Aberdeen Western Peripheral Route

Appendix A10.15 - Fish

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1 Introduction

1.1 General Background

1.1.1 This Appendix reports the assessment of potential impacts on fish populations and their supporting habitats in the vicinity of the Northern Leg of the proposed scheme, supporting Chapter 10 (Ecology and Nature Conservation).

1.1.2 To aid the interpretation of the assessment, the AWPR Northern Leg study area has been divided into five route sections as follows:

- Section NL1 ch314800 – 316000 (Derbeth to Tulloch Road);
- Section NL2 ch316000 – 317400 (SAC Craibstone);
- Section NL3 ch317400 – 322600 (A96 to Nether Kirkton);
- Section NL4 ch322600 – 325370 (Nether Kirkton to Corsehill); and
- Section NL5 ch325370 – 331000 (Corsehill to Blackdog).

1.1.3 Fisheries surveys were included as part of the Ecological Impact Assessment (EcIA), and were undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volumes 10 and 11 and the Environment Impact Assessment (Scotland) Regulations 1999. The three stages of EcIA have been modified to be directly applicable to the proposed scheme, and are based on matrices from an early draft version of IEEM guidance on EcIA (IEEM, 2002) and Transport Advisory Guidance (STAG and WEBTAG). The bulk of the assessment for the AWPR Northern Leg was undertaken before the 2006 issue of the IEEM guidelines. This assessment therefore follows the general approach described in the IEEM 2002 guidelines, with cognisance of the later 2006 guidelines.

Survey Aims

1.1.4 The purpose of the survey was to establish the baseline conditions for fisheries within the catchment of the River Don, which could then be used to identify the impacts of the proposed scheme on fish within the catchments. Thus, the aims of the survey were to:

- assess the presence and status of fish populations in the River Don catchment
- determine the likely presence of, or use by rare, protected or sensitive species (e.g. Atlantic salmon, *Salmo salar* or brook lamprey *Lampetra planeri*);
- assess the fish habitat quality within the watercourses comprising the River Don catchment and evaluate the importance of these areas for fish (e.g. spawning areas);
- assess any impacts the proposed scheme may have upon fish populations within the River Don catchment; and
- identify appropriate mitigation measures and determine any residual impacts.

1.2 Background

Fish Species of the Don Catchment: Biology and Distribution

1.1.5 The fish species present in the River Don catchment, their migratory status and estimates of their relative abundances are given in Table 1 (definitions for the migratory status and descriptions of relative abundance scores are given in the glossary at the end of this document). The fish species present within the River Don catchment are consistent with those species expected for an upland spate river in North East Scotland, with no omissions or unexpected inclusions.

Table 1 – Species, Migratory Status and Likely Relative Abundance of Fish in the River Don Catchment

Common Name	Scientific Name	Migratory Status	Relative Abundance	
			Lower River	Tributaries
Atlantic salmon	*Salmo salar*	Anadromous	abundant	abundant
Brown/sea trout	*Salmo trutta*	Potamodromous/anadromous	common	abundant
European eel	*Anguilla anguilla*	Catadromous	present	present
Brook lamprey	*Lampetra planeri*	Potamodromous	present	common
River lamprey	*Lampetra fluviatilis*	Anadromous	present	present
Sea lamprey	*Petromyzon marinus*	Anadromous	rare	rare
Minnow	*Phoxinus phoxinus*	Local	common	common
3-spined stickleback	*Gasterosteus aculeatus*	Local	common	rare
Pike	*Esox lucius*	Potamodromous	rare	rare
Perch	*Perca fluviatilis*	Potamodromous	rare	rare
Flounder	*Pleuronectes flesus*	Amphidromous	common	present

Atlantic salmon (*Salmo salar*)

1.1.6 The distribution of salmon in the River Don catchment is likely to be similar to that in the River Dee, with salmon spawning at suitable sites throughout the system and juveniles occupying suitable habitats in all accessible sections of the main stem and tributaries (refer to Chapter 25: Ecology and Nature Conservation – Southern Leg).

1.1.7 In most rivers, salmon begin to enter the system in early spring, often as early as February, but the precise timing varies between catchments. These 'springers' are often the biggest fish (multi-sea winter) and are the part of the population that has shown the biggest decline in recent years.

1.1.8 Atlantic salmon are autumn and winter spawners but the precise timing of their spawning season varies between and within catchments.

1.1.9 At certain stages of their development salmonid eggs are very sensitive to mechanical shock. Immediately after fertilisation the eggs are not sensitive, but within a few hours any shock or vibration can result in epiboly or yolk overgrowth. The eggs then remain sensitive for approximately the first third of the incubation period, until they are eyed (Jensen, 1997).

1.1.10 Incubation time for Atlantic salmon is temperature dependant. On hatching, the alevins live within the gravel for the first few weeks relying on their yolk sac for nutrition. They emerge from the gravel during the spring, with the timing being linked to temperature and incubation period.

1.1.11 Salmon parr generally 'drift feed' on aquatic invertebrates which they collect from the water column and water surface.

1.1.12 Juvenile salmon migrate to the sea after one, two, three, and exceptionally four years in the river, as smolts. Downstream migration usually begins in April with fish moving at night, either individually or in small groups. As the season progresses (usually during May) migration occurs both day and night, and the fish move in large shoals at the surface.

1.1.13 Atlantic salmon are known to be sensitive to noise and vibration disturbance.

Brown/sea trout (*Salmo trutta*)

1.1.14 Brown trout breed in winter, from October to January, in gravelly shallows (Wheeler, 1969). The seagoing form is known as sea trout, and they migrate seawards as smolts slightly earlier than salmon, usually during March and April. Brown trout and sea trout are found throughout the Don catchment. Juvenile trout feed on aquatic invertebrates, and become piscivorous as they get older.

European eel (*Anguilla anguilla*)

1.1.15 The life cycle of the European eel involves a massive catadromous migration from their spawning grounds in the Sargasso Sea, which takes up to three years to complete. Larval eels arrive in Scottish estuaries during February (Wheeler, 1969) at which stage they are transparent and are referred to as glass eels. As they enter the rivers they become pigmented and are known as elvers. Eels feed almost exclusively on benthic invertebrates, although some individuals become piscivorous as they grow. They are commonly nocturnally active and are cryptic during the day. Eels spend a considerable period feeding and growing in freshwater (from seven to nineteen years), before turning silver and heading seawards in the autumn. Eels are present throughout the Don catchment, including the upper river and small tributary streams. Research has shown that eels are relatively insensitive to sound (Turnpenny et al., 1993), but that they do react to lights (Hadderingh & Smythe, 1997).

