Appendix A40.7 – Water Vole Survey

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1 Introduction

1.1 General Background

1.1.1 This report is one of the appendices supporting Chapter 40 (Ecology and Nature Conservation) of the AWPR Environmental Statement (ES). It considers the potential impacts on water vole populations associated with the Fastlink of the proposed scheme. The results of the surveys carried out for the purposes of this assessment are also presented and area shown on Figures A40.9a-f.

1.1.2 The three component route sections in this report for the Fastlink of the proposed scheme are as follows:

- Section FL1: Stonehaven to Howieshill (ch0 – ch3200);
- Section FL2: Howieshill to Cookney (ch3200 – ch6300); and
- Section FL3: Cookney to Cleanhill Junction (ch6300 – ch10200).

1.1.3 All tables and figures are structured in this manner.

1.1.4 The Ecological Impact Assessment (EcIA) was undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 10 and 11 (Highways Agency 2005) and the Environmental Impact Assessment (Scotland) Regulations 1999, along with cognisance of Institute of Ecology and Environmental Management (IEEM) guidelines (IEEM 2002).

1.1.5 These studies included desk-based consultation to collate existing information about water vole populations in the study area for the proposed scheme and field surveys to provide current data about the status of water vole populations and the habitats that support them.

1.1.6 Cumulative impacts are assessed in a separate report combining the predicted impacts for all habitats and species over the proposed route (refer to Part E of the ES).

Aims

1.1.7 The purpose of the assessment was to:

- assess the presence and status of water vole populations and their habitats in the study area;
- assess the quality of riparian habitat present and evaluate the importance of the area for water vole;
- assess any potential impacts that the proposed scheme may have upon the local water vole population; and
- identify appropriate mitigation measures.

1.2 Background to Assessment

Biology

1.2.1 Water voles (*Arvicola terrestris*) are the largest of the British voles. Most water vole populations are associated with water features, including rivers, ponds, land drains and marshland. They show a preference for permanent slow-flowing water features with densely vegetated banks. They feed upon the aerial stems and leaves of waterside plants. During winter, roots, bark and rhizomes represent an important part of the water voles diet.

1.2.2 Water voles are usually found within 2m of the water's edge where they dig burrows into soft banks. Female water voles are territorial and defend their resources from other females. In contrast, male water voles do not defend territories. Territorial ownership is marked by discrete latrine sites consisting of flattened piles of droppings topped with fresh ones. The length of home ranges can vary from 30m to 150m for females and 60m to 300m for males (Strachan, 1998). A series of abutting water vole territories is called a colony.

1.2.3 Water voles are patchily distributed across the UK. They are found throughout England, Wales and Scotland, including northeast Scotland (Jefferies, 2003; Telfer et al 2001), but are absent from Ireland (Harris et al., 1995). Most UK populations are found below an altitude of 50m (Harris et al 1995). However, in some river catchments water voles are restricted to tributaries in the upper reaches of the river system where mink are relatively scarce. Such populations of voles have been recorded in the Scottish Highlands at altitudes above 900m (Raynor, 2002).

1.2.4 Studies have shown that water vole populations in North Scotland survive as 'metapopulations' (Stewart et al 1999; Aars et al 2001; 2006; Telfer et al 2001). A metapopulation comprises a network of colonies, often with low numbers of individuals, with a fragmented distribution. Water vole metapopulations exist as the result of a balance between colony extinctions and dispersal. (Stewart et al, 1999). Water vole populations are able to retain high levels of genetic variability through dispersal and interaction between these fragmented colonies and an ability to found new colonies in areas of suitable habitat (Aars et al., 2006).

1.2.5 The British water vole population suffered a steady decline throughout the 20th century owing to habitat destruction and agricultural intensification. This decline has been rapidly accelerated in recent years through predation by feral American mink (*Mustela vison*). Abundant mink can wipe out a water vole colony. Therefore, mink presence will render areas of potentially suitable water vole habitat unsuitable.

1.2.6 Two national surveys by the Vincent Wildlife Trust in 1989-1990 and 1996-1998 have highlighted a serious population crash with the loss of 88% of the remaining water vole population in only seven years. The 1990 population of Scottish water voles was estimated at 2,374,000 whilst the 1998 population was estimated at only 354,000 water voles (Jefferies, 2003).

Legal Status

1.2.7 The water vole was afforded partial protection under the Wildlife and Countryside Act (WCA) (1981) (as amended) when, in 1998, it was added to Schedule 5 in respect of Section 9 (4) only. Further protection was afforded when the Nature Conservation (Scotland) Act 2004 revised Part 1 of the WCA (1981). These acts make it an offence to intentionally or recklessly damage, destroy or obstruct access to any structure or place that water voles use for shelter or protection, or to disturb water voles while they are using such a place.

1.2.8 In January 2005 the Department for Environment, Food and Rural Affairs (DEFRA) released a consultation paper that recommended the water vole should have its protection status increased to full protection under Schedule 5 of the Wildlife and Countryside Act (1981) (as amended). However, as yet there has been no date set for these changes. The changes will mean that, as for red squirrel (see Appendix A40.6: Red Squirrel), it will be illegal to intentionally or recklessly kill, injure or capture water voles or to possess or transport water voles or any part of a water vole unless acquired legally, or to kill or capture water voles by indiscriminate methods such as snaring or poisoning.

1.2.9 National Planning Policy Guidance 14 (NPPG 14) refers to natural heritage and how this should relate to Scotland's land use planning process. NPPG 14 makes the presence of a protected species (e.g. water vole) a material consideration in the assessment of development proposals.

1.2.10 The water vole is identified for priority action by the Biodiversity Steering Group (United Kingdom Biodiversity Partnership, 2005) and has a national Species Action Plan. In addition, it is a Northeast Scotland Local Biodiversity Action Plan species.

2 Methods

2.1 Consultation

2.1.1 Sections of the River Dee and River Don catchments were surveyed in 1990 and 1996 as part of the National Water Vole Survey (Jefferies, 2003). In addition, this survey looked at the River Ythan catchment (approximately 15km north of the study corridor) and coastal burns in the Buchan area (approximately 15km north of the study corridor). The results of the surveys were checked for information relevant to this assessment.

2.1.2 A water vole survey was carried out by Jacobs in 2004 and 2005 (as part of a previous AWPR route alignment investigation). This survey looked at a survey corridor that overlapped with the Southern Leg and Northern Leg survey corridor in places (see Appendices A10.8 and A25.7). This survey found no evidence of water voles.

2.2 Survey Methods

2.2.1 The DMRB does not give specific guidance on water vole survey techniques, therefore the survey methodology followed that described in the Water Vole Conservation Handbook (Strachan, 1998). This involved searching for evidence of water voles and making an assessment of the habitat present.

2.2.2 All riparian zones, watercourses and wetlands within 250m either side of the alignment were surveyed for water voles. The survey was extended beyond 250m where considered appropriate. All water features were initially identified from Ordnance Survey maps, aerial photographs and then through a preliminary walkover survey. Survey locations are detailed in Table 1 and presented in Figures 40.9a–f.

2.2.3 All watercourses and ponds were surveyed from the channel/pond, where possible, to give the best view of bank habitat.

2.2.4 The survey was undertaken during May, July and August 2006. This is an optimal time to carry out water vole surveys as it is during the breeding season and latrine marking is at its peak (Woodroffe, 2000). The survey was conducted following periods of dry weather meaning that neither precipitation nor high water levels would have washed any such latrines away. However, due to the variable nature of wildlife and the limitations of survey methods it is possible that not all field signs will have been recorded.

Water Vole Presence

2.2.5 The survey consisted of searching for field signs as described in Strachan (1998), including burrows, nests, runs, latrines, footprints and feeding stations.

2.2.6 Several equations have been produced to estimate water vole populations based upon latrine counts (Morris et al., 1998, Aars et al., 2001). However, many of these studies have been carried out in locations inappropriate for comparison with this study (lowland rivers in England and upland populations of water voles in Scotland). Lambin et al (unpublished) produced an equation for estimating water vole population numbers using mark-recapture studies carried out on 6 lowland streams of the River Ythan catchment in North-East Scotland. It was felt that this equation was most appropriate to use for the water vole surveys undertaken for the ES.

2.2.7 Lambin's equation is $y = 0.653x$ where x = latrines counted per 100m and y= water voles per 100m. When water vole populations are fragmented or small, water voles are likely to maintain fewer latrines as conflicts with neighbouring water voles are likely to be rare. For this study, Lambin's equation is unlikely to produce reliable population estimates due to the sparsity of latrines identified (see Table 5). However, as water vole latrines have been found, Lambin's equation has been applied as it allows comparison between sites by offering an index of vole activity (WildCRU Oxford University 2004).

Habitat Suitability

2.2.8 The habitat suitability of water features for water voles was assessed using landscape factors known to be conducive to supporting water vole colonies (Woodroffe, 2000; Strachan, 1998). This assessment was based upon:

- flow rate of water bodies - water voles prefer static to moderate flowing water bodies;
- water depth - water voles prefer water bodies to have a depth of at least 0.3m;
- suitability of vegetation - water voles require stands of emergent vegetation or tall grasses on which to feed; areas of heavily shaded, wooded bank provide little suitable feeding habitat;
- the composition of habitat types - availability of non-linear foraging habitat may provide refuge from mink predation even where mink are present;
- bank suitability - water voles require areas of soft bank in which to excavate their burrows, overly rocky bank habitat is unsuitable; and
- the status of mink in the local area.

