Appendix A10.13 – Terrestrial Invertebrates

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Contents

1 Introduction

1.1 General Background

Proposed Scheme

1.1.1 Jacobs has been commissioned by Aberdeen City Council to undertake a Stage 3 Environmental Impact Assessment (EIA) of the proposed Aberdeen Western Peripheral Route (AWPR) near Aberdeen. The AWPR is a new 46km dual carriageway proposed jointly by Transport Scotland, Aberdeen City Council and Aberdeenshire Council. The scheme comprises the following key elements:

- **Northern Leg:** North Kingswells to Blackdog.
- **Southern Leg:** Charleston to North Kingswells.
- **Fastlink:** Stonehaven to Cleanhill.

1.1.2 For ease of discussion, reports have been divided into three separate appendices using the three road sections described above. Cumulative impacts are assessed in a separate report combining the predicted impacts for all habitats and species over the proposed route from Stonehaven to Blackdog (refer to Part E of the Environmental Statement).

1.1.3 This report is concerned with the impacts on Terrestrial Invertebrate populations associated with the Northern Leg.

1.1.4 To aid the interpretation of the assessment, these three sections have been further sub-divided, the five component route sections for the Northern Leg are as follows:

- Section NL1 ch314750 – 316000 (Derbeth to Tulloch Road);
- Section NL2 ch316000 – 317400 (SAC Craibstone);
- Section NL3 ch317400 – 322600 (A96 to Nether Kirkton);
- Section NL4 ch322600 – 325370 (Nether Kirkton to Corsehill); and
- Section NL5 ch325370 – 331000 (Corsehill to Blackdog).

Aims

1.1.5 The purpose of the survey was to determine the suitability of 16 statutory and non-statutory designated sites (Table 1) within the study area as potential habitats for terrestrial invertebrates, (with particular respect to invertebrates of national and local importance). These sites lie within 500m of the proposed route (Figures 10.11a-g) many of these areas will not be affected by construction and operation of the scheme but limited impacts upon invertebrate species may occur. Thus, the aims of the survey were to:

- assess the potential presence and status of terrestrial invertebrates in the study area;
- assess the quality of terrestrial habitats present and evaluate the importance of the area for terrestrial invertebrates;
- assess any impacts the proposed scheme may have upon the local terrestrial vertebrate populations; and
- identify appropriate mitigation measures and determine any residual impacts.

1.2 Background

Biology

1.2.1 Invertebrates comprise an enormous group of organisms, both in terms of number of species and number of individuals. There are almost thirty thousand species of macro invertebrates in Britain, excluding groups whose members are all microscopic. For insects alone, there are an estimated 14,000 species which occur in Scotland. In comparison with other taxa very little is known of species distribution, abundance and hence relative importance in terms of local biodiversity in Scotland.

1.2.2 In this report, in addition to habitat potential for invertebrates in general being assessed, a small number of terrestrial species have been selected for evaluation as they are priority species included in national and/or local Biodiversity Action Plans or are considered as being locally important in the North East Scotland Biodiversity Audit. It is likely that these are a tiny proportion of the species with a high nature conservation value but this discrepancy is inevitable considering the lack of local knowledge.

1.2.3 Invertebrates are important in both ecosystem functioning and in agricultural systems. As herbivores, predators, parasites and as a food source for other species, they are a vital element in terrestrial food chains. At the base of many food chains, arthropods are important components of the diets of invertebrates and birds, and are also an integral part of the nutrient- and energy-processing abilities of the soil (Coleman and Crossley, 1996). They also present an important contribution to agricultural systems through pest control and pollination.

1.2.4 The evaluation of habitats for overall potential for terrestrial invertebrates is a more practical method of assessing nature conservation value than individual species surveying. Ideal feeding areas include woodland, dead wood, scrub, marshy grassland, rough grassland and areas with a mosaic of habitats. Bare earth and early successional stages of vegetation can provide nesting and sunning habitats and are often of value to specialist invertebrates. Overwintering habitats are sought in terrestrial features such as field margins with long rank grassland, which tends to support more species than short swards, piles of dead wood, hedgerows, low dense scrub, below rocks and in stonewall crevices.

Status

1.2.5 A systematic field survey for terrestrial invertebrates was not attempted, instead the habitats were assessed with particular reference to those invertebrates either listed as UK or Local Biodiversity Priority Species, (the NESBAP), or are Locally Important Species of Conservation Concern, listed in, the LBAP Steering Group Report (2003) (Table 2). Sixteen habitats with statutory and non-statutory designations were chosen to be surveyed (Table 1) as areas with potential for terrestrial invertebrates. The habitats within 500m of the proposed route corridor in the Northern Leg were generally assessed for their potential value to species of terrestrial invertebrates.

2 Methods

2.1 Existing Data

2.1.1 Consultation was undertaken with a variety of statutory and non-government organisations including, North East Scotland Biological Records Centre (NESBReC) and the Local Biodiversity Officer. The likelihood of particular species being present in the area was assessed, based on previous records detailed in the NBN Gateway (National Biodiversity Network) and in the North East Scotland Biodiversity Audits (1998). Entomologists acting as Local Recorders were also consulted to assess the likelihood of potential species occupying the habitats within the study area.

2.2 Survey Methods

2.2.1 Six habitats were chosen to be individually assessed by an entomologist for their potential for locally important invertebrate status (Table 1, Figures 10.11a-g). Habitats in the Northern Leg were generally assessed for potential suitability using the Phase 1 habitat data and target notes (Figures 10.2a-g, Appendix 10.1) and with a priori knowledge of the habitat requirements of particular invertebrates of local importance (Table 5). The sites are also cross-referenced to the Habitat Areas, HA, determined by species composition and detailed in Figures 10.3a-g. In the present study, a combination of both species and habitat assessment was employed, factors taken into consideration were as follows:

- herbaceous food plant availability;
- age, structure and suitability of woodlands for saprophytic invertebrates including deadwood;
- the presence of permanent long grassland, tall ruderal vegetation, scrub, hedgerows and walls as potential sites for over-wintering;
- proximity of a range of habitats to form the mosaic required for different invertebrate life stages; and
- likelihood of a species being present in the area following existing data searches.

2.2.2 The habitat surveys were conducted over a three-week period in September 2004, which is at the limit of the ideal survey period; additional information was however obtained through the Phase 1 Habitat Survey that was performed from May to September (refer to Terrestrial Habitats Report A10.1).

Table 1 – Sites Individually Surveyed for Habitat Evaluation

Site No.	Site Name / Designation	Terrestrial Habitat/Terrestrial Invertebrate Figure Nos.	Predominant Habitats	HA/ Chainage	Phase 1 Target Note Numbers
1	Brimmond Hill / DWS	10.2/10.11a	Gorse-covered heath and tall ruderals	N6 –N8/ ch314100-315400	7, 8, 10
2	Gough Burn /DWS	10.2/10.11b	Alder and willow car, marshy and acid grassland, mixed plantation woodland, dense scrub	HA N14 – N15 and HA N18-N19/ ch315600-316500	13,14
3	Craibstone	10.2/10.11b	Broadleaved semi-natural and mixed plantation, parkland, improved grassland, open water	HA N25-26, N28 and N30/ ch316400-317100	17-22
4	Goval Wood	10.2/10.11e	Semi-natural broadleaved woodland, coniferous and mixed plantation woodland, acid grassland, wet heath	HA N56-N58/ ch323550-324650	57-60
5	Corby Loch / DWS	10.2/10.11f	Willow carr, marshy grassland, fen, wet heath and open water	HA N85/ ch327300-328000	92-101
6	Red Moss / SINS	10.2/10.11f	Raised bog	HA N82-N83/ ch326800-327900	79

2.3 Survey Limitations

2.3.1 Most of the invertebrate records within North East Scotland and the Aberdeenshire area have been collected by local naturalists and are confined largely to rural areas. This reflects the bias placed upon their preferred collection areas. Due to the difficulty of identification, and the absence of a systematic survey, species diversity and number will most likely be under represented.

2.4 Habitat Evaluation

2.4.1 Factors that are likely to influence the maintenance of terrestrial invertebrate populations are judged to be of the greatest importance when evaluating habitat value. Invertebrates require abundant food sources, suitable egg laying opportunities and a mosaic of suitable habitats providing the variety of conditions required to accommodate the various life stages, and over-wintering habitats. Areas possessing sub-optimal food resources that have other habitat qualities (e.g. low levels of disturbance and suitable over wintering cover) are of lesser importance, as they are less likely to be vital to local invertebrate population survival. Details of how values of importance to the local invertebrate population survival were derived are given below:

- **Very High Value** – A locally unique key resource, vital for maintenance of existing invertebrate populations.
- **High Value -** Optimal habitat owing to locally abundant food, egg laying habitats and shelter.
- **Medium Value** - Despite suitable habitat, the location is considered sub-optimal due to habitat fragmentation.
- **Low Value -** Location offers marginal food resources and/or poor habitat/cover and/or suffers from substantial disturbance.

2.5 Assessment of Nature Conservation Value

2.5.1 The value of the local habitats and potential species populations were determined by reference to any designations and the results of the consultations, literature review and field surveys. The criteria used were based on the Ratcliffe Criteria (Ratcliffe, 1977) used in the selection of biological Sites of Special Scientific Interest (SSSI). Sites and features were classified according to the criteria identified in Table 2.

