



Appendix A10.7 – Red Squirrel

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1 Introduction

1.1 General Background

- 1.1.1 This Appendix reports the assessment of potential impacts on red squirrel populations in the vicinity of the Northern Leg of the proposed scheme, supporting Chapter 10 (Ecology and Nature Conservation).
- 1.1.2 To aid the interpretation of the assessment, the AWPR Northern Leg study area has been divided into five route sections as follows:
- Section NL1 ch314800 – 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).
- 1.1.3 Studies on red squirrel were included as part of the Ecological Impact Assessment (EclA), and were undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volumes 10 and 11 and the Environmental Impact Assessment (Scotland) Regulations 1999. The three stages of EclA have been modified to be directly applicable to the proposed scheme, and are based on matrices from an early draft version of IEEM guidance on EclA (IEEM, 2002) and Transport Advisory Guidance (STAG and WEBTAG). The bulk of the assessment for the AWPR Northern Leg was undertaken before the 2006 issue of the IEEM guidelines. This assessment therefore follows the general approach described in the IEEM 2002 guidelines, with cognisance of the later 2006 guidelines.
- 1.1.4 These studies included desk-based consultation to collate existing information about red squirrels in the area affected by the scheme and field surveys to provide current data about the status of red squirrel populations undertaken between May and July 2004. The survey results were reviewed against the current design, and no further surveys were considered necessary to undertake this assessment.

Aims

- 1.1.5 This report aims to provide an indication of the presence or absence of red squirrels in various woodland areas between May and July 2004, and an assessment of the status of red squirrels and associated habitat within 500m of the proposed scheme. It provides an assessment of the potential impacts associated, makes recommendations for measures to mitigate for these impacts and gives an assessment of the residual impacts remaining after mitigation is implemented.
- 1.1.6 This report is presented in the following structure:
- an overview of the biology, legislative status and protection of red squirrel populations and habitat;
 - a summary of previous survey information;
 - the objectives and limitations of the present survey;
 - survey and impact assessment methods;
 - survey results and an evaluation of the area's sensitivity/importance for red squirrels;
 - an assessment of the potential development impacts;

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- mitigation proposals are described, where and when appropriate; and
- residual impacts of the proposed scheme following mitigation.

1.2 Red Squirrels

Background

Biology

- 1.2.1 The red squirrel *Sciurus vulgaris* is distributed throughout the Northern Palaearctic. The last fifty years has seen a drastic decline in their numbers and distribution over their geographic range in the British Isles. They are now restricted to Scotland, Ireland, Northern England and small pockets in Wales and Southern England. There are estimated to be around 160,000 red squirrels within the United Kingdom. Scotland has an estimated population of around 120,000 (Harris et al., 1995) and as such, holds the core of the United Kingdom population.
- 1.2.2 The red squirrel is the only squirrel native to the United Kingdom. They have variable fur colour from bright ginger through to red and dark brown in the summer, or black tinged with grey in winter; the large ear tufts that they have in mid-winter disappear by the summer (Corbert and Southern, 1977). The other species present is the grey squirrel (*Sciurus carolinensis*) introduced to Britain in the 19th century, which may compete with the red squirrel in some habitat types.
- 1.2.3 The continuing spread of grey squirrels is regarded as a major threat to the survival of red squirrels. Red and grey squirrels occupy a similar ecological niche and so are in direct competition with each other for habitat and food resources (termed inter-specific competition). Grey squirrels appear to be better adapted to the current fragmented British Woodland and so out-compete the native reds, typically displacing them within 15 years of their arrival to an area (see paragraph 1.2.9). Furthermore, grey squirrels carry squirrel poxvirus (SQPV), which is potentially fatal to red squirrels but does not appear to affect greys. This together with habitat loss and fragmentation, and changes in woodland management practices are all considered to be contributing factors to red squirrel decline.
- 1.2.4 In North East Scotland red squirrels are considered to be widespread but not common. Forestry Commission Records (Legge, 2002) suggest that North East Scotland has the largest area in the UK in which red squirrels have been continuously present between 1973 and 1992.
- 1.2.5 Red squirrels are territorial and active during the daytime, spending about three-quarters of their active time above ground in trees and shrubs. Their main foods are tree seeds, such as hazel nuts and seeds from conifer cones, although they also eat tree flowers, shoots and fungi. They often suffer periods of food shortage especially during July. They live in dreys, which are constructed of twigs in a tree fork, or hollow or above a whorl of branches close to the stem of a conifer (Tittensor, 1970). Dreys are lined with soft hair, moss and dried grass. Several squirrels may share the same drey, or use the same drey on different days, alternatively one squirrel may use several dreys.
- 1.2.6 Breeding can begin in mid-winter and continue through the summer, depending on the weather and how much food is available (Holm, 2000). Females have one or two litters a year, usually of about 2-4 young. Juveniles are weaned at around ten weeks, but do not breed until they are one year old. In favourable habitat red squirrels can live at a population density of one squirrel per hectare of woodland. Typical population densities in northeast Scotland are higher than this and vary between 1.81 squirrels per hectare and 2.1 squirrels per hectare (Legge, 2002), although populations vary each year depending on the seed crop. They can survive for up to six years in the wild.
- 1.2.7 Red squirrels can be found in broadleaved woodland (comprising small-mast tree species such as silver birch, ash, willow, aspen, alder, yew and hawthorn), but tend to be found at higher densities in mature coniferous woodland. This trend is often a response to the presence of grey squirrels in the area, since competition from grey squirrels is considered to be less pronounced in coniferous

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woodlands (see paragraph 1.2.10), rather than due to habitat preferences. In coniferous woodland, their optimum habitat requirement is mature species such as Scot's pine, Norway spruce and European larch. Their preference is for mature Scot's pine. Red squirrels are not usually found in immature plantations of Sitka spruce (at the thicket stage), but can be found in mature, thinned plantations. Beech trees in particular are favoured by grey squirrels. The size and type of woodland and the connectivity between woodland patches are important factors in maintaining the persistence of red squirrels.

- 1.2.8 Despite the well documented displacement of red squirrels by greys, it appears that in some Scottish woodland red and grey squirrels have co-habited the same woodland for decades, and one (Craigvinean Forest, Dunkeld, Perthshire) has been studied in detail over several years (Bryce and MacDonald, 2000). It appears that habitat type plays a crucial role in the success of this red squirrel population: observations suggest that, not only are there tree species mixes (small-mast producing species) that favour red squirrel survival, but also that the physical layout of the woodlands might be important. Not enough is yet understood about the potential for habitat partitioning between red and grey squirrels, and considerable benefits could be gained from close monitoring of squirrels in these areas (Scottish Squirrel Group, 2004).
- 1.2.9 Grey squirrels in woods containing broad-leaved trees (specifically oak) can take greater advantage of the autumn seed crop than red squirrels, increasing their weight by around 20% (Kenward and Tonkin, 1986) thus enabling them to be in better breeding condition in the spring (Wauters and Dhondt, 1989). Consequently grey squirrels in mixed and deciduous woods may still breed in years when red squirrels do not, and may displace the red squirrel population in these woods over successive years (Skelcher, 1997).
- 1.2.10 As red squirrels are predominantly associated with conifer forests where food remains in the canopy for most of the year, a large weight increase is likely to be a disadvantage in this environment as squirrels have to be light to reach seeds at the ends of tree branches (Gurnell, 1987). Consequently the breeding success of grey squirrels will be less pronounced in coniferous woodland, which is possibly why red and grey squirrels have been seen to co-exist in these types of woodland (Skelcher, 1997). In such situations it seems that small blocks or belts of seed-producing broad-leaf trees within extensive conifer forests enable grey squirrel colonisation. They then act as survival habitats from which grey squirrels can expand and contract into and out of conifer stands according to prevailing seed supplies (Gurnell, 1996). By controlling grey squirrel numbers either by culling them or removing large-masted tree species, the probability of diseases such as squirrel poxvirus (SQPV) being transmitted to red squirrels could be reduced (Scottish Squirrel Group, 2004).

Legal Status

- 1.2.11 Enhanced statutory protection for red squirrels in the United Kingdom is provided under Schedules 5 and 6 of the Wildlife and Countryside Act 1981(as amended). This Act has recently been further amended by the Nature Conservation (Scotland) Act 2004, which includes the term 'recklessly' to the list of prohibited actions. Under Sections 9 and 11 of this Act, it is an offence to:
- intentionally (or recklessly) kill, injure, take or possess a wild red squirrel (Section 9);
 - intentionally (or recklessly) damage, destroy or obstruct access to any structure or place used by a red squirrel for shelter or breeding (Section 9);
 - intentionally (or recklessly) disturb a red squirrel while it is occupying a structure or place that it uses for protection (Section 9);
 - sell, offer for sale, expose for sale or have for the purpose of sale, any red squirrel, or to infer that red squirrels can be bought or sold (Section 9) and;
 - kill or capture red squirrels by indiscriminate methods such as snaring or poisoning (Section 11).

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- 1.2.12 Section 18 of the Act states that attempting to commit any such offence is legally the same as committing the offence.
- 1.2.13 In certain circumstances licences can be granted under Section 16 (3) for the destruction or removal of red squirrels for instance: to prevent serious damage to livestock, crops, growing timber or any other property; to prevent the spread of disease; for science and education purposes; or for conservation. Control of red squirrels without such a licence is an offence.
- 1.2.14 There is no scope for licensing the destruction or disturbance of red squirrel dreys for the purposes of development. Therefore, any proposal for damage to or loss of red squirrel habitat would have to be agreed with Scottish Natural Heritage and the Scottish Executive.
- 1.2.15 The red squirrel is also protected under the Wild Mammals (Protection) Act 1996, which makes it illegal to subject them to any wilful act of cruelty or abuse.
- 1.2.16 This species is listed under Appendix III of the Bern Convention but, in view of its more favourable conservation status in mainland Europe, is not listed on the EC 'Habitats' Directive (EC/92/43).
- 1.2.17 The red squirrel is listed on the UK Biodiversity Action Plan as a Priority Species and has a UK Species Action Plan (SAP). The red squirrel is considered to require local action to conserve and enhance populations in the Local Biodiversity Action Plan for North East Scotland, and therefore also has a Local SAP. Furthermore, the Scottish Red Squirrel Action Plan (2006-2011) has been prepared under the auspices of the UK Biodiversity Action Plan (BAP).

2 Methods

2.1 Previous Survey Information

- 2.1.1 The following individuals and organisations were consulted during the course of the Desk Study in order to collate any existing information on the red squirrel resource within the proposed route corridor:
- North East Scotland Biological Records Centre (NESBReC) – Lesley Cropper;
 - Aberdeen City Council – James Hale;
 - NES Biodiversity Partnership: Local Biodiversity Officer - Maria Hardy;
 - Scottish Natural Heritage;
 - The Forestry Commission – Woodland Officer, Gavin Legge; and
 - The Grampian Squirrel Group – Chairman, Gavin Legge.

2.2 Survey Methods

- 2.2.1 The Jacobs squirrel survey was undertaken to establish whether red and/or grey squirrels were present in 12 woodland areas within a 16km long and 1km wide route corridor (see Figures 10.7a-g) between May and July 2004. According to the North East Scotland Biodiversity Red Squirrel Local Species Action Plan (Legge, 2002), in the North East red squirrels have come to be associated mainly with coniferous woods. In line with this information the surveys were primarily undertaken in coniferous woodlands, although mixed and broad-leaved woodland were also surveyed.
- 2.2.2 There are four indirect methods of studying squirrels in the field; visual counts, hair-tube surveys, drey counts and feeding transects. Only visual counts and hair-tube surveys can distinguish between red and grey squirrels.

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2.2.3 Hair-tube surveys are more accurate than visual surveys at identifying the difference between red and grey squirrels. Visual sightings are often just a fleeting glimpse of an animal as it moves through a leafy tree canopy and it is not always easy to distinguish red from grey squirrels, even though adult grey squirrels are about a third larger than red squirrels (Gurnell et al 2001).. Primarily due to this consideration as well as the large amount of woodland area to be surveyed throughout the proposed route corridor, it was decided that the most practical method for detecting the presence and/or absence of red and grey squirrels was to carry out hair-tube surveys according to Gurnell et al 2001. Furthermore, several of the woodlands within the survey area comprised dense immature Sitka spruce, and lacked forest rides thus rendering them inappropriate for visual surveys. Drey counts and feeding transects were not applied as these methods cannot distinguish the difference between red and grey squirrels.

2.2.4 Although squirrel presence is confirmed by finding hairs in at least one of the tubes, the number of squirrel hairs left in a tube is not necessarily related to the number of individuals visiting the tube. One squirrel may visit many tubes, and the sampling area of each tube is not known (Gurnell et al 2001). As such this exercise did not aim to provide an estimate of red and grey squirrel population sizes but rather an indication of the presence of the species in various woodland areas.

Hair-tube Surveys

- Each hair-tube used for the survey was 300mm long and made out of 65mm by 65mm square ended, PVC down-pipe.
- Two wooden blocks (25mm x 25mm x 5mm) covered by double sided sticky tape were placed inside the roof at either end of each tube, approximately 3cm from the entrance.
- Coated wire was used to attach a hair-tube to a horizontal branch of a tree at a height of approximately 2m.
- The tube was then baited with peanuts, hazelnuts, sunflower and pumpkin seeds.
- Each hair-tube was systematically placed between 100m to 200m apart in woodlands identified as providing suitable red squirrel habitat.
- As the squirrel enters the tube to get the food, it leaves some of its hairs on the tapes, which are removed for later examination under a microscope (see paragraph 2.1.8 for details).
- According to the methodology in Gurnell et al 2001, 'Sticky blocks should be retrieved after 7 or 14 days,' although it does not have any bearing on the results if the blocks are collected after this time period (see paragraph 2.1.8 for details).

Dates of Survey

2.2.5 Dates of red squirrel hair-tube surveys are presented in Table 1.

Table 1 – Hair-tube Surveys

Hair-Tube Survey Number	Woodland Areas Surveyed	Date of Hair-Tube Deployment	Date of Hair-Tube Collection	Number of Days Hair-Tubes left in Field
One	W1 – W8	25 May - 27 May 2004	21 June - 23 June 2004	27
Two	W9 – W12	24 June 2004	8 July 2004	14

1st Red Squirrel Survey

2.2.6 In the first survey, 70 numbered hair-tubes were systematically placed in eight woodland areas between 25 and 27 May 2004 (see Figures 10.7b-f and Table 2). The hair-tubes were set out to cover as much area of suitable woodland habitat as possible whilst concentrating on those

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woodland areas that could potentially be directly impacted by the proposed route corridor. These hair-tubes were collected four weeks later between 21 and 23 June 2004.