2.2.9 For each factor, each water feature was assessed using a high, medium or low scale, to determine the habitat suitability for water voles. Suitability of vegetation and bank were given greater weight than flow rate and flow depth. Water features were assessed for water voles as follows:

- high suitability: waterbody offers all landscape factors in a favourable state, i.e. slow flowing /static water of a depth of at least 0.3m with moderate/high suitable vegetation, moderate/high bank suitability and either absence of mink or high potential refuge from predation.
- moderate suitability: waterbody offers moderate/high vegetation and bank suitability with either suitable water depth or suitable flow rate the location and unknown status of mink and/or some potential refuge from predation.
- low/moderate suitability: waterbody offers moderate/high vegetation and bank suitability, but neither suitable water depth nor suitable flow rate and/or confirmed presence of mink and no potential refuge from predation.
- low suitability: waterbody offers either poor vegetation, low bank suitability and/or confirmed presence of mink and no potential refuge from predation

2.2.10 In addition, the overall area of suitable habitat on each water feature was taken into account. Where areas of good quality water vole habitat were either small or fragmented, the water feature was awarded a lower value for its suitability.

Mink Presence

2.2.11 Signs of mink were noted, including footprints, scats (faeces) and actual sightings. Each waterbody was assessed for mink populations and classed as being present, likely to be present or status.

Water Vole Survey Locations

2.2.12 Water vole survey locations in sections FL1-FL3 are presented in Table 1.

Table 1 – Water Vole Survey Locations

Site Number	Grid Reference	Habitat Area	Name	Figure
Section FL 1				
1	NO 873 874 – NO 873 886	F3, F4 and F6	Megray Burn	40.9a
2	NO 873 887 – 878 888	F7	Limpet Burn	40.9b
3	NO 872 887 – NO 869 892	F6 and F7	Limpet Burn	40.9b
4	NO 872 887 – NO 867 900	F8 and F10	Coneyhatch Burn and Drains at Coneyhatch Farm and Fishermyre Farm	40.9b
5	NO 874 901 - NO 869 903	F8 and F10	Green Burn	40.9b
6	NO 869 904	F12	Drain at Fishermyre Moss	40.9b
7	NO 866 904	F12	Fishermyre Moss	40.9b
8	NO 861 903	n/a	Fishermyre Pond	40.9b
Section FL 2				
9	NO 861 909 – NO 869 911	F12 and F13	Allochie Burn and Drains at Allochie	40.9c
10	NO 862 911- 871 919	F13	Back Burn	40.9c
11	NO 874 917 – 869 920	F15	Burn of Muchalls and Muchall Ditches	40.9c
12	NO 877 925	F16	Burn of Blackbutts	40.9c
Section FL 3				
13	NO 876 935	F18 and F19	Cookney Ditch	40.9d
14	NO 874 940	F18 and F19	Stoneyhill Burn	40.9d
15	NO 877 948	F20	Balnagubs Burn	40.9d
16	NO 877 950	F18	East Rothnick Burn, North Rothnick Burn and Tributary Burn of Elsick	40.9d
17	NO 875 962	F20	Whiteside Burn	40.9e
18	NO 875 962	F22	Crossley Burn, East Crossley Burn, Cairns Burn and Cairnfield Burn	40.9e
19	NO 867 968	F22 – F26	Stranog Burn	40.9e
20	NO 870 975	F26	Greens of Crynoch Burn, Wedderhill Burn, Polton Burn and Craigentath Burn	40.9f
21	NO 875 975 – NO 875 978	F27	Crynoch Burn	40.9f

2.3 Evaluation of Nature Conservation Value

2.3.1 The ecological value of the local water vole population and the habitats that support it was determined by reference to any designations, the results of the consultations, literature review and field surveys. The criteria used were based on the Ratcliffe Criteria (Ratcliffe, 1977) used in the selection of biological Sites of Special Scientific Interest (SSSI). Sites and features were classified according to the general criteria identified in Table 2.

Table 2 – Evaluation of Ecological Receptor

Ecological Importance	Attributes of Ecological Receptor
International (European)	Habitats An internationally designated site or candidate site i.e. Special Protection Area (SPA), provisional SPA (pSPA), Special Areas of Conservation (SAC), candidate SAC (cSAC), Ramsar site, Biogenetic/Biosphere Reserve, World Heritage Site or an area which meets the published selection criteria for such designation. A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat that are essential to maintain the viability of a larger whole. Any river classified as Excellent A1 and likely to support a substantial salmonid population. Any river with a Habitat Modification Score indicating that it is Pristine or Semi-Natural or Obviously Modified. Species Any regularly occurring population of an internationally important species, which is threatened or rare in the UK, i.e. a UK Red Data Book species or listed as occurring in 15 or fewer 10km squares in the UK (categories 1 and 2 in the UK BAP) or of uncertain conservation status or of global conservation concern in the UK BAP. A regularly occurring, nationally significant population/number of any internationally important species.
National (Scottish)	Habitats A nationally designated site i.e. Site of Special Scientific Interest (SSSI), Areas of Special Scientific Interest (ASSI), National Nature Reserve (NNR), Marine Nature Reserve, or a discrete area, which meets the published selection criteria for national designation (e.g. SSSI selection guidelines) A viable area of a priority habitat identified in the UK Biodiversity Action Plan (UK BAP), or of smaller areas of such habitat that are essential to maintain the viability of a larger whole. Any river classified as Excellent A1 and likely to support a substantial salmonid population. Any river with a Habitat Modification Score indicating that it is Pristine or Semi-Natural or Obviously Modified. Species A regularly occurring, regionally or county significant population/number of an internationally/nationally important species. Any regularly occurring population of a nationally important species which is threatened or rare in the region or county (see local BAP). A feature identified as of critical importance in the UK BAP.
Regional (Northeast Scotland)	Habitats Sites which exceed the county-level designations but fall short of SSSI selection criteria. Viable areas of key habitat identified in the Regional BAP or smaller areas of such habitat that are essential to maintain the viability of a larger whole. Viable areas of key habitat identified as being of regional value in the appropriate SNH Natural Heritage Future area profile. Any river classified as Excellent A1 or Good A2 and capable of supporting salmonid population. Any river with a Habitat Modification Score indicating that it is Significantly Modified or above. Species 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. A regularly occurring, locally significant population/number of a regionally important species. Sites maintaining populations of internationally/nationally important species that are not threatened or rare in the region or county.

Ecological Importance	Attributes of Ecological Receptor
Authority Area (e.g. County or District) Aberdeenshire/ City of Aberdeen	Habitats Sites that are recognised by local authorities e.g. Sites of Interest for Nature Conservation (SINS) and District Wildlife Sites (DWS). County/District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves (LNR). A viable area of habitat identified in County/District BAP or in the relevant SNH Natural Heritage Future area profile. A diverse and/or ecologically valuable hedgerow network. Semi-natural ancient woodland greater than 0.25 ha. Any river classified as Good A2 or Fair B and likely to support coarse fishery. Any river with a Habitat Modification Score indicating that it is Significantly Modified or above. Species Any regularly occurring, locally significant population of a species that is listed in a County/District BAP on account of its regional rarity or localisation. A regularly occurring, locally significant population of a county/district important species (particularly during a critical phase of its life cycle). Sites 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. Sites/features that are scarce within the county/district or which appreciably enrich the county/ district habitat resource.
Local (Immediate local area or village importance)	Habitats Areas of habitat considered to appreciably enrich the habitat resource e.g. species-rich hedgerows, ponds etc. Sites that retain other elements of semi-natural vegetation that due to their size, quality or the wide distribution of such habitats within the local area are not considered for the above classifications. Semi-natural ancient woodland smaller than 0.25ha. Any river classified as Fair B or Poor C and unlikely to support coarse fishery. Rivers with a Habitat Modification Score indicating that it is Severely Modified or above. Species Populations/assemblages of species that appreciable enrich the biodiversity resource within the local context. 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.
Less than Local (Limited ecological value)	Sites that retain habitats and/or species that are of limited ecological importance due to their size, species composition or other factors. Any river classified as Impoverished D and/or with a Habitat Modification Score indicating that it is Severely Modified.

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 3 and includes positive impact criteria in accordance with IEEM guidance (2002). The magnitude of each impact was assessed independently of value or statutory status.

Table 3 – Magnitude of 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 4.

Table 4 – Significance of Impact

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 adverse impact significance greater than or equal to Moderate would require specific mitigation to be undertaken to ameliorate the impact significance to acceptable levels.

2.5 Limitations to Assessment

2.5.1 The survey was carried out during May, July and August 2006, which is the optimum time of year for conducting a water vole survey as latrine marking is at its peak (Woodroffe, 2000). The survey was conducted following periods of dry weather meaning that neither precipitation nor high water levels would have washed any such latrines away. Due to the variable nature of wildlife and the limitations of survey methods, it is possible that not all field signs will have been recorded. The greatest potential for field signs to have gone unrecorded occurred where surveys took place in areas of bog and marshy grassland. In such areas, water voles are unlikely to use burrow systems and may not latrine mark. This means that evidence of water voles can be much more difficult to find.

3 Baseline

3.1 Consultation Information

3.1.1 No evidence was found of previous water vole surveys being carried out within the Fastlink study corridor. However, otter surveys for the AWPR that commenced in February 2006 covered a wider corridor than that featured within this report as the preferred route alignment had not been selected at that stage. During the otter surveys, water vole signs were identified at a fishing pond (Fishermyre Pond) at Grid Reference NO 861904. No other water vole signs were recorded during these surveys, which extended as far south as Stonehaven. However, the otter surveys were undertaken at a sub-optimal time of year to survey for water voles and not all water features were surveyed, therefore other water vole colonies may not have been identified at that time.

3.1.2 SNH reported that water voles have been sighted north of Stonehaven (pers.comm. to SNH via Mr David MacDonald from the Stonehaven and District Angling Association). Xavier Lambin of Aberdeen University identified colonies of water voles along tributries of the Burn of Monboys in 2005 (Xavier Lambin, pers.comm.). The Burn of Monboys lies approximately 500m west of the route corridor.