2.5.2 The ecological receptors were identified from the baseline studies, and their value assessed according to best practice guidelines (IEEM, 2002). Following the guidelines, the impacts on ecological receptors were then identified, and the effects of the proposed development predicted. Any mitigation required was determined, and the significance of the residual effects evaluated.

2.5.3 All ecological receptors, both habitats and species, identified from the baseline studies were assigned a value according to the criteria in Table 2 or were determined to be of no value.

Table 2 – Evaluation of Ecological Receptors

Ecological Importance	Attributes of Ecological Receptor
International (European)	An internationally designated site or candidate site (SPA, pSPA, SAC, cSAC, Ramsar site, Biogenetic/Biosphere Reserve, World Heritage Site) or an area which meets the published selection criteria for such designation, irrespective of whether or not it has yet been notified; A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat which are essential to maintain the viability of a larger whole; Any regularly occurring population of an internationally important species, which is threatened or rare in the UK. i.e. a UK Red Data Book species or listed as occurring in 15 or fewer 10km squares in the UK (categories 1 and 2 in the UK BAP) or of uncertain conservation status or of global conservation concern in the UK BAP; A regularly occurring, nationally significant population/number of any internationally important species.
National (Scottish)	A nationally designated site (SSSI, ASSI, NNR, Marine Nature Reserve) or a discrete area, which meets the published selection criteria for national designation (e.g. SSSI selection guidelines)

Ecological Importance	Attributes of Ecological Receptor
	irrespective of whether or not it has yet been notified; A viable area of a priority habitat identified in the UK BAP, or of smaller areas of such habitat which are essential to maintain the viability of a larger whole; Any regularly occurring population of a nationally important species which is threatened or rare in the region or county (see local BAP); A regularly occurring, regionally or county significant population/number of an internationally/nationally important species; A feature identified as of critical importance in the UK BAP.
Regional (North East Scotland)	Sites which exceed the County level designations but fall short of SSSI selection guidelines, where these occur; Viable areas of key habitat identified in the Regional BAP or smaller areas of such habitat which are essential to maintain the viability of a larger whole; Viable areas of key habitat identified as being of Regional value in the appropriate Natural Area profile; Any regularly occurring, locally significant population of a species listed as being nationally scarce which occurs in 16-100 10km squares in the UK or in a Regional BAP or relevant Natural Area on account of its regional rarity or localisation; A regularly occurring, locally significant number of a regionally important species. Sites maintaining populations of internationally/nationally important species that are not threatened or rare in the region or county.
Authority Area (e.g. County or District) (Aberdeenshire/ City of Aberdeen)	Sites that are recognised by local authorities (e.g. District Wildlife Sites (DWS) or Sites of Interest to Nature Conservation (SINS)); County/District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves (LNR) selected on County/District ecological criteria (County/District sites where they exist, will often have been identified in local plans) A viable area of habitat identified in County/District BAP or in the relevant SNH Natural Heritage Future area; Any regularly occurring, locally significant population of a species which is listed in a County/District BAP on account of its regional rarity or localisation; A regularly occurring, locally significant population of a County/District important species (particularly during a critical phase of its life cycle); Sites/features that are scarce in the County/District or which appreciably enrich the County/ District habitat resource; A diverse and/or ecologically valuable hedgerow network Semi-natural ancient woodland greater than 0.25 ha.
Local (immediate area or village importance)	Areas of habitat considered to appreciably enrich the habitat resource in the local context (survey area, parish or neighbourhood, e.g. species-rich hedgerows, ponds etc). Sites that retain other elements of semi-natural vegetation that due to their size, quality or the wide distribution of such habitats in the local area are not considered for the above classifications. Semi-natural ancient woodland smaller than 0.25 ha.
Less than Local (limited ecological importance)	Sites that retain habitats that are of limited ecological importance due to their size, species composition or other factors.

2.5.4 Within the context of the habitat evaluation the following parameters in Table 2 apply;

- **National/International** - Very High Value
- **Regional/Authority Area** - High Value
- **Local** - Medium Value
- **Less than Local** - Low Value

2.6 Impact Assessment

Impact Magnitude

2.6.1 The magnitude of impacts is assessed in terms of their nature, time and space. The level of the impact magnitude is determined in this assessment, according to best practice guidelines for ecological assessment (IEEM 2002). Methods of impact prediction used included direct measurements, correlations, expert opinion and information from other developments. Impacts include those that are predicted to be direct, indirect, temporary, permanent, cumulative, reversible or irreversible. The magnitude of each impact was assessed independently of its value or statutory status. The criteria used to describe the magnitude of an impact on an ecological receptor are described in Table 3.

2.6.2 Negative impacts are defined as effects that are detrimental to the nature conservation value of any component of the ecosystem and anything that might reduce that component's viability. Positive impacts are defined as those that increase conservation value and which improve a component's viability. Major effects are likely to have a permanent effect on the receptor.

2.6.3 The levels of impact magnitude are based on the ecological concept of integrity. Features that determine the integrity of an ecological receptor include the condition, resources, and existing processes on a site, and ecological interactions such as ecology and behaviour of species and habitats, community dynamics and spatial connectivity between sites or populations. In general terms, ecological integrity can be defined as: 'the coherence of ecological structure and function, that enables the feature to be maintained in its present condition' (IEEM 2002).

Table 3 – Impact Magnitude

Impact Magnitude	Criteria
High negative	The change is likely to permanently, adversely affect the integrity of an ecological receptor, in terms of the coherence of its ecological structure and function, across its whole area that enables it to sustain the habitat, complex of habitats and/or the population levels of species of interest (at a regional or higher level).
Medium negative	The change is not likely to permanently adversely affect the ecological receptor's integrity but the effect on the receptor is likely to be substantial in terms of its ecological structure and function and may change its evaluation. Likely to result in changes in the localised distribution of a species but not affect its population status at a regional level.
Low negative	The change may adversely affect the ecological receptor, but there will probably be no permanent effect on its integrity and/or key attributes and is unlikely to change its evaluation.
Negligible	The change may slightly adversely affect the receptor but will have no permanent effect on the integrity of the receptor or its key attributes. There are no predicted measurable changes to the species assemblage or population and the effect is unlikely to result in an increased vulnerability of the receptor to future impacts.
Positive	The change is likely to benefit the ecological receptor, but may not improve its evaluation
High positive	The change is likely to restore an ecological receptor to favourable conservation status, or to create a feature of recognisable value (at a regional or higher level).

Impact Significance

2.6.4 The significance of an impact has been determined according to the system illustrated in Table 4. In this assessment, according to best practice guidelines (IEEM 2002), the significance of an effect on an ecological receptor is described as a product of its value and the magnitude of the predicted impact. A matrix of the possible significance of ecological effects, adapted from the IEEM (2002) guidelines, is shown in Table 4. The significance levels resulting from the product of value and

impact magnitude are major, moderate, minor, or no effect. Some professional judgement is then required to determine at what level effects become significant, based on knowledge of the study area gained through the desk and field studies.

2.6.5 Impact significance greater than or equal to moderate would require mitigation to be undertaken to ameliorate the impact significance to acceptable levels.

Table 4 – Impact Significance

Magnitude / Importance	High Negative	Medium Negative	Low Negative	Negligible	Positive	High Positive
International	Major	Major	Moderate	Negligible	Moderate	Major
National	Major	Major	Moderate	Negligible	Moderate	Major
Regional	Major	Moderate	Minor	Negligible	Minor	Moderate
Authority Area	Moderate	Moderate	Minor	Negligible	Minor	Moderate
Local	Minor	Minor	Minor	Negligible	Minor	Minor
Less than Local	Minor	Negligible	Negligible	Negligible	Negligible	Negligible

2.6.6 The level of significance of impacts predicted on ecological receptors is an important factor in influencing the decision-making process and determining the necessity and/or extent of mitigation measures. Impacts can be beneficial or adverse, either improving or decreasing the ecological status health or viability of a species, population or habitat.

3 Baseline

3.1 Data Search

3.1.1 A combination of North East Scotland (NES) Biodiversity Audit Data (2003), NES and UK BAP data in addition to the knowledge of local recorders was used to produce a table of potential invertebrates of local significance, (Table 5). The known habitat requirements of the species were used to assess the potential importance of habitats within the 500m route corridor and with particular reference to six specific sites (Table 1).