Table 2– Woods Surveyed in 1st Hair-tube Survey

Wood Name	Wood Code	Generic Grid Reference	No. of Hair-tubes deployed
Newhills (North)	W1	NJ 873100	4
Craibstone (South)	W2	NJ 873102	6
Craibstone (North)	W3	NJ 869107	9
Parkhead Wood	W4	NJ 866105	3
Kirkhill Forest (North)	W5	NJ 857135	12
East Woodlands	W6	NJ 859143	13
Monument Wood	W7	NJ 864144	8
Littlejohn's Wood	W8	NJ 905150	15
Total			70

2nd Red Squirrel Survey

2.2.7 In the second survey, a further 41 numbered hair tubes were deployed in four woodland areas on the 24 June 2004 (see Figures 10.7b-d and Table 3), and collected two weeks later on the 8 July 2004.

Table 3 – Woods Surveyed in 2nd Hair-Tube Survey

Wood Name	Wood Code	Generic Grid Reference	No. of Hair-tubes deployed
Newhills (South)	W9	NJ 873097	4
West Woods	W10	NJ 862107	8
Kirkhill Forest (South)	W11	NJ 857120	12
Standingstones Wood	W12	NJ 855126	17
Total			41

Squirrel Hair Analysis

2.2.8 Gurnell et al 2001, states that: 'It is not possible to separate red and grey squirrel hairs on the basis of colour, and the hairs have similar cuticle scale patterns and medullas.' However, when viewed under a phase contrast microscope (x 400) the cross-section differs; red squirrel hairs have a concave or dumb-bell shaped cross-section whereas grey squirrels have a round one. Staining a sample of hairs with ink enabled the type of cross-section to be seen more easily (Gurnell and Pepper, 1994; Dagnall et al 1995; and Teerink, 1991).

Negative Staining Technique

- Tapes were placed in warm water containing a strong detergent and left to soak overnight.
- Ten representative hairs from each identifiable cluster were removed with forceps. Very fine, small underfur hairs and cracked or damaged hairs were avoided. Hairs less than 1.5mm long were discarded, as these belonged to either mice or voles.
- Complete hairs were then measured from bulb to tip, making a note of the colour bands along the hair using a binocular microscope (x 80) to do so.
- Hairs were placed in a 5:1 solution of Indian ink: water.

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- Two or three hairs were placed on a slide together with a few drops of ink solution.
- They were then covered with a coverslip and examined at the widest part (the shield region) using a light microscope (x 400).
- Mounts that showed a continuous dark band along the shield region were likely to be red squirrel.
- Mounts that did not show a continuous dark band along the shield region were likely to be grey squirrel.

2.2.9 In conjunction with the hair-tube survey methodology, ecologists also recorded any sightings of red squirrels, and dreys of either species within the proposed route corridor. These included observations made during the Phase 1, otter, badger and winter bird surveys conducted for this proposal in 2004/2005. These observations were made on an ad-hoc, incidental basis and did not follow a set survey method.

Assessment of Habitat Value for Red Squirrels

2.2.10 In addition to the hair-tube surveys, data relating to the quality of red squirrel habitats were researched so that a general assessment could be made as to the suitability of the habitat for red squirrels. Factors that are likely to influence the survival of local red squirrel are judged to be of the greatest importance when assessing habitat value. Areas with successful drey sites are therefore of key importance. As red squirrel populations may be limited by foraging opportunities (Gurnell 1993), areas possessing or allowing access to optimal foraging habitat are judged to be of key importance. Areas possessing sub-optimal foraging habitat but other habitat qualities (e.g. low levels of disturbance, abundance of large-masted tree species and presence of grey squirrels) are of lesser importance as they are less likely to be vital to local red squirrel survival. Details of how values of importance to the local red squirrel population are derived are given below. It should be noted that coniferous woodland is generally construed as being of higher value habitat for red squirrels compared with broadleaved woodland, not because of active selection of coniferous woodland by red squirrels as a preferred habitat type, but rather that – due to the limited success of grey squirrels in coniferous woodlands – inter-specific competition with grey squirrels is considered to be less pronounced in coniferous woodlands than woodlands containing broadleaved species.

- **Very High Value** - A locally unique key resource, vital for maintenance of existing red squirrel populations.
- **High Value** - Optimal foraging habitat owing to locally abundant conifers and small-mast producing broad-leaved trees coupled with low disturbance and suitable woodland habitat for cover and dreys.
- **Medium Value** - Despite abundant foraging opportunities, location is considered sub-optimal due to either moderate disturbance levels, lack of cover, abundance of large-masted broad-leaved tree species or presence of grey squirrels.
- **Low Value** - Location offers sub-optimal foraging opportunities, has poor cover, presence of grey squirrels, or suffers from disturbance.

Size of Woodland required for Red Squirrel Conservation

2.2.11 The size and type of woodland and the connectivity between woodland patches are important factors in maintaining red squirrel populations. An area of conifer forest between 2000 and 5000 hectares is considered ideal to conserve a population of red squirrels. It may be possible to support a small viable red squirrel population in core reserves of 200-300 hectares, providing a suitable age structure of trees and shrubs is maintained and where necessary, numbers of grey squirrels are controlled (Pepper and Paterson, 1998). Contiguous areas of coniferous woodland over 200ha (very narrow gaps i.e. for power lines or minor roads can be seen in the context of contiguous cover) comprising of a variety of tree species (e.g. pines, spruces, firs and larches) ensures there is

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food for red squirrels throughout the year. As such, these areas are considered to be important areas for conserving red squirrels (Reynolds and Bentley, 2004).

- 2.2.12 It has been shown (Verbeylen et al 2003) that viable populations of red squirrels can be maintained in an area of woodland as small as 3.5ha. However, this is providing there are vegetated corridors with sufficient cover to aid dispersal to other woodland areas.

Population Density

- 2.2.13 It is not practicable to give an estimate of the population size in the woodland areas, as this requires calibration with trapping in the same areas (Garson and Lurz 1998, in Gurnell et al 2004). However, the Local Species Action Plan (Legge 2002) states that: 'Typical population densities in North East Scotland vary between 1.81 per ha and 2.1 per ha, and populations vary from year to year depending on the seed crop.' There is however no information on red squirrel population densities in woodlands surveyed within 500m of the proposed scheme.

2.3 Evaluation of Ecological Importance

- 2.3.1 The method for assessing the value of an ecological receptor uses all information collated in determining the baseline status of the resource. The ecological evaluation of a receptor is determined by reference to statutory and non-statutory site designations, the results of the consultations, literature review and field surveys. The evaluation method incorporates a geographical framework where ecological receptors are assessed according to a series of criteria that are presented in Table 4. These criteria are based on the Ratcliffe Criteria (Ratcliffe 1977) used in the selection of biological Sites of Special Scientific Interest (SSSI) and include size (extent), naturalness, rarity, typicality, vulnerability and position in an ecological/ geographical unit.
- 2.3.2 The criteria used in the ecological evaluation process include reference to the legal protection conferred on species or habitats as well as the conservation status of the receptor, such as presence on national or local Biodiversity Action Plans. These factors give rise to a level of conservation importance being assigned to species/habitats that reflects the geographical framework used in the evaluation process. Thus, for example, species such as otters and bats that are protected by international legislation are referred to as internationally important in terms of their conservation status. Other species such as Wych elm, which are identified as priority species in the NE Scotland BAP are referred to as regionally important species.
- 2.3.3 The ecological evaluation of a feature or area of habitat takes into account the level of conservation importance of the species, as well as other factors such as the level of use of the habitat or feature by a species, whether the species or habitat is locally or regionally common or rare, as well as other criteria that contribute to a feature's importance. In this way, the method of evaluation provides a system that combines legislative protection on species and/or habitats and conservation parameters that all contribute to the ecological importance of the receptor.
- 2.3.4 Red squirrels are listed under Appendix III of the Bern Convention but in view of its more favourable conservation status in mainland Europe, is not listed on the EC 'Habitats' Directive (EC/92/43). Red squirrels in the United Kingdom are protected under Schedules 5 and 6 of the Wildlife and Countryside Act 1981(as amended), which has recently been further amended by the Nature Conservation (Scotland) Act 2004. The red squirrel is listed as a Priority Species on the UK BAP and is also a Local BAP species.
- 2.3.5 Red squirrels are considered a species of **national** conservation concern and are threatened in North East Scotland. Habitats supporting populations of red squirrels in the Aberdeen area are, therefore, assessed as being of **regional** ecological value as regularly occurring, locally significant populations of a nationally important species, which occurs in a Regional and UK BAP. Habitats maintaining locally significant populations are evaluated as being of **national** importance. Habitats not currently supporting red squirrel but considered to be potentially suitable for the species are

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considered to appreciably enrich the habitat resource within the local context are evaluated as being of **county** or **local** value.

Table 4- Evaluation of Ecological Receptor

Ecological Importance	Attributes of Ecological Receptor
International (European)	<p>Habitats</p> <p>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</p> <p>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</p> <p>Any river classified as excellent A1 and likely to support a substantial salmonid population.</p> <p>Any river with a Habitat Modification Score indicating that it is Pristine or Semi-Natural or Obviously Modified</p> <p>Species</p> <p>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</p> <p>A regularly occurring, nationally significant population/number of any internationally important species.</p>
National (Scottish)	<p>Habitats</p> <p>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) irrespective of whether or not it has yet been notified</p> <p>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</p> <p>Any river classified as excellent A1 and likely to support a substantial salmonid population.</p> <p>Any river with a Habitat Modification Score indicating that it is Pristine or Semi-Natural or Obviously Modified.</p> <p>Species</p> <p>A regularly occurring, regionally or county significant population/number of an internationally/nationally important species</p> <p>Any regularly occurring population of a nationally important species which is threatened or rare in the region or county (see local BAP)</p> <p>A feature identified as of critical importance in the UK BAP.</p>
Regional (North East Scotland)	<p>Habitats</p> <p>Sites which exceed the County-level designations but fall short of SSSI selection guidelines, where these occur</p> <p>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</p> <p>Viable areas of key habitat identified as being of Regional value in the appropriate SNH Natural Heritage Future area profile</p> <p>Any river classified as excellent A1 or good A2 and capable of supporting salmonid population.</p> <p>Any river with a Habitat Modification Score indicating that it is significantly modified or above.</p> <p>Species</p> <p>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 SNH Natural Heritage Future area on account of its regional rarity or localisation</p> <p>A regularly occurring, locally significant population/number of a regionally important species.</p> <p>Sites maintaining populations of internationally/nationally important species that are not threatened or rare in the region or county.</p>
County (City of Aberdeen/ Aberdeenshire)	<p>Habitats</p> <p>Sites that are recognised by local authorities (e.g.) Sites of Interest for Nature Conservation (SINS) and District Wildlife Sites (DWS)</p> <p>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</p>

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Ecological Importance	Attributes of Ecological Receptor
	<p>plans)</p> <p>A viable area of habitat identified in County/District BAP or in the relevant SNH Natural Heritage Future area profile</p> <p>A diverse and/or ecologically valuable hedgerow network</p> <p>Semi-natural ancient woodland greater than 0.25ha.</p> <p>Any river classified as good A2 or fair B and likely to support coarse fishery.</p> <p>Any river with a Habitat Modification Score indicating that it is significantly modified or above.</p> <p>Species</p> <p>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</p> <p>A regularly occurring, locally significant population of a County/District important species (particularly during a critical phase of its life cycle)</p> <p>Sites supporting populations of internationally/nationally/regionally important species that are not threatened or rare in the region or county, and are not integral to maintaining those populations.</p> <p>Sites/features that are scarce within the County/District or which appreciably enrich the County/District habitat resource</p>
<p>Local (Immediate area or village importance)</p>	<p>Habitats</p> <p>Areas of habitat considered to appreciably enrich the habitat resource within the local context (survey area, parish or neighbourhood, e.g. species-rich hedgerows, ponds etc).</p> <p>Sites that retain other elements of semi-natural vegetation that due to their size, quality or the wide distribution of such habitats within the local area are not considered for the above classifications.</p> <p>Semi-natural ancient woodland smaller than 0.25ha.</p> <p>Any river classified as fair B or poor C and unlikely to support coarse fishery.</p> <p>Any river with a Habitat Modification Score indicating that it is severely modified or above.</p> <p>Species</p> <p>Populations/assemblages of species that appreciable enrich the biodiversity resource within the local context</p> <p>Sites supporting populations of county/district important species that are not threatened or rare in the region or county, and are not integral to maintaining those populations</p>
<p>Less than Local (Limited ecological importance)</p>	<p>Sites that retain habitats and/or species are of limited ecological importance due to their size, species composition or other factors.</p> <p>Any river classified as impoverished D and/or and with a Habitat Modification Score indicating that it is severely modified.</p>

2.4 Impact Assessment

2.4.1 In the assessment of significance of impact, consideration has been given both to the magnitude of impact and to the sensitivity of the receiving environment or species. The sensitivity of a feature was determined with reference to its level of importance although other elements have been taken into account where appropriate. Methods of impact prediction used indirect measurements, correlations, expert opinion, and information from previous developments. Impacts include those that are predicted to be direct, indirect, temporary, permanent, cumulative, reversible or irreversible.

Impact Magnitude

2.4.2 The magnitude of an impact has been assessed for each element of the development. A definition of the magnitude impacts is presented in Table 5 and includes positive impact criteria in accordance with IEM guidance (2002). The magnitude of each impact was assessed independently of its value or statutory status.

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Table 5 – 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.
Medium negative	The change is not likely to permanently, adversely affect the integrity of an ecological receptor, but the effect is likely to be substantial in terms of its ecological structure and function and may be significant in terms of its ecological objectives. Likely to result in changes in the localised or temporary distribution of species assemblage or populations but not affect the population status at a regional scale or permanently.
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 be significant in terms of its ecological objectives. Impacts are unlikely to result in changes to the species assemblage or populations, but core species more vulnerable to future impacts
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, and/or enhance the biodiversity resource of the receptor.
High positive	The change is likely to restore an ecological receptor to favourable conservation status, contribute to meeting BAP objectives (local and national) and/or create a feature that is of recognisable value for biodiversity.