Brook lamprey (*Lampetra planeri*)

1.1.16 Brook lamprey spend their entire lives in freshwater, although they do migrate upstream to spawn and there is thought to be a tendency for the larvae (called ammocoetes) to move downstream during development (Wheeler, 1969). Spawning occurs during early April at partially shaded sites, in excavated depressions in sand and gravel. Where river lamprey and brook lamprey occur together the brook lamprey occupy the headwaters and breed well upstream of the river lamprey (Wheeler, 1969). As both species are found in the River Don it is likely that brook lamprey are most prevalent in the upper river, and tributaries. Brook lamprey metamorphose after six years buried in the sediment feeding on organic matter. Adult brook lamprey do not feed, and die after spawning.

River lamprey (*Lampetra fluviatilis*)

1.1.17 River lamprey breed in freshwater in April and May and inhabit freshwaters throughout their larval stage. Spawning sites commonly have sand and gravel substrata, flowing water and are usually at least partly in the shade (Wheeler, 1969). The male creates a nest by removing pebbles with his sucker disc, and excavating sand by shaking his tail. River lamprey are present in both the Rivers Dee and Don, and may penetrate into some of the larger tributaries. River lamprey larvae live buried in silty habitats where they feed on organic matter for five years. In early autumn river lamprey ammocoetes metamorphose into the adult form, usually around 120mm in length, and migrate downstream to the sea. As adults, river lamprey are parasitic, feeding on the blood and tissue of other fish, returning to rivers to spawn when 300-500mm in length.

Sea lamprey (*Petromyzon marinus*)

1.1.18 Sea lamprey breed in freshwater in May and June and inhabit freshwaters throughout their larval stage. Spawning requires a gravel substratum and clean fast-flowing water, but adjacent silty areas are also required for the larvae. Sea lamprey are present in the River Don catchment but are probably most abundant in the main stem. Sea lamprey ammocoetes are blind and toothless and live buried in silty and sandy substrates for around five years, feeding on organic matter (Wheeler 1969). In late summer the ammocoetes metamorphose into the adult form, usually 150-200mm in length, during which phase they are referred to as transformers. After metamorphosis the adult sea lamprey, which now have eyes and teeth, migrate downstream to the sea and become parasitic, feeding on the blood and tissue of other fish. Maturity is reached after one or two years at sea, at which point the adults, now 600-800mm in length, return to rivers to spawn.

Minnow (*Phoxinus phoxinus*)

1.1.19 Minnows are found in most rivers and streams and in some stillwaters. They are a shoaling species, rarely larger than 100 mm and live for a maximum of 6 years (Wheeler 1969). They are likely to be found throughout much of the Don catchment, including some of the tributary streams, and may be locally abundant where the habitat is suitable.

3-spined stickleback (*Gasterosteus aculeatus*)

1.1.20 One of the most widespread of the fishes of northern Europe, the three-spined stickleback is found in virtually all waters except fast flowing hill streams (Wheeler 1969). In the River Don, sticklebacks are present in the slower flowing reaches of the main stem and may also be found in the lower sections of slow flowing tributary streams. Three-spined sticklebacks rarely exceed 60 mm in length and spawning occurs in April and May. Male sticklebacks build nests, fan the eggs with their pectoral fins, and then guard a small brood of offspring.

Pike (*Esox lucius*)

1.1.21 Pike are solitary, ambush predators that prefer still or relatively slow flowing habitats with cover. Spawning occurs in the spring on vegetation in shallow water and often in inundated riparian vegetation in field margins and field drainage ditches. They are found in the lower reaches of the River Don but are only present in low numbers and are likely to be absent from the upper river and tributaries.

Perch (*Perca fluviatilis*)

1.1.22 Perch are found in stillwaters and slow flowing reaches of rivers and, like the pike, are restricted to the lower reaches of the River Don where they are present in low numbers. Spawning occurs in April or May on submerged vegetation or branches. Perch live in small shoals and feed mainly on aquatic invertebrates but they become increasingly piscivorous as they grow.

Flounder (*Pleuronectes flesus*)

1.1.23 Some flounders spend part of their lives in freshwater, but their movements between fresh and saltwater are not directly linked with reproduction. Although most abundant in the lower reaches of rivers and estuaries, some flounders are known to penetrate a long distance into freshwater, and may enter the lower reaches of some tributary streams. In the River Don flounders are likely to be found in the lower sections of the main stem, where they may be seasonally common, and they may also be present in the downstream sections of tributary streams that feed the lower river. The timing of entry into freshwater varies with region, but in Eastern Scotland flounders are known to spend the summer at sea (Dando, 1984).

Sensitive periods for fish

1.1.24 According to their biology and behaviour each species has one or more sensitive periods during the calendar year, during which time certain activities, in specific parts of their habitat, could have an impact on them. These sensitive periods are summarised in Table 2.

Table 2 – Extent of the Potentially Sensitive Periods for Fish in the Don Catchment

	Jan		Feb		Mar		Apr		May		Jun		July		Aug		Sep		Oct		Nov		Dec	
MSW (spring) salmon																								
2-SW (summer) salmon																								
1-SW salmon (grilse)																								
Salmon spawning																								
Salmon eggs																								
Salmon smolt emigration																								
Autumn 'smolt' emigration																								
Sea trout																								
Sea trout spawning																								
Sea trout eggs																								
Sea trout smolt emigration																								
Brown trout spawning																								
Brown trout eggs																								
Elver immigration																								
Silver eel emigration																								
Brook lamprey spawning																								
Sea lamprey immigration																								
Sea lamprey spawning																								
Sea lamprey ammocoete emigration																								
River lamprey immigration																								
River lamprey spawning																								
River lamprey ammocoetes emigration																								
Minnow spawning																								
Stickleback spawning																								
Pike spawning																								
Perch spawning																								
Flounder migration																								

Status

1.1.25 Atlantic salmon have declined throughout much of their range and some populations have reached critically low levels. A wide range of factors have been implicated in this decline including reduced survival at sea due to overfishing and reduced production in freshwaters through deterioration of habitats and barriers to migration (Hendry & Cragg-Hine, 2003).

1.1.26 Sea and river lamprey have also declined in abundance in many catchments, with barriers to migration and reduced habitat quality again being implicated (Maitland, 2003).

1.1.27 There is also concern over eel populations, which have declined substantially across much of Western Europe in recent years and stocks are now considered to be outside safe biological limits.