Table 5 – Potential Terrestrial Invertebrates of Local Significance (* UK BAP Species, † NES BAP Species)

English Name	Latin Name	Habitat Requirements
Scottish Wood Ant*	Formica aquilonia	Mature Caledonian pine forest/ birch woodland
Narrow-headed Ant*	Formica exsecta	Mature Caledonian pine forest/ birch woodland, open but sheltered
Hairy Wood Ant	Formica lugubris	Mature Caledonian pine forest/ birch woodland, open but sheltered
Gt. Yellow Bumble Bee	Bombus distinguendus	Wet and dry grasslands but recent records only coastal
A Leaf Beetle	Crytocephalus decemmaculatus	Bare sand and shingle, coastal
A Ground Beetle	Dyschirius angustatus	Bare sand and shingle, coastal
Beetle	Ampedus tristis	Mature Caledonian pine forest
Beetle	Cercyon alpinus	Uplands in association with deer dung
Beetle	Chrysanthia nigricornis	Mature Caledonian pine forest

English Name	Latin Name	Habitat Requirements
Northern Brown Argus Butterfly*	Aricia artaxerxes	Well drained, moorland, rock-rose for egg laying
Pearl-bordered Fritillary Butterfly*	Boloria euphrosyne	Unimproved grassland, scattered scrub or bracken
Small Pearl-bordered Fritillary Butterfly	Boloria selene	Wet woodland and moorland
Large Heath Butterfly	Coenonympha tullia	Lowland mosses and moorland, wet woodland
Small Blue Butterfly	Cupido minimus	Coastal calcareous grassland
Dingy Skipper Butterfly	Erynnis tages	Meadows with Lotus species, roadsides, embankments, heaths and moorlands
A Pyralid Moth	Catoptria permutatella	Pine forests and mosses
Black Mountain Moth	Psodos coracina	Upland moorlands with crowberry
Dark Bordered Beauty Moth	Epione paralellaria	Regeneration of aspen scrub
Narrow-bordered Bee Hawk Moth*	Hemaris tityus	Unimproved grassland with devil's- bit scabious, open woodlands
Lunar Yellow Underwing Moth	Noctua orbona	Sand dunes, moorland, birch woodland
Cousin German Moth	Paradiarsia sobrina	Regeneration of birch scrub
Netted Mountain Moth*	Semiothisa carbonaria	Upland sites with bearberry
Northern Dart Moth*	Xestia alpicola alpina	Upland sites with ling heather, bearberry and crowberry
Sword-grass Moth*	Xylena exsoleta	Rough lowland grasslands containing broad-leaved dock
Kentish Glory Moth	Endromis versicolora	Upland birch and alder woodlands
Scotch Burnet Moth	Zygaena exulans subochracea	Upland areas with crowberry
Northern Blue Damselfly	Coenagrion hastulatum	Mesotrophic sheltered pools, shallow margins of lochs
A Hoverfly*	Blera fallax	Wet rot holes associated with secondary decay of pine wood
Aspen Hoverfly*†	Hammerschmidtia ferruginea	Wet decaying cambian of dead or standing trees
A Hoverfly	Metasyrphus lapponicus	Acidophagous woods
A Cranefly*	Lipsothrix ecucullata	Wet seepages in damp deciduous woodlands
A Cranefly	Rhabdomastix hilaris	Exposed sediments in wet woodlands
A Stiletto Fly	Thereva lunulata	Sandy riverbanks with open conditions
A Robber Fly	Laphria flava	Caledonian pinewoods
Mountain Whorl Snail	Vertigo alpestris	Lightly shaded dry stone walls
Wall Whorl Snail	Vertigo pusilla	Lightly shaded dry stone walls
A Wolf Spider Group	Dipoena torva	Caledonian pine woods
A Spider	Lepthyphantes insignis	Subterranean species of agricultural land
A Wolf Spider	Arctosa cinerea	Lakeside stones and wet open sites
Stonefly*	Brachyptera putata	Lower sections of neutral of basic waters

3.1.2 Of the 39 invertebrates listed, 23 were excluded as being highly unlikely to occur in the survey area (Table 6) due to habitat requirements or their known distribution being outwith the Aberdeenshire areas, or that there are a lack of records for recent times.

Table 6 – Species Unlikely to be in the Aberdeenshire Area

Species	Reason for exclusion
Formica aquilonia	Restricted to Caledonian mature pine forest
Formica exsecta	Restricted to Caledonian mature pine forest
Formica lugubris	Restricted to Caledonian mature pine forest
Crytocephalus decemmaculatus	Only recorded in Braemar, pre- 1970
Dyschirius angustatus	Only recorded in Morayshire, pre- 1970
Ampedus tristis	Restricted to Caledonian mature pine forest
Cercyon alpinus	Upland species associated with deer dung
Chrysanthia nigricornis	Only known site is Glen Tanar, Aboyne
Aricia artaxerxes	Requires base-rich un-improved grasslands with rock rose
Erynnis tages	Only known site is in Morayshire
Epione paralellaria	Requires young saplings of Aspen
Hemaris tityus	Restricted to the Moray Firth and west coast
Noctua orbona	Only known in Cornhill, Banffshire
Semiothisa carbonaria	Upland species
Xestia alpicola alpina	Upland species
Zygaena exulans subochracea	Upland species
Coenagrion hastulatum	Mesotrophic loch upland species
Blera fallax	Only known from Grantown-on-Spey area
Hammerschmidtia ferruginea	Requires large, mature Aspen woods with deadwood
Metasyrphus lapponicus	Only known in Speyside; may now be extinct in Scotland
Lipsothrix ecucullata	Only known in the Cairngorms and Morayshire
Laphria flava	Restricted to Caledonian mature pine forest
Dipoena torva	Complex group of spiders, not well known; recent taxonomic discoveries relating to a rare member of this group are from Speyside

3.1.3 The likelihood of the 16 remaining species being present was then assessed on a site by site basis (Table 7).

Table 7 – Habitat Potential for Locally Important Species (O demotes that a survey is recommended or X that the species is very unlikely to occur)

Species	Site Number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bombus distinguendus	X	X	X	O	O	X	O	X	X	X	X	X	X	O	X	O
Boloria euphrosyne	O	O	X	X	X	X	O	X	O	O	X	O	O	O	O	O
Boloria selene	O	O	X	X	X	X	O	X	O	O	X	O	O	O	O	O
Coenonympha tullia	X	O	X	X	X	X	O	X	X	X	X	O	O	O	O	X
Cupido minimus	X	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X
Catoptria permutatella	O	X	X	X	X	X	O	X	X	O	X	X	X	X	X	X
Paradiarsia sobrina	X	O	X	X	X	X	X	X	X	X	X	X	O	X	O	X
Xylena exsoleta	O	O	O	O	O	X	O	X	O	O	X	O	O	O	O	O
Endromis versicolora	O	X	X	X	X	X	X	X	X	O	X	X	X	X	O	X
Rhabdomastix hilaris	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X	X
Thereva lunulata	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X	X
Vertigo alpestris	X	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X
Vertigo pusilla	X	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X
Lepthyphantes insignis	X	X	X	X	O	X	O	X	X	O	O	X	X	X	O	O
Arctosa cinerea	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X	X
Brachyptera putata	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X	X

3.1.4 The North-East Scotland Biological Records Centre (NESBReC) currently only holds non-confidential records of two of these species near Aberdeen: the pyralid moth Catoptria permutatella and Sword-grass moth. Records for other species are held but most of these are from upper Deeside or the Morayshire coast.

3.1.5 Although two sites (6 and 8, Table 7) were not deemed likely to be potential habitats for viable communities of locally important species, and many sites are unlikely to be potential habitats for many protected species the habitats were never the less evaluated for general suitability for invertebrate populations.

3.1.6 A summary of the survey results and habitats suitable for terrestrial invertebrates is presented in Table 8.

Survey Results – Specific Sites

Site 1 Brimmond Hill

3.1.7 The summit of Brimmond Hill is heather (Calluna vulgaris) dominated dry heath habitat with scattered clumps of gorse scrub. Heather occupies approx. 90-100% of the vegetation cover with occasional deer grass (Scirpus cespitosa), and sedge sp, with cross-leaved heath (Erica tetralix) and Sphagnum spp. occasional in wetter areas.

3.1.8 On the lower, eastern slopes, the amount of gorse scrub increases and forms extensive dense stands in a mosaic with dry heath that includes heather and also bilberry (Vaccinium myrtillus) and deer grass. Around the lower slopes, dense gorse becomes dominant and forms a continuous habitat with scattered birch and rowan trees scattered throughout. The scrub habitat also includes scattered broom. Towards the southeast of the hill, on the lower slopes, areas of bracken and semi-improved acid grassland are present within the dense scrub.

3.1.9 Although not of local importance, the broom-tip moth (Chesias rufata) has declined dramatically in national terms, it feeds on gorse species and may occur here. The density of cover leaves little ground exposed and as a result this site is probably not of great importance for other locally important terrestrial invertebrates. The possibility remains that insects attracted to these flowers (bees, wasps, flies) may be of interest as well as their predators (spiders, hoverflies, etc.) The habitat will be suitable fort the subterranean spider Lepthyphantes insignis. Although there are no other locally important species particularly associated with gorse, there may be locally important species using this habitat when in flower.

Site 2 Gough Burn

3.1.10 The site is a mosaic of wetland habitats comprising rush pasture, marshy grassland, willow carr woodland and gorse scrub, with a small section of mire vegetation in the central section of the site.

3.1.11 The majority of the site is comprised of marshy grassland dominated by soft rush, sharp-flowered rush, tufted hair-grass (Deschampsia cespitosa), common sedge (Carex nigra), and Yorkshire-fog with abundant herb species that include common marsh-bedstraw (Galium palustre), common sorrel, devil's-bit scabious (Succisa pratensis), creeping buttercup, Meadow buttercup (Ranunculus acris), marsh pennywort (Hydrocotyle vulgaris), ragged-robin (Lychnis flos-cuculi), and yellow-rattle (Rhinanthus minor). Willow carr is developing in several locations throughout the site, particularly along the axis of Gough Burn along the NW edge and in an extensive stand in the south of the site. Alders, birches and other shrubs are also present and willow scrub is scattered throughout the site. The willow carr supports a ground flora with water horsetail (Equisetum fluviatile), Opposite-leaved golden-saxifrage (Chrysosplenium oppositifolium), water mint (Mentha aquatica), monkey flower (Mimulus guttatus), broad buckler-fern, creeping buttercup and soft rush.