Impact Significance

2.4.3 The significance of an impact was determined according to the matrix of importance and magnitude as illustrated in Table 6.

Table 6 - 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
County	Moderate	Moderate	Minor	Negligible	Minor	Moderate
Local	Minor	Minor	Minor	Negligible	Minor	Minor
Less than Local	Minor	Negligible	Negligible	Negligible	Negligible	Negligible

2.4.4 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. In general, an impact significance greater than or equal to Moderate would require specific mitigation to be undertaken to ameliorate the impact significance to acceptable levels.

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Survey Limitations

- 2.4.5 Both hair-tube surveys were undertaken at optimal times of year, as red squirrels are active all year round (although they are much less active in winter when they have extended periods of torpor) and tend to breed from mid-winter to late summer.
- 2.4.6 In the survey methodology, Gurnell et al 2001, state: ‘up to 20 tubes may be used to survey one piece of woodland by deploying them 100m to 200m apart in lines or in the pattern of a grid. The number of tubes used for each site in any survey should be standardised.’ This was done as far as was practicable, although it was not always possible to find suitable tree species to place the tubes on. As a result in some woodland areas tubes were placed closer together and in others they were placed farther apart (although never further apart than 200m). A number of woodlands did not have rides or were too dense to place tubes in the interior of the wood. In these situations the tubes tended to be placed on trees at the edge of the woodland. The shape of some woodland areas was not conducive to placing the tubes in a grid pattern or line (for example W2 and W3 on Figure 10.7b) where positive results for red squirrel presence were still recorded). Placing the tubes in a grid pattern may have provided greater information, however as this survey was only interested in determining the presence of red squirrels, this is not considered to be a significant issue.
- 2.4.7 Although considered the most efficient method for detecting squirrel presence/absence within woodlands (Gurnell et al 2001) it is possible that the hair-tubes failed to detect the presence of squirrels in some locations. The presence of feeding signs and dreys was therefore also noted by surveyors. Although it is recognised that these signs cannot distinguish between red or grey squirrels they are indicative of squirrel activity within woodland and as such can be used to help verify positive/negative hair-tube results. This was of particular significance for woodlands where the tubes were placed in trees at the woodland edge.
- 2.4.8 As it was not possible to survey every area of woodland throughout the proposed route corridor, surveys concentrated mainly in those woodland areas where red squirrel records exist, woodland areas that could potentially be directly impacted by the generic route options, and those woodland areas where suitable red squirrel habitat has been identified.

3 Baseline

3.1 Data Search

- 3.1.1 Red squirrel records (post 2000), held by the North East Scotland Biological Records Centre (NESBReC) and Gavin Legge, (Woodland Officer from the Forestry Commission and Chairman of the Grampian Squirrel Group) are shown in Table 7 and on Figures 10.7b-d (apart from records at Stoneywood and Dovecot Wood). Grid references for red squirrel sightings seen outside the 500m buffer are marked with an astyrix. There have also been unrecorded sightings of red squirrel in Kingshill Wood and Kirkhill Forest (throughout the whole area), East Woodlands and Monument Wood (G. Legge pers.comm.). There have also been unrecorded sightings of red squirrel at Goval and Littlejohn’s Wood (local residents’ pers.comm.).

Table 7 - SBREC and Grampian Squirrel Group Records of Red Squirrel Presence in Local Woodlands

Wood Name	Grid Reference	Section	Date
Craibstone Scottish Agricultural College (SAC)	NJ 870105	NL2	01/05/2000
Craibstone Scottish Agricultural College (SAC)	NJ 8710	NL2	01/01/2003
Craibstone Scottish Agricultural College (SAC)	NJ 8710	NL2	01/01/2005
Craibstone Scottish Agricultural College (SAC)	NJ 8711	NL2	
Craibstone Golf Course	NJ864102	NL2	01/03/2005

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Wood Name	Grid Reference	Section	Date
Parkhead Farm, Parkhead Wood	NJ 865103	NL2	03/01/2006
Parkhead Wood	NJ 8610	NL2	
West Woods	NJ 860104*	West of Section NL2	
Clintery Woods	NJ 851111*	West of Section NL2	
Clintery Woods	NJ 854111*	West of Section NL2	
Stoneywood	NJ 895110*	East of Section NL3	
Corsehill Farm, Kirkhill Forest (South)	NJ 859114	West of Section NL3	01/01/2005
Kirkhill Forest (South)	NJ 856115	West of Section NL3	04/05/2005
Kirkhill Forest (South)	NJ 853121	West of Section NL3	30/05/2005
Standingstones Wood	NJ 855125	NL3	17/07/2001
Kirkhill Forest	NJ 845121*	West of Section NL3	
Kirkhill Forest	NJ 847123*	West of Section NL3	
Kirkhill Forest	NJ 844126*	West of Section NL3	
East Woodlands	NJ 857140	NL3	01/10/2005
East Woodlands	NJ 8514	NL3	02/12/2005
Monument Wood	NJ 865143	NL3	
Monument Wood	NJ 863144	NL3	
Monument Wood	NJ 865144	NL3	01/10/2003
Dovecot Wood	NJ 898138*	South of Section NL4	

3.2 Survey Results

3.2.1 The results of the two hair-tube surveys between May and July 2004 show that red squirrels were present in seven of the 12 woodland areas surveyed with hair-tubes. Grey squirrels were present and co-existing with red squirrels in one of these woodland areas. These results show presence/absence of red and/or grey squirrels only and are not indicative of population status. The hair-tube results are shown on Figures 10.7a-g and in Table 8. Hair-tube surveys were not required in Goval Wood as red squirrel presence was confirmed through a visual sighting (see below).

3.2.2 Jacobs ecologists recorded five incidental sightings of red squirrels (see Figures 10.7b-f):

- an individual was seen in East Woodlands at grid reference NJ 859143 on 6 April 2004;
- a pair was seen in and around a drey at Craibstone (North) at grid reference NJ 868107 on the 5 July 2004;
- an individual was seen in the area of Kirkhill Forest (North) and East Woodlands at grid reference NJ 855145 on 9 July 2004.
- an individual was seen at grid reference NJ 883154 in Goval Wood on 4 July 2004.
- an individual was seen at grid reference NJ906154 in Littlejohn's Wood on 9 November 2004.

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Table 8 – Overall Hair-Tube Survey Results

Wood Name	Wood Code	Grid Reference	No. of Hair-Tubes Deployed	No. of Hair-Tubes with Red Squirrel Hairs	No. of Hair-Tubes with Grey Squirrel Hairs	Red Squirrel Present	Grey Squirrel Present
Newhills (South)	W9	NJ 873097	4	0	0	NO	NO
Newhills (North)	W1	NJ 873100	4	2	0	YES	NO
Craibstone (South)	W2	NJ 873102	6	3	1	YES	YES
Craibstone (North)	W3	NJ 869107	9	0	0	NO	NO
Parkhead Wood	W4	NJ 866105	3	0	0	NO	NO
West Woods	W10	NJ 862107	8	1	0	YES	NO
Kirkhill Forest (South)	W11	NJ 857120	12	0	0	NO	NO
Standingstones Wood	W12	NJ 855126	17	0	0	NO	NO
Kirkhill Forest (North)	W5	NJ 857135	12	3	0	YES	NO
East Woodlands	W6	NJ 859143	13	6	0	YES	NO
Monument Wood	W7	NJ 864144	8	1	0	YES	NO
Littlejohn's Wood	W8	NJ 905150	15	1	0	YES	NO

3.3 Survey Results Summary

3.3.1 The overall results of the Jacobs hair-tube surveys between May and July 2004 show that:

- red squirrel were found to be present in seven of the 12 woodland areas surveyed with hair-tubes (see Figures 10.7b-f and Table 8);
- grey squirrel were found to be present in one of the 12 woodland areas surveyed with hair-tubes (see Figure 10.7b); and
- red and grey squirrel were found to co-exist in one of the 12 woodland areas surveyed with hair-tubes (see Figure 10.7b).

3.3.2 There were five woodlands surveyed where red squirrels were not detected by the hair-tube surveys, however, records from the consultation exercise indicated the presence of red squirrels in these woodlands (Table 9). Taking a precautionary approach, red squirrels were therefore considered to be present in 12 of the woodlands in the study area.

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Table 9 - Summary of Woodland Areas with Red Squirrel Records within 500m of Proposed Scheme

Wood Name	Wood Code	Grid Reference	NESBReC Records (post 2000)	Grampian Squirrel Group Records (post 2000)	Jacobs Hair-Tube Survey 2004	Jacobs Visual Sightings 2004/5	Unrecorded Sightings (Personal Communication)
Newhills (North)	W1	NJ 873100	NO	NO	YES	NO	NO
Craibstone (South)	W2	NJ 873102	NO	NO	YES	NO	NO
Craibstone (North)	W3	NJ 869107	YES	NO	NO	YES	NO
Parkhead Wood	W4	NJ 866105	YES	NO	NO	NO	NO
West Woods	W10	NJ 862107	NO	NO	YES	NO	NO
Kirkhill Forest (South)	W11	NJ 857120	NO	NO	NO	NO	YES
Standingstones Wood	W12	NJ 855126	YES	NO	NO	NO	YES
Kirkhill Forest (North)	W5	NJ 857135	NO	NO	YES	NO	YES
East Woodlands	W6	NJ 859143	YES	NO	YES	YES	YES
Monument Wood	W7	NJ 864144	YES	YES	YES	NO	YES
Goval Wood	W13	NJ 883154	NO	NO	n/a	YES	YES
Littlejohn's Wood	W8	NJ 905150	NO	NO	YES	YES	YES

4 Evaluation

4.1 Introduction

4.1.1 In this section of the assessment, woodland areas showing the presence of red squirrel (as the result of consultation, literature review and field surveys) are assigned an evaluation of National or Regional Importance depending on whether the area is considered to be a core or non-core reserve for red squirrels. This is based on Ratcliffe Criteria (Ratcliffe 1977) (see Table 4). Evaluation of each woodland area's nature conservation value for red squirrel is show in Table 10

4.1.2 The ecological evaluations have been derived from data regarding the presence of red squirrels populations from consultation information and from survey results, as well as the habitat suitability of woodland habitat areas. Full details of the method of evaluation are provided in section 2.3 (Assessment of Ecology and Nature Conservation Value of Red Squirrel Populations).

4.2 Habitat Type

4.2.1 Detailed botanical information on woodland habitat types, including dominant tree species, and descriptions of ground flora can be found in Appendix A10.1 Phase 1 Habitat Survey Report.

4.3 Evaluation of Sections

4.3.1 No evidence of red squirrels were recorded for Section NL1, Derbeth to Tulloch Road, and no woodland areas were assessed as potentially suitable for red squirrels. Therefore, no-hair-tube surveys were undertaken and consequently no areas of Section NL1 are evaluated as being of any value to red squirrels.

4.3.2 For Sections NL2-NL5 evaluations of the woodland habitat areas are provided in Table 10.

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Table 10 - Woodland Evaluation in Sections NL2-NL5

Habitat Section and Location	Wood Name	Wood Code	Habitat Area (c.f. Phase 1 Report)	Age and Type of Woodland	Habitat Evaluation (c.f. Phase 1 Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
Section NL2 SAC Craibstone	Newhills (South)	W9	N16	Semi-Mature Coniferous Plantation Sitka spruce species 6-10m high	Local	Medium	Local	Dense Sitka spruce plantation with few other coniferous species. Directly adjacent to high quality habitat to the north (W1) and close to the large woodland policies of the Scottish Agricultural College (Craibstone), but otherwise isolated. Red squirrel records in adjacent woodland. This woodland habitat does not currently support red squirrels but is considered to be potentially suitable for the species and is considered to appreciably enrich the habitat resource within the local context therefore red squirrels that may occur here are evaluated as being of local value.
	Newhills (North)	W1	N16	Semi-Mature Coniferous Plantation	Local	High	Regional	Optimal foraging and breeding habitat within mature Scot's pine plantation. Within 150m of further high quality habitat (potential commuting corridor). Red squirrel present. This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the Regional and UK BAP.
	Craibstone (South)	W2	N24	Mature Mixed Plantation Broad-leaved Semi-natural woodland	County	High	Regional	Optimal foraging and breeding opportunities in high quality habitat adjacent to mature species-rich woodland (mix of conifers and small-masted broad-leaves). Potential commuting corridor. Red squirrel present here and in adjacent woodlands. This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the Regional and UK BAP. Grey squirrel record found from 2005 hair-tube survey (on-going inter-specific competition).

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Habitat Section and Location	Wood Name	Wood Code	Habitat Area (c.f. Phase 1 Report)	Age and Type of Woodland	Habitat Evaluation (c.f. Phase 1 Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
	Craibstone (North)	W3	N25	Mature Coniferous /Broad-leaved/Mixed Plantation Broad-leaved Semi-natural woodland with regeneration Part of W3 is an arboretum of labelled, mainly exotic trees, planted by the Forestry Department of the University of Aberdeen,	County	High	Regional	Mixture of mature conifers and small-masted broad-leaves with young small-masted broad-leaves present contribute to optimal foraging and breeding opportunities. Contiguous to mature species-rich woodland and mature coniferous woodland >50ha. Potential commuting corridor. Recent sightings of red squirrel and dreys. Red squirrels present (NESBReC post 2000 record and hair tube record) in surrounding woodland. This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the Regional and UK BAP.
	Parkhead Wood	W4	N21	Mature Coniferous Plantation	Local	High	Regional	Mixture of Scots pine and Sitka spruce plantation within and contiguous to areas of mature coniferous and mixed woodland >50ha. Potential commuting corridor. Red squirrel present in surrounding woodland. This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the Regional and UK BAP.
	West Woods	W10	N22	Mature Coniferous Plantation The small strip of woodland labelled W10, parallel to the A96 has many Wych elms.	County	High	Regional	Optimal habitat of mixture of coniferous species within and contiguous to mature coniferous woodland >100ha. Red Squirrel present. This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the Regional and UK BAP.