1.1.28 Brown trout, minnows, 3-spined stickleback, pike, perch and flounder are widespread and are not currently considered to be in decline throughout much of their normal range.

1.1.29 Some of the fish species present in the Don catchment are afforded protection under the law via conservation legislation (Table 3):

1.1.30 Salmon in the River Don catchment are protected under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003 (summary given in Annex 1). The key parts of this Act for the current proposal being that it is an offence:

- 'to knowingly take, injure or destroy; any smolt, parr, salmon fry or alevin.'
- 'to injure or disturb any salmon spawn during the annual close time.'
- 'to obstruct or impede salmon in their passage to any spawning bed or any bank or shallow in which the spawn of salmon may be'.

1.1.31 A local Species Action Plan (SAP) has been prepared for Atlantic salmon by the Northeast Scotland Biodiversity Partnership.

1.1.32 As a consequence of declining populations all three lamprey species are now listed in Annexes IIa and Va of the Habitats Directive, Appendix III of the Bern Convention and as Species of Conservation Concern in the UK Biodiversity Action Plan (BAP) (Maitland 2003).

1.1.33 All three species of lamprey are also listed on the North East Scotland Local Biodiversity Action Plan (NESLBAP).

1.1.34 Brown trout, eel, minnow, 3-spined stickleback, pike, perch and flounder are not nationally scarce and not afforded specific legal protection.

Table 3 – Inclusion of Species in Conservation Legislation

Common name	Salmon & Freshwater Fisheries Act	Habitats Directive	UK BAP	NESLBAP
Atlantic salmon	✔	✖	✖	✔
Brown/sea trout	✔ (sea)	✖	✖	✖
European eel	✖	✖	✖	✖
Brook lamprey	✖	✔	✔	✔
River lamprey	✖	✔	✔	✔
Sea lamprey	✖	✔	✔	✔
Minnow	✖	✖	✖	✖
3-spined stickleback	✖	✖	✖	✖
Pike	✖	✖	✖	✖
Perch	✖	✖	✖	✖
Flounder	✖	✖	✖	✖

Note: ✔ = present, ✖ = absent.

2 Methods

2.1 Literature Review and Consultation

2.1.1 Information regarding the fish populations in the River Don catchment was requested from Scottish Natural Heritage (SNH), who deferred to the Don District Salmon Fisheries Board (Don DSFB). Often it is the people who live and work on the river who have the best understanding of the fish populations within it. To benefit from this local knowledge, and collect any existing fish population data, meetings were held with fisheries interests from the River Don catchment.

2.2 Survey Methods

2.2.1 The character and ecological quality of the various watercourses was assessed through a detailed Freshwater report that incorporates River Habitat Survey (RHS) and macroinvertebrate survey (Appendix A10.16).

2.2.2 The River Don catchment contains relatively few fish species and, providing there are no barriers to migration, these species are likely to be found in most places where habitats are suitable. Consequently, it is often possible to judge which species are likely to be present by studying the habitat available at the site. This was achieved via two walkover surveys of the flowing water sites, close to the proposed crossing points. Field drainage ditches and static water bodies were not included for fish walkover surveys.

2.2.3 An initial walkover survey of the 11 main watercourses crossed by the Northern Leg of the proposed route was carried out on the 18 to 20 August 2004. During this survey some basic water quality testing was undertaken as part of the water resources impact assessment (see Water Quality Report A9.4). A second walkover survey was carried out on the 12 and 13 January 2005 and focussed on sites close to the proposed watercourse crossing points. During this walkover the location of any redds (spawning sites of salmonids) was recorded and note was made of the visual appearance of the habitat, with a view to determining its likely suitability for salmonid spawning. A third walkover survey was carried out on the 01-02, and 08 May 2007, and focussed on the proposed crossing points of all 13 watercourses. During this survey fish habitat was recorded, using the HABSCORE assessment methodology.

2.2.4 HABSCORE is a system for measuring and evaluating stream salmonid habitat features. It is based on a series of empirical statistical models relating the density of salmonid populations within a range of age groups (0+ salmon; >0+ salmon; 0+ trout; >0+ trout <20cm; and >0+ trout >20cm) to observed habitat variables. The outputs generated by the models include an estimate of the expected fish density (the Habitat Quality Score, HQS) and can provide a measure of the degree of habitat utilisation (the Habitat Utilisation Index, HUI) where quantitative densities are available. Both of these statistics are produced for each of five criteria; 0+ salmon; >0+ salmon; 0+ trout; >0+ trout <20cm; and >0+ trout >20cm.

2.2.5 The surveys were focussed at the proposed crossing points, although as a consequence of slight route alignment changes since the surveys were completed certain areas surveyed are no longer at the precise crossing point, although are still in the vicinity. Notes were taken at each of the sites describing the nature of the in-stream and riparian habitat, particularly any factors likely to influence resident fish populations, such as the physical size of the stream, and the substrate composition. The extent of any channel modification and presence of impassable barriers for a 500m stretch was taken from the RHS (Appendix 10.16). The water quality of each watercourse was considered by referring to existing data and inferred through the Average Score Per Taxon (ASPT) scores from the macroinvertebrate survey (Appendix 10.16). From these data, and using professional judgement, the fish species most likely to be present in the watercourse were inferred. For the fish habitat/HABSCORE assessment, site habitat features (HAB*form*), catchment data (MAP*form*), and data on the fish species most likely to be present were used to calculate (HABSCORE software programme) the suitability of habitat for salmonids (salmon and trout). Site habitat was recorded from the bank and from within each watercourse. Data collected included site description, reach dimensions, substrate, flow, description of cover, position within the catchment and general catchment features.

2.2.6 A precautionary approach has been adopted such that if the habitat appeared to be suitable for a species then it is assumed to be present. The width and depth of the stream and substrate composition at the proposed crossing point were considered in assessing the suitability of the habitat for the spawning of salmonids, and during the fish habitat/HABSCORE assessment.

2.3 Survey Limitations

2.3.1 The first walkover survey was carried out in late August 2004 when water levels were expected to be relatively low and water clarity high. This would have allowed a good assessment of available habitat to be made. However, unseasonably heavy rain in the area at the time of the survey meant that water levels and suspended solids content in many of the watercourses were high. This made assessment of the habitat more difficult but gave a better indication of how the watercourses might look during the winter, when they could potentially be used as spawning sites for salmonids. This ensured that the relative importance of watercourses which may be almost dry under summer low flows was not underestimated.