3.1.12 The site could potentially be suitable for a number of locally important Lepidoptera including priority species listed below, as well as a few species of flying insects with aquatic larvae, caddis flies, etc. It is unlikely to be of much importance to other locally important invertebrates. Locally important species that the site may support are, the pearl-bordered fritillary, the small pearl-bordered fritillary, the large heath butterfly and the sword-grass moth.

Site 3 Craibstone

3.1.13 Craibstone Estate is a large site centred around college buildings and comprises a number of very different habitats. Of chief invertebrate interest is the mature semi-natural broad-leaved and mixed woodland which occurs in various places around the outer edges of the estate.

3.1.14 North of the burn, mature beech woodland is present that is of long-established origin, with an understorey that includes hazel, wych elm, holly, laurel (Prunus laurocerasus) and rhododendron.

3.1.15 South of the burn there are beech woodlands supporting an understorey of semi-mature silver birch and spruce sp., over a ground flora with broad buckler-fern, and honeysuckle (Lonicera pericyclamen). In other areas, south of the burn silver birch dominates the canopy, and here the ground flora is more species-diverse with additional creeping soft-grass, tufted hair-grass, wavy hair-grass, raspberry (Rubus idaeus), hard-fern (Blechnum spicant), common nettle and chickweed-wintergreen. Throughout the canopy, sycamore, wych elm and aspen are occasional species with occasional introduced shrub species

3.1.16 The woodland immediately to the northwest of the campus buildings comprises blocks of mature coniferous plantation and young or semi-mature mixed plantations. Canopy species include Scot's pine, sitka spruce, and Douglas fir with downy birch, silver birch, beech, sycamore and abundant goat willow.

3.1.17 The semi-mature aspen (also found in the north-western part of the estate) is the subject of a major conservation effort in the north-east with several locally and nationally important species of invertebrate, bryophyte and fungus having been discovered to be dependent on the plant. The

priority species listed in Table 5 which depend on aspen generally require either large stands of the tree, deadwood, or young growth, none of which occurs in this location at Craibstone. Nevertheless there may be other locally important species of invertebrates present.

3.1.18 Rare spiders have been recorded from arable farmland in the Craibstone area in the recent past. The spiders are from a complex group where new taxonomic discoveries are currently being made and with further investigation may turn out to be relatively widespread. This is the case with many relatively unknown species. The area may support the giant yellow bumble bee, the pearl-bordered fritillary, the small pearl-bordered fritillary, the sword-grass moth and the subterranean spider associated with arable land Lepthyphantes insignis.

3.1.19 None of the other habitats within the estate are identified as being of potentially high interest for terrestrial invertebrates.

Site 4 Goval woods

3.1.20 The North section of Goval Wood, presents a mosaic of woodland habitats with predominantly wet semi-natural broad-leaved woodland with localised patches of semi-mature conifer plantation and more open habitats with wet heath habitats.

3.1.21 Broad-leaved woodland areas are comprised of mature silver birch and downy birch with occasional rowan, goat willow and coniferous areas comprise Scot's pine with occasional spruce sp. The ground flora under these woodland areas is dominated by common sedge, wavy hair-grass, Polytrichum sp., broad buckler-fern, chickweed-wintergreen, heath wood-rush (Luzula multiflora) and wood-sorrel with occasional soft rush, heather, cross-leaved heath and other species characteristic of wet heath habitats.

3.1.22 The wet heath habitats are dominated by heather, cross-leaved heath, soft rush, with locally abundant common sedge, heath rush, jointed rush (Juncus articulatus), wavy hair-grass, and frequent chickweed-wintergreen, crowberry (Empetrum nigrum), hare's-tail cotton-grass, common cotton-grass (Eriophorum angustifolium), tormentil (Potentila erecta) and star sedge (Carex echinata). Bryophytes are an important feature of the ground flora in all habitats with well developed Sphagnum spp. and Polytrichum sp. cushions. In the area north of Goval farm the wet heath forms a mosaic with acid grassland that includes heath rush, Yorkshire-fog, soft rush, common cotton-grass, tormentil, bilberry, mat-grass (Nardus stricta), heath wood-rush, sedge sp, creeping bent (Agrostis stolonifera), wavy hair-grass and red fescue (Festuca rubra).

3.1.23 The wet heath has potential for several species of Lepidoptera of local importance which are currently found nearby at higher altitudes in Donside and Deeside. There is a range of habitats present, from open heathland through encroaching birch scrub to mature deciduous forest, and hence potential for a diverse range of invertebrate species. It should be noted that isolated patches of deciduous woodland in this area (e.g. East Woodlands, on the other side of the River Dee) have in the past proved interesting for Lepidoptera.

3.1.24 The locally important Lepidoptera that may be found are the pearl-bordered fritillary, the small pearl-bordered fritillary, large heath butterfly, cousin German moth and the sword-grass moth.

Site 5 Corby Loch

3.1.25 The isolated nature of this privately owned loch and neighbouring Lily Loch and the extensive wet grassland and bog surrounding result in undisturbed habitats potentially of great interest for insects associated with wetlands, as well as other wildlife. There is much marshy grassland surrounding the loch. The species-rich sward is dominated by Yorkshire-fog, soft rush, common sorrel, marsh thistle (Cirsium palustre), cock's-foot, greater bird's-foot-trefoil (Lotus uliginosus), creeping buttercup, common vetch (Vicia sativa), and lesser stitchwort (Stellaria graminea) in drier areas. Where the ground becomes wetter, the sward includes dominant sharp-flowered rush, meadow buttercup, marsh cinquefoil (Potentilla palustris) common reed (Phragmites australis) and

occasional marsh-bedstraw, cuckoo-flower (Cardamine pratensis), ragged-robin, and meadow vetchling (Lathyrus pratensis).

3.1.26 The range of species occurring is probably high and there may well be some interesting and/or rare invertebrate species present in this area. Locally important species to be found here may include, giant yellow bumble bee, the pearl-bordered fritillary, the small pearl-bordered fritillary, the large heath butterfly, and the sword-grass moth.

Site 6 Red Moss

3.1.27 This site maintains an extensive raised bog habitat and hence is rare both in a local and national context. There are localised areas with dry modified bog habitat with well drained, leggy heather dominated vegetation with a few areas that retain peat hags. In areas where the effects of drainage are less pronounced, species such as hare's-tail cotton-grass become co-dominant with heather, and Sphagnum spp. present in wet hollows.

3.1.28 Much of the area has suffered human disturbance with extensive peat extraction in the past leaving cutting edges in the peat and level areas of bog of differing heights. There are also ditches draining much of the ground. There is a great deal of encroachment of birches and willows in all parts and much of the relatively dry bog is. Large heath butterfly is known to occur and probably a range of other heathland Lepidoptera including possibly pearl-bordered fritillary, small pearl-bordered fritillary, sword-grass moth and kentish glory moth, in the lag areas. The locally important subterranean spider species Lepthyphantes insignis is also a possible species present.

Table 8 – Specific Habitat Features of Use to Terrestrial Invertebrates in the Northern Section

Area	HA/ Chainage	Grid Reference	Habitats of use to invertebrates	General invertebrate potential	Locally important invertebrate potential
Brimmond Hill	HA N6 –N8/ ch314100-315400	NJ 860 090	Dry heath, scrub, bracken, semi-improved acid grassland, scattered birch and rowan	Aranae, Diptera, Hymenoptera and Lepidoptera	The subterranean spider Lepthyphantes insignis.
Gough Burn	HA N14-N15and HA N17-N18/ ch315600-316500	NJ 866 097 NJ 874 104	Marshy grassland, willow carr and Gorse scrub, running water and mire vegetation	Diptera Lepidoptera, and Trichoptera	Pearl-bordered fritillary, the small pearl-bordered fritillary, large heath butterfly and the sword-grass moth.
Craibstone	HA N25-N26, N28 and N30/ ch316400-317100	NJ 873 105	Mature beech wood and mature coniferous plantation, semi-mature birch and aspen	Aranae, Hymenoptera, and Lepidoptera	Giant yellow bumble bee, the pearl-bordered fritillary, the small pearl-bordered fritillary, the sword-grass moth and the subterranean spider associated with arable land *Lepthyphantes insignis*.
Goval Wood	HA N56-N58/ ch323550-324650	NJ 885 156	Mature and semi-mature broad-leaved woodland, coniferous woodland willow scrub and wet heath	Aranea, Coleoptera, Diptera Isopoda, Tricoptera and Lepidoptera	Pearl-bordered fritillary, the small pearl-bordered fritillary, large heath butterfly, cousin German moth and sword-grass moth.
Corby Loch	HA N85/ ch327300-328000	NJ 925 145	Marshy grassland and open water	Diptera, Hymenoptera, Lepidoptera, Odonata and Trichoptera	Giant yellow bumble bee, the pearl-bordered fritillary, small pearl-bordered fritillary, large heath butterfly, and the sword-grass moth.
Red Moss	HA N82-N83/ ch326800-327900	NJ 913 160	Modified bog and wet heath	Aranea, Coleoptera and Lepidoptera	Pearl-bordered fritillary large heath butterfly, small pearl-bordered fritillary, sword-grass moth and kentish glory moth and the subterranean spider *Lepthyphantes insignis*.

3.1.29 In addition to the sites pre-determined for survey there are seven other areas of habitat that are of potential value for terrestrial invertebrate communities (Table 9). These areas were also evaluated for their habitat potential for invertebrates, a summary of which is presented in Table 10.