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Habitat Section and Location	Wood Name	Wood Code	Habitat Area (c.f. Phase 1 Report)	Age and Type of Woodland	Habitat Evaluation (c.f. Phase 1 Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
Section NL3 A96 – Nether Kirkton	Kirkhill Forest (South)	W11	N31, N34	Mature Coniferous Plantation Scot's pine, European Larch, Sitka spruce	County	Very High	National	Optimal habitat of mixture of coniferous species within and contiguous to mature coniferous woodland >400ha. Recent sightings of red squirrel. Red squirrel records in surrounding woodland (W12) and in this woodland (NESBReC records 2005) but over 500m from the proposed scheme.
	Standingstones Wood	W12	N34, N35, N37	Mature Coniferous Plantation Scot's pine, European Larch, Sitka spruce	County	Very High	National	Optimal habitat of mixture of coniferous species within and contiguous to mature coniferous woodland >400ha. Red squirrel records (NESBReC record 2001) in this woodland within 500m of proposed scheme. This woodland habitat is considered to maintain locally significant populations of red squirrels that are evaluated as being of national importance.
	Kirkhill Forest (North)	W5	N37, N38, N40	Mature Coniferous Plantation Small areas of Mixed Plantation and Broad-leaved Semi-natural woodland	County	Very High	National	Optimal foraging and breeding habitat (tree species present and age structure) within and contiguous to mature coniferous woodland >400ha. Red squirrel present in potentially good numbers. This woodland habitat is considered to maintain locally significant populations of red squirrels that are evaluated as being of national importance.
	East Woodlands	W6	N40, N41, N43, N45	Mature Coniferous Plantation Broad-leaved Semi-natural woodland	Local - County	Very High	National	Optimal foraging and breeding habitat (tree species present and age structure) within and adjacent to mature contiguous coniferous woodland >400ha. Commuting corridor between woodland blocks. Red squirrel present in potentially good numbers. This woodland habitat is considered to maintain locally significant populations of red squirrels that are evaluated as being of national importance.

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Habitat Section and Location	Wood Name	Wood Code	Habitat Area (c.f. Phase 1 Report)	Age and Type of Woodland	Habitat Evaluation (c.f. Phase 1 Report)	Habitat Value for Red Squirrel	Evaluation for Red Squirrel	Reason for Evaluation
	Monument Wood	W7	N47	Mature Coniferous Plantation	Local	High	Regional	Optimal foraging and breeding habitat within mature Scot's pine / larch plantation. Within 200m of further high quality habitat (potential commuting corridor). Recent records of red squirrel (NESBReC record 2005) within 500m of proposed scheme. This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the Regional and UK BAP.
Section NL4 Nether Kirkton - Corsehill	Goval Wood (W13)	None	N56, N57, N58	Mature Coniferous/Mixed Plantation Broad-leaved Semi-natural woodland	Local - County	High	Regional	Suitable tree species present for foraging and breeding. Recent sighting of red squirrel (and a NESBReC post 2000 record). Part of contiguous woodland >100ha. This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the Regional and UK BAP.
Section NL5 Corsehill - Blackdog	Littlejohn's Wood	W8	N67, N71, N72	Mature Coniferous/Broad-leaved Plantation Broad-leaved Semi-natural woodland	County	High	Regional	Suitable tree species present for foraging and breeding. Recent records and sightings of red squirrel. Part of contiguous woodland >100ha. This woodland habitat is considered to support populations of red squirrels. Red squirrels are assessed as being of regional ecological value in this woodland because there are considered to be regularly occurring, locally significant populations of this nationally important species, which occurs in the Regional and UK BAP.

Evaluation of Red Squirrel Activity and Habitat

- 4.3.3 Section NL3 of the proposed scheme is likely to be the most important Section along the route in terms of red squirrel habitat, range and population.

Section NL2

- 4.3.4 Although woodland area W9 (approximately 4.5ha) is contiguous to the mature Scot's pine plantation of woodland area W1 (approximately 4ha), where red squirrels are present, the lack of foraging opportunities in this small dense semi-mature Sitka spruce plantation may have led to a negative result for this woodland. This result means that it is considered to be of local importance. It also may also be possible that red squirrels found in woodland W1 travel to and from woodland W2 since the two woodlands are less than 150m apart and are connected by a hedgerow: potentially serving as a commuting corridor. Due to the presence of red squirrels, woodlands W1 and W2 are considered to be of regional importance to red squirrels.
- 4.3.5 Red squirrels found in the woodland areas W2-W4 and W10 Table 10 are likely to be utilising the entire habitat of these woodlands, which are situated in close proximity to each other and spread out over an area of approximately 100ha, less than a kilometre south of the A96 trunk road. The tree species mixture and varied age structure in W2 and W3 has probably contributed to the presence of red squirrels in this area, (part of W3 is an arboretum of labelled, mainly exotic trees, planted by the Forestry Department of the University of Aberdeen).
- 4.3.6 Red squirrel live in a three-dimensional habitat, and the fact that the woodlands are managed to create an open canopy, with a range of different tree species of different ages makes the woodlands around Craibstone an important area for red squirrel conservation. Any grey squirrels found in this area, are likely to have moved west from the city of Aberdeen and are kept under control by local gamekeepers or by the Forestry Commission (Gavin Legg pers.comm.). Red squirrels found in coniferous woodland area W10 are likely to utilise the entire woodland area W2-W4, even though the only records for red squirrel in this woodland area are NESBReC records within 1km, since this coniferous woodland area is contiguous to W10 where hair-tube survey results confirmed red squirrel presence. This area of woodland thus is considered to be of regional importance to red squirrels.
- 4.3.7 Overall Section NL2 is considered to be of regional importance to red squirrels.

Section NL3

- 4.3.8 Woodland areas W5, W6, W11, W12 and W7 (see Table 10) in Section NL3 all form part of, or are contiguous with Kirkhill Forest, an area of conifer forest of over 400ha. It is likely that there is a stable red squirrel population in this area, where grey squirrels have not yet penetrated. Due to the size of the woodland, age and mixture of tree species present, these woodland areas are considered to be a core reserve for and of national importance to red squirrels.
- 4.3.9 Woodland area W7 (approximately 10ha) is a mature Scot's pine plantation which has red squirrels present. Red squirrels have been seen moving between this wood and woodland area W6 approximately 150-200m away (local resident pers.comm.). Even though this woodland is small, there are almost certainly red squirrels breeding here, as dreys have been observed (Gavin Legge pers.comm.). Coniferous trees are the most suitable trees for building dreys, and they provide high-energy food nearly all year (Corbett and Southern 1977, Wauters and Dhondt 1987, in Verboom and van Apeldoorn 1990). This woodland is therefore considered to be of regional importance for red squirrels.
- 4.3.10 Overall Section NL3 is considered to be of national importance to red squirrels.

Section NL4 and NL5

- 4.3.11 Both Goval Wood (W13) (comprising habitat areas N56, N57 and N58) and Littlejohn's Wood (W8) are part of larger contiguous areas of mixed woodland and both have tree species that are attractive to red squirrels. Red squirrels have been seen in Goval Wood (W13) and woodland south of Littlejohn's Wood (W8) (Jacobs incidental records). These woodland areas are therefore considered to be of regional importance for red squirrels.

5 Potential Impacts

5.1 Overall Impact Assessment of Sections NL1-NL5

- 5.1.1 There are no references to the red squirrel in the Highways Agency network ecological information. An Advice Note on the red squirrel in the DMRB was targeted for publication in 2006, however, as yet no release date has been finalised.
- 5.1.2 According to the Scottish Strategy for Red Squirrel Conservation (2004), the precise reasons for the decline of the red squirrel are unknown, but the following have been identified as likely factors:
- competition from the introduced grey squirrel *Sciurus carolinensis*;
 - changes in woodland habitat;
 - conflicting management objectives for woodland habitats;
 - disease (e.g. squirrel poxvirus, a potentially fatal virus for the red squirrel. The grey squirrel appears unaffected by the virus and is thought to be a carrier of the disease.); and
 - road kills.
- 5.1.3 Development of the roads transport infrastructure contributes to the process of habitat fragmentation as a consequence of:
- direct mortality
 - habitat loss and isolation; and
 - disturbance and avoidance due to noise, pollution and visual stimuli.
- 5.1.4 Plant and animal populations most severely affected by habitat fragmentation are those that exist as metapopulations that maintain their genetic diversity by moving between habitat patches. Sub-populations inhabit patches of habitat, but there is some immigration and emigration between patches. Where sub-populations die out, normally they are replaced by immigration from other patches, but this process is hindered or prevented by isolation due to habitat fragmentation. Reducing the connectivity of patches may cause permanent loss of sub-populations (particularly in small patches which may not be able to maintain a viable population). If losses occur in several patches over a short period, metapopulations without a 'mainland' habitat could become extinct.
- 5.1.5 Being small, sub-populations are more likely to fluctuate over time and will have a higher probability of extinction. The possibility of recolonisation is also likely to be reduced due to the resistance to animal dispersal posed by structures such as roads. By their linear nature, roads have considerable potential to fragment and isolate nature conservation resources (in addition to the more direct effects of habitat destruction and modification), and a wide range of mitigation measures have been instigated across the country in recent years in an attempt to reduce such negative effects on wildlife, as well as to maximise any enhancement opportunities (The Highways Agency 2004).

5.2 Generic Impacts

- 5.2.1 The range of potential nature conservation impacts of road schemes, and their significance, will depend on the individual circumstances of each scheme. 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.
- 5.2.2 It should be noted that the impacts associated with the operational phase of the scheme are considered to be permanent, whereas temporary impacts, which are only apparent while the road is being built, are discussed in association with the construction phase.

Direct Mortality

- 5.2.3 Woodland areas where red squirrel could enter or cross the carriageway are where animals are particularly vulnerable to direct mortality during the construction and operational phases of the carriageway. In these areas red squirrels moving between dreys, habitats, home ranges and foraging areas may cross the carriageway and be killed

Construction

- 5.2.4 Direct mortality due to construction of the proposed scheme could represent a significant impact in areas where red squirrels are present. They could suffer direct mortality during construction through tree felling, or by works traffic clearing the site, or indirect mortality through stress. If there is a drey present, it is an offence under the Wildlife and Countryside Act 1981 (see paragraph 1.2.9), to undertake the tree clearance phase of the construction works within the sensitive breeding period (December – August inclusive), if this leads to the death (either directly or indirectly) of a red squirrel.

Operation

- 5.2.5 Direct mortality during the operational phase could represent a significant impact in areas where red squirrels are currently present. As red squirrels have overlapping ranges, and juvenile females aged 10-18 weeks, can move distances as much as 1.5km away from their parental woodland (Gurnell 1994), there will be movement throughout the year. Red squirrel may attempt to cross the carriageway during the operational phase of the road and therefore be at increased risk of mortality resulting from traffic. Mortality may increase in areas where the carriageway either fragments or isolates areas of woodland. This impact could affect a high proportion of the local population. For example, according to the North Merseyside Action Plan for red squirrels, up to 50 animals per year have been killed in the Formby area of North Merseyside alone (The Highways Agency BAP).

Habitat Loss

Operation

- 5.2.6 Habitat loss could represent a significant impact in areas where red squirrels are present. Although occurring during the construction phase, habitat loss is regarded as an operational impact since the loss would be permanent. The loss of woodland habitat due to the proposed scheme may represent a substantial loss of red squirrel breeding and foraging habitat and may affect the long-term viability of woodland areas to support red squirrels. Red squirrels can be prone to starvation, and any reduction in habitat may decrease the available food supply and increase the likelihood of starvation (Gurnell 1987). The presence of a mixture of coniferous tree species (Scot's pine, Douglas fir, European larch and Norway spruce) means that red squirrels can forage throughout the year and the loss of any one of these tree species may lead to a gap in foraging opportunities for red squirrel.

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- 5.2.7 Edge effects of the road resulting from noise, disturbance and pollution may result in the abandonment of a greater area of woodland by red squirrels than that lost directly by the footprint of the road. It should be noted as there is no scope for licensing the destruction or disturbance of red squirrel dreys under the Wildlife & Countryside Act 1981 (as amended), any damage to or loss of red squirrel habitat would have to be agreed with Scottish Natural Heritage and the Scottish Executive prior to construction/clearance activities commencing.
- 5.2.8 The total amount of land-take required in order to construct the Northern Leg of the proposed scheme is estimated at approximately 3.16km² / 316ha. Table 11 shows the estimated total pre-construction and post-construction areas of Phase 1 Habitats present within the proposed land-take. The post-construction figures take account of both anticipated habitat loss to construction and habitat created or changed as a result of mitigation.

Table 11 - Summary of Areas of Land-take by Phase I Habitat Category

Phase 1 Habitat Description	Phase 1 Habitat Categories within proposed scheme land-take	
	Pre-construction (Ha)	Post-construction (Ha)
Woodland mixed plantation	6.57	25.53
Woodland broadleaved plantation (including standard trees)	3.57	4.22
Woodland broadleaved semi-natural	7.06	2.16
Woodland coniferous plantation	19.19	14.28
Scattered scrub	4.30	11.30
Dense continuous scrub	4.94	13.56
Acid grassland semi-improved	2.32	1.86
Acid grassland unimproved	0.47	0.43
Amenity grassland	0.83	0.63
Improved grassland	153.04	112.41
Marshy grassland	1.91	1.44
Neutral grassland semi-improved	0.41	0.36
Neutral grassland unimproved	0.16	0.16
Poor Semi-improved grassland	18.06	13.13
Arable	88.42	39.61*
Built up areas (buildings)	1.42	0.72
Herb & Fern bracken continuous	1.71	0.24
Open water	0.29	0.13
Parkland broadleaved	0.59	0.26
Parkland coniferous	0.22	0.07
Heathland wet heath acid	0.15	0
Total	315.63	242.50

**Figure assumes all potential return to agriculture is achieved*

Habitat Fragmentation and Isolation

Construction

- 5.2.9 Construction processes associated with the proposed scheme would fragment and isolate the red squirrel habitats. Consideration will need to be given so as to avoid inappropriate siting of construction compounds and storage facilities, which may lead to a reduction and/or severance to red squirrel home ranges and may restrict movement of red squirrels through noisy and/or open areas.