3.1.3 The 1996 National Water Vole Survey (Jefferies, 2003) found remnant water vole populations to be present at a few isolated locations on the Upper Dee catchment. These populations were recorded on the Muir of Dess (approximately 40km from the study corridor), the Upper Derry (approximately 65km from the study corridor) and the Water of Feugh (approximately 20km from the study corridor). Sites on the Lower Don that were found to be positive for water voles during the 1990 survey were found to be negative in 1996 with no new sites identified. Mink were recorded throughout both catchments during the 1996 survey. Other notable water vole colonies in other river catchments identified in the National Water Vole Survey in proximity to the study sites include scattered, declining colonies around the lowland farmland of Buchan (approximately 25km north of the study corridor), several populations in narrow burns flowing directly to the sea along the Buchan coastline (approximately 25km north of the study corridor) and clusters of water voles surviving in the headwaters of tributaries of the River Ythan (approximately 35km north of the study corridor) (NES LBAP, 2005, Telfer et al., 2001).

3.2 Survey Results

Water Vole Presence

3.2.1 Evidence of water voles was identified on Green Burn (Water Feature 5), on a drain at Fishermyre Moss (Water Feature number 6), within a dry ditch in Fishermyre Moss (Water Feature 7) and at Fishermyre Pond (Water Feature number 8), approximately 3km north of Stonehaven (locations shown on Figure 40.9b). These locations all lie within section FL1. No evidence of water voles was identified anywhere else. Descriptions of locations exhibiting evidence of water voles and the field signs identified are described in Table 5.

3.2.2 Latrine sites were identified at Green Burn (Water Feature 5), on a drain at Fishermyre Moss (Water Feature 6) and at Fishermyre Pond (Water Feature 8). Only footprints were recorded away from water features on the surface of the Moss itself despite a thorough search. These were found running along a 30m length of dry ditch. The identified footprints could be evidence of dispersing water voles as opposed to evidence of a colony as no feeding stations, latrines or burrows were found along the dry ditch. However, it is likely that water vole colonies exist within Fishermyre Moss itself, as it provides good nesting and foraging habitat. Being of a non-linear nature, the habitat also potentially provides a degree of refuge from mink predation.

3.2.3 Using the water vole population equation produced by Lambin et al (unpublished), an index of activity was produced for the three sites where latrines were recorded. The equation produced values of between 2 and 2.6 water voles per 100m of habitat (see Table 5). This suggests that activity is similar between the three colonies and is comparable with fragmented water vole populations elsewhere in Scotland (WildCRU, Oxford University, 2004). It is assumed that the water vole population at each of the colonies is small (perhaps as small as 1-2 breeding females per colony) given the low levels of activity and the short length of habitat exhibiting field signs (no greater than 100m for each of the three sites). As stated previously, it is difficult to make an estimation of population size from latrines as water voles may not be maintaining latrines and may be defecating within their burrow systems.

3.2.4 The identified and potential colonies on and around Fishermyre Moss, although fragmented, lie within 1km of one another. This is well within the likely dispersal distance of water voles: mean of 2km in uplands, mean of 1km in lowlands (Aars et al., 2006); maximum of 3.6km (Stoddart, 1970), suggesting that the three identified colonies represent parts of an overall water vole metapopulation. The survival of each of the individual water vole colonies identified is likely to increase the probable survival of the other water vole colonies and the population in this area as a whole, particularly given the low numbers of water voles assumed to be present.

3.2.5 Fragmented, spatially isolated habitats supporting small populations can suffer the effects of inbreeding depression (Madsen et al., 1995) which can lead to a loss of fitness and increased probability of extinction. Aars et al. (2006) have shown that small water vole populations in patchy habitat can retain high levels of genetic variability through frequent dispersal over broad geographical ranges. The habitat between the four positive sites comprises of peat bog at Fishermyre Moss and wet grassland at Fishermyre Farm (see Appendix A40.1). These habitats allow maintenance of genetic variability as they link the various identified colonies together and allow juvenile voles to safely disperse and set up new colonies. Dispersing water voles will travel over land as well as along water features (Telfer et al., 2001). Dispersal is of particular importance given the likely small population size.

3.2.6 A feature of water vole metapopulations is the impermanence of the colonies that it comprises. It is likely that the identified colonies go through cycles of extinction followed by recolonisation from neighbouring colonies. Extinction could be on account of predation or fluctuations in habitat suitability. It is therefore also likely that areas of unoccupied suitable habitat identified close to the existing colonies have supported water voles in the recent past and will be recoloninsed in the near future (Telfer et al., 2001).

3.2.7 The three identified colonies and potential colony on and around Fishermyre Moss have some severance due to two roads Figure 40.9b. A C-road separates the colony at Green Burn from the colony at Fishermyre Moss, whilst the B979 separates Fishermyre Pond from Fishermyre Moss. However, it is likely that water voles will attempt to cross these roads when dispersing given the narrow width of the roads.

Habitat Suitability

3.2.8 Of the 21 sites surveyed, only five water features exhibiting 'high' suitability for water voles were identified. These were recorded at:

- Coneyhatch Burn;
- Green Burn;
- Drainage ditch at Fishermyre Moss; and
- Fishermyre Moss (away from water features); and
- Fishermyre Pond;

3.2.9 All five areas identified as being of high value habitat for water voles are located within 1km of each other. These locations are linked to one another by Fishermyre Moss and wet grassland around Fishermyre Farm.

3.2.10 Eight sites were identified as offering either 'low' or 'low/moderate' habitat suitability for water voles, and eight were identified as being of moderate suitability.

3.2.11 These locations are described in Table 5 and shown on Figures 40.9a–f.

Mink Presence

3.2.12 The gamekeeper at Fishermyre Pond reported occasionally seeing mink at the pond. Evidence of mink was also found at Back Burn (Water Feature 10), Burn of Muchalls and Muchalls ditches (Water Feature 11), along the length of the Crynoch Burn (Water Feature 20) and the associated ditches (Greens of Crynoch Burn, Wedderhill Burn, Polton Burn and Craigentath Burn (Water Feature 20).

Table 5 – Table of Sites Exhibiting Positive Signs of Water Voles

Watercourse, number and Habitat Area	Evidence identified	Habitat Description	Adjacent Land-use	Activity Index
Green Burn (5) Habitat Areas F8 and F10	Four latrines were identified in a 100m section of the drainage ditch near the water edge. Nine burrows were identified. More burrows and latrines may have been present concealed within the vegetation higher up the bank. Eight feeding stations were identified adjacent to the drainage channel. Runs through the vegetation were identified throughout the 100 metre stretch.	Drainage ditch with steep sloping banks (approximately 45^{o}). Banks approximately 1.2m tall. Water depth fluctuates between 20cm at shallowest up to 40cm at deepest. Channel is approximately 2 metres wide. Bank with lush vegetation comprising grasses, rushes and tall herbs. Some emergent vegetation in channel.	Adjacent land-use comprises species rich wet grassland/ marsh habitat with pockets of wet woodland and gorse scrub. The habitat is not grazed probably on account of its dampness. This provides potential nesting habitat in the tall grasses and rushes present and provides cover for dispersing voles. Green Burn flows under a C- road into a drainage ditch at Fishermyre Moss. A fuller description of the surrounding habitat can be found in Appendix A40.1 (Terrestrial Habitats).	2.6
Fishermyre Moss Drain (6) Habitat Area F12	Four latrines were identified along an approximately 60m of drainage ditch. No burrows were identified. Three feeding stations were found. Runs led away from the drainage ditch into the surrounding vegetation.	Drainage ditch approximately 50cm wide, with short banks (approximately 20cm). Banks well vegetated with *Juncus* spp and some emergent *Juncus spp* within the channel itself. Drainage ditch varies between 10 and 40cm in depth. Ditch is shaded for a 20m section where it passes through willow scrub.	The surrounding land use comprises Fishermyre Moss, which consists of areas of grasses and rushes, heather, occasional pockets of gorse and willow scrub and occasional pools of standing water. The drainage ditch at Fishermyre Moss is linked to Green Burn by a culvert underneath a C-road that lies to the south. A fuller description of the surrounding habitat can be found in Appendix A40.1 (Terrestrial Habitats).	2.6
Fishermyre Moss (7) Habitat Area F12	A series of water vole footprints were identified along a 30m length of muddy ditch within the moss itself. Runs were identified throughout *Juncus spp* and grass vegetation however these could not be conclusively attributed to water voles as bank/field vole droppings and feeding stations were also found throughout the wetter parts of the moss. No water vole latrines, burrows or feeding stations were found despite a thorough search. Water vole field signs are difficult to find here as linear watercourses are limited and shallow and do not offer burrowing habitat. Water voles are likely to be using nests in collapsed vegetation and foraging throughout the moss.	Fishermyre Moss is approximately 55ha in size, it comprises an extensive area of marshy grassland (approximately 35ha) dominated by grasses and rushes with occasional patches of willow scrub and occasional pools of standing water. North of this area approximately 20ha of the moss is dominated by heather and is much drier.	Fishermyre Moss is bordered by agricultural land to the north and east; to the south is another area of marshy grassland; to the west an extensive area is separated from the moss by the B979. Fishermyre pond is contained within heather moorland. A fuller description of the surrounding habitat can be found in Appendix A40.1 (Terrestrial Habitats).	n/a

Watercourse, number and Habitat Area	Evidence identified	Habitat Description	Adjacent Land-use	Activity Index
Fishermyre Pond (8) Habitat Area – Not Applicable	Three latrines were identified around the western edge of the pond (100m stretch), two burrows were found on the banks of the pond, seven feeding stations were identified and runs were found throughout the surrounding vegetation.	The pond is approximately 1ha in size. Depth is approximately 20-30cm near the edges and over 50cm near the centre. The pond fringes mainly consist of shallow sloping banks (approximately 20^{o} and 30cm in height) with .*Juncus spp*.	The pond is bounded to the north and south by heather moorland whilst to the east there is a small wet flush between the pond and the B979. Beyond the B979 lies Fishermyre Moss. There is another wet flush between the western end of the pond and the Burn of Monboys which lies approximately 500m west of the pond.	2