Table 9 – General Habitat Features of Use to Terrestrial Invertebrates in the Northern Section

Site Number	Terrestrial Habitat/ Terrestrial Invertebrate Figure No.	Predominant Habitats	HA/ Chainage	Phase 1 Target Note Numbers
A	10.2/ 10.11d	Acid grassland and conifer plantation at Monument Wood	HA N41, N42 N47/ ch321500 – 321600	46-48
B	10.2/ 10.11d	Broad-leaved plantation woodland	HA N50/ ch321900	52
C	10.2/ 10.11d	Improved and semi-improved neutral grassland	HA N54 / ch323100 – 323200	54
D	10.2/ 10.11e	Mixed plantation woodland	HA N54/ ch323300	55
E	10.2/ 10.11e-f	Broad-leaved woodland, deadwood, wet heath/acid grassland mosaic	HA N71 and N72/ ch325500 – 326000	72-73
F	10.2/ 10.11e-f	Marshy grassland	HA N80/ ch326500	90
G	10.2/ 10.11e-f	Dense scrub	HA N87/ ch328000	101

A Acid Grassland and Monument Wood

3.1.30 This is an area of semi-improved and un-improved acid grassland the sward of which is comprised of red fescue, perennial rye-grass (Lolium perenne), cock's-foot, wavy hair-grass and broad-leaved dock, common sorrel, cat's-ear (Cerastium fontanum). There are small areas of rocky outcrops supporting thinner and less enriched soil with a more diverse community with dominant species including wavy hair-grass, sheep's sorrel, curled dock (Rumex crispus), bilberry, heath wood-rush, common cat's-ear (Hypochaeris radicata), creeping soft-grass, heath speedwell (Veronica officinalis), heath bedstraw, tormentil, eyebright (Euphrasia officinalis), white clover (Trifolium repens), ribwort plantain (Plantago lanceolata), germander speedwell, creeping buttercup and occasional bracken. Monument Wood, is a relatively extensive conifer plantation comprising, in the south, largely of semi-mature European larch. The ground flora is species poor and includes broad buckler-fern, wood-sorrel, rough meadow-grass, creeping soft-grass and chickweed-wintergreen. This area is of little value to terrestrial invertebrates. The acid grassland has the potential to support Aranae and Coleoptera and Lepidoptera particularly species of local importance; pearl-bordered fritillary, sword-grass moth and the subterranean spider Lepthyphantes insignis.

B Broad-leaved Plantation Woodland

3.1.31 This area comprises a fenced-off section of a silage field consisting of recently planted broad-leaved woodland plantation with young trees 1-3m high and including Swedish whitebeam (Sorbus intermedia), ash, Wych elm, pedunculate oak and rowan over a ground flora dominated by semi-improved grassland with Yorkshire-fog, cock's-foot, false oat-grass, (Arrhenatherum elatius) red fescue, creeping thistle, common nettle and broad-leaved dock. This semi-improved grassland will potentially support a range of Aranae, Coleoptera, Hymenoptera and Lepidoptera.

C River Don Crossing

3.1.32 Improved grassland meadows extend down to the banks of the River with species rich neutral grassland along the whole of the north bank and the south bank north of the proposed road. Riparian areas of vegetation include tall herb vegetation including elder (Sambucus nigra), ground elder (Aegopodium podagraria), hogweed (Heracleum sphondylium), common nettle, Leopard's-bane (Doronicum pardalianches), common comfrey (Symphytum officinalis), meadowsweet (Filipendula ulmaria), broad-leaved dock, and sweet cicely (Myrrhis odorata). Grassland areas maintain a diverse range of species that include reed sweet-grass, Yorkshire-fog, cock's-foot, dog rose, water forget-me-not (Mysotis scorpioides), cleavers (Galium aparine), male-fern, hedge woundwort (Stachys sylvatica), nipplewort (Lapsana communis) cat's-ear, common knapweed (Centaurea nigra), meadow vetchling, white clover, common vetch, tufted vetch (Vicia cracca), monkey flower and common blue-sowthistle (Cicerbita macrophylla). The area will support a range of Aranae, Coleoptera, Hymenoptera and Lepidoptera. More particularly the improved grassland meadows and strip of acid grassland may support the subterranean spider Lepthyphantes insignis, and the sword-grass moth. There is also potential for the habitat to support the giant Yellow bumble bee.

D Small Mixed Plantation Woodland

3.1.33 This comprises a small area of mixed plantation northeast of River Don, between the river and the B977. The canopy comprises semi-mature woodland with pine sp., sycamore, beech and spruce sp. over bracken-dominated ground flora with creeping soft-grass, bramble and common nettle. The ground flora is poor and this area is of little value for terrestrial invertebrates. The area may support a range of Coleoptera and Aranae but is not thought to be suitable for any of the listed (Table 5) locally important species.

E Broad-leaved Semi-Natural and Plantation Woodland

3.1.34 Areas of young semi-natural broad-leaved woodland are present in the Northwest corner of Littlejohn's Wood. There are numerous tree stumps indicating the presence of a former plantation. Most of the habitat area comprises birch woodland with a young, dense canopy of downy birch and silver birch and occasional rowan over a ground flora with broad buckler-fern, wavy hair-grass, wood-sorrel and chickweed-wintergreen. Towards the north of the habitat area, the canopy becomes increasingly open with a mosaic of wet heath and acid grassland being the dominant habitat type. Wavy hair-grass and heather are dominant with occasional chickweed-wintergreen, heath bedstraw, common sedge, red fescue, purple moor-grass, Sphagnum spp , bilberry, hard-fern, heath wood-rush, climbing corydalis, cross-leaved heath, heath rush, mat-grass and tormentil. Along the north and west boundaries of the wood, a line of mature beech is present, planted along the lines of old and defunct dry stone walls. To the right of this area is a semi-mature coniferous plantation, comprising blocks with semi-mature Sitka spruce and occasional broad-leaved species such as rowan, birch and beech around the edges of the woodland. The combination of young regenerating birch and acid grassland/heath mosaic and dry stone walls has the potential to support a range of Aranae, Coleoptera, Gastropoda, Hymenoptera and Lepidoptera. Particularly the nationally and locally important species pearl-bordered and small pearl-bordered fritillary, sword-grass moth, cousin german moth, the wall whorl snail and the mountain whorl snail.

F Marshy Grassland

3.1.35 An area of marshy grassland with a small pond is present in the northeast corner of an improved grassland field. Marshy grassland is dominated by soft rush, Yorkshire-fog, and creeping buttercup with abundant heath bedstraw, tormentil, cock's-foot, sweet vernal-grass (Anthoxanthum odoratum), red fescue and common sorrel. The pond has soft rush around the margins with no aquatic vegetation noted. This area has the potential to support a range of Diptera, Hymenoptera, Lepidoptera and Odonata. This area has the potential to support the nationally important species the pearl-bordered fritillary and the sword-grass moth and the locally important species The giant yellow bumble bee.

G Dense Scrub

3.1.36 This area comprises low intensity pasture in fields northeast of Corby Loch. Most of the areas comprise species-poor semi-improved grassland, with frequent clumps of gorse along field margins and in field corners. Marshy grassland is present in low-lying areas with impeded drainage, dominated by soft rush, tufted hair-grass and Yorkshire-fog. This area has the potential to support a range of Aranae, Coleoptera and Lepidoptera. More particularly the area has the potential to support the nationally important species the pearl-bordered fritillary and the sword-grass moth and the locally important species the subterranean spider Lepthyphantes insignis.

Table 10 – General Habitat Features of Use to Terrestrial Invertebrates in the Northern Section

Area	HA/ Chainage	Grid Reference	Habitats of Use to Invertebrates	General Invertebrate Potential	Locally Important Invertebrate Potential
Monument Wood	HA N41, N42 N47/ ch321500 – 321600	NJ 861 542 – NJ 865 610	Acid grassland, bracken, rocky outcrops	Aranae, Coleoptera and Lepidoptera	Pearl-bordered fritillary, sword-grass moth and the subterranean spider *Lepthyphantes insignis*.
Small broad-leaved plantation woodland	HA N50/ ch321900	NJ 869 145	Semi-improved neutral grassland, semi-improved acid grassland, very young broad-leaved woodland	Aranae, Coleoptera, Hymenoptera and Lepidoptera	No particular species
River Don crossing	HA N54 / ch323100 – 323200	NJ 882 146	Scattered trees, semi-improved neutral grassland, tall ruderal vegetation	Aranae, Coleoptera, Diptera Hymenoptera and Lepidoptera, and Trichoptera	Giant yellow bumble bee, sword-grass moth and the subterranean spider *Lepthyphantes insignis*.
Small mixed plantation woodland	HA N54/ ch323300	NJ 882 147	Semi –mature broad-leaved and coniferous woodland	Aranae and Coleoptera	No particular species
Broad-leaved Semi-Natural and Plantation Woodland	HA N71 and N72/ ch325500 – 326000	NJ 904 952 – NJ 908 023	Broad-leaved woodland, deadwood, wet heath/acid grassland mosaic, dry stone walls	Aranae, Coleoptera, Gastropoda, Hymenoptera, and Lepidoptera	Pearl bordered and small pearl bordered fritillary, sword-grass moth, the cousin german moth, the wall whorl snail and the mountain whorl snail.
Marshy grassland	HA N80/ ch326500	NJ 913 152	Open water, marshy grassland	Diptera, Hymenoptera, Lepidoptera and Odonata	Giant yellow bumble bee, the pearl-bordered fritillary and the sword-grass moth.
Dense scrub	HA N87/ ch328000	NJ 927 860	Marshy grassland, semi-improved neutral grassland, Gorse scrub	Aranea, Coleoptera and Lepidoptera	Pearl-bordered fritillary, the sword-grass moth, and the subterranean spider *Lepthyphantes insignis*.