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Operation

- 5.2.10 Where the proposed scheme either fragments or isolates woodland, there may be an impact on the long-term genetic diversity of the local red squirrel population. This barrier may cut off populations by restricting movement of red squirrels either during population dispersal, during the breeding season or when red squirrels are foraging throughout their range. Red squirrels are likely to become stressed by any disruption to, or change in their home range. There is also the potential for cumulative impact of further development on those red squirrels isolated on the Aberdeen side of the road. There were a total of 42 red squirrel records (NESBReC records, hair-tube records and sightings) within 1500m of the proposed scheme.
- 5.2.11 While most of the red squirrel records were located on the western side of the proposed scheme, a small number of the records occurred on the Aberdeen side of the proposed road. This population would be effectively partitioned from the main red squirrel population by the proposed scheme.

Disturbance

Construction

- 5.2.12 Disturbance due to construction operations may represent a significant impact in areas where red squirrels are present. Construction methods may include blasting in areas of rock cutting during construction of the proposed scheme, however, noise from machinery and vehicles, light for night working, dust and the presence of humans can all have adverse effects. Consideration will need to be given so as to avoid the inappropriate siting of construction compounds and/or storage sites, which could exacerbate such impacts e.g. if they were placed close to dreys. Under the relevant legislation it would be an offence if construction works were to obstruct access to a drey, disturb a squirrel in a drey or damage/destroy a drey (see paragraph 1.2.11).
- 5.2.13 Red squirrels may attempt to avoid any periodic disturbance and move away from affected habitat areas, resulting in the effective loss of these sites. However, construction disturbance would be temporary, and it is not known if future re-colonisation would be prevented once construction is complete.

Operation

- 5.2.14 During the operational phase of the proposed scheme, red squirrels are likely to suffer disturbance from traffic noise as well as from road lighting. This disturbance is likely to increase with proximity to the proposed scheme and may prompt squirrels to move away from the carriageway to forage and/or breed. As a result this may expose both migrant and any resident red squirrels in areas further away from the road to increased levels of stress, intra and inter-specific competition and starvation, due to increased pressure for limited resources.

Pollution and Other Indirect Impacts

Construction and Operation

- 5.2.15 Any accidental spillage, polluted runoff, airborne or light pollution may have an impact on red squirrel populations in the area. As red squirrels spend approximately 75% of their time in the canopy (Gurnell 1987), they are more likely to be affected by indirect impacts such as pollution of food sources or food caches.

5.3 Specific Impacts

5.3.1 The specific impacts associated with the construction and operational phases of the proposed scheme on local red squirrel populations at specific locations within Sections NL1-NL5 of the route corridor are shown in Table 11. The significance of the impact is derived from the impact assessment process described in paragraphs 2.3.1 – 2.3.9.

Section NL1

5.3.2 There are no potential impacts on red squirrels identified in this section.

Section NL2

5.3.3 In the locality of those woods (see Figure 10.7b) considered to be of regional importance for red squirrels and where the construction and operational phases of the proposed carriageway, potential impacts on the local population, direct mortality, habitat loss and disturbance would represent a medium negative impact of Moderate significance where the road runs through the middle of Craibstone (North) (W3) and; bisects the western edge of Craibstone (South) (W2). Habitat fragmentation and isolation would represent a high negative impact of Major significance on the overall red squirrel population where the road runs through these woodlands.

5.3.4 The overall potential impacts in Craibstone (South) would be similar to Craibstone (North) as the carriageway would remove the western edge of Craibstone (South) and isolate this woodland from the western side of Craibstone (North). Red squirrels in the western and the eastern sides of these woodlands would become isolated from each other, and red squirrels moving between dreys, habitats, home ranges and foraging areas may cross the carriageway and be killed (see Figure 10.7b).

5.3.5 Approximately 5.5ha of good quality habitat (small-masted broad-leaved semi-natural woodland and a mixture of coniferous species) would be lost from the middle of Craibstone (North) (W3) (7ha would remain to the west and 7ha to the east of the scheme). This is approximately 28% of the woodland area of Craibstone (North). Approximately 3ha of good quality habitat (small-masted broad-leaved semi-natural woodland and a mixture of coniferous species) would be lost from the western edge of Craibstone (South) (W2) (7ha would be left to the east and 0.5ha to the west of the scheme). This loss of woodland would have a significant impact on the integrity, structure; function and local distribution of red squirrels in this area (see Figure 10.7b).

5.3.6 Red squirrels within the vicinity of the carriageway in the above areas (during construction and operation) may be disturbed, but is likely to move away to other suitable habitat within these or the surrounding woodlands. However, the effects of disturbance of the carriageway passing through these smaller woodlands would still have a greater impact than it would if it passed through larger woodlands.

5.3.7 Approximately 18ha of high quality woodland (including Newhills (North)) on the eastern side of the carriageway would be isolated from over 100ha of woodland on the western side of the carriageway (including West Woods which is predominantly outside the 500m buffer). Refer to Table 11 for information regarding specific habitat loss.

Section NL3

5.3.8 In the locality of those woods (see Figures 10.7c-d) considered to be of national importance for red squirrels where the construction and operational phases of the proposed carriageway impacts on the local population, direct mortality would represent a high negative impact of Major significance where the road runs through the eastern edge of Standingstones Wood (W12); the eastern edge of Kirkhill Forest (North) (W5) and; bisects the south eastern strip of East Woodlands (W6) from the

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northern part of that wood. Direct mortality would represent a medium negative potential impact of Moderate significance where the road runs through the northern edge of Monument Wood (see Figure 10.7d).

- 5.3.9 The carriageway would bisect Kirkhill Forest (North) (W5) isolating red squirrels in the western and the eastern sides of this woodland (see Figures 10.7b-d). Red squirrels that commute along the woodland corridor at the south eastern edge of East Woodlands may be prevented from doing so by the proposed carriageway. Any movement to and/from these woodlands including Monument Wood (W7) (see Figure 10.7d) would be made more dangerous by the proposed carriageway.
- 5.3.10 The overall potential impacts in Kirkhill Forest (South) (W11) would be similar to Standingstones Wood (W12) as red squirrels are likely to be moving throughout these woodland areas. Even though Monument Wood is isolated, there are hedgerows linking it to East Woodlands (see Figure 10.7d). The carriageway would bisect these two woodlands making any movement to and/from them more dangerous.
- 5.3.11 Woodland areas where habitat loss would represent a medium negative potential impact of Moderate significance on the overall red squirrel population are where the road runs through the northern edge of Monument Wood (see Figure 10.7d).
- 5.3.12 Approximately 1.5ha of mature Scot's pine woodland would be lost from Monument Wood (approximately 8ha would remain to the south of the scheme, and 0.5ha would remain to the north of the scheme) (see Figure 10.7d). This equates to approximately 15% of this woodland area and is significant in terms of loss of overall woodland habitat.
- 5.3.13 Woodland areas where habitat loss would represent a low negative potential impact of Moderate significance on the overall red squirrel population are where the road runs through the eastern edge of Standingstones Wood (W12); the eastern edge of Kirkhill Forest (North) (W5) and; bisects the south eastern strip of East Woodlands (W6) from the northern part of that wood.
- 5.3.14 Areas of habitat lost are very small in comparison to the overall areas of the woodlands present in this area within 500m of the scheme (approximately 113ha of which 100ha is outside the scheme and 13ha is inside the scheme). Approximately 2ha of coniferous woodland would be lost from Standingstones Wood (3ha would be left inside the scheme and 35ha left outside the scheme), 3ha from Kirkhill Forest North (8ha left would be inside the scheme and 35ha left outside the scheme), and 1ha from East Woodlands (2ha left inside the scheme and 30ha left outside the scheme) (see Figures 10.7c-d). This equates to approximately 5% of the woodland in this area within 500m of the proposed scheme (note that woodlands west of the scheme extend beyond the 500m buffer) and should not affect this area's integrity as a core reserve for red squirrels (see Figures 10.7c-d). However, as this area is considered to be of national importance to red squirrels the overall potential impact significance of this habitat loss is considered to be Moderate. Refer to Table 11 for information regarding specific habitat loss.
- 5.3.15 Woodland areas where disturbance during the construction and operational phases of the carriageway would represent a medium negative potential impact of Moderate significance on the overall red squirrel population are where the road runs through the northern edge Monument Wood (W7).
- 5.3.16 Any red squirrel within the vicinity of the carriageway in the above areas (during construction and operation) may be disturbed, but is likely to move away to other suitable habitat within these or the surrounding woodlands (see paragraphs 5.2.11 – 5.2.13). However, the effects of disturbance of the carriageway passing through these smaller woodlands would still have a greater impact than it would passing through larger woodlands.
- 5.3.17 Woodland areas where disturbance during the construction and operational phases of the carriageway would represent a low negative potential impact of Moderate significance on the

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overall red squirrel population are where the road runs through Standing Stones Wood (W12); through Kirkhill Forest (North) (W5) and; through East Woodlands (W6).

- 5.3.18 As the area around Kirkhill Forest is considered a core reserve for red squirrels, disturbance with a low negative impact would be of Moderate significance to red squirrel populations in this area.
- 5.3.19 Woodland areas where habitat fragmentation and isolation would represent a high negative potential impact of Major significance on the overall red squirrel population are: where the road runs through Standingstones Wood (W12); Kirkhill Forest (North) (W5) and; between Kirkhill Forest (North) and Lower Overton approximately 40ha of coniferous plantation and semi-natural deciduous woodland would be isolated from over 400ha of woodland on the western side of the carriageway; where the road runs through East Woodlands; between East Woodlands and Monument Wood and; along the northern edge of Monument Wood (see Figure 10.7d). The carriageway would isolate Monument Wood from over 400ha of woodland to the north and west, and a woodland corridor between East Woodlands and Kirkhill Forest (North) would be fragmented by the carriageway.

Section NL4

- 5.3.20 The only woodland in this Section where there are red squirrels is Goval Wood (W13). The re-aligned A947 would fragment approximately 2ha of coniferous shelterbelt on the east side of Goval Wood. This shelterbelt has already been fragmented by the existing A947, but it is likely that further fragmentation will have a low negative potential impact of Minor significance on red squirrels that may be in this area. However, checks for dreys will still need to be undertaken (see paragraph 5.24) during construction (see Figure 10.7e). Direct mortality and habitat loss are also assessed as being of low negative potential impact of Minor significance on the overall red squirrel population in this area. Refer to Table 11 for information regarding specific habitat loss.

Section NL5

- 5.3.21 Direct mortality, habitat loss and disturbance would represent a medium negative potential impact of Moderate significance during the construction and operational phases of the carriageway where the road runs through Littlejohn's Wood (W8). Habitat fragmentation and isolation would represent a high negative potential impact of Major significance on the overall red squirrel population where the road runs through this wood (see Figures 10.7e-f).
- 5.3.22 This woodland is contiguous to woods to its northwest and southeast, the carriageway (and associated side roads) would cut off these areas and again movement of red squirrels to and/or from these areas would become more dangerous (see Figures 10.7e-f).
- 5.3.23 Approximately 1.5ha of habitat would be lost from Littlejohn's Wood, although this is difficult to quantify as a large coniferous section of this woodland was recently felled in November 2004. Any further loss in red squirrel habitat in this area would have a detrimental effect on red squirrels inhabiting what remains of this woodland. Reduction in woodland area may lead to increased territorial competition between red squirrels leading to movement away from this wood and increasing the chances of squirrel mortality through road kill, stress or predation (see paragraphs 5.2.6 and 5.2.7). Refer to Table 11 for information regarding specific habitat loss.
- 5.3.24 squirrelled squirrels within the vicinity of the carriageway in the above areas (during construction and operation) may be disturbed, but is likely to move away to other suitable habitat within these or the surrounding woodlands. However, the effects of disturbance of the carriageway passing through these smaller woodlands will still have a greater impact than it would passing through larger woodlands.
- 5.3.25 This wood would be isolated from over 100ha of woodland to the north and south respectively. Red squirrel populations in the above woodland areas would become isolated from other squirrel

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populations due to the presence of the carriageway. This could lead to a loss of genetic diversity and ultimately local extinction; either through isolation and/or population decline due to road kills.

5.4 Potential Impacts Summary

- 5.4.1 The greatest potential impacts of the proposed scheme are associated with the operation of the road, particularly the resultant fragmentation and isolation of red squirrel habitat. The road would sever woodland which currently supports red squirrel populations and would thus act as a barrier restricting movement of red squirrels within their home range. This isolation of populations may lead to loss of genetic diversity and ultimately potential local extinction and therefore may compromise the currently favourable conservation status of red squirrels within the area.

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Table 12- Specific Impacts on Red Squirrels within Sections NL1-NL5.