2.3.2 The second walkover survey was carried out in January 2005 with the intention of assessing the suitability of the habitat present in the watercourses for salmonid spawning. Although this was completed successfully for the tributary burns, high water conditions meant that it was not possible to look for redds on the main stem of the River Don.

2.4 Assessment of Nature Conservation Value

2.4.1 The nature conservation value of fish populations at each site was determined by reference to any designations and the results of the consultations, literature review and field surveys. The criteria used were based on the Ratcliffe Criteria (Ratcliffe, 1977) used in the selection of biological Sites of Special Scientific Interest (SSSI). Sites and features were classified according to the criteria identified in Table 4; an approach considered valuable and appropriate when applied to designated sites such as the River Dee SAC. The application of this approach to the undesignated River Don catchment, and its populations of ecologically sensitive or protected species, is believed to be appropriate given the good local information on the size, conservation status and the quality of

sensitive species present; an approach supported by the IEEM Guidelines for Ecological Impact Assessment.

Table 4 – Evaluation of Ecological Receptors

Value/ Importance	Criteria
International (European)	Habitats An internationally designated site or candidate site (SPA, pSPA, SAC, cSAC, Ramsar site, Biogenetic/Biosphere Reserve, World Heritage Site) or an area which would meet the published selection criteria for designation. A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat which are essential to maintain the viability of a larger whole. Any 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 internationally important species, threatened or rare in the UK. i.e. a UK Red Data Book species categories 1& 2 of UK BAP) or of uncertain conservation status or of global conservation concern in the UK BAP. A regularly occurring, nationally significant population/number of an internationally important species.
National (Scottish)	Habitats A nationally designated site (SSSI, ASSI, NNR, Marine Nature Reserve) or a discrete area which would meet the published selection criteria for national designation (e.g. SSSI selection guidelines). A viable area of a priority habitat identified in the UK BAP, or of smaller areas of such habitat essential to maintain wider viability. 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 (North East 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 habitat essential to maintain wider viability. Viable areas of key habitat identified as 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 10 km 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.
Authority Area (e.g. County or District) Aberdeenshire/ City of Aberdeen	Habitats Sites recognised by local authorities (e.g.) District Wildlife Sites (DWS) and Sites of Interest for Nature Conservation (SINS). County/District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves (LNR). 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 listed in a County/District BAP due to regional rarity or localisation. A regularly occurring, locally significant population of a County/District important species. Sites supporting populations of internationally/nationally/regionally important species that are not threatened or rare in the region or county, and not integral to maintaining those populations. Sites/features scarce in the County/District or which appreciably enrich the County/ District habitat resource.

Value/ Importance	Criteria
Local (immediate area or local village importance)	Habitats Areas of habitat that appreciably enrich the local 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 within the local area are not considered for the above classifications. Semi-natural ancient woodland smaller than 0.25 ha. 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 importance)	Sites that retain habitats and/or species of limited ecological importance due to their size, species composition or other factors. Any river classified as impoverished D and/or and with a Habitat Modification Score indicating that it is severely modified.

2.5 Impact Assessment

2.5.1 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.

Impact Magnitude

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

Table 5 – Impact Magnitude

Impact Magnitude	Criteria
High negative	The change is likely to permanently, adversely affect the integrity of an ecological receptor, in terms of the coherence of its ecological structure and function, across its whole area that enables it to sustain the habitat, complex of habitats and/or the population levels of species of interest.
Medium negative	The change is not likely to permanently adversely affect the ecological receptor's integrity but the effect on the receptor is likely to be substantial in terms of its ecological structure and function. Likely to result in changes in the localised or temporary distribution of a species but not affect its 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.
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.
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

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

Table 6 – Impact Significance

Importance \ Magnitude	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

2.5.4 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, impact significance greater than or equal to Moderate would require specific mitigation to be undertaken to ameliorate it to acceptable levels.

3 Baseline

3.1 Literature Review and Consultation

3.1.1 Fish population data and available habitat data, were supplied for the River Don and its major tributaries by Mr George Alpine, clerk to the Don DSFB. These data are summarised in Table 7. This was supplemented by three walkover surveys (August 2004, January 2005 and May 2007) and with reference to published literature and relevant supplementary data from RHS and macroinvertebrate surveys (Appendix A10.16), water quality sampling (Appendix A9.4) and SEPA.

Table 7 – Summary of the Fisheries Information Provided by the Don DSFB

Watercourse	Species						
	Minnow	**Brook lamprey**	**Sea trout**	**Eel**	**Stickleback**	**Brown trout**	**Salmon**
River Don	✔	✔	✔	✔	✔	✔	✔
Goval Burn 1	✔	✔	✔	✔	✖	✔	✔
Goval Burn 2	✔	✔	✔	✔	✖	✔	✔
Green Burn	✔	✔	✖	✔	✖	✔	✖
Gough Burn	✔	✔	✖	✔	✖	✔	✖

Note: ✔ = present, ✖ = absent.

3.1.2 Information on the fish likely to be present in each watercourse has been collected by considering water quality and RHS data, examining the habitat during walkover surveys.

Baseline Northern Leg

3.1.3 The Northern Leg of the proposed scheme crosses 11 watercourses (Figures 10.12 a-g). The species likely to be present were assessed following walkover surveys and through consultation (Table 8). The approximate dimensions of each burn are provided below based upon survey measurements during August 2004.

3.1.4 Kepplehill Burn (Figure 10.12a) is a very small tributary to the River Don (0.3-0.6m wide and < 0.2m deep) and may be completely dry in summer.

3.1.5 Gough Burn (Figure 10.12b) is another tributary of the River Don. It is a small burn (0.8-1.5m wide and <0.3m deep) with a sand, gravel and boulder substrate. Based on the habitat, the fish species most likely to be present are small brown trout, brook lamprey, and eels.

3.1.6 Craibstone Burn (Figure 10.12b) is a small, shallow burn (<1m wide) that ultimately feeds into the River Don. At the proposed crossing point the burn has a relatively shallow gradient and the substrate is made up mostly of sand and gravel. Some brown trout may be present in deeper pools.

3.1.7 Green Burn (Figure 10.12b) is a small to medium sized tributary (0.6-1.5m wide and <0.25m deep) to the River Don. At the proposed crossing point the channel is heavily modified having been extensively straightened and dredged. The substrate is made up mainly of fine sediments with some coarse woody debris (CWD). Brown trout are also likely to be present.

3.1.8 At the downstream crossing point Bogenjoss Burn (Figure 10.12d) is slightly larger (variable width and <0.3m deep) but is still classed as small and has a steep, sinuous channel with some good clean gravel areas. There is also a large amount of sand and CWD apparently washed in from the surrounding forestry land. Brown trout are probably present but migratory salmonids are unlikely.