Table 6 – Water Vole Habitat Assessment

Watercourse Number and Name	Habitat Area	Water Depth (m)	Flow	Vegetation Suitability for Water Voles	Suitability of Banks for Water Voles	Mink Present	Additional Notes	Suitability for Water Voles
Section FL 1								
1 - Megray Burn	F3, F4 and F6	0.15	Slow	High	Moderate	Unknown	Banks shallow.	Moderate
2 - Limpet Burn	F7	0.15	Slow	High	Moderate	Unknown	Banks shallow. Burn flows through an area of marshy grassland potentially providing additional foraging and nesting habitat.	Moderate
3 - Limpet Burn (northern stretch)	F6 and F7	0.3	Moderate	Moderate	High	Unknown		Moderate
4 - Coneyhatch Burn	F8 and F10	0.2- 0.5 around Coneyhatch Farm, largely dry elsewhere	Static	High around Coneyhatch Farm, moderate elsewhere.	High	Unknown	Sections around Coneyhatch Farm may occasionally support water vole colonies given suitable habitat and connectivity to nearby colonies, however no evidence of water voles was found at the time. Drier sections provide wildlife corridor linking extent populations with good habitat.	High
5 - Green Burn	F8 and F10	0.2 – 0.4	Slow	High	High	Unknown	Water voles present. Surrounding habitat comprises marshy grassland providing additional foraging and nesting habitat.	High
6 - Drain at Fishermyre Moss	F12	0.1 - 0.4	Slow	High	Moderate	Unknown	Water voles present. Approx 60m of suitable habitat; drain is dry in upper reaches. Surrounding habitat comprises marshy grassland providing additional foraging and nesting habitat	High
7 - Fishermyre Moss	F12	0-0.5	Static	High	n/a	Unknown	Water voles present. Moss with occasional pools and extensive grasses, *Juncus*, *Sphagnum* and heather cover.	High

Watercourse Number and Name	Habitat Area	Water Depth (m)	Flow	Vegetation Suitability for Water Voles	Suitability of Banks for Water Voles	Mink Present	Additional Notes	Suitability for Water Voles
8 - Fishermyre Pond	n/a	0.5+	Static	High	High	Yes	Water voles present.	High
Section FL 2								
9 - Allochie Burn	F12 and F13	0.2	Slow	Low-High	Moderate	Unknown	Occasional poached sections, Mainly low habitat with occasional small (< 15m) patches of high habitat.	Low - Moderate
10 - Back Burn	HF13	0.05- 0.1	Moderate	Moderate	Moderate	Yes	Right bank heavily poached	Low
11 - Burn of Muchalls and Muchall Ditches	F15	0.1- 0.5	Fast	High	Low	Yes		Low
12 - Burn of Blackbutts	F16	0 – 0.01	Static	Moderate	Moderate	Unknown	Mainly dry	Low
Section FL 3								
13 - Cookney Ditch	F18 and F19	0.1-0.3	Slow	Moderate	Moderate	Unknown	Heavily shaded by gorse in parts	Moderate
14 - Stoneyhill Burn	F18 and F19	0.01 – 0.2	Static – slow	Low	Moderate	Unknown		Low
15 - Balnagubs Burn	F20	0.1-0.3	Slow	Moderate	Moderate	Unknown	Heavily shaded by gorse in parts while some banks are exposed clay. One small section of high habitat (approx 100m).	Moderate
16 - East Rothnick Burn, North Rothnick Burn and Tributary Burn of Elsick	F18	0 – 0.5	Static	High	High	Unknown	Dense vegetation, steep banks, some gorse cover, evidence of bank voles. Main artery provided high habitat; much of rest dry.	Moderate
17 - Whiteside Burn	F20	0.1-0.3	Slow	Moderate	Moderate	Unknown	Heavily shaded by gorse in parts.	Moderate
18 - Crossley Burn, East Crossley Burn, Cairns Burn and Cairnfield Burn	F22	0.05 - 0.1	Slow	Moderate	High	Unknown		Moderate
19 - Stranog Burn	F22 – F26	0	N/a	Moderate	Low	Unknown	Heavily shaded by gorse in parts.	Low
20 - Greens of Crynoch Burn, Wedderhill Burn, Polton Burn and Craigentath Burn	F26	0.05 - 1	Slow	High	High	Yes		Low - Moderate
21 - Crynoch Burn	F27	0.1 – 0.3	Fast	Low	Low	Yes		Low

3.3 Survey Results Summary

3.3.1 Evidence of water voles was found at four locations within the route corridor. All of these sites were within 500m of one another and located around Fishermyre Moss. Three of these locations exhibited evidence of supporting small water vole colonies (at Green Burn, Fishermyre Pond and Ditch at Fishermyre Moss). Evidence of dispersing water voles was found on a dry ditch in Fishermyre Pond. It is assumed that water voles live within Fishermyre Moss itself.

3.3.2 It is assumed that the occupied sites represent colonies which are linked genetically and by suitable dispersal habitat, to make up a larger metapopulation. It is assumed that this metapopulation extends no further east than the colony identified at Green Burn but extends west to the tributaries of the Burn of Monboys (approximately 1.5km west of the study area). Additional surveys are being carried out in 2007 to confirm this.

3.3.3 The colonies identified around Fishermyre Moss are likely to be small and reliant on the connectivity provided by the moss. The moss provides potential nesting habitat within the tall vegetation, an abundant food supply and refuge from predators. The land around Fishermyre Moss also offered the best habitat in the study corridor through the provision of burrowing habitat along drainage ditches associated with the moss and within Fishermyre Pond. Water voles at Fishermyre Pond are likely to be occasionally predated by mink. No evidence of water voles was found elsewhere.

4 Evaluation of Habitat Areas

4.1.1 The water vole population identified within the study corridor has been evaluated as a whole. In addition, each water feature has been evaluated in terms of its importance to water voles on the basis of presence of water voles, habitat quality (see Table 6) and distance from known water vole populations.

Section FL1

4.1.2 The water vole population at Fishermyre Moss is identified as being of national importance. This is on account of the site supporting a regularly occurring population of a nationally important species which is threatened or rare in the region or county (see Table 2). Individual water features are evaluated in Table 6.

4.1.3 Water features 5-8 are all evaluated as being of national importance to water voles. Water vole colonies have been identified on water features 5, 6, 7 and 8. In addition, each of these water features offers habitat of high suitability for water voles. Each of these water features is likely to be essential to the viability of the Fishermyre water vole population as a whole. Further to potentially supporting several water vole colonies, Fishermyre moss (Water Feature 7) provides alternative foraging habitat and nesting habitat to that offered by the drainage ditches. In addition, it provides a linkage between the water vole colonies identified throughout the area, which allows water voles to disperse and colonise new areas and allows genetic exchange making the moss fundamental to the survival of this fragmented, small population.

4.1.4 Coneyhatch Burn and associated ditches (watercourse 4) have been awarded county importance. No evidence of water vole was found on the drainage ditches at the time of survey, however large sections of the associated drainage ditches offer habitat of high quality. These are less than 500m from an existing water vole colony and are linked via a (dry) drainage ditch and the wet grassland at Coneyhatch Farm which both provide dispersal routes for water voles. Given that there are frequent fluctuations in suitable site occupancy associated with the natural dynamics of water vole metapopulations, there is a significant probability that this site has previously supported water voles and will do so again in the near future. It may therefore offer an important habitat resource to the wider Fishermyre water vole metapopulation.

4.1.5 Water features 1-3 are evaluated as being of local importance to water voles. Whilst no water voles have been identified on these waterbodies, they offer some suitable habitat and are well linked and close to the population at Fishermyre. Therefore, there is the possibility that these waterbodies could become colonised in the future.

Section FL2

4.1.6 Water features 9-10 are evaluated as being of local importance to water voles. Whilst no water voles have been identified on these water features, they offer some suitable habitat and are well linked and close to the population at Fishermyre. Therefore, there is the possibility that these water features could become colonised in the future.

4.1.7 Water features 11 and 12 are evaluated as being of less than local importance for water voles. Although offering some suitable habitat and being moderately close to the Fishermyre population (approximately 2km away), these water features are isolated from the Fishermyre population by intensive farmland and roads. It is therefore considered unlikely that these water features will be colonised by water voles in the future.

Section FL3

4.1.8 Water features 13-18 are evaluated as being of less than local importance for water voles. Although offering some suitable habitat and being moderately close to the Fishermyre population (between 2 and 6km away), these water features are isolated from the Fishermyre population by intensive farmland and roads. It is therefore considered unlikely that these water features will be colonised by water voles in the future.

4.1.9 Water features 19 – 21 are not included in Table 6 as they are evaluated as being of no ecological value to water voles. This is due to the distance from the nearest known water vole population (all greater than 7km). These sites are all severed from the water vole population by intensive agricultural land. Water voles would be unable to colonise these areas using the main arterial watercourses as these are all well used by mink. Any water voles attempting to colonise any of the suitable stretches of these main watercourses would be likely to suffer from mink predation.

4.1.10 If mink were not present throughout the study area, it would be expected to support a moderate/good water vole population given the suite of localised waterbodies, many of which offer suitable habitat for water voles. Despite possessing some areas of suitable habitat, it is highly unlikely that water voles will recolonise and gain a foothold elsewhere in the study corridor whilst mink are still present.

4.1.11 SNH is currently piloting a mink eradication program in the Western Isles with a view to protecting breeding birds on the islands (SNH, 2003). Although the trapping scheme is progressing well, it is expensive and labour intensive. Whilst mink eradication on an island system is viable, it is likely to be much more difficult to achieve on the mainland as mink would be able to recruit from the wider population unless trapping was undertaken on a massive scale. Given the logistical problems, mink eradication on the mainland is unlikely to happen in the near future.