Habitat Section and Location	Woodland Name (Code) and Evaluation	Phase of Scheme	Impacts	Impact magnitude/significance
NL2 - N16	Newhills (South) (W9) Local	Construction and Operation	No significant impacts are predicted as woodland is of low value to red squirrels and is situated 70m away from the proposed scheme.	Negligible/Negligible
NL2 - N16	Newhills (North) (W1) Regional	Construction and Operation	Woodland is 150m from the proposed route and therefore no significant impact is predicted.	Negligible/Negligible
NL2 - N24	Craibstone (South) (W2) Regional	Construction	Increased risk of red squirrel mortality during clearance of woodland for construction works.	Medium negative/Moderate
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works, to move into other areas of woodland.	Medium negative/Moderate
		Operation	Increased risk of direct mortality through RTAs if squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas	Medium negative/Moderate
			High value habitat comprising mature mixed broadleaved and coniferous woodland will be lost, which is likely to constitute red squirrel; foraging and/or breeding habitat.	Medium negative/Moderate
			Proposed scheme severs Craibstone (South) leaving the woodland to the east of the carriageway and to the west fragmented. The resultant habitat fragmentation will prevent dispersal of red squirrels between woodland areas and inhibit their movement into the neighbouring contiguous woodland (Craibstone (North) and Parkhead Wood to the northwest.	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational phase of the scheme. Likely to cause red squirrels, in close proximity to the carriageway, to retreat into the wood away from the road.	Medium negative/Moderate
NL2 - N25	Craibstone (North) (W3) Regional	Construction	Increased risk of red squirrel mortality during clearance of woodland for construction works.	Medium negative/Moderate
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works, to move into other areas of woodland.	Medium negative/Moderate
		Operation	Increased risk of direct mortality through RTAs if squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas	Medium negative/Moderate
			High value habitat comprising mature mixed broadleaved and coniferous woodland will be lost, which is likely to constitute red squirrel; foraging and/or breeding habitat. This is approximately 28% of the woodland area of Craibstone (North).	Medium negative/Moderate

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Habitat Section and Location	Woodland Name (Code) and Evaluation	Phase of Scheme	Impacts	Impact magnitude/significance
			Proposed scheme severs Craibstone (North) leaving woodland to the east of the carriageway and to the west. The resultant habitat fragmentation will prevent dispersal of red squirrels between these woodland areas and inhibit their movement into the neighbouring contiguous woodland (Craibstone (South) and Newhills (North) to the east, and Parkhead Wood and West Woods to the west.	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational phase of the scheme. Likely to cause red squirrels, in close proximity to the carriageway, to retreat into the wood away from the road.	Medium negative/Moderate
NL2 - N21	Parkhead Wood (W4) Regional	Construction and Operation	Woodland is 200m from the proposed route and therefore no significant impact is predicted.	Negligible/Negligible
NL2 - N22	West Woods (W10) Regional	Construction and Operation	Woodland is 500m from the proposed route and therefore no significant impact is predicted.	Negligible/Negligible
NL3 - N31, N34	Kirkhill Forest (South) (W11) National	Construction and Operation	Woodland area is between 50m and 160m from the proposed route and therefore no significant impact is predicted.	Negligible/Negligible
NL3 - N34, N35, N37	Standingstones Wood (W12) National	Construction	Increased risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Major
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works, to retreat deeper into the woodland.	Low negative/Moderate
		Operation	Increased risk of direct mortality through RTAs if squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas	High negative/Major
			High value habitat comprising mature coniferous woodland will be lost, which is likely to constitute red squirrel; foraging and/or breeding habitat.	Low negative/Moderate
			Proposed scheme severs Standingstones wood leaving woodland to the east of the carriageway and to the west in the local area fragmented. The resultant habitat fragmentation will prevent dispersal of red squirrels between these woodland areas and inhibit their movement into the neighbouring contiguous woodland (Kirkhill Forest (South) and Kirkhill Forest (North)).	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational phase of the scheme. Likely to cause red squirrels, in close proximity to the carriageway, to retreat into the wood away from the road.	Low negative/Moderate
NL3 - N37, N38,	Kirkhill Forest (North)	Construction	Increased risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Major

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Habitat Section and Location	Woodland Name (Code) and Evaluation	Phase of Scheme	Impacts	Impact magnitude/significance
N40	(W5) National		Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works, to retreat deeper into the woodland.	Low negative/Moderate
		Operation	Increased of risk of direct mortality through RTAs if squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas	High negative/Major
			High value habitat comprising mature coniferous woodland will be lost, which is likely to constitute red squirrel; foraging and/or breeding habitat.	Low negative/Moderate
			Proposed scheme severs Kirkhill Forest leaving woodland to the east of the carriageway and to the west in the local area fragmented. The resultant habitat fragmentation will prevent dispersal of red squirrels between these woodland areas and inhibit their movement into the neighbouring contiguous woodland (Lower Overton to the west, Standingstones Wood to the south and East Woodlands to the north).	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational phase of the scheme. Likely to cause red squirrels, in close proximity to the carriageway, to retreat into the wood away from the road.	Low negative/Moderate
NL3 - N40, N41, N43, N45	East Woodlands (W6) National	Construction	Increased risk of red squirrel mortality during clearance of woodland for construction works.	High negative/Major
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works, to retreat deeper into the woodland.	Low negative/Moderate
		Operation	Increased of risk of direct mortality through RTAs if squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas	High negative/Major
			Loss of approximately 1ha of high value habitat comprising mature broad-leaved and coniferous woodland, which is likely to constitute red squirrel; foraging and/or breeding habitat.	Low negative/Moderate
			Proposed scheme severs Kirkhill Forest leaving woodland to the east of the carriageway and to the west in the local area fragmented. The resultant habitat fragmentation will prevent dispersal of red squirrels between these woodland areas and inhibit their movement into the neighbouring contiguous woodland (Lower Overton and Kirkhill Forest (North) to the south, and Monument Wood to the east.	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational phase of the scheme. Likely to cause red squirrels, in close proximity to the carriageway, to retreat into the wood away from the road.	Low negative/Moderate
		NL3 - N47	Monument Wood (W7) Regional	Construction

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Habitat Section and Location	Woodland Name (Code) and Evaluation	Phase of Scheme	Impacts	Impact magnitude/significance
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works, to retreat deeper into the woodland.	Medium negative/Moderate
		Operation	Increased of risk of direct mortality through RTAs if squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas	Medium negative/Moderate
			High value habitat comprising mature coniferous woodland will be lost, which is likely to constitute red squirrel; foraging and/or breeding habitat. This is approximately 15% of the woodland area of Monument Wood.	Medium negative/Moderate
			Proposed scheme severs Monument Wood leaving woodland to the south of the carriageway and to the north fragmented. The resultant habitat fragmentation will prevent dispersal of red squirrels between woodland areas and inhibit their movement into the neighbouring contiguous woodland (East Woodlands and Kirkhill Forest (North) to the west).	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational phase of the scheme. Likely to cause red squirrels, in close proximity to the carriageway, to retreat into the wood away from the road.	Medium negative/Moderate
NL4 - N56, N57, N58	Goval Wood (W13) Regional	Construction and Operation	Woodland is over 400m from the proposed route and therefore no significant impact is predicted. The re-aligned A947 will cut through an immature coniferous shelter belt contiguous to the eastern side of this woodland; the resulting impacts of direct mortality, habitat loss and fragmentation and disturbance in this location will be minor.	Low negative/Minor
NL5 - N67, N71, N72	Littlejohn's Wood (W8) Regional	Construction	Increased risk of red squirrel mortality during clearance of woodland for construction works.	Medium negative/Moderate
			Risk of disturbance through increased noise levels and human presence during the construction phase of the scheme. Likely to force red squirrels that are in close proximity to construction works, to move into other areas of woodland.	Medium negative/Moderate
		Operation	Increased of risk of direct mortality through RTAs if squirrels attempt to cross the carriageway when foraging or dispersing to other woodland areas	Medium negative/Moderate
			High value habitat comprising mature mixed broadleaved and coniferous woodland will be lost, which is likely to constitute red squirrel; foraging and/or breeding habitat.	Medium negative/Moderate
			Proposed scheme severs Littlejohn's Wood leaving woodland to the south of the carriageway and to the north fragmented. The resultant habitat fragmentation will prevent dispersal of red squirrels between these woodland areas and inhibit their movement into the neighbouring contiguous woodland (Red Moss to the north and Corsehill to the south).	High negative/Major
			Risk of increased disturbance through noise and/or traffic pollution during the operational phase of the scheme. Likely to cause red squirrels, in close proximity to the carriageway, to retreat into the wood away from the road.	Medium negative/Moderate

6 Mitigation

6.1 Mitigation Principles

- 6.1.1 The best mitigation to reduce potential impacts of the proposal involves the selection of the least damaging route alignment combined with sensitive scheme design. The underlying principles are avoidance of damage or direct effects or, if this cannot be achieved, mitigation of impacts. Where impacts cannot be fully mitigated compensation may be necessary (COST 341, 2002).

Avoidance and Reduction of Mitigation Measures at the Project Planning Stage (EIA)

- 6.1.2 Impacts should be minimised when planning a new infrastructure. Carrying out Environmental Impact Assessments (EIA) on projects ensures that environmental considerations are taken into account at an early stage. All major projects, including infrastructure projects, are subject to EIA according to the EU Council Directive (97/11/EC of 3rd March 1997).
- 6.1.3 The EIA process ensures detailed assessment of adverse and beneficial environmental effects for a range of alternative solutions, depending on the details of assessments included in the Strategic Environmental Assessment (SEA) process. The scoping process is the basis for consideration of alternatives. These assessments are followed by recommendations for measures to minimise or compensate negative environmental impacts (COST 341, 2002).

6.2 Mitigation Measures

Direct Mortality

Advanced Works

- 6.2.1 To off-set the effect of direct mortality, habitat (shrubs and scrub) planting in the proposed areas surrounding the wildlife overbridge and green bridge in Table 13 must be undertaken before these bridges are constructed. By the time the proposed carriageway is operational, the habitat leading up to the bridges would be at a level which would provide sufficient cover to aid the passage of mammals across them.

Construction

- 6.2.2 Preconstruction surveys must be undertaken to ensure previous data are still relevant and areas for specific mitigation are identified ahead of construction. Surveys must be undertaken by an experienced ecologist immediately prior to tree felling works to confirm the presence/absence of active dreys. All drey trees must be marked and avoided during felling: There is no scope for licensing the destruction or disturbance of red squirrel dreys under the Wildlife and Countryside Act (1981) and Nature Conservation (Scotland) Act (2004).
- 6.2.3 In woodland areas that are to be removed, phased tree clearance would be carried out to avoid both the felling of drey trees and disturbance to red squirrels. This will minimise direct squirrel mortality from construction works and any stress-induced mortality from increased levels of disturbance associated with the construction phase. All tree clearance works are to be undertaken out with the red squirrel breeding season. Such activities must be undertaken from September – November only so as to minimise stress to red squirrels during this sensitive period.
- 6.2.4 Should any active drey be present in the vicinity of the proposed carriageway or other area of proposed works, a method statement will be developed specific to each drey in liaison with SNH. This will involve setting up an exclusion zone around each drey within which construction works will

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not be permitted. The dreys will be monitored by ecologists and once all possible assurances can be given that the dreys are inactive, the drey trees can be removed.

Operation

6.2.5 Mitigation measures to avoid direct mortality of red squirrels during the operational scheme will involve the construction of the wildlife overbridge and green bridge at Kirkhill Forest (North) (W5) (see paragraph 6.2.17). This will offset the impacts of the operation of the carriageway on the direct mortality of red squirrels in this area. In addition to controlling grey squirrel numbers either by culling them, or removing large-masted tree species which could reduce the probability of diseases such as squirrel poxvirus being transmitted to red squirrels.

6.2.6 Table 13 shows the mitigation measures that need to be carried out to offset impacts of direct mortality associated with construction and operational phases of the proposed scheme.

Table 13 - Mitigation Measures to Offset Direct Mortality

Mitigation Measure	Section	Chainage Area	Wood Area	Figure Number	
<p>All tree clearance works are to be undertaken out with the red squirrel breeding season. Such activities must be undertaken from September – November only so as to minimise stress to red squirrels during this sensitive period</p> <p>Preconstruction surveys of the proposed carriageway to be undertaken to update data and surveys immediately prior to tree felling works to confirm the presence / absence of active dreys</p> <p>Suitable mitigation measures to be put in place if active red squirrel dreys are found in the vicinity of the proposed carriageway, e.g. restrict plant and personnel to a prescribed working corridor away from any occupied drey until all assurances can be made that the drey is inactive (see paragraph 6.2.4).</p>	NL2	316300-316600	adjacent to the western edge of Craibstone (South) (W2)	10.7b and 11.5c	
		316600-316800 316920-317200	through the middle of Craibstone (North) (W3)		
	NL3	319100-319400	eastern edge of Standingstones Wood (W12)	10.7c and 11.5g	
		319700-319900 319900-320400	eastern edge of Kirkhill Forest (North) (W5)		
		320765-320920	carriageway bisects the south eastern strip of East Woodlands (W6) from the northern part of that wood	10.7d and 11.5e	
		321230-321610	northern edge Monument Wood (W7)		
	NL4	324000	Goval Belt arm of Goval Wood (W13)	10.7f	
	NL5	325570-325960	middle and northern edges of Littlejohn's Wood (W8)	10.7e-10.7f	
	Wildlife overbridge at least 7.5m wide with hedges planted along both sides of the bridge. Habitats on both sides of proposed carriageway to be linked up to the bridge by planting vegetation.	NL3	319960	eastern edge of Kirkhill Forest (North) (W5)	10.7c and 11.5f-11.5g
	Green bridge 10m wide to be planted with native shrubs to create a wildlife corridor that is 4m wide.		320180		
Advanced Works - To off-set the effect of direct mortality, habitat (tree and scrub) planting in the proposed areas leading up to wildlife bridge and green bridge must be undertaken before the bridges are constructed.	319910-320010 320160-320260				

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Mitigation Measure	Section	Chainage Area	Wood Area	Figure Number
Red squirrel rope bridge to be constructed across A947.	NL4	324400	Goval Belt arm of Goval Wood (W13)	10.7f and 11.5j

Habitat Loss

Advanced Works

- 6.2.7 To off-set the effect of habitat loss habitat (tree and scrub) planting in the proposed areas in Table 14 must be undertaken before existing habitats are cleared for road construction. For details on specific habitat creation refer to section 6 in the Terrestrial Habitats report in Appendix A10.1. Many coniferous species take >15 years to reach cone bearing age and pre-planting on this time scale will not be possible. However, red squirrels will be able to derive benefits from immature trees through the provision of shelter and food such as berries, shoots, fungi etc. Moreover, this will increase the age structural diversity of the woodland which is beneficial to red squirrels (Pepper and Patterson, 1998). The importance of planting a number of different tree species in the same area cannot be understated. It is vital that when planting trees that there is a variation of tree species that will create a year-round food source for red squirrels to account for good/bad seed years in different tree species (see paragraph 6.2.12) as this will discourage red squirrels from attempting to cross the carriageway in order to forage in woodland areas on the opposite site of the road.

Construction

- 6.2.8 Ideally all construction compounds and storage areas will be located away from areas of woodland used by red squirrels. Where this is not possible, surveys will be carried out as described in paragraph 6.2.4 to ensure that red squirrel dreys are not destroyed.
- 6.2.9 At the start of the construction period, all personnel on site will be made aware of the mitigation requirements for specific areas and their responsibilities to ensure that high standards of ecological management are achieved.
- 6.2.10 In advance of any work starting, contractors will provide a Method Statement outlining how tree-felling will be undertaken. A proposed schedule of work will be supplied to the Ecological Clerk of Works at an early stage, and regularly updated. No ecologically sensitive work will proceed without the Ecological Clerk of Works being informed at least 24 hours in advance, and either being present or giving permission for the work to continue in his or her absence.
- 6.2.11 Temporary fencing will be erected to define the working area (in agreement with the Ecological Clerk of Works) and to prevent habitat damage or loss out with the working area. The fence will be of stout construction, two metres high and erected prior to the start of any works (including site clearance). Contractors will be held responsible for reinstating any habitat loss (to a standard acceptable to the Ecological Clerk of Works) that may occur beyond the agreed working area.