4 Evaluation

4.1 Specific Site Evaluation

Site 1 Brimmond Hill

4.1.1 This area comprises mostly of gorse scrub and heath with scattered birch and rowan and broom throughout. On the lower slopes there are localised areas of bracken and semi-improved acid grassland. This area is of importance to gorse feeding species but the density of the scrub will prevent use of the area by many ground dwelling invertebrates. When in flower the habitat may support Diptera, Hymenoptera and Lepidoptera and the ground may support one subterranean species of local value. The area is assessed as being of low value and therefore of local ecological value.

Site 2 Gough Burn

4.1.2 The site is a mosaic of wetland habitats comprising rush pasture marshy grassland, willow carr woodland and gorse scrub, with a small section of mire vegetation in the central section of the site. It has the potential to support a range of Diptera, Lepidoptera and Trichoptera including two species of national Value and two species of local Value. This habitat is assessed as being of medium Value and therefore of county ecological value.

Site 3 Craibstone

4.1.3 Craibstone Estate is a large site centred around college buildings and comprises a number of very different habitats. Of chief invertebrate interest is the mature semi-natural broad-leaved and mixed woodland which occurs in various places around the outer edges of the estate. Young stands of regenerating aspen are important for several nationally important specialist invertebrates. The arable fields surrounding Craibstone have previously been host to rare Aranae, the area also has the potential to support a range of Lepidoptera and Hymenoptera. The habitat has the potential to support two species of national value and three species of local value. There is considerable fragmentation of this habitat due to its use as an agricultural college. This area is assessed as being of medium Value for terrestrial invertebrates and therefore of county ecological value.

Site 4 Goval woods

4.1.4 The north section of Goval Wood, presents a mosaic of woodland habitats with predominantly wet semi-natural broad-leaved woodland with localised patches of semi-mature conifer and broad-leaved plantation and scrub with more open habitats comprising wet heath and acid grassland. To the south there is much scrub and semi-improved acid grassland. Wet heath will potentially support a range of Lepidoptera, whereas the mature woodlands in addition to the Lepidoptera may support and range of Coleoptera, Diptera and Isopoda. The grasslands may support a range of Aranea. Overall the area has the potential to support two species of national value and three species of local value. The isolated nature of the wood contributes to the assessment of the site as being of medium value and therefore of county ecological value.

Site 5 Corby Loch

4.1.5 In addition to the loch there are a range of wetland habitats associated with the area such as willow scrub and marshy grassland. This habitat will potentially support a range of Diptera, Hymenoptera, Lepidoptera, and Odonata. Particularly, two Lepidoptera of national value and three species of local value. Due to its proximity to Lily loch and its undisturbed nature this area is assessed as being of high value to terrestrial invertebrates and therefore of regional ecological value.

Site 6 Red Moss

4.1.6 Largely dry modified bog with heather dominated areas and much birch and willow scrub. There are localised areas with dry modified bog habitat with well drained, leggy heather-dominated vegetation. The area has been greatly affected by human disturbance due to draining and peat extraction. The heath areas are known to support locally important Lepidoptera and have the potential to support a range of Aranea and Coleoptera. There is potential to support two species of national value and four species of local value. This area is assessed as being of medium value and therefore of county ecological value.

4.2 General Evaluation: Northern Section

A Acid Grassland and Monument Wood

4.2.1 In this area the acid grassland sward and rocky outcrops has the potential to support a range of Aranae and Coleoptera and Lepidoptera. The habitat has the potential to support two species of national value and one species of local value. This area is assessed as being of medium value to terrestrial invertebrates and therefore of county ecological value.

B Broad-leaved Plantation Woodland

4.2.2 The young broad-leaved woodland is not yet of value to terrestrial invertebrates but the acid grassland sward has the potential to support a range of Aranae, Coleoptera, Hymenoptera and Lepidoptera. The area is however very small and surrounded by improved agricultural fields. The habitat is therefore assessed as being of low value and therefore of local ecological value.

C River Don Crossing

4.2.3 The semi-improved grassland and riparian vegetation may support a range of Aranea, Coleoptera, Hymenoptera, Lepidoptera and Trichoptera in addition to one species of national value and two species of local value. The area is however an isolated small strip of vegetation that is again surrounded by improved fields. The habitat is therefore assessed as being of low value and therefore of local ecological value.

D Small Mixed Plantation Woodland

4.2.4 This area supports semi-mature mixed trees with a poor ground flora. Due to the age structure and plantation nature of the woodland, this area is likely to be of limited interest to terrestrial invertebrates. It may support a range of Aranae and Coleoptera but is unlikely to have any of the locally important species. This is a small area that is assessed as being of low value and therefore of local ecological value.

E Broad-leaved Semi-Natural and Plantation Woodland

4.2.5 The area supports a combination of regenerating birch woodland and acid grassland/heath mosaic with dry stone walls has the potential to support a range of Aranae, Coleoptera, Gastropoda, Hymenoptera and Lepidoptera including two species of national value and four species of local value. The area is a reasonable size and links the area of woodland to the north and Red Moss, it is therefore assessed as being of medium value and therefore of county ecological value.

F Marshy Grassland

4.2.6 The marshy grassland has the potential to support a range of Diptera, Hymenoptera and Lepidoptera, with the small pond having the potential to support Odonata. This area has the potential to support two species of national value and one species of local value. This is however a very small area surrounded by improved fields. This area is therefore evaluated as being of low value and therefore of low ecological value.

G Dense Scrub

4.2.7 There poor semi-improved grassland sward and the areas of marshy grassland and scrub have the potential to support a range of Aranae, Coleoptera and Lepidoptera. In addition, two species of national value and one species of local value. This area is small although the marshy grassland may provide links to the larger area of marshy grassland to the north. The area is assessed as being of low value and therefore of low ecological value.

4.3 Evaluation Summary

4.3.1 These sites were initially chosen for survey due to the likelihood of a good invertebrate fauna. The most important area of habitat for invertebrates is Corby Loch the being of regional value due to the mosaic of habitats high value due to the mosaic of habitats present and their relatively undisturbed nature. Other than Brimmond Hill (assessed as being of low value due to it encroachment by dense stands of gorse) all other specific sites were assessed as being of medium value. Although these sites provided suitable habitat for invertebrates they were often degraded, fragmented or liable to disturbance. Of the general sites only sections A and E were assessed as being of medium value and therefore county ecological value. These results are presented in Table 11.

Table 11 – General Habitat Features of Use to Terrestrial Invertebrates in the Northern Section

Site Ref	Site Name	Habitats of Potential Value for Invertebrates	Potential Species and Evaluation	Site Evaluation
1	Brimmond Hill	Low	Local	Local
2	Gough Burn	Medium	National	County
3	Craibstone	Medium	National	County
4	Goval Wood	Medium	National	County
5	Corby Loch	High	National	Regional
6	Red Moss	Medium	National	County
A	Acid grassland and Monument Wood	Medium	National	County
B	Broad-leaved plantation woodland	Low	None	Local
C	River Don Crossing	Medium	National	County
D	Small mixed Plantation Woodland	Low	None	Local
E	Broad-leaved Semi-Natural and Plantation Woodland	Medium	National	County
F	Marshy Grassland	Low	National	Local
G	Dense Scrub	Low	National	Local

5 Potential Impacts

5.1 Impact Assessment

5.1.1 The greatest impacts upon terrestrial invertebrates due to the road development would be direct habitat loss and fragmentation of habitats. The significance of impacts would depend on the individual circumstances of each habitat and the nature of the impact. However, it is possible to identify a number of main areas of concern, which have general applicability (Highways Agency, 1999). These are set out in this section in the following order: Direct Mortality, Habitat Loss, Habitat Fragmentation and Isolation, Disturbance, Pollution and Indirect Impacts. It should be noted that the impacts associated with the operational phase of the scheme are considered to be permanent, whereas temporary imparts, which are only apparent while the road is being built, are discussed in association with the construction phase.

5.2 Generic Impacts

Direct Mortality

5.2.1 Work during the construction phase involving large earth works and heavy machinery would result in the death of a range of ground dwelling invertebrates, particularly slower moving, flightless arthropods, which cannot avoid being crushed by construction machinery. This is unlikely to permanently affect the population dynamics of any community. Direct mortality caused by the construction of the road would constitute an impact of Low Negative magnitude.

5.2.2 The principle cause of direct mortality resulting from operation of the scheme is likely to be through invertebrates, particularly Gastropoda and Diptera having an increased risk of being crushed by vehicles. Although there are no peer reviewed research driven figures for invertebrate roadkill, it is known to have a major impact on roadside arthropod populations (Oxley and Fenton, 1974; Mader, 1984). The only survey conducted to date in the UK was undertaken by the RSPB in 2004 (www.rspb.org.uk/bugcount). The study observed that, in total, one invertebrate was killed for every five miles travelled. This mortality unlikely to permanently affect the population dynamics would constitute an impact of Low Negative magnitude

Habitat Loss

5.2.3 The operational scheme would result in the direct loss of habitat, this will only be a small loss of the total available constituting a Low Negative impact. However, impacts affecting the integrity of the habitat as a whole that maintains several populations of nationally important species may be of a Medium Negative impact.