Table 7 – Habitat Evaluation

Watercourse Number and Name	Habitat Area	Suitability of Habitat for Water Voles	Proximity to nearest water vole colony	Evaluation	Reason for Evaluation
Section FL 1					
1 - Megray Burn	F3, F4 and F6	Moderate	1.5km	Local	Offers suitable water vole habitat and is in close proximity and well linked to an existing water vole population. Could therefore become colonised in near future.
2 - Limpet Burn	F7	Moderate	1.5km	Local	Offers suitable water vole habitat and is in close proximity and well linked to an existing water vole population. Could therefore become colonised in near future.
3 - Limpet Burn (northern stretch)	F6 and F7	Moderate	1km	Local	Offers suitable water vole habitat and is in close proximity and is well linked to an existing water vole population. Could therefore become colonised in near future.
4 - Coneyhatch Burn	F8 and F10	High	<0.5km	County	Offers high quality water vole habitat and is in close proximity to an existing water vole population and is well connected by drainage ditches and wet grassland. Could therefore be occasionally populated by water voles. Away from main watercourse and so unlikely to be used by mink.
5 - Green Burn	F8 and F10	High	Water voles present	National	Supports water vole colony, offers good habitat and is of importance to survival of the Fishermyre water vole population as a whole. Away from main watercourse and so unlikely to be used by mink.
6 - Drain at Fishermyre Moss	F12	High	Water voles present	National	Supports water vole colony, offers good habitat and is of importance to survival of the Fishermyre water vole population as a whole. Away from main watercourse and so unlikely to be used by mink.
7 - Fishermyre Moss	F12	High	Adjacent to water vole colony	National	Provides linkage between the three existing identified colonies. Offers suitable habitat and is likely to be used by water voles. Is of importance to survival of the Fishermyre water vole population as a whole. Away from main watercourse and so unlikely to be used by mink.
8 - Fishermyre Pond	n/a	High	Water voles present	National	Supports water vole colony, offers good habitat and is of importance to survival of the Fishermyre water vole population as a whole. Infrequently visited by mink.
Section FL 2					
9 - Allochie Burn	F12 and F13	Low- Moderate	<1km	Local	Offers some suitable water vole habitat and is in close proximity to an existing water vole population. Could therefore become colonised in near future.
10 - Back Burn	F13	Low – Moderate	1km	Local	Offers some suitable water vole habitat and is in close proximity to an existing water vole population. Could therefore become colonised in near future; particularly if management practices changed (i.e. fencing of banks to prevent poaching and control of mink).
11 - Burn of Muchalls and Muchall Ditches	F15	Moderate	2km	Less than local	Offers some suitable habitat, is moderately close to but isolated from known water vole populations by intensive farm land and roads. Is unlikely to be colonised by water voles in the future.
12 - Burn of Blackbutts	FR16	Low	2.5km	Less than local	Offers little suitable habitat, is moderately close to but isolated from known water vole populations by intensive farm land and roads. Is unlikely to be colonised by water voles in the future.

Watercourse Number and Name	Habitat Area	Suitability of Habitat for Water Voles	Proximity to nearest water vole colony	Evaluation	Reason for Evaluation
Section FL 3					
13 - Cookney Ditch	F18 and F19	Moderate	3.5km	Less than local	Offers some suitable habitat, is moderately close to but isolated from known water vole populations by intensive farm land and roads. Is unlikely to be colonised by water voles in the future.
14 - Stoneyhill Burn	F18 and F19	Low	4km	Less than local	Offers little suitable habitat, is moderately close to but isolated from known water vole populations by intensive farm land and roads. Is unlikely to be colonised by water voles in the future.
15 - Balnagubs Burn	F20	Moderate	5km	Less than local	Offers some suitable habitat, is moderately close to but isolated from known water vole populations by intensive farm land and roads. Is unlikely to be colonised by water voles in the future.
16 - East Rothnick Burn, North Rothnick Burn and Tributary Burn of Elsick	F18	Moderate	5.5km	Less than local	Offers some suitable habitat, is moderately close to but isolated from known water vole populations by intensive farm land and roads. Is unlikely to be colonised by water voles in the future.
17 - Whiteside Burn	F20	Moderate	6km	Less than local	Offers some suitable habitat, is moderately close to but isolated from known water vole populations by intensive farm land and roads. Is unlikely to be colonised by water voles in the future.
18 - Crossley Burn, East Crossley Burn, Cairns Burn and Cairnfield Burn	F22	Moderate	6km	Less than local	Offers some suitable habitat, is moderately close to but isolated from known water vole populations by intensive farm land and roads. Is unlikely to be colonised by water voles in the future.
19 - Stranog Burn	F22 – F26	Low	7km	No ecological value to water voles	Is not close to any known water vole populations and offers little suitable habitat. Is very unlikely to be colonised by water voles in the future.
20 - Greens of Crynoch Burn, Wedderhill Burn, Polton Burn and Craigentath Burn	F26	Moderate	7.5km	No ecological value to water voles	Is not close to any known water vole populations and offers some suitable habitat. Is very unlikely to be colonised by water voles in the future.
21 - Crynoch Burn	F27	Low	7.5km	No ecological value to water voles	Is not close to any known water vole populations and offers little suitable habitat. Is very unlikely to be colonised by water voles in the future.

4.2 Evaluation Summary

4.2.1 Water voles are sparsely distributed in the northeast of Scotland, particularly in lowland areas with only a few known populations (Jefferies, 2003). This makes the population found around Fishermyre Moss of particular importance. No water voles were found elsewhere within the Fastlink study area or during surveys for the AWPR Southern Leg and AWPR Northern Leg, highlighting the local scarcity of this species.

4.2.2 The most important waterbodies identified in the area are water features 5-8 (Green Burn, Drain at Fishermyre Moss, Fishermyre Moss and Fishermyre Pond), which have been evaluated as being of national importance. These water features are of greatest importance as they offer the best habitat within the study corridor and support a water vole population.

4.2.3 The survival of the population identified is attributable to the suite of suitable habitats found at water features 5-8. As these habitats are sited in a matrix of semi-natural habitat, this allows dispersal to new sites and enables genetic mixing between these small fragmented colonies.

5 Potential Impacts

5.1.1 This section examines the potential impacts (without mitigation) of the construction and operation of the proposed scheme that could affect all water vole populations in the vicinity of the scheme. It is thought that the water vole population identified at Fishermyre Moss has the potential to expand as far north as Back Burn (Water Feature 10) and as far south as Megray Burn (Water Feature 1). Beyond these limits, it is assumed to be highly unlikely that any water features will be colonised by water voles and therefore there will be no impact on water voles any further north than Back Burn. Impact assessment will therefore only examine impacts that could potentially affect water features 1-10.

5.1.2 Following guidance from the DMRB, impacts assessed include direct mortality, habitat loss, habitat fragmentation, disturbance and pollution. 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.

5.1.3 Potential impacts can affect the water vole population in two ways. The first is through placing limits upon the ability of existing water vole populations to expand their range in the future. The second is through impacting upon the existing water vole population identified at Fishermyre Moss (water features 4-8). Impacts of the proposed scheme that would affect the likely survival of the identified water vole colonies at a local scale can, in turn, impact upon the likely survival of the local water vole metapopulation.

5.2 General

Direct Mortality – Construction

5.2.1 Water voles are strongly associated with their burrow systems and nests. In the presence of any disturbance, water voles will seek refuge within their burrow systems. This will leave them liable to direct mortality during the construction of the proposed scheme, when works to clear any ditch systems or re-profile any water features may result in the destruction of burrow systems. Any works to clear or drain any areas of wetland may result in water voles being crushed by works vehicles. Activities that could result in generating vibration in the vicinity of water vole burrows (e.g. bore hole operations or the movement of heavy vehicles) could cause burrow systems to collapse leading to further direct mortality.

5.2.2 Water voles may become trapped within any lengths of narrow pipe, containers or wire mesh associated with the construction of the proposed scheme. There will be a greater risk of this occurring where such items have been discarded in areas of tall vegetation, marshland or in drainage ditches.

Direct Mortality – Operation

5.2.3 It may be necessary to install culverts where the proposed scheme would cross drainage ditches and burns. Inappropriate design of culverts may result in fast flows of water or a lack of air space, particularly during flood events. Any water voles attempting to swim under the road in such conditions could drown or be swept away.

5.2.4 Water voles normally avoid areas of open ground as they perceive a greater risk of predation (Carter and Bright, 2003; Dean, 2003), therefore it is unlikely that water voles would attempt to cross the carriageway and suffer any mortality through being run over.

Habitat Loss – Construction

5.2.5 Loss of habitat during construction may result through inappropriate siting of temporary work compounds, balancing ponds, storage of materials and temporary site access roads.

Habitat Loss – Operation

5.2.6 The scheme would result in a loss of existing and potential water vole habitat where the road is proposed to cross and/or would run close to water features (see Table 8). Loss of habitat has been one of the main factors that have contributed to the water vole's decline over the last century (Strachan and Jefferies, 1993). The reckless destruction of water vole burrows is an offence under the Wildlife and Countryside Act (1981) (as amended).

5.2.7 Waterbodies that would be crossed by the scheme would be culverted, re-aligned or diverted into the road drainage system (in the case of some minor drainage ditches). These processes could result in a loss and degradation of habitat. Culverting of water features results in the removal of riparian vegetation and loss of soft banks. Culverts may not be used due to water voles' increased perception of predation risk (Carter and Bright, 2003). Watercourses that are proposed to be realigned and regraded can result in direct impacts through changes to their channel morphology and flow resulting in erosion and sedimentation. The installation of watercourse crossings such as culverts may affect water voles through the loss of suitable vegetation, increased flow rates or the loss of suitable burrowing habitat.

5.2.8 The proposed scheme also has the potential to result in indirect habitat loss through impacts on the local hydrology of an area. The scheme may act as a barrier or obstruction to groundwater flow or surface runoff in some areas of wetland or drainage ditches, which can result in changes the the local hydrological regime such as drying out or flooding. Fluctuations of water levels can reduce the availability of cover, burrowing habitat and food resources to water voles (WildCRU, Oxford University, 2004; Strachan, 1998).

5.2.9 The edge effects of the proposed scheme have the potential for increasing the overall habitat loss associated with the road. Spray and road runoff polluted with contaminants could have affects on soils and local water quality in adjacent areas, making them unsuitable for wetland plant species.