Operation

- 6.2.12 Mitigation for the loss of red squirrel habitat will include the planting of suitable tree species, of value to red squirrels within a kilometre of the proposed scheme in the chainage areas mentioned below. These species include: Scot's Pine *Pinus sylvestris*; European larch *Larix decidua*; Norway spruce *Picea abies*; Lodgepole pine *Pinus contorta*; Douglas fir *Pseudotsuga menziesii*; yew *Taxus baccata* and hawthorn *Crataegus monogyna*. Other species that can be planted which have a general conservation value and do not encourage grey squirrels, are: birch *Betula pendula*; rowan *Sorbus aucuparia*; ash *Fraxinus excelsior*; willow *Salix sp.*; aspen *Populus tremula* and alder *Alnus glutinosa*. Large masted tree species such as oak *Quercus sp.*, beech *Fagus sylvatica*, chestnuts *Aesculus sp.* and hazel *Corylus avellana* must not be planted within a kilometre of the proposed

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scheme, where this does not conflict with existing conservation management plans. If possible established large mast seed species (over 30 years old) that produce significant seed crops (that could aid grey squirrel incursion), within a kilometre of the areas where red squirrels are present, will be felled where possible. Berry producing trees such as yew *Taxus baccata*; hawthorn *Crataegus monogyna* and rowan *Sorbus aucuparia* must be planted at distances approximately greater than 2km beyond the perimeter of Aberdeen Airport (where this does not conflict with existing conservation management plans).

6.2.13 Table 14 shows the mitigation measures that are needed to offset the construction and operational impacts of habitat loss (by minimising habitat loss and replacing felled trees with alternative suitable tree species).

Table 14- Mitigation Measures to Offset Habitat Loss

Mitigation Measure	Section	Chainage Area	Wood Area.	Figure Number
<p>Minimise habitat loss/ damage. Erect temporary fencing to define the working area (in agreement with the Ecological Clerk of Works) No ecologically sensitive work to proceed without the Ecological Clerk of Works being informed at least 24 hours in advance and either being present or giving permission for the work to continue in his or her absence.</p>	NL2	316300-316600	Adjacent to the western edge of Craibstone (South) (W2)	10.7b and 11.5c
		316600-316800 316920-317200	Through the middle of Craibstone (North) (W3)	
	NL3	319100-319400	Eastern edge of Standingstones Wood (W12)	10.7c and 11.5f-g
		319700-320400	Kirkhill Forest (North) (W5)	
		320765-320920 321230-321610	Bisects the south eastern strip of East Woodlands (W6) from the northern part of the wood. Northern edge Monument Wood (W7).	10.7d and 11.5g
	NL5	325570-325960	Middle and northern edge of Littlejohn's Wood (W8)	
	NL4	324000	Goval Belt part of Goval Wood (W13)	10.7f and 11.5j
<p>Advanced Works - To off-set the effect of habitat loss habitat (tree and scrub) planting in the proposed areas must be undertaken before existing habitats are cleared for road construction. Contractors will be held responsible for reinstating any habitat loss (to a standard acceptable to the Ecological Clerk of Works) that may occur beyond the agreed working area. Replace felled trees with alternative suitable tree species near to or adjacent to the following areas. These include: Scot's Pine <i>Pinus sylvestris</i>; European larch <i>Larix decidua</i>; Norway spruce <i>Picea abies</i>; Lodgepole pine <i>Pinus contorta</i>; Douglas fir <i>Pseudotsuga menziesii</i>; Silver birch <i>Betula pendula</i>; Ash <i>Fraxinus excelsior</i>;</p>	NL2	316450-316800	Open areas between Craibstone (South) (W2) and Craibstone (North) (W3) on the west side of the scheme (to be planted for ecology purposes).	10.7b and 11.5c
		316980-317060	Open area to east of Craibstone (North) (W3) on the east side of the scheme (to be planted for ecology purposes).	
		317000-317370	Open areas to west of Craibstone (North) (W3) on the west side of the scheme (to be planted for ecology purposes).	
	NL3	318900-319200	Open area at northern end of Kirkhill Forest (South) (W11) on the west side of the scheme (to be planted for ecology purposes).	10.7c and 11.5f

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Mitigation Measure	Section	Chainage Area	Wood Area.	Figure Number
Willow <i>Salix sp.</i> ; Aspen <i>Populus tremula</i> ; Alder <i>Alnus glutinosa</i> ; Yew <i>Taxus baccata</i> (to be planted >2km from Aberdeen Airport); Hawthorn <i>Crataegus monogyna</i> (to be planted >2km from Aberdeen Airport); and Rowan <i>Sorbus aucuparia</i> (to be planted >2km from Aberdeen Airport).		319430-319770	Open area at western and northern edges of Standingstones Wood (W12) on the west side of the scheme (to be planted for ecology purposes).	
		320400-320870	Open area north and east of Kirkhill Forest (North) (W5) on the west side of the scheme (to be planted for landscape and ecology purposes).	10.7c and 11.5g
		321490-321520	Corridor between the northern edge of Monument Wood (W7) and East Woodlands (W6) on the west side of the scheme (to be planted for ecology purposes).	10.7d and 11.5h
		321630-322130	Three open areas to north east of Monument Wood (W7) to the north of the scheme (to be planted for landscape and ecology purposes).	
	NL5	325700-325900	Open area to the south of Littlejohn's Wood (W8) to the south of the scheme (to be planted for ecology purposes).	10.7e-10.7f and 11.5k

Habitat Fragmentation and Isolation

- 6.2.14 Two ways to offset the effects of habitat fragmentation and isolation on red squirrel populations are translocation and reintroduction. These involve complex procedures that, if not fully observed, carry a high risk of failure. Generally translocation and reintroduction should be a lower priority than sustaining existing populations (Pepper and Patterson 1998). Translocation of red squirrels is not a viable option as this species becomes stressed when trapped, and in addition to this if they are released in to other red squirrel territories they will be subjected to competition for the territory, food and resources, that will lead to added stress. It is considered less stressful to leave fragmented populations completely alone.

Advanced Works

- 6.2.15 To off-set the effect of habitat fragmentation and isolation, habitat (tree and scrub) planting in the proposed areas in Table 15 must be undertaken before existing habitats are cleared for road construction.

Construction and Operation

- 6.2.16 The proposed mitigation will reduce the local effects of habitat fragmentation and isolation resulting from the construction and operation of the proposed scheme. However, it is considered that additional measures may be required in the context of wider impacts of the full proposed scheme. Although not incorporated into this impact assessment, a number of red squirrel conservation projects and/or grey squirrel control schemes have been evaluated for their suitability to provide additional offset mitigation. This will aid in maintaining and enhancing red squirrel populations in the Aberdeen area in line with the red squirrel LBAP and the Scottish Red Squirrel

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Action Plan 2006-2011. Further details of the approach to identifying appropriate offset mitigation are provided in Part E of the ES (Chapter 56: Mitigation).

- 6.2.17 The impacts of habitat fragmentation and isolation during the operational phase are to be lessened through the construction of a wildlife overbridge and a green bridge where the carriageway cuts through or isolates a substantial area of woodland at Kirkhill Forest (North) (W5). Planting shrubs and scrub on these bridges will provide cover and wildlife corridors for red squirrels to move between areas where they are present. New areas of habitat are also to be created by planting suitable tree species that have direct value for red squirrels (Scot's Pine; Larch; Norway spruce; Lodge pole pine; Douglas fir; yew and hawthorn) (see Appendix A10.1 Terrestrial Habitats Phase 1 Survey Report) in open areas, and alongside the proposed road scheme to encourage movement between previously isolated or fragmented woodland:
- 6.2.18 Wildlife overpasses or green bridges (Sauvajot 2002) and passages adapted to allow climbing animals to cross the carriageway above the traffic are readily used by red squirrels moving between woodland blocks (COST 341 2002).
- 6.2.19 Tree-top overpasses can be situated in wooded areas with important populations of red squirrels and where the impacts due to direct mortality (road kill) are concentrated. They must 1) be tight enough for squirrels to walk on, 2) be safe from predators, 3) have places for squirrels to hide, 4) have good connections on either side of the carriageway and 5) be safe in relation to road users. The design of the tree-top overpasses depends on the type of road. On wider roads where the distance between tree crowns is great, the connection needs to be stable. Constructions with steel cables enclosing a narrow pathway wide enough for squirrels to walk on, or walkways consisting of two steel cables with a net between (20cm – 30cm), will need to be built. Squirrels will also use ropes with a diameter of 4-10cm on narrow roads. Planting trees and shrubs or the provision of additional ropes and planks can facilitate access to the overpasses by the squirrels. On dual carriageways installations for traffic signs over the road can be adapted with a wooden walkway, shelters and hiding places (COST 341 2002). However, due to the width of the proposed carriageway (approximately 30m wide plus embankment or cutting) it is unfeasible that red squirrels will use tree-top rope overpasses. Red squirrels are shy and do not tend to go into exposed/open areas. Treetop rope and/or plank overpasses may however be a viable mitigation option on narrower access roads.
- 6.2.20 In areas where there is no wildlife overbridge or green bridge, for example at Craibstone (South) (W2) and Craibstone (North) (W3); populations of red squirrels that are left on the inside of the route corridor (depending on the size and health of the fragmented population) may be self-sustaining, or may die out naturally (due to genetic isolation). However, the habitat creation detailed in Table 13 will connect woodland severed by the proposed scheme to other areas of woodland, thus ameliorating the impacts of fragmentation and isolation.
- 6.2.21 Table 15 shows the mitigation measures that are necessary to offset the impacts of construction and operation on habitat fragmentation and isolation.

Table 15 – Mitigation Measures to Offset Habitat Fragmentation and Isolation

Mitigation Measure	Section	Chainage Area	Wood Area	Figure Number
Advanced Works - Plant suitable tree species to offset and improve the loss of medium / low quality woodland. These include: Scot's Pine <i>Pinus sylvestris</i> ; European larch <i>Larix decidua</i> ; Norway spruce <i>Picea abies</i> ; Lodgepole pine <i>Pinus contorta</i> ; Douglas fir <i>Pseudotsuga menziesii</i> ;	NL2	316450-316800	Open areas between Craibstone (South) (W2) and Craibstone (North) (W3) on the west side of the scheme (to be planted for ecology purposes).	10.7b and 11.5c
		316980-317060	Open area to east of Craibstone (North) (W3) on the east side of the scheme (to be planted for ecology purposes).	

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Mitigation Measure	Section	Chainage Area	Wood Area	Figure Number
<p>Birch <i>Betula pendula</i>; Ash <i>Fraxinus excelsior</i>; Willow <i>Salix sp.</i>; Aspen <i>Populus tremula</i>; Alder <i>Alnus glutinosa</i>; Yew <i>Taxus baccata</i> (to be planted >2km from Aberdeen Airport); Hawthorn <i>Crataegus monogyna</i> (to be planted >2km from Aberdeen Airport); and Rowan <i>Sorbus aucuparia</i> (to be planted >2km from Aberdeen Airport).</p>		317000-317370	Open areas to west of Craibstone (North) (W3) on the west side of the scheme (to be planted for ecology purposes).	
	NL3	318900-319200	Open area at northern end of Kirkhill Forest (South) (W11) on the west side of the scheme (to be planted for ecology purposes).	10.7c and 11.5f-h
		319430-319770	Open area at western and northern edges of Standingstones Wood (W12) on the west side of the scheme (to be planted for ecology purposes).	
		320400-320870	Open area north and east of Kirkhill Forest (North) (W5) on the west side of the scheme (to be planted for landscape and ecology purposes).	10.7c and 11.5g
		321490-321520	Corridor between the northern edge of Monument Wood (W7) and East Woodlands (W6) on the west side of the scheme (to be planted for ecology purposes).	10.7d and 11.5h
		321630-322130	Three open areas to northeast of Monument Wood (W7) to the north of the scheme (to be planted for landscape and ecology purposes).	
NL5	325700-325900	Open area to the south of Littlejohn's Wood (W8) to the south of the scheme (to be planted for ecology purposes).	10.7e-10.7f and 11.5k	
Wildlife overbridge at least 7.5m wide with hedges planted along the bridge. Habitats on both sides of proposed carriageway to be linked up to the bridge by planting vegetation.	NL3	319960	Eastern edge of Kirkhill Forest (North) (W5)	10.7c and 11.5f - 11.5g
Green bridge at least 10m wide with scrub planting 4m wide on the north side of the bridge. Habitats on both sides of proposed carriageway to be linked up to the bridge by planting vegetation.		320180	Eastern edge of Kirkhill Forest (North) (W5)	
Red squirrel rope bridge to be constructed across A947.	NL4	324400	Goval Belt part of Goval Wood (W13)	10.7f and 11.5j

Disturbance

Construction

6.2.22 Mitigation measures intended to minimise disturbance to red squirrels located within adjacent woodland habitats to the proposed carriageway are to include where applicable, a walk-over survey of the proposed road alignment, undertaken by an experienced ecologist, to confirm the presence /

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absence of active dreys. Should any drey be present within the vicinity of the proposed carriageway or other area of proposed works, then consultation with Scottish Natural Heritage will be required to agree proposed mitigation measures. There is no scope for licensing the destruction or disturbance of red squirrel dreys under the Wildlife and Countryside Act (1981) and the Nature Conservation (Scotland) Act (2004). Therefore suitable mitigation measures must be put in place if active dreys are found in the areas where red squirrels are present. This means restricting plant and personnel to a prescribed working corridor away from any occupied drey (see paragraph 6.2.4). The size of this exclusion zone will be specific to each drey and will depend on the type of construction activities which are to be carried out.