Habitat Fragmentation and Isolation

5.2.4 In addition to the barrier that would be created after the scheme is built, (discussed below as an operational impact – see section 5.2.5), there would also be habitat fragmentation and isolation through the provision for construction compounds, storage facilities and access roads. Although many invertebrates do not travel large distances, this fragmentation and isolation has the potential to have an impact upon the quality of a population. Therefore, this impact is assessed as being of Low Negative magnitude.

5.2.5 Large roads are absolute barriers to gene flow as shown in forest Carabid populations (Keller and Largiader 2003) and land snails will not cross even un-paved roads as narrow as 3m (Baur and Baur 1990). The operational scheme would also result in habitat fragmentation to those invertebrates that attempt to cross the road but suffer mortality. The road may also restrict immigration and emigration thus decreasing genetic dispersal and increasing competition amongst currently stable populations. The magnitude of these impacts is judged to be Low Negative.

Disturbance

5.2.6 During the operational phase there would be considerable disturbance from mowing of the verges. Frequent mowing along verges disturbs invertebrates and leads to a loss of overwintering habitat. The result of shortened vegetation is generally a reduction in the abundance and diversity of most groups and species (Morris, 2000). This disturbance favours a few opportunistic and robust species, often non-native, to the detriment of those that are slower to adapt (Mader, 1984; Hollifield and Dimmick, 1995; Haskell, 2000). The potential extinction of local ground dwelling invertebrates therefore increases. These disturbances can be considered to have an impact of Low Negative magnitude.

Pollution and Other Indirect Impacts

5.2.7 Activities associated with road construction can cause soil compaction which reduces the presence of terrestrial niches and leads to increased runoff and decreased soil porosity therefore causing soil dwelling invertebrate mortality (Noss, 1995). This mortality would constitute an impact of Low Negative magnitude.

5.2.8 During operation, in addition to destroying invertebrate habitat on the area used for the road itself there would be a reduction in the quality of habitat on road verges by altering vegetation, changing soil dynamics, and modifying microclimates.

5.2.9 De-icing salts cause saline pollution from, particularly NaCl but also MgCl2, CaCl2 this may cause invertebrate mortality from desiccation. These salts also produce ions which alter the soil pH and therefore change the plant communities which could be detrimental to the invertebrates using this vegetation as habitat.

5.2.10 Road surfaces tend to absorb solar radiation at a higher rate than natural surfaces, increasing soil and air temperatures (Haskell, 2000). This increased aridity has been known to decrease invertebrate diversity (Grindal and Brigham, 1998). The pollution caused by the operation of the road is assessed as having an impact of Low Negative magnitude.

5.2.11 Runoff from the operational road may contain compounds used in the manufacture of cars including zinc, cadmium and copper. Petroleum products also include heavy metals that could contribute to invertebrate mortality. Earthworms are known to bio-accumulate heavy metals, which will then be passed up the food chain. Again, this impact of pollution is Low Negative.

5.3 Specific Impacts

5.3.1 Terrestrial invertebrates are at risk from the construction and operational phase of the scheme throughout the site. Invertebrates would be particularly at risk in areas of scrub woodland or rank grassland where populations may be greater. The specific sites (summaries of which can be found in Table 10) would not be directly impacted upon by the development but may be affected through indirect impacts such as pollution, fragmentation and isolation. The general areas assessed in the Northern Leg (Table 11 and 12) would suffer some direct mortality. The summaries for the impacts and general areas of suitable habitat are presented in Table 12.

Direct Mortality

5.3.2 The construction of the road would cause direct mortality to terrestrial invertebrates, particularly in the general sites of which areas summarised in Table 12. None of the specifically evaluated sites in the Northern Leg would be affected as the proposed route option does not infringe upon any of the sites in this area. Direct mortality would therefore not affect the integrity of the terrestrial populations; this impact is assessed as being as Low Negative. The operation of the road would also cause direct mortality to the sites detailed in Table 12. This is a Low negative impact upon local and county evaluated sites resulting in impacts of Minor significance. The full impacts for each habitat are presented in Table 12.

Habitat Loss

5.3.3 Most of the specifically evaluated sites have been avoided during the footprint of the proposed construction corridor and would suffer no direct habitat loss. Small areas on Gough Burn would be lost due to culvert construction and there would be small areas of direct habitat loss to Craibstone. The general areas of habitat of value to the terrestrial invertebrates would also suffer loss; these are valued at county value. This is a low negative impact in terms of the overall habitat available from would therefore result in an impact significance of Minor. The full impacts for each habitat are presented in Tables 12.

Habitat Fragmentation and Isolation

5.3.4 The construction and operation of the scheme would form a physical barrier to terrestrial invertebrates, preventing them from moving freely within and between available areas of habitat. The specific sites evaluated and presented Gough Burn and Craibstone would suffer minimal fragmentation. The areas evaluated in Table 12 would suffer fragmentation. This isolation caused by construction and operation has the potential to have an impact upon the terrestrial invertebrates, but due to the distribution of populations this impact is likely to affect only localised areas, therefore this impact is a Low Negative magnitude on local to county value areas. The significance of these impacts are therefore of Minor significance.

Disturbance

5.3.5 Invertebrates would suffer disturbance from the construction phase but operation of the road would be of greater impact. The verges would be cut frequently disturbing overwintering invertebrates and removing habitat. Trampling by humans can also cause direct mortality and loss of habitat. Disturbance is considered to be a Low Negative Impact upon a local to county Value habitats, the significance of this impact is therefore of Minor significance.

Pollution and Other Indirect Impacts

5.3.6 During construction there could be pollution of the drainage ditches that connect Corby Loch and Red Moss this could subsequently affect the surrounding wetland vegetation and therefore reduce overall habitat quality for terrestrial invertebrates. Terrestrial invertebrates may also suffer from pollution during the operation of the road. Pollutants derived from vehicles may cause direct mortality and alter the vegetation community structure causing indirect displacement or mortality. These impacts are evaluated as being Medium Negative on local to county Value habitats resulting in a significance of Minor to Moderate.

5.4 Impact Assessment Summary

5.4.1 There are no impacts of Moderate significance resulting from habitat loss, the greatest impacts of the scheme result from habitat fragmentation, disturbance and pollution with a potentially permanent negative affect upon terrestrial invertebrate communities in the Corby Loch area should the integrity of the habitats be permanently affected. The overall significance of impacts of construction and operation of the scheme are Minor with a Moderate impact at Corby Loch, a summary of these effects is presented in Table 12.

6 Mitigation

6.1 Introduction

6.1.1 The main methods for mitigation for terrestrial invertebrates are ensuring best practice during construction, minimising habitat loss and fragmentation and management of the operational phase of the scheme. The aims of mitigation are to:

- reduce mortality during construction by using best practice;
- minimise habitat loss by fencing off areas outwith the working corridor;
- minimise the affects of habitat fragmentation by maintaining or creating corridors to link habitats;
- minimise pollution and disturbance; and
- where possible manage habitats for terrestrial invertebrates.

6.2 Specific Mitigation for the Northern Section

Direct Mortality

6.2.1 Direct mortality of terrestrial invertebrates during the construction of the scheme should be reduced by covering the ground with an appropriate geosynthetic where heavy machinery or trampling is expected.

6.2.2 Direct mortality through construction will be further limited by fencing off and avoiding the most sensitive areas (Table 12) to avoid incidental damage.

6.2.3 Direct mortality during operation cannot be mitigated for.

Habitat Loss

6.2.4 Only small amounts of valuable habitat are lost in Sections A and E of the general habitat areas that are suitable for invertebrates. In these sections where the loss of habitat is unavoidable and the subsequent degradation of adjacent valuable areas occurs, these sites would be returned to their former quality, once construction is completed. Where habitat loss is permanent, suitable habitat should be created and strategically positioned to offset this loss. This will include the establishment of species-rich grassland on the vast majority of embankment slopes within the proposed scheme.

6.2.5 There is specific mitigation in place to replace habitat lost through direct landtake. Planting of native mixed woodland will take place on the areas detailed in Table 12. Creation of species rich grassland on the embankments will encourage the colonisation of these areas by invertebrates. Dry stone walls will be restored along new road boundaries, providing new habitat for invertebrates such as a range of Gastropoda and Aranea. All details of specific habitat creation are presented in Ecology Chapter 10 Table 14.

6.2.6 Where the felling of trees is necessary, the dead wood should be retained (ensuring no fire risk) and allowed to decay providing habitat for saproxylic invertebrates and cover for ground dwelling woodland invertebrates.

Habitat Fragmentation and Isolation

6.2.7 The replacement or creation of dry stone walls along the route will provide overwintering sites and refuge for a range of invertebrates.

6.2.8 There is mitigation in place to replace habitat lost through direct landtake. Planting of native mixed woodland will take place on the areas detailed in Table 12. Creation of species rich grassland on embankments will encourage the colonisation of these areas by invertebrates. Existing grassland under pressure from over-grazing and poaching will be fenced in riparian zones to prevent further damage and encourage habitat regeneration. Dry stone walls will be restored along new road boundaries, providing new habitat for invertebrates such as a range of Gastropoda and Aranea.