Severance and Habitat Fragmentation – Construction and Operation

5.2.10 The proposed scheme would sever several waterbodies. Severed water features would either be diverted into the road drainage system (in the case of some drainage ditches) or culverted. Culverted sections of water feature are unlikely to be frequently used by water voles as they would offer long exposed sections (70-200m) of bare habitat where water voles would perceive a high risk of predation (Carter and Bright, 2003). It is anticipated that water voles would not attempt to cross the carriageway for the same reasons. Therefore, the proposed scheme would provide an effective barrier to movements of water voles from one side of the road to the other and would fragment the water vole population where it separates colonies from one another.

5.2.11 This is predicted to have two effects on the local water vole population. Water voles would be prevented from dispersing and colonising new or previously occupied areas and they would be prevented from interacting with neighbouring water vole colonies, separated from one another by the proposed scheme. Both of these effects would increase the potential for the local water vole population as a whole to become extinct.

5.2.12 It is important for the viability of small, fragmented populations of water voles, such as the one present within the AWPR route, to be able to maintain genetic variance through interactions between local colonies and to be able to colonise unoccupied suitable areas of habitat as and when they become available. If a large proportion of the overall population is limited to a single colony, in a small patch of suitable habitat, the likelihood of a population becoming extinct through a single stochastic event is increased.

5.2.13 As well as fragmenting water vole populations, the proposed scheme may lead to the fragmentation of water vole habitat. Fragmented lengths of ditch or wetland may become unsuitable habitat for water voles, reducing the carrying capacity by offering insufficient food or burrowing resources. The effects of fragmented habitat would add to the overall effects of habitat loss.

Disturbance – Construction

5.2.14 Any works taking place within 20m of a water vole colony may disturb water voles. Levels of disturbance will depend upon what works are taking place, e.g., the use of loud machinery 20m from the channel or works within the affected water feature are likely to cause a greater disturbance than hand digging 10m from the channel. Disturbed voles could forage less, seeking refuge in burrow systems.

Disturbance – Operation

5.2.15 Water vole colonies can persist in heavily disturbed urban environments (Strachan and Moorhouse, 2006) with water voles quickly becoming accustomed to increased noise disturbance. Human activity is unlikely to significantly increase in the vicinity of water vole colonies consequently operational disturbance is unlikely to have a significant impact upon water voles.

Pollution – Construction

5.2.16 Any spillages of cement, petrochemicals, lubricants, solvents, etc, used for plant and general works into water features or wetlands during the construction of the proposed scheme may harm water voles, vegetation and water quality of their habitat.

5.2.17 Where road construction takes place close to a water feature, excavation and equipment movements may potentially result in sediment laden runoff from site, which can then drain into local watercourses. This may add to the degradation of water vole habitat.

Pollution – Operation

5.2.18 Runoff from the road may contain toxic chemicals such as zinc, cadmium and copper. Compounds such as polychlorinated piphenyls (PCBs) could also be present, which have the potential to affect mammalian reproductive rates (Grogan et al., 2001). Further details regarding impacts from waterborne pollution can be found in Chapter 39 (Water Environment) of the Environmental Statement and in the Freshwater Ecology Report in Appendix A40.9.

5.3 Specific Impacts

5.3.1 This section addresses impacts (without mitigation) on the water vole populations known to occur at water features 5-8, Green Burn, Fishermyre Drain, Fishermyre Moss and Fishermyre Pond).

5.3.2 It is considered possible that water voles could extend their current distribution to adjacent local watercourses by the time the road is constructed, however potential impacts on any future water vole colonies have been addressed in the general impacts section.

5.3.3 Specific impacts on water voles are presented in Table 9. The potential impacts from construction and operation of the scheme have been assessed to determine the overall magnitude and significance of the impact of the road on water voles.

Section FL2

5.3.4 The water vole population and water vole habitat identified within Section 1 is considered to be of National importance.

5.3.5 Potential impacts of the road in this section include:

- increased likelihood of direct mortality attributable to the destruction of burrows or nests potentially containing water voles where the road alignment severs water features/wetlands known to contain water voles;
- increased likelihood of direct mortality attributable to the inappropriate design of the culvert at Ch3125;
- direct loss of water vole habitat due to the landtake of the road (refer to Appendix 40.1 for detailed information regarding habitat loss);
- potential further loss of water vole wetland habitat should road construction disturb the local hydrology resulting in the drying out of wetlands (refer to Appendix 40.1 for detailed information regarding habitat loss);
- severance and isolation of water vole colonies from one another; and
- fragmentation and severance of currently contiguous water vole habitat.

5.3.6 Consequently, the magnitude of impact as a result of the proposed scheme is assessed as being high negative, resulting in an impact of Major significance.

Table 9 –Specific Impacts (only identified in Section FL1)

Section and Habitat Area	Receptor	Phase of Scheme	Impact	Impact Magnitude/ Significance
Section FL1				
FL1-F8 and F10	Green Burn and adjacent grassland	Construction	Risk of direct mortality during clearance of wet grassland habitat	High negative/Major
		Operation	Loss of wet grassland habitat due to the direct landtake of the road (refer to Specific Impacts Chapter in the Terrestrial Habitats Report (Appendix 40.1) for detailed information regarding habitat loss).	High negative/Major
		Operation	Potential loss of wet grassland habitat due to the road's potential disruption to local hydrology (refer to Specific Impacts Chapter in the Terrestrial Habitats Report (Appendix 40.1) for detailed information regarding habitat loss).	High negative/Major
		Operation	Severance of wet grassland habitat and colony of water voles on Green Burn from the rest of the water vole meta-population and existing contiguous water vole habitat (refer to Specific Impacts Chapter in the Terrestrial Habitats Report (Appendix 40.1) for detailed information regarding habitat loss). Road could provide a barrier to the potential future colonisation of waterbodies 1-4.	High negative/Major
		Operation	Fragmentation of the water vole meta- population and fragmentation of wet grassland habitat.	High negative/Major
FL1- F12	Fishermyre Moss Drain	Construction	Risk of direct mortality during clearance of drainage ditch	High negative/Major
		Operation	Risk of direct mortality if the culvert proposed at Ch3125 is inappropriately designed.	High negative/Major
		Operation	Loss of a 140m length of occupied water vole habitat within drainage ditch due to the direct landtake of the road.	High negative/Major
		Operation	Severance of water vole colony on ditch from the rest of the water vole meta-population and existing contiguous water vole habitat.	High negative/Major
		Operation	Fragmentation of the water vole meta- population and fragmentation of occupied water vole habitat.	High negative/Major
FL1- F12	Fishermyre Moss	Construction	Risk of direct mortality during clearance of marshy grassland habitat.	High negative/Major
		Operation	Loss of marshy grassland habitat due to the direct landtake of the road (refer to Specific Impacts Chapter in the Terrestrial Habitats Report (Appendix 40.1) for detailed information regarding habitat loss).	High negative/Major
		Operation	Potential loss of marshy grassland habitat due to the road's potential disruption to local hydrology (refer to Specific Impacts Chapter in the Terrestrial Habitats Report (Appendix 40.1) for detailed information regarding habitat loss).	High negative/Major
		Operation	Severance of marshy grassland habitat and any water voles therein from the rest of the water vole meta-population and existing contiguous water vole habitat (refer to Specific Impacts Chapter in the Terrestrial Habitats Report (Appendix 40.1) for detailed information regarding habitat loss).	High negative/Major
		Operation	Fragmentation of the water vole meta population and fragmentation of marshy grassland habitat.	High negative/Major

Section FL2

5.3.7 The potential water vole habitat identified within Section FL2 is considered to be of Local Importance. There would be no potential impacts on water voles from this section of the Fastlink.

Section FL3

5.3.8 The potential water vole habitat identified within Section FL3 is considered to be of Less than Local importance. There would be no potential impacts on water voles from this section of the Fastlink.

5.4 Summary of Impacts

5.4.1 The impact of direct mortality during construction through careless site clearance and inappropriate works on water features could impact upon the survival of entire water vole colonies; this could have knock on effects upon the local water vole metapopulation, which is reliant upon the persistence of a suite of colonies to colonise vacated habitat and to permit interaction to maintain high genetic variation.

5.4.2 Habitat loss and the barrier effects of the scheme could effectively restrict water voles to small ranges, making isolated colonies vulnerable to genetic restrictions and limiting the rescue effect of dispersal from neighbouring colonies. This increases the potential for large proportions of the overall population to suffer extinction events.

6 Mitigation

6.1 Introduction

6.1.1 As outlined in the Environmental Impact Assessment (Scotland) Regulations 1999, mitigation measures are intended 'to prevent, reduce or where possible, offset any significant adverse impacts on the existing ecology and nature and conservation value of the surrounding area.'

6.1.2 Suitable water vole mitigation measures are described in 'Water Vole Mitigation Techniques' (Arnott, 2001) and 'the Water Vole Conservation Handbook' (Strachan and Moorhouse, 2006). These documents focus on the avoidance of mortality to water voles and on the creation of new habitat to mitigate for any losses. Another element of the mitigation proposed to address the potential impacts of the scheme will be measures to avoid or mitigate the fragmentation of the water vole population present.

6.2 General

6.2.1 The mitigation measures outlined below form a hierarchy of measures to be adopted and comprise prevention/avoidance, reduction and offset measures. All of the mitigation measures described in this chapter have been developed in consultation with the appropriate statutory advisory organisation, i.e. SNH and will compliment the Species Management Plan that will be prepared. The Species Management Plan will include details on habitat management and methodologies to promote long-term conservation objectives.

6.2.2 As part of the Species Management Plan, a method statement will be prepared which will include the schedule for further surveys, locations for replacement habitat, replacement habitat design, replacement habitat management plans, methods for water vole translocation, monitoring schedules, etc. The contents of the method statement will be produced in consultation and in agreement with SNH. A licence will be required from SNH in order to carry out the destruction of water vole burrows. The method statement will be submitted with the licence application.