3.1.9 The River Don (Figure 10.12e) at the proposed crossing point is a wide (46-55m wide), deep section of the lower main stem offering a range of habitats, mostly deep and relatively slow flowing but with some fast flowing riffles in the vicinity. Migratory salmonids and lampreys are likely to be present as both adults and juveniles.

3.1.10 Mill Lade Aqueduct ((Figure 10.12e) is another River Don tributary. As its name suggests this is an artificial channel with concrete sides which feeds a disused mill. The channel is medium-sized (0.8-1.2 m wide) and approximately 0.5m deep, slow flowing and densely vegetated with a silt substrate. The habitat is not suitable for salmonid spawning.

3.1.11 Goval Burn (Figure 10.12e) is a large burn (4-7m wide and <1m deep), with swift flows and a gravel substrate, which feeds into the River Don. The habitat and physical size look suitable to be used by migratory salmonids but there is an apparently impassable barrier close to the proposed crossing point in the form of a 1.5 m high weir feeding an off-take to an impoundment. Lamprey may also be present as far as this barrier.

3.1.12 Corsehill Burn (Figure 10.12e) is a small River Don tributary that runs through an extensively modified channel adjacent to a side road. This small burn has a sand, gravel and boulder substrate and could contain brown trout, although migratory salmonids would be unlikely due to the small size and shallow depth.

3.1.13 Red Moss Burn (Figure 10.12f) is a small burn with heavily peat-stained water that runs into Corby Loch and then on to the sea. There is minimal salmonid spawning habitat at the proposed crossing point, which has a substrate composed mainly of sand and boulders. There are also some

obstructions to fish migration downstream of the existing road crossing. However, the proximity to Corby Loch may mean that salmonids are present for some of the time.

3.1.14 Blackdog Burn (Figure 10.12g) is a very small silty burn (0.3-0.5m wide and <0.1m deep) that runs straight to the sea.

Table 8 – Fish Species Likely to be Present at the Proposed Crossing Point in the Named Northern Section Watercourses, as Determined During the Walkover Surveys

Watercourse	Minnow	Brook Lamprey	Sea Lamprey	River Lamprey	Sea Trout	Brown Trout	Eel	Stickleback	Salmon	Pike	Perch
Kepple Hill Burn	×	Ⓟ	×	×	×	Ⓟ	Ⓟ	×	×	×	×
Gough Burn	×	Ⓟ	×	×	×	✓	✓	×	×	×	×
Craibstone Burn	×	Ⓟ	×	×	×	✓	✓	×	×	×	×
Green Burn	×	Ⓟ	×	×	Ⓟ	✓	✓	×	×	×	×
Bogenjoss Burn U/S	×	Ⓟ	×	×	×	Ⓟ	Ⓟ	×	×	×	×
Bogenjoss Burn 2 D/S	×	×	×	×	×	✓	✓	×	×	×	×
River Don	✓	✓	✓	✓	✓	✓	✓	✓	✓	Ⓟ	Ⓟ
Mill Lade Aqueduct	Ⓟ	Ⓟ	×	×	×	Ⓟ	✓	Ⓟ	×	×	×
Goval Burn	Ⓟ	✓	Ⓟ	Ⓟ	✓	✓	✓	Ⓟ	✓	×	×
Corsehill Burn	×	Ⓟ	×	×	×	✓	✓	Ⓟ	×	×	×
Red Moss Burn	×	Ⓟ	×	×	×	✓	✓	Ⓟ	×	×	×
Blackdog Burn	×	Ⓟ	×	×	×	Ⓟ	Ⓟ	×	×	×	×

Note: ✓ indicates present, Ⓟ = possible, × indicates absent.

4 Evaluation

4.1 Context

4.1.1 Evaluation of the fish community in each of the watercourses crossed by the proposed route was made with reference to the habitats present and the fish species most likely to be present at the proposed crossing point. For consistency, these evaluations were made in the light of water quality data, macroinvertebrate communities and the degree of channel modification. The freshwater habitat areas equate to individual burns that are at risk of impact from the proposed scheme. The evaluation will utilise the process specified in Section 2.2 and will summarise the ecological importance of each freshwater habitat area for the receptors (in this case, the fish community).

4.1.2 Watercrossings in the Northern Leg include the main stem of the River Don and ten small tributary burns, nine of which ultimately feed into the Don (Kepplehill Burn, Gough Burn, Craibstone Burn, Green Burn, Bogenjoss Burn, Goval Mill Lade, Goval Burn, Corsehill Burn, Red Moss Burn and Blackdog Burn). Overall the watercourses in the Northern Leg support fish species whose nature conservation value ranges from local to national importance.

4.1.3 The penetration of migratory salmonids into the tributary burns will depend to a great extent on the physical size and water depth of the watercourse, as well as the presence of any obstructions to migration, and may vary between years. The presence of habitat suitable for salmonids to spawn in (salmon, brown trout and sea trout) is likely to lead to the recognition of regional value of the watercourse in question, whereas the presence of salmon themselves would indicate national value. The probable or likely presence of brook lamprey in these burns is likely to assign a regional

value to the watercourse concerned as this species is recognised in the UK BAP as species of conservation concern, though this is tempered by the judgement of local conditions and how appropriate the habitat is for lamprey.

4.2 Watercourse Evaluation

Section NL1 ch314800 – 316000 (Derbeth to Tulloch Road)

4.2.1 The only watercourse in this section likely to be interrupted by the proposed scheme is the Kepplehill Burn. This very small burn has been extensively modified, straightened and culverted under the existing road. At the proposed crossing point the burn has a relatively shallow gradient, low flow, and the substrate matrix comprises gravel/coarse sand, fine sand/silt. It also has areas of overhanging vegetation, and has been graded good (A2) on the basis of its invertebrate fauna and water quality, but the channel may dry during the summer, reducing the use of the tributary for salmonid spawning and juveniles. At other times brown trout, eels and brook lamprey are the most likely fish species to utilise the habitats present (DonDSFB). The results of the HABSCORE assessment indicate that Kepplehill Burn survey area provides habitat for juvenile trout (Table 10). These factors combine to give the Kepplehill Burn local value.

Section NL2 ch316000 – 317400 (SAC Craibstone)

4.2.2 The three burns flowing around Craibstone (Gough, Craibstone and Green Burns) are all of excellent ecological health (A1) based on their macroinvertebrate fauna and water quality. These three watercourses offer a neighbouring network of habitats suitable for several species and together they were evaluated as being of county value for their fish populations. Each watercourse is evaluated below.

4.2.3 Gough Burn is a medium-sized burn (0.8-1.5m wide and <0.3m deep) that has been extensively modified. At the proposed crossing point the burn has a moderate gradient, moderate flow, and the substrate matrix comprises boulder, cobbles, gravel/coarse sand, and fine sand/silt. It also has several areas of coarse woody debris (CWD), which have created pool and riffle sequences, large boulders, undercut banks and overhanging vegetation. The invertebrate fauna and water quality indicates that the watercourse is in excellent condition. Brown trout, brook lamprey, and eels are the most likely fish species to utilise the habitats present (DonDSFB). Gough Burn can be regarded as significant at a county level.

4.2.4 Craibstone Burn runs through the grounds of Craibstone College, and is a small, shallow burn (<1m wide). At the proposed crossing point the burn has a relatively shallow gradient, moderate flow, and the substrate matrix comprises large boulders, cobbles, gravel/coarse sand, and fine sand/silt. It also has several areas of undercut banks and overhanging vegetation. Brown trout, brook lamprey, and eels are the most likely fish species to utilise the habitats present (Don DSFB).. The burn has obviously been modified in places but the invertebrate fauna and water quality indicate that the watercourse is in excellent condition (A1). These factors combine to suggest the Craibstone Burn is of county significance for fish.

4.2.5 Green Burn is a medium-sized burn (0.6-1.5m wide and <0.25m deep). At the proposed crossing point the channel is heavily modified having been extensively straightened and dredged. The gradient and flow is moderate, and the substrate matrix comprises large boulders, cobbles, gravel/coarse sand, and fine sand/silt. It also has several areas of submerged vegetation, coarse woody debris, and overhanging vegetation. The invertebrate fauna and water quality of this tributary have been shown to be excellent (A1) and brown trout, sea trout, brook lamprey, and eels are the most likely fish species to utilise the habitats present (Don DSFB).The Green Burn is therefore considered to be of county level significance for fish.

4.2.6 The results of the HABSCORE assessment indicate that the survey areas of the Gough and Craibstone Burns provide suitable habitat for juvenile trout. The results of the HABSCORE assessment also indicate that the survey area of the Green Burn provides suitable habitat for juvenile salmon and trout (Table 10).

Section NL3 ch317400 – 322600 (A96 to Nether Kirkton)

4.2.7 This section of the route crosses the Bogenjoss Burn system, located in Kirkhill woodland, at two locations along its length. The Bogenjoss Burn (site a, downstream at Bogenjoss) is a medium sized tributary of the River Don (variable width and <0.3m deep). At the proposed crossing point the gradient is steep, the flow is quick, and the substrate matrix comprises large boulders, cobbles, gravel/coarse sand, and fine sand/silt. It also has areas of CWD and overhanging vegetation. Brown trout, brook lamprey, and eels are the most likely fish species to utilise the habitats present (Don DSFB).

4.2.8 The Bogenjoss Burn (site b, upstream at Kirkhill woodland) is a lot smaller than the downstream survey site (width 0.3m and 0.3m deep). At the proposed crossing point the gradient is steep, the flow is low, and the substrate matrix comprises gravel/coarse sand, and fine sand/silt. It also has areas of CWD, and extensive areas of overhanging vegetation. The habitat for fish improves as the burn descends. Brown trout, and eels are the most likely fish species to utilise the habitats present (DonDSFB). The results of the HABSCORE assessment indicate that the survey areas of the Bogenjoss Burn provide suitable habitat for juvenile trout (Table 10). The Bogenjoss Burn is considered to be of county value for its fish population.

Section NL4 ch322600 – 325370 (Nether Kirkton to Corsehill)

4.2.9 This section of the proposed scheme crosses four watercourses, the River Don, Goval Burn and the Mill Lade Aqueduct and the Corsehill Burn. By virtue of the presence of the nationally important salmon and well renowned salmon fishery and all three species of lamprey in some of these rivers (the River Don and the Goval Burn), this section can be summarised as being of National significance. Each watercourse is evaluated below.

4.2.10 The River Don has been classified as being of good ecological health (B grade) and is considered to be significantly modified. With this information alone, the river would be classed as of regional value, but it has considerable value as a salmonid fishery and is rewarded with the presence of all three species of lamprey (sea, river and brook lamprey) which has resulted in the recognition of its national value. The River Don, at the proposed crossing point, is a wide (46-55m), deep section of the lower main stem. It offers a range of habitats, predominantly deep and relatively slow flowing, with some fast flowing riffles. The gradient is shallow, and the substrate matrix comprises large boulders, cobbles, gravel/sand, and fine sand/silt. Salmonids, lamprey, eel, 3-spined stickleback, perch, pike and minnow are the most likely fish species to utilise the habitats present (Don DSFB).

4.2.11 Goval Mill Lade Aqueduct is a canalised, slow flowing, deep, concrete walled channel with silt substrate and extensive macrophyte growth. At the proposed crossing point the channel gradient is shallow, the flow is low, and the substrate matrix comprises bedrock/artificial, and fine sand/silt. It also has areas of overhanging vegetation, and extensive areas of submerged vegetation (up to 60% cover). Brown trout, brook lamprey, eel, 3-spined stickleback, and minnow are the most likely fish species to utilise the habitats present (Don DSFB). This watercourse offers no spawning habitat for salmonids but small brown trout may be present if they are able to access the mill lade at the upstream end. Mill Lade Aqueduct was evaluated as of less than local value mainly because it is entirely artificial, has a regulated flow regime, and is unsuitable for salmonids.

4.2.12 Goval Burn (Plate 9) is a larger tributary of the River Don (5.6-6.9m wide and <2m deep). At the proposed crossing point the channel is heavily modified and has historically been extensively straightened and dredged. The gradient is relatively shallow, the flow is moderate-low, and the substrate matrix comprises large boulders, cobbles, gravel/coarse sand, and fine sand/silt. It also has several areas of submerged vegetation and few areas of overhanging vegetation. Brown trout,

sea trout, brook lamprey and eels are the most likely fish species to utilise the habitats present (DonDSFB), if they are able to ascend the approximately 1.5m high weir behind the cottages. The potential presence of these species has led to the Goval Burn being evaluated as being of regional value.

4.2.13 Corsehill Burn is a medium sized tributary of the River Don (1.9-5.0m wide and <0.3m deep). The burn runs through an extensively modified channel adjacent to a side road. At the proposed crossing point the burn has a steep gradient, moderate-low flow, and the substrate matrix comprises large boulders, cobbles, gravel/coarse sand and fine sand/silt. Salmonids, lamprey and eel are the most likely fish species to utilise the habitats present (DDSFB).

4.2.14 The results of the HABSCORE assessment indicate that the survey areas of the River Don, Goval and Corsehill Burns provide suitable habitat for juvenile salmon and trout. The results of the HABSCORE assessment also indicate that the survey area of the Goval Mill Lade provides suitable habitat for juvenile trout (Table 10).

Section NL5 ch325370 – 331000 (Corsehill to Blackdog)

4.2.15 This most northern section of the proposed scheme crosses two watercourses; Blackdog Burn and Red Moss Burn.

Red Moss Burn is a small sized tributary (1.5-2.5m wide and <0.3m deep), with heavily peat-stained water that runs into Corby Loch (Site of Special Scientific Interest, SSSI) and then on to the sea. At the proposed crossing point the gradient is moderate, the flow is low, and the substrate matrix comprises sparse areas of gravel/coarse sand dominated by areas of fine sand/silt. There are also some obstructions to fish migration downstream of the existing road crossing, areas of submerged vegetation, CWD, undercut banks, and overhanging vegetation. Brown trout, brook lamprey, eel, 3-spined stickleback and eel are the most likely fish species to utilise the habitats present (DonDSFB). The results of the HABSCORE assessment indicate that the survey area of the Red Moss Burn provides suitable habitat for juvenile trout (Table 10). The fish populations of Red Moss Burn have been evaluated as of local value as it provides little in the way of salmonid spawning habitat.

4.2.16 Blackdog Burn (site a, upstream) is a small sized burn (1.0-2.0 m wide and <0.4 m deep). At the proposed crossing point the burn has a steep gradient, the flow is low, and the substrate matrix comprises large boulders, cobbles, gravel/coarse sand and fine sand/silt. It also has areas of submerged vegetation, CWD, undercut banks, overhanging vegetation, and areas of deep water. The concrete apron at the A90 crossing may represent a barrier to migration. Brown trout, brook lamprey and eel are the most likely fish species to utilise the habitats present (DonDSFB).

4.2.17 Blackdog Burn (site b, downstream) is a small - medium sized burn (1.5-2.5m wide and <0.3m deep) that runs under the A90 and straight to the sea. At the proposed crossing point the burn has a steep gradient and the substrate matrix comprises large boulders, cobbles, gravel/coarse sand and fine sand/silt. It also has areas of submerged vegetation, CWD, undercut banks, overhanging vegetation. The concrete apron at the A90 crossing may represent a barrier to migration. Brown trout, brook lamprey and eel are the most likely fish species to utilise the habitats present (DonDSFB). The results of the HABSCORE assessment indicate that the survey areas of the Blackdog Burn provide suitable habitat for juvenile trout (Table 10). The fish populations of Blackdog Burn were evaluated as being of local value on the basis that brook lamprey are likely and that sea trout may be able to gain access under high flows.

Table 9 – Watercourse Evaluation for Fish Populations and Habitat

Section & Evaluation	Watercourse	Code	Catchment area (km^2)	Fish species likely	Fish species possible	Evaluation	Comment
Section NL1 Less than local	Kepplehill Burn	KPP	0.25	Brown trout Eel Brook lamprey		Local value	This burn may not be flowing all year round and is straightened and culverted. Habitat is not suitable for more significant species.
Section NL2 County	Gough Burn	GOB	1.06	Brown trout Brook lamprey Eel	Minnow	County level	This burn has excellent biological status which in turn feeds the fish population. Native brown trout are believed to be present and brook lamprey (UK BAP species) possible, but no migratory salmonids live in this burn and little appropriate spawning habitat is available
	Craibstone Burn	CSB	0.5	Brown trout Brook lamprey Eel		County level	This burn has excellent biological status which in turn feeds the fish population. Native brown trout are believed to be present and brook lamprey (UK BAP species) possible, but no migratory salmonids live in this burn and little appropriate spawning habitat is available
	Green Burn	GRB	2.77	Brown trout Sea trout Brook lamprey Eel		County level	This burn has excellent biological status which in turn feeds the fish population. Native brown trout are believed to be present and brook lamprey (UK BAP species) possible, but no migratory salmonids live in this burn and little appropriate spawning habitat is available
Section NL3 County	Bogenjoss Burn upstream	BJB u/s	1.25	Brown Trout Eel		County value	The upstream section of this burn is very small and is likely to dry during the summer months
	Bogenjoss Burn downstream	BJB d/s	1.59	Brown trout Brook lamprey Eel		County value	The downstream section is larger and more sinuous, offering more habitat for the native brown trout and may also support brook lamprey (UK BAP species), but no migratory salmonids live in this burn and little appropriate spawning habitat is available

Section & Evaluation	Watercourse	Code	Catchment area (km^2)	Fish species likely	Fish species possible	Evaluation	Comment
Section NL4 National	River Don	DON	1228.1	Sea trout Brown trout Salmon Brook lamprey Sea lamprey River lamprey Eel 3-s-stickleback Perch Pike Minnow		National value	The presence of Atlantic salmon (and indeed a renowned salmon fishery), sea trout and all three species of lamprey has contributed to the River Don being assigned national value.
	Goval Burn	GOV	39.77	Brown trout Sea trout Brook lamprey Eel	Salmon Minnow Sea lamprey River lamprey 3-s-stickleback	Regional value	The size and good biological status of Goval Burn, as well as the potential presence of salmon, sea trout and lamprey (if they can ascend the 1.5m weir) mean that it has been evaluated as being of regional value.
	Mill Lade Aqueduct	MLA	n/a	Eel 3-s-stickleback Minnow	Brown trout Brook lamprey	Less than local value	The aqueduct if a man-made structure and lacks any salmonid spawning habitat.
	Corsehill Burn	CHB	1.79	Brown trout Eel	Brook lamprey 3-s-stickleback	Less than local	This very small burn has a small catchment
Section NL5 Local	Red Moss Burn	RMB		Brown trout Brook lamprey 3-s-stickleback Eel		Local value	This burn flows into Corby Loch (SSSI) and will contribute to the fish populations within the loch itself, although it does contain potential barriers to fish migration.
	Blackdog Burn	BDB		Brown trout Brook lamprey Eel	Sea trout	Local value	Blackdog Burn flows straight to the sea and is very small/culverted at the proposed crossing point.