Disturbance

6.2.9 During operation, 5m wide verges, as a minimum, will be created to protect adjacent habitats from disturbance by noise and vibration. Where operationally practical, parts of these verges would only be cut in autumn on a three year rotational basis to ensure that there is always some suitable habitat for overwintering invertebrates.

Pollution and Other Indirect Impacts

6.2.10 During the construction phase, contractors will adhere to SEPA best practice guidelines with regards to preventing pollution incidents in aquifer fed or inundated habitats. The relevant guidelines include:

- PPG1: General Guide to the Prevention of Water Pollution;
- PPG3: The Use and Design of Oil Separators;
- PPG5: Works in, Near, or Liable to Affect Watercourses; and
- PPG6: Working at Construction and Demolition Sites.

6.2.11 Construction phase mitigation will include the installation of drainage systems to divert runoff into drains, soak-aways and detention basins in order to avoid contamination of watercourses. Chemical and oil storage tanks would be set back at least 30m from any watercourse and secondary containment would be provided to prevent pollution incidents from occurring.

6.2.12 During operation of the scheme, the installation of a safe drainage system will be required involving sediment and oils traps to prevent runoff into the surrounding vegetation. Further details regarding pollution control during construction and operation can be found in Chapter 9 (Water Environment).

6.2.13 Verges of at least 2m wide will be established, these will retard the spread of pollutants into the surrounding habitats.

6.3 Mitigation Summary

6.3.1 During construction, mortality can be minimised by ensuring that best practice is adopted.

6.3.2 Habitat fragmentation is unavoidable, but appropriate strategic habitat creation will be designed to limit this impact.

6.3.3 Although mortality through the operation of the scheme is unavoidable, mitigation will be put in place to improve existing invertebrate habitats and protect adjacent habitats from the operational effects of the scheme thus enhancing the existing communities.

7 Residual Impacts

7.1 Residual Impacts

Direct Mortality

7.1.1 Although direct mortality would occur during construction and operation of the road, with the effective implementation of appropriate mitigation measures, this is not predicted to compromise the long-term integrity of and species or species assemblages of terrestrial invertebrates in the study area. Residual impacts are therefore assessed as being of Negligible significance.

Habitat Loss

7.1.2 Many areas of the proposed scheme pass through Low Value agricultural land. With the significant habitat re-creation implemented as appropriate mitigation, the construction of the road would be unlikely to result in long term impacts upon the integrity of the invertebrate communities. Residual impacts are therefore assessed as being of Minor significance.

Habitat Fragmentation and Isolation

7.1.3 There would be fragmentation of Gough Burn and Craibstone Campus and the habitats evaluated in Table 12. The areas of habitat creation will minimise these impacts during construction and operation will result in an impact of Minor significance.

Disturbance

7.1.4 The road scheme would be likely to increase the overall level of disturbance to invertebrates in the study area through the direct and indirect impacts of the operation of the scheme. The effective implementation of appropriate mitigation would ensure that disturbance would be kept to a minimum during the construction phase, and the creation and appropriate maintenance of verges will minimise disturbance during the operation of the scheme. Residual impacts are therefore assessed as being of Negligible significance.

Pollution and Other Indirect Impacts

7.1.5 The implementation of the proposed mitigation would ensure that the risk of pollutants reaching any watercourse is negligible and therefore there should be no negative impact on terrestrial invertebrates during construction. Measures implemented during construction will reduce pollution impacts during operation and the verges in addition to reducing disturbance will act as a buffer to pollution. As such the magnitude and significance of this impact is assessed as Minor. The potential impacts of pollution and indirect hydrological disruption will be mitigated for by Best Practice guidelines as directed by SEPA. There is still a Low Negative impact in this area that results in a residual impact of Minor significance.

7.2 Residual Impacts Summary

7.2.1 With the effective implementation of the mitigation detailed in this assessment, the construction and operation of the proposed road would not compromise the long-term integrity of the terrestrial invertebrates in the study area, although individual mortality is inevitable. Habitat creation and appropriate mitigation including Best Practice during construction will ensure that the overall residual impact of this scheme will be Minor or Negligible. Details of residual impacts are presented with the mitigation measures for specific areas in Table 12.

Table 12 – Residual Impacts for the Northern Section

Area	Grid Reference/ Habitat Area	Habitat Value	Impact					Overall Impact Significance	Mitigation	Residual Impacts
			Habitat Loss	Direct Mortality	Fragmentation	Pollution	Disturbance			
Brimmond Hill	NJ 860 090/ HA N6-N8	Local	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	No mitigation required	**Negligible**
Gough Burn	NJ 866 097 – NJ 874104/ HA N14-N15 and HA N18 – N19	County	Low	Negligible	Negligible	Low	Low	Minor	Generic mitigation and Best Practice will minimise impacts although there is no specific mitigation in this area	**Minor**
Craibstone	NJ 873105/ HA N25 –N26 N28 and N30	County	Low	Negligible	Negligible	Low	Low	Minor	Planting of coniferous and mixed woodland Figure 11.5b will partially off-set these impacts	**Negligible**
Monument Wood	NJ 861 542 – NJ 865 610 / N47	County	Low	Low	Low	Low	Low	Minor	Compensation for habitat loss by planting of mixed woodland north of the proposed route between chainages 321630 and 322130 (HA N50).	**Negligible**
Small broad-leaved plantation woodland	NJ 869 145 / N50	Local	Low	Low	Low	Low	Low	Minor	Restoration of dry stone walls where linear habitat lost. Compensatory planting of coniferous woodland at ch321490in HA N46 and the above mixed woodland for habitat lost in N50.	**Negligible**
River Don crossing	NJ 882 147 / N52-N54	Local	Low	Low	Low	Low	Low	Minor	Construction of bridge to avoid in-channel works and to incorporate riparian exclusion zone to avoid adverse impacts to riverbank habitats.	**Negligible**

Area	Grid Reference/ Habitat Area	Habitat Value	Impact					Overall Impact Significance	Mitigation	Residual Impacts
			Habitat Loss	Direct Mortality	Fragmentation	Pollution	Disturbance			
									Soft banks to be maintained on both banks to reduce severance impacts. Riparian strip to be fenced off on south bank to protect bank from poaching by livestock and to create more diverse habitat with tall herbaceous vegetation, scrub and riparian trees (HA N52)	
Small mixed plantation woodland	NJ 882 147 / N54	Local	Low	Low	Low	Low	Low	Minor	Mixed woodland habitat loss compensated by creation of mixed plantation and Riparian woodland in the Goval Plains (N61) and riparian woodland adjacent to bridge and river on north bank (N52) Species-rich grassland to be created on embankment slopes.	**Negligible**
Broad-leaved Semi-Natural and Plantation Woodland	NJ 904952 – NJ 908023/ N71-N72	County	Low	Low	Low	Low	Low	Minor	Habitat loss, severance and fragmentation to be compensated by planting of native mixed woodland in remaining areas of recently felled conifer forest, Littlejohn's Woods (N72). To north of proposed road, woodland to be left unmanaged to allow natural regeneration as has occurred in northwest corner of existing wood. South of road, woodland to be planted with Scot's Pine to provide habitat	**Negligible**

Area	Grid Reference/ Habitat Area	Habitat Value	Impact					Overall Impact Significance	Mitigation	Residual Impacts
			Habitat Loss	Direct Mortality	Fragmentation	Pollution	Disturbance			
									diversity. Mature beech trees to be retained as boundary to realigned Newpark Road north of proposed road.	
Marshy grassland	NJ 913152 / N80	Local	Low	Low	Low	Low	Low	Minor	Restoration of dry stone walls along boundaries of new roads where linear habitat lost. Species-rich grassland to be created on embankment slopes.	**Negligible**
Dense scrub	NJ 927860 /N87	Local	Medium	Medium	Low	Low	Low	Minor	Restoration of dry stone walls along boundaries of new roads where linear habitat lost. Species-rich grassland to be created on embankment slopes. Isolated field fragments to be retained as open grassland and scrub habitats.	**Negligible**
Goval Wood	NJ 885156 / N56	County	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	No Mitigation Required.	**Negligible**
Corby Loch	NJ 925145 / N85	Regional	Negligible	Negligible	Negligible	Medium	Negligible	Moderate	Avoidance of hydrological and/or pollution impacts by pollution control through best practice over and above SEPA pollution prevention guidelines	**Negligible**
Red Moss	NJ 913160 / N82	County	Negligible	Negligible	Negligible	Low	Negligible	Moderate	Pollution control through best practice at site over and above SEPA pollution prevention guidelines to prevent hydrological and/or	**Negligible**

Area	Grid Reference/ Habitat Area	Habitat Value	Impact					Overall Impact Significance	Mitigation	Residual Impacts
			Habitat Loss	Direct Mortality	Fragmentation	Pollution	Disturbance			
									pollution impacts on drainage channels connecting Red Moss and Lily and Corby Lochs.	

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9 Glossary of Terms and Acronyms

BAP: Biodiversity Action Plan.

Carr: wet woodland, usually alder or willow.

DMRB: Design Manual for Roads and Bridges.

DWS: District Wildlife Site.

Native: a species occurring naturally, in its normal geographic range.

NESBReC: North East Scotland Biological Records Centre.

PCB: polychlorinated biphenyls.

SAC: Candidate Special Area of Conservation.

Scrub: the collective name for small shrubs and trees.

SEPA: Scottish Environmental Protection Agency.

SNH: Scottish Natural Heritage.

SSSI: Site of Special Scientific Interest.