Direct Mortality

6.2.3 Direct mortality of water voles during the site clearance or in-channel works of the Fastlink construction phase will be avoided by ensuring that no voles are present prior to the start of works. This will require a process of habitat destruction and water vole translocation before works begin. Water vole translocation will require the creation of replacement habitat at least a year in advance of any translocation exercise. This will allow vegetation to mature, creating a suitable receptor site for translocated water voles. This is likely to be a licence condition specified within the SNH licence to destroy water vole habitat. New habitats will be created for any impacts that result in the deterioration of habitat quality in water features 4-8 (Coneyhatch Burn and drains at Coneyhatch Farm/Fishermyre Farm to Fishermyre Moss) (or any other water features identified in future

surveys as containing water voles). The requirements of water vole receptor sites/habitat creation areas are described under habitat loss (paragraphs 6.2.11 to 6.2.16).

6.2.4 Waterbodies that would be affected by the proposed scheme include those that would be directly under the footprint of the scheme and water features within 20m of any works, where the Ecological Clerk of Works considers that construction activities are likely to cause vibrations which may result in the collapse of water vole burrows.

6.2.5 Once the vegetation at water vole receptor sites has established (at least a year after their creation, or longer if deemed necessary by the Ecological Clerk of Works or SNH), a pre-construction water vole survey will be undertaken. Only water features 1-10 (Megray Burn - Back Burn) will be re-surveyed, as it is considered to be highly unlikely that any of the other water features in the AWPR corridor will be colonised within the next ten years (either because they offer unsuitable habitat or are too far away from the Fishermyre population). Pre-construction surveys will be carried out between May and September; the optimal time for carrying out water vole surveys. The aim of these surveys will be to identify the presence of water voles at each watercourse and to map all latrines, feeding stations and burrows.

6.2.6 Where water voles are found to be present, a translocation exercise will be undertaken between 1 March and 1 May or between 1 September and 1 November, in order to avoid separating female voles from any dependent young. The translocation procedure is based upon methods described in the Environment Agency's Water Vole Mitigation Techniques handbook (Arnott, 2001) and is described below.

6.2.7 Where the affected water feature is a drainage ditch, a 20m length of bankside vegetation at each end of the watercourse will be strimmed to deter water voles from moving into the affected area. Where the affected area is an area of wetland, the affected area will be fenced off with 10mm gauge mesh fencing to a height of 500mm. The fencing will be buried into the ground to a depth of 200mm to deter water voles from burrowing into the trapping area. Water vole traps measuring 30cm x 13cm will be placed at approximate 10m intervals, next to latrine sites or feeding stations, in areas of dry land and secured so that they cannot fall into the water when a vole is caught. Traps will be baited with sliced apple and carrot and checked twice a day (once in the morning and once in the evening). Captured voles will be transferred to a suitable transportation box containing food and bedding straw and taken to the receptor site. Each animal caught will be kept separate to reduce the risk of injury through fighting. Once at the receptor site, individual water voles will be placed into release pens measuring 1m x 1m, allowing the animal to acclimatise to its new environment and create its own subterranean burrow system. Release pens will be situated at the water's edge, with food, water and bedding material. Trapping will continue for at least seven days at each water body and will continue for four days after the last vole has been caught.

6.2.8 Once trapping has been completed, each water vole burrow will be dug out by hand to ensure that there are no remaining voles in the works area prior to the start of any activities that could result in water vole mortality. Bankside habitat along the water feature will then be rendered unsuitable immediately after the end of the trapping period, either through strimming or compaction, to deter water voles re-entering the cleared habitat. Such works will be carried out in the presence of an ecologist to ensure that any potentially remaining voles are unharmed. Monitoring at the receptor site will take place one month and four months after the translocation and then annually for five years.

6.2.9 The potential for water voles to be trapped in construction materials during works will be reduced through adherence to construction best practice guidelines (e.g. Charles and Connolly, 2005). This will ensure the maintenance of a tidy construction site free of any objects in which water voles could become trapped.

6.2.10 Where the road alignment passes within 50m of any part of water features 1-10 (Megray Burn to Back Burn) that have not been made unsuitable for water voles, a buffer fence will be erected 20m from the edge of the water feature. This will reduce the likelihood of any works vehicles crushing water voles, their burrows or their nests.

Habitat Loss

6.2.11 Replacement habitat would be created for the habitat loss the would occur as a result of the scheme at water features 4-8 (Coneyhatch Burn and drains at Coneyhatch Farm / Fishermyre Farm to Fishermyre Pond) (or any other water features identified in future surveys as having recently contained water voles affected by the road). Any replacement habitat will be created a year in advance of works starting on the impacted water feature. This will ensure that a suitable receptor site is ready for any water voles to be translocated as well as mitigating for habitat loss. A number of areas are under consideration to provide replacement habitat. The final optimum locations will be determined and supported by data collected from the additional 2007 surveys.

6.2.12 Water vole mitigation habitat will be created within 500m of an existing water vole colony, as this will permit genetic exchange and recruitment between colonies. Mitigation habitat will be linked to an existing colony by either wetland or unmanaged grassland.

6.2.13 Several areas of suitable replacement habitat areas will be created as opposed to a single large one in order to spread the population over a wider area, making it less susceptible to extinction events (e.g. through mink predation).

6.2.14 Mitigation habitat will comprise drainage ditches, ponds and wetland. Wetland areas will have islands with steep banks that remain dry over winter. These will provide a winter refuge for water voles. The design of any drainage ditch or ponds will include:

- friable and loam-rich bank soils. Banks with a stony substrate are unlikely to be used by water voles;
- a bank face that is stable and vegetated with tall grasses and herbs (examples of plants eaten by water voles can be found in the Water Vole Conservation Handbook [Strachan, 1998]);
- a bank face that is stepped to provide refuge areas during peak flow;
- a depth of at least 30cm of water immediately in front of the bank to allow water voles to escape quickly and enter their burrows unseen;
- a pre-planted coir roll to protect the bank from erosion- planted up with a mixture of wetland plants, reeds, rushes and water plants;
- wetland plants in the marginal zone; and
- grass and intermittent bank plants further up the bank in the drier areas.

6.2.15 The engineering of any new watercourses or realignment of watercourses should include meanders in order to create a more diverse flow pattern and more natural in-channel features. Uniform, straight sections should be avoided.

6.2.16 Habitat creation can also be achieved through the sensitive management of existing watercourses which are currently unsuitable for water voles around the Fishermyre population. A survey of all watercourses proposed for management will be undertaken to assess the presence or absence of water voles and aid the design of a management plan. Management could include bank re-profiling, channel deepening, clearance or planting of vegetation and fencing to limit the detrimental effects of poaching by livestock.

6.2.17 Works compounds and storage sites will be sited at least 30m away from any water feature and avoid areas of set aside and wetland. This will limit the amount of water vole habitat loss.

Habitat Fragmentation and Isolation

6.2.18 Isolation of water vole colonies from one another as a result of the scheme could affect the survival of all the water vole colonies identified within the study area. It is therefore important to retain a link

between the colonies. Underpasses or culverts of excessive length cannot be used to maintain connectivity as these structures are unlikely to be used by water voles.

6.2.19 In order to retain links between colonies, additional water vole habitat will be created west of the road alignment and water vole colonies to the east will be moved to this new habitat. Habitat creation and the translocation exercise will ensure that a viable reservoir population exists from which colonisation of additional areas can take place.

Disturbance

6.2.20 Disturbance will be avoided during construction through the erection of a buffer fence. Where the road alignment passes within 50m of any part of water features 1-10 that have not been made unsuitable for water voles, a buffer fence will be erected 20m from the edge of the water feature. No works will take place in this area and workers will not enter this area, thereby preventing water voles from being disturbed.

Pollution and Other Indirect Impacts

6.2.21 During the construction phase, contractors must adhere to SEPA best practice guidelines with regards to preventing pollution incidents. Relevant guidelines include:

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

6.2.22 Construction will require the installation of drainage systems to divert runoff into drains, soakaways and detention basins in order to avoid contamination of waterbodies. Chemical and oil storage tanks will be set back at least 10m from any watercourse and secondary containment will be provided to prevent pollution incidents from occurring. Disturbance to channel beds and banks will be kept to a minimum to prevent erosion and siltation. The operation of the scheme will also require the installation of a safe drainage system. Further details regarding pollution control during construction and operation can be found in Chapter 39 (Water Environment) of the Environmental Statement.

6.3 Specific Mitigation

6.3.1 Mitigation includes areas where landowner agreement has been assumed, as well as areas where Compulsory Purchase Order is to be obtained. Where the application of specific mitigation would result in a significant residual impact, the aim is to reduce this by additional, wider-area offset mitigation. This additional offset mitigation is in the process of being developed and specific location details are unable to be provided at the time of writing this report. Wider mitigation elements are discussed further in Chapter 56 (Mitigation).

6.3.2 Potential impacts on water voles have only been identified as occurring in Section FL1. Consequently, specific mitigation measures are restricted to Section FL1 in Table 10.

Table 10 – Specific Mitigation (only required for Section FL1)

Direct Mortality	Habitat Loss	Severance
Section FL1		
Water vole colonies in Fishermyre Moss (water features 6 and 7) would be trapped and translocated to receptor sites (newly created wetlands). All receptor sites will have established vegetation prior to the start of any translocation. Where Megray Burn, Limpet Burn, Green Burn, wetland adjacent to Green Burn and Fishermyre Moss would be crossed by the scheme, these sites will be made unsuitable for water voles prior to the start of site clearance once it has been established that no water voles are present.	The realignment of Megray Burn between Chainages 0 and 700 will be designed to provide suitable water vole habitat. Loss of habitat and habitat fragmentation will be offset by the creation of new water vole habitat. This replacement habitat will function as the receptor site for any translocated water voles. A number of areas are under consideration to provide the replacement habitat. The final optimum locations will be determined and supported by data collected from the additional 2007 surveys.	Water vole colonies identified on Green Burn (water course 5) will be trapped and translocated to receptor sites west of the AWPR (newly created wetlands). This will prevent water voles from being isolated from the wider metapopulation. The U88K underbridge at Ch 2940 will allow water voles to cross the AWPR carriageway. The drain at Fishermyre Moss will cross under the road via a buried structure (2.7m wide and 84m long) at Ch3125. This crossing point will reduce the severance of habitats east and west of the carriageway. The culvert will have a dry mammal ledge.