Table 10 – Fish Habitat and HABSCORE Assessment Results (Habitat Quality Score, HQS)

Catchment	River	NGR (Mid Site)	Date	HABSCORE Results	Salmon		Trout		
					0	>0+	0+	<20cm	>20cm
River Don	Kepplehill	NJ 867 910	1st May 2007	**HQS (density)**	#	#			
	Burn			**HQS lower C.I.**	#	#	36.86	1.54	3.69
				HQS upper C.I.	#	#	1018.72	54.05	40.45
River Don	Cough Burn	NJ 870 102	1st May 2007	**HQS (density)**	#	#			
				HQS lower C.I.	#	#	12.54	7.44	1.18
				HQS upper C.I.	#	#	185.06	143.75	11.06
River Don	Craibstone	NJ 867 107	1st May 2007	**HQS (density)**	#	#			
	Burn			**HQS lower C.I.**	#	#	17.3	7.27	1.54
				HQS upper C.I.	#	#	266.52	153.59	14.62
River Don	Green Burn	NJ 866 112	1st May 2007	**HQS (density)**					
				HQS lower C.I.	1.83	1.04	19.89	9.67	1.15
				HQS upper C.I.	22.54	12.02	299.24	185.49	10.78
River Don	Bogenjoss	NJ 859 112	1st May 2007	**HQS (density)**	#	#			
	Burn a			**HQS lower C.I.**	#	#	1.49	0.87	1.06
	DS			**HQS upper C.I.**	#	#	22.21	18.22	9.77
River Don	Bogenjoss	NJ 858 144	1st May 2007	**HQS (density)**	#	#			
	Burn b			**HQS lower C.I.**	#	#	8.58	3.26	0.67
	US			**HQS upper C.I.**	#	#	142.97	65.49	6.17
River Don	River Don	NJ 880 146	2nd May 2007	**HQS (density)**					
				HQS lower C.I.	1.16	0.3	0.02	0.01	0.14
				HQS upper C.I.	2.22	4.9	0.4	0.31	1.56

Catchment	River	NGR (Mid Site)	Date	HABSCORE Results	Salmon		Trout		
					0	>0+	0+	<20cm	>20cm
River Don	Goval Mill	NJ 889 150	8th May 2007	**HQS (density)**	#	#			
	Lade			**HQS lower C.I.**	#	#	0.64	0.32	0.95
				HQS upper C.I.	#	#	9.82	5.96	8.75
River Don	Goval Burn	NJ 894 155	8th May 2007	**HQS (density)**					
	S Goval			**HQS lower C.I.**	0.98	0.02	*	0.05	0.43
	Reservoir			**HQS upper C.I.**	0.77	0.77	*	1.54	8.05
River Don	Corsehill	NJ 866 112	8th May 2007	**HQS (density)**					
	Burn			**HQS lower C.I.**	0.73	0.02	*	0.03	0.19
				HQS upper C.I.	8.4	0.77	*	1.11	4.99
River Don	Red Moss	NJ 924 151	2nd May 2007	**HQS (density)**					
	Burn			**HQS lower C.I.**	#	#	2.82	0.86	0.96
				HQS upper C.I.	#	#	45.56	21.57	8.87
River Don	Blackdog	NJ 956 141	2nd May 2007	**HQS (density)**					
	Burn a			**HQS lower C.I.**	#	#	2.11	3.13	1.27
	DS A90			**HQS upper C.I.**	#	#	35.48	61.54	11.68
River Don	Blackdog	NJ 949 143	2nd May 2007	**HQS (density)**					
	Burn b			**HQS lower C.I.**	#	#	1.33	1.18	0.93
	US A90			**HQS upper C.I.**	#	#	22.49	22.83	8.37

* Not a representative result (model variables out of range: dimensions, nature, substrate, flow, and cover)

Species not likely to be present, therefore not considered in the model

5 Potential Impacts

5.1 Impact Assessment

5.1.1 The range of potential ecological impacts of road schemes, and their significance, depends on the individual circumstances of each scheme. However, it is possible to identify a number of main areas of concern, which have general applicability (Highways Agency, 1998). An assessment of the likely impacts on the water quality of the watercourses is given in Chapter 9 (Water Environment.) The magnitudes of potential impacts on fisheries are set out in this section in the following order: direct mortality; habitat loss; habitat fragmentation; disturbance; and sub-lethal pollution. It should be noted that the impacts associated with the operational phase of the scheme are considered to be permanent, whereas temporary impacts, which are only apparent while the road is being built, are discussed in association with the construction phase.

Direct Mortality

5.1.2 Installation of standard tubular culverts at proposed road crossing points could require the mechanical removal of the river bed and the dewatering of sections of the river. This would result in considerable local mortalities if the fish were not moved beforehand and would, in general, induce a high negative impact locally during construction and operation. The impact on the fish population from each watercourse as a whole would range from low to high, depending upon the size of the watercourse (length) and the proportion affected, as well as the presence of salmonid habitat and populations within the watercourse. The presence of salmon or sea trout at a given crossing point could constitute an offence under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003 and may raise the impact to medium or high negative for the salmon and sea trout populations.

5.1.3 Fish eggs cannot easily be moved and could be lost from the dewatered area, resulting in a high negative impact locally. This could also constitute an offence under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003.

5.1.4 It is possible that noise and vibration from construction works during the sensitive stages of salmonid egg incubation could result in damage to eggs close to the source of the vibration. This damage would result in egg death if during the earlier stages of egg development. This would have a high negative impact locally but the impact would reduce to medium or low negative impact on the population as a whole, depending upon the value of the watercourse for salmonid spawning. This could also constitute an offence under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003.

5.1.5 There is little likelihood of direct mortality to fish during the operational phase of the bypass.

Habitat Loss

5.1.6 Re-alignment of sinuous channels to facilitate the installation of watercourse crossings reduces habitat diversity and alters the dynamics of flow and sediment transfer. This would represent a medium negative impact on the fish present in the re-aligned section, but where the distance to be impacted is not considered sufficient to cause long-term damage to the fish population integrity in the watercourse as a whole, it is likely to be considered as a low negative impact.

5.1.7 If river crossings required the use of full tubular or concrete based culverts, habitat loss would result equivalent to the dimensions of the culvert. Although occurring during the construction phase of the scheme this habitat loss is regarded as an operational impact since the loss will be permanent. The habitat loss would be a high negative impact locally but would only affect a very small proportion of the total river length. The level of impact would therefore be low or medium negative and would be related to the proportion of