutrient Index	5.22	7.64	6.08
River Macrophyte Nutrient Index EQR	0.67	0.24	0.68
Number of hydrophyte taxa (NTAXA)	5	2	4
Number of hydrophyte taxa EQR	1.10	0.40	0.57
Number of Functional Groups	4	2	3
Filamentous Green Algae Cover (%)	0.5	1.7	0.5
Filamentous Green Algae Cover EQR	0.96	0.87	0.96
Overall EQR	0.67	0.24	0.65
Classification (confidence of class)	Good (82.4)	Poor (61.9)	Good (73.7)
Overall Macrophyte Cover (%)	4	5	1.5
St Winfrid's moss/pale Liverwort *	-	-	1
Cladophora glomerata/Rhizoclonium hieroglyphicum*	2	3	2
Yellow iris/yellow flag	-	2	-
Kneiff's feather-moss *	-	-	1
Purple loosestrife	-	1	-
Water mint	-	1	-
Water forget-me-not	-	2	-
Hemlock water-dropwort *	1	-	-
Amphibious bistort *	-	3	-
Long-beaked water feather-moss *	4	-	-
Yellow fringe-moss *	2	-	-
River grimmia	-	-	3
Fox-tail feather-moss *	1	-	1

*hydrophyte (i.e. truly aquatic) species as classified in River LEAFPACS 2 (WFD-UKTAG, 2014b).

Ponds

13.1.11   The PSYM classification along with the observed indices and EQIs are given in Table 25.

Table 25: PSYM results and classification

Metric	WF41	WF42
No. of submerged + marginal plant species (SM)	11	9
EQI (SM)	0.61	0.49
Number of uncommon plant species (U)	3	2
EQI (U)	0.74	0.49
Trophic Ranking Score (TRS)	8.8	8.8
EQI (TRS)	1.57	1.57
Average Score Per Taxon (ASPT)	4.26	4.38
EQI (ASPT)	0.78	0.82
Odonata + Megaloptera (OM) families	1	1
EQI (OM)	0.36	0.36
Coleoptera families (CO)	3	2
EQI (CO)	0.79	0.51

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Metric	WF41	WF42
Index of Biotic Integrity (%)	56%	39%
PSYM quality category	Moderate	Poor
Priority species	0	0
Meets Priority Pond Criteria?	No	No

14 References

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