- 6.2.23 Disturbance will be minimised with temporary fencing erected to define an exclusion zone to prevent habitat damage out with the road alignment (to be supervised by an Ecological Clerk of Works – see below). This will consist of a stout fence 2m high erected prior to the start of any works including site clearance (See above – mitigation for habitat loss).

Operation

- 6.2.24 In the short-term it will be impossible to avoid disturbance to red squirrels during the operational phase of the scheme. In long-term it is possible that red squirrels will become habituated to the noise of traffic associated with the scheme. Table 16 shows the mitigation measures that must be implemented to offset disturbance.

Table 16 – Mitigation Measures to Offset Disturbance

Mitigation Measure	Section	Chainage Area	Wood Area	Figure Number
<p>All tree clearance works are to be undertaken out with the red squirrel breeding season. Such activities must be undertaken from September – November only so as to minimise stress to red squirrels during this sensitive period.</p> <p>Walkover survey of the proposed carriageway to be undertaken by an experienced ecologist immediately prior to tree felling works to confirm the presence / absence of active dreys</p> <p>Suitable mitigation measures to be put in place if active red squirrel dreys are found in the vicinity of the proposed road alignment, e.g. restrict plant and personnel to a prescribed working corridor away from any occupied drey until all assurances can be made that the drey is inactive (see paragraph 6.2.4).</p>	NL2	316300-316600	Adjacent to the western edge of Craibstone (South) (W2)	10.7b and 11.5c
		316600-316800 316920-317200	Through the middle of Craibstone (North) (W3)	10.7b and 11.5c
	NL3	319100-319400	Eastern edge of Standingstones Wood (W12)	10.7c and 11.5f
		319700-320400	Eastern edge of Kirkhill Forest (North) (W5)	10.7c and 11.5f-g
		320765-320920	Carriageway bisects the south eastern strip of East Woodlands (W6) from the northern part of that wood	10.7d and 11.5g
	321230-321610	Northern edge Monument Wood (W7)	10.7d and 11.5h	
	NL4	324000	Goval Belt part of Goval Wood (W13)	10.7f
	NL5	325600-325960	Southern and northern edges of Littlejohn's Wood (W8)	10.7e-10.7f and 11.5k

6.3 Mitigation Summary

- 6.3.1 Where the proposed scheme either fragments or isolates woodland, there may be an impact on the long-term genetic diversity of the local red squirrel population. This barrier may cut off populations by restricting movement of red squirrels, either during population dispersal, during the breeding season, or when red squirrels are foraging throughout their range. Red squirrels are likely to become stressed by any disruption to, or change in their home range. Any increase in mortality where the carriageway either fragments or isolates areas of woodland, could affect a substantial proportion of the local red squirrel population. For example, according to the North Merseyside

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Action Plan for red squirrels, up to 50 animals per year have been killed in the Formby area of North Merseyside alone (The Highways Agency BAP).

- 6.3.2 Therefore, any measures that are needed to protect red squirrels should be in place prior to the construction phase starting. This includes planting suitable tree and shrub species within the 500m buffer of the route corridor. The main reason for this is that it may take time for red squirrels to become habituated to an operational road and therefore it is important to provide additional habitat for them to move into before the carriageway becomes operational. Management of grey squirrels will include fragmenting existing beech avenues within 500m of the proposed carriageway (where this does not conflict with existing conservation management plans) to dissuade the dispersal of this species.
- 6.3.3 As red squirrels may cross the carriageway during the operational phase of the road and therefore be at increased risk of mortality, traffic mitigation measures such as the wildlife overbridge and green bridge will need to be installed during the construction phase of the scheme. Where areas of red squirrel habitat will be affected by the scheme and valuable areas are to be lost, this must be compensated for through re-planting and the creation of additional habitat. This includes planting and connecting up woodland areas within 500m from the proposed carriageway. Creating corridors and larger areas of contiguous woodland in these areas will partially compensate for habitat fragmentation and isolation caused by the proposed scheme. Furthermore, this planting may indirectly mitigate for direct mortality of red squirrels as if appropriate habitat is provided they may be less likely to attempt to cross the carriageway to forage and/or breed in areas on the opposite side of the road.
- 6.3.4 Disturbance or destruction of a red squirrel drey constitutes a violation in the relevant legislation and therefore a method statement specific to each potentially affected drey will be developed in liaison with SNH. Implementation of these mitigation measures will ensure that no drey trees will be felled or disturbed until further surveys give all possible assurance that the drey is inactive. It is essential that all personnel working on site are aware of the mitigation in place and of the obligations. All the mitigation measures discussed in this section must be fully operational before the road scheme is opened to traffic.
- 6.3.5 The primary aim of the Scottish strategy for red squirrel conservation (Scottish Squirrel Group 2004) is to maintain populations of red squirrels across their current range. Implicit in this aim is that the populations will be viable in the long term and that they will be present in all of the main centres of population where they occur today. The aim also accepts that, at the moment, not enough is known about the population in Scotland, or about the management of red squirrels, to be able to predict what proportion of the present red squirrel population might be safeguarded.
- 6.3.6 Controlling grey squirrel numbers in woodlands north of the River Dee is a primary objective for the Forestry Commission. Therefore any management of grey squirrel numbers in these areas will be of benefit to red squirrels. It is likely that a long-term management plan will be agreed between Jacobs, the Scottish Executive and the Forestry Commission to manage those woodlands north of the River Dee that have been fragmented by the proposed scheme for red squirrel conservation purposes. This will include on-going monitoring of red squirrels once the road is operational, and on-going monitoring of grey squirrels once control measures have been put in place.
- 6.3.7 As part of the development of the Environmental Management Plan, a Red Squirrel Management Plan will be developed to ensure that the mitigation for red squirrels as proposed in this ES and the Mitigation Vision Statement are translated into a deliverable commitments. This will help to maintain and enhance red squirrel populations in the Aberdeen area in line with the red squirrel LBAP and the Scottish Red Squirrel Action Plan 2006-2011.

7 Residual Impacts

Table 17 – Short to Long-term Impacts of Construction and Operation after Mitigation

Reason for Impact	Section	Wood Name and Code	Chainage Area	Impact Significance of Construction before Mitigation	Impact Significance of Operation before Mitigation	Short - Long-term Impact Significance of Construction after Mitigation	Short - Long-term Impact Significance of Operation after Mitigation
Direct Mortality	NL2	Craibstone (South) (W2)	316300-316600	Major	Major	Negligible - Negligible	Major-Moderate
		Craibstone (North) (W3)	316600-316800 316920-317200				
	NL3	Kirkhill Forest (South) (W11)	319100-319400	Major	Major	Negligible - Negligible	Moderate-Minor
		Standing-stones Wood (W12)	319700-319900				
		Kirkhill Forest (North) (W5)	319900-320400 320000-320100 320150-320250				
		East Woodlands (W6)	320765-320920	Major	Major	Negligible - Negligible	Major-Moderate
		Monument Wood (W7)	321230-321610				
	NL4	Goval Wood (W13)	324000	Minor	Minor	Negligible - Negligible	Minor-Negligible
	NL5	Littlejohn's Wood (W8)	325570-325960	Major	Major	Negligible - Negligible	Moderate – Moderate*
	Habitat Loss	NL2	Craibstone (South) (W2)	316300-316600	Negligible	Moderate	Negligible
Craibstone (North) (W3)			316600-316800 316920-317200				
NL3		Standing-stones Wood (W12)	319100-319400				
		Kirkhill Forest (North) (W5)	319700-320400				

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Reason for Impact	Section	Wood Name and Code	Chainage Area	Impact Significance of Construction before Mitigation	Impact Significance of Operation before Mitigation	Short - Long-term Impact Significance of Construction after Mitigation	Short - Long-term Impact Significance of Operation after Mitigation
		East Woodlands (W6)	320765-320920				
		Monument Wood (W7)	321230-321610				
	NL4	Goval Wood (W13)	324000	Negligible	Minor	Negligible	Minor-Negligible
	NL5	Littlejohn's Wood (W8)	325600-325960	Negligible	Moderate	Negligible	Moderate-Minor*
Habitat Fragmentation	NL2	Craibstone (South) (W2)	316300-316600	Moderate	Major	Negligible	Major-Major
		Craibstone (North) (W3)	316600-317200	Moderate	Major	Negligible	Major-Major
	NL3	Kirkhill Forest (North) (W5)	319900-320400	Moderate	Major	Negligible	Moderate-Minor
		East Woodlands (W6)	320765-320920	Moderate	Major	Negligible	Major-Major
		Monument Wood (W7)	321230-321610				
	NL4	Goval Wood (W13)	324000	Minor	Minor	Negligible	Minor-Negligible
	NL5	Littlejohn's Wood (W8)	325600-325960	Moderate	Major	Negligible	Moderate-Moderate*
Disturbance	NL2	Craibstone (South) (W2)	316300-316700	Moderate	Moderate	Minor-Negligible	Moderate-Minor
		Craibstone (North) (W3)	316700-317200				
	NL3	Standing-stones Wood (W12)	319100-319200				
			319700-319900				
	Kirkhill Forest (North) (W5)	319900-320400					
	East Woodlands (W6)	320765-320920					
	Monument Wood (W7)	321230-321610					

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Reason for Impact	Section	Wood Name and Code	Chainage Area	Impact Significance of Construction before Mitigation	Impact Significance of Operation before Mitigation	Short - Long-term Impact Significance of Construction after Mitigation	Short - Long-term Impact Significance of Operation after Mitigation
	NL4	Goval Wood (W13)	324000	Minor	Minor	Minor-Negligible	Minor-Negligible
	NL5	Littlejohn's Wood (W8)	325600-325960	Moderate	Moderate	Minor-Negligible	Moderate-Minor*

* as stated in paragraph 5.3.23, much of Littlejohn's Wood has been felled post-survey and assessment, thus the residual are assessed accordingly.

Direct Mortality

- 7.1.1 Table 17 describes the residual impacts of direct mortality on red squirrels throughout the scheme after mitigation has been implemented. Short-term Major residual impacts remain in areas (W2, W3, W6, and W7) where the only mitigation provided to offset direct mortality will be the planting of appropriate tree species. In the long term the residual impacts may be reduced to a Moderate significance as these woodlands mature and the habitat is utilised by any remaining red squirrels. The residual impact of direct mortality in area W8 (Littlejohn's Wood and Corsehill Wood) is assessed as being of Moderate significance since much of this area has been felled post-survey.
- 7.1.2 Short-term moderate impacts remain in areas W5, W11 and W12 where a slight increase in the risk of mortality may have a detrimental effect on populations present if red squirrels fail to utilise the wildlife overbridge and green bridge that have been constructed. In the long-term these residual impacts will be reduced to Minor significance as red squirrels utilise these structures.
- 7.1.3 It is extremely unlikely that red squirrels will use proposed culverts or badger tunnels that cross underneath the carriageway to move between habitats in these areas, particularly given the long length of many of the mainline culverts.

Habitat Loss

- 7.1.4 There will be short and long-term residual impacts of habitat loss after mitigation measures are put in place.
- 7.1.5 In the short term, loss or reduction of habitat could lead to increased intra and inter-specific competition, migration, starvation and reduction in foraging and breeding areas. All of these factors could lead to genetic isolation of red squirrel populations remaining in areas of reduced habitat. Any planting of new suitable tree species will take approximately 10-15 years or possibly longer, before producing cones or seeds, or to be used as places of breeding. However, red squirrels will be able to derive benefits from immature trees through the provision of shelter and food such as berries, shoots, fungi etc. Moreover, this will increase the age structural diversity of the woodland which is beneficial to red squirrels (Pepper and Patterson 1998). In the short term following mitigation after construction, the residual impact in areas (W2, W3, W5, W6, W7, W8 and W12) described in Table 17 will be of Moderate significance.
- 7.1.6 In the long term, this trend will slowly be reversed and impacts to red squirrels minimised by providing them with a suitable mixture of tree species and habitat in which to breed and feed. In addition, the removal of large mast tree species to dissuade grey squirrel migration, will probably lead to the reduced probability of disease (squirrel poxvirus), being transmitted to red squirrels, and thereby contribute to the conservation of this species in line with Local Species Action Plan. In the long term following mitigation, the residual impact will be reduced to a Minor significance, although

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this will ultimately depend on the amount of suitable habitat that is provided, how it is managed and whether it is situated in areas that will attract red squirrels.

Habitat Fragmentation and Isolation

- 7.1.7 As described in Table 17, short-term residual impacts of habitat fragmentation and isolation after mitigation will be Major during operation in areas (W2, W3, W6 and W7) as these areas will have difficulty withstanding the immediate effects of fragmentation. Habitat fragmentation and isolation is considered to constitute a moderate residual impact in area W8 since much of this area has been felled post-survey.
- 7.1.8 In the long term, the residual impacts of habitat fragmentation and isolation after construction and operation of the proposed carriageway in areas (W2, W3, W6, W7 and W8) will remain the same as it has not been possible to provide measures to fully mitigate potential impacts in these areas at the local level.
- 7.1.9 Again, it is unlikely that red squirrels will use culverts or badger tunnels provided that cross underneath the carriageway to move between habitats in these areas. Red squirrel populations may not recover in these areas as they are not large enough to sustain core populations; or the extant populations will face competition from invading grey squirrels.
- 7.1.10 Short-term Moderate impacts remain in areas W5, W11 and W12 where a slight increase in the risk of habitat fragmentation and isolation may have a detrimental effect on populations present if red squirrels fail to utilise the wildlife overbridge and green bridge that have been constructed. In the long-term these residual impacts will be reduced to minor significance as red squirrels utilise these structures.

Disturbance

- 7.1.11 There will be short and long-term residual impacts of disturbance after mitigation measures are put in place.
- 7.1.12 Short-term minor residual impacts remain in areas (W2, W3, W5, W6, W7, W8 and W12) described in Table 17 where there may be a slight increase in disturbance for red squirrels using the wildlife overbridge or green bridge at Kirkhill Forest (North) (W2) or any areas of habitat in the vicinity of the carriageway. This disturbance may be reduced in the long-term, as the vegetation on these bridges and adjacent to the carriageway becomes denser, and if red squirrels become habituated to the noise of the traffic.
- 7.1.13 In the long term following mitigation, the residual impacts of disturbance in these areas will be of Negligible significance.

Pollution and other Indirect Impacts

- 7.1.14 These are of Negligible significance.

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