6.4 Mitigation Summary

Construction

6.4.1 Measures undertaken during construction to avoid unnecessary impacts on water voles will include:

- further ecological input during the detailed design stage of the road;
- the appointment of an Ecological Clerk of Works to oversee all works;
- the production of a water vole mitigation method statement to be agreed with SNH;
- adherence to best practice guidelines where work compounds are sited in sensitive locations;
- the capture and translocation of water voles from impacted parts of the waterbodies to newly created replacement habitat;
- isolated water vole colonies, severed from the rest of the local water vole metapopulation will be translocated to the replacement habitat;
- the construction of two underpasses will reduce the barrier effects of the road;
- replacement habitat will be created well in advance of the start of clearance to give enough time for vegetation to establish; and
- watercourses impacted by the road will be made unsuitable for water voles to prevent them colonising areas of land beneath the foot print of the scheme prior to the start of site clearance.

Further Survey and Monitoring

6.4.2 Water vole colonies undergo cycles of extinction and re-establishment, which is an important feature of the metapopulation dynamics that allows water vole populations to persist. In order for new colonies to be founded, water voles disperse over several kilometres. Therefore, there is a

possibility that water features surveyed in the current survey that showed no evidence of water voles could contain water voles before construction of the road begins. Likewise, occupied sites may become vacant. It is therefore important to monitor the Fishermyre population up to the commencement of construction in order to identify any additional important water features of importance to water voles. Water features 1-10 will be surveyed each year between May 1 and October 1 (it is deemed highly unlikely that any other watercourses will be colonised). The results of these surveys will be used to update the mitigation proposed here.

6.4.3 Monitoring of both translocated water vole populations and areas of habitat creation will take place at least annually (length of monitoring period to be determined through consultation with SNH) following the opening of the road.

7 Residual Impacts

7.1.1 The significance of any residual impacts predicted to occur after implementation of mitigation measures are described in Table 11 below. Specific impacts on water voles have only been identified as occurring in Section FL1. Therefore residual impacts are also limited to Section FL1.

Table 11 – Residual Impact Significance (only required for Section FL1)

Impact	Description	Pre-Mitigation Impact Significance	Post Mitigation Residual Impact Significance
Section FL1			
Direct Mortality	Construction – The adherence to best practice construction guidelines, the translocation of water voles from works areas and the rendering of waterbodies unsuitable for water voles prior to site clearance will limit the potential for increased water vole mortality.	Major Negative	Negligible
Habitat Loss	Operation – Loss of suitable water vole habitat will be mitigated for by the creation and management of new areas of wetland connected to existing water vole habitat.	Major Negative	Minor Negative in the short to medium term. Negligible in the long term.
Habitat Fragmentation and isolation	Operation- Replacement habitat will be created adjoining fragmented wetland habitat in order to retain large enough areas of habitat to support water voles. The fragmentation and isolation of water vole colonies will be reduced by translocating water vole colonies east of the road to new habitat west of the road thereby maintaining connectivity between separate colonies. The road would act as barrier to movements of water voles occupying habitat west of the road to suitable habitat east of the road. Underpasses will reduce this barrier effect however this impact will not be completely obviated.	Major Negative	Minor Negative in the short to medium term. Negligible in the long term.

Impact	Description	Pre-Mitigation Impact Significance	Post Mitigation Residual Impact Significance
Section FL1			
	The impact will be offset through habitat creation west of the road to account for habitats east of the road becoming more inaccessible to water voles.		
Disturbance	Construction – Works will avoid taking place close to water vole colonies where possible.	Minor Negative	Minor Negative in the short term. Negligible in the long term.
Pollution	Construction – Best Practice Guidelines including prevention / emergency response measures will ensure that there are no negative impacts attributable to pollution.	Major Negative	Negligible
Overall Residual Impact	**Negligible**		

7.2 Residual Impacts Summary

7.2.1 With the application of the mitigation measures described in this assessment, the construction of the Fastlink section of the scheme is unlikely to compromise the viability of the local area to support water voles or impact upon water voles in the wider Aberdeenshire area. However, the road is still likely to exert an overall negative residual impact on water voles in the study area due to the barrier effect of the road, fragmenting areas of habitat.

7.2.2 The mitigation proposed aims to partially address this issue by creating more suitable water vole habitat to the west of the road alignment. This would be achieved by creating large areas of new wetland habitat linked to exiting water vole colonies and then translocating water voles to this new habitat. The result of this would be that it will become much less important for water voles to access habitats to the east of the road as sufficient suitable habitat and sufficient suitable links to existing water vole populations will be present within land west of the alignment to allow for successful water vole colonies.

7.2.3 Residual impacts of Minor significance on water voles would remain due to operational habitat habitat loss and fragmentation/ isolation and disturbance during construction. The residual impact of habitat loss, however, is predicted to be of Negligible significance in the long-term once the newly created areas of wetland habitat have matured. Direct mortality and potential pollution during construction are assessed as being of Negligible significance.

8 References

Aars, J., Lambin, X., Denny, R. and Griffin, A. (2001) Water Vole in the Scottish Uplands: Distribution Patterns of Disturbed and Pristine Populations Ahead and Behind the American Mink Invasion Front. Animal Conservation 4, 187 – 194.

Aars, J., Dallas, J.F., Piertney, B., Marshall, F., Gow, J.L., Telfer, S. and Lambin, X. (2006) Widespread Geneflow and High Genetic Variability in Populations of Water Voles *Arvicola terrestris* in Patchy Habitats. Molecular Ecology 15, 1455 - 1466

Carter, S.P. and Bright, P.W. (2003) Reedbeds as Refuges for Water Voles (*Arvicola terrestris*) from Predation by Introduced Mink (*Mustela vison*). Biological Conservation 111, 371 – 376

Charles, P and Connolly, S (eds) (2005) Environmental Good Practice on Site. CIRIA, London

Dean, M. (2003) Development Mitigation for Water Voles: A Research Project into the Effectiveness of 'Displacement' as a Mitigation Technique. Institute of Ecology and Environmental Management In Practice April 2003, IEEM

DEFRA, (2005). Fourth Quinquennial Review of Schedules 5 and 8 of the Wildlife and Countryside Act 1981: http://www.defra.gov.uk/corporate/consult/wildlifeact-review58/consultation.pdf

Grogan, A., Philcox, C., Macdonald, D. (2001). Nature Conservation and Roads: Advice in Relation to Otters. WildCRU, Oxford.

Harris, S., Morris, P., Wray, S., and Yalden, D. (1995). A Review of British Mammals. JNCC, Peterborough.

Highways Agency (2005). Design Manual for Roads and Bridges www.official-documents.co.uk/document/deps/ha/dmrb/index.htm

IEEM (2002) Draft Guidelines for Ecological Impact Assessment. Institute of Ecology and Environmental Management, UK.

Jefferies, D.J. (2003). The Water Vole and Mink Survey of Britain 1996-1998 with a History of the Long-Term Changes in the Status of Both Species and their Causes. The Vincent Wildlife Trust, UK.

JNCC (September 2002). Fourth Quinquennial Review of Schedules 5 and 8 of the Wildlife and Countryside Act, 1981. Report and Recommendations from the Joint Nature Conservation Committee.

Lambin, X., Telfer, S., and Sah, S.A.M. (unpublished) Estimating Water Vole Population Size With Latrine Counts, Department of Zoology, University of Aberdeen.

Morris, P.A., Morris, M.J., MacPherson, D., Jefferies, D.J., Strachan, R. and Woodroffe, G.L. (1998) Estimating Numbers of the Water Vole, *Arvicola terrestris* – a Correction to the Published Method. Journal of Zoology, 246: 61-62

Madsen, T., Stille, B. and Shine, R. (1996). Inbreeding Depression in an Isolated Population of Adders *Vipera berus*. Biological Conservation. 75, 113-118.

NES LBAP (2005). Water Vole Local Species Action Plan www.nesbiodiversity.org.uk/Water%20Vole_Web_Sep03.doc

Ratcliffe, D.A. (1977). A Nature Conservation Review. Cambridge University Press, Cambridge.

Raynor, R. (2002). Water Voles in the Highlands: a Myth or an Undiscovered Refuge? British Wildlife 13, pp. 255-257.

SEPA (2004) Pollution Prevention Guidelines, www.sepa.org.uk/guidance/ppg/

SNH (2003). News Releases: Positive Outlook for Mink Eradication Scheme www.snh.org.uk/pdfs/scottish/wisles/Minkfig.pdf

Stoddart, D.M (1970) Individual Range, Dispersion and Dispersal in a Population of Water Voles (*Arvicola terrestris*) Journal of Animal Ecology 39: 403-425.

Stewart, W. A., Dallas, J. F., and Piertney, S.B. (1999) Metapopulation Genetic Structure in the Water Vole, *Arvicola terrestris*, in NE Scotland, Biological Journal of the Linnean Society , 68: 159 - 171

Strachan, R. (1998). Water Vole Conservation Handbook. Environment Agency, English Nature, WildCRU. Oxford, UK.

Strachan and Moorhouse (2006) Water Vole Conservation Handbook 2nd Ed. Environment Agency, English Nature, WildCRU. Oxford, UK.

Strachan and Jefferies (1993) The Water Vole *Arvicola terrestris* in Britain 1989 – 1990: its Distribution and Changing Status. – The Vincent and Wildlife Trust, London.

Telfer, S., Holt, A., Donaldson, R. and Lambin, X. (2001) Metapopulation Processes and Persistence in Remnant Water Vole Populations. OIKOS 95: 31 – 42. Copenhagen

The Nature Conservation (Scotland) Act 2004
http://www.opsi.gov.uk/legislation/scotland/acts2004/20040006.htm

United Kingdom Biodiversity Partnership (2005). www.ukbap.org.uk

Woodroffe, G. (2000). The Water Vole. The Mammal Society

WildCRU, Oxford University (2004) Water Vole Surveys in Fife and Central Cairngorms. SNH commissioned report No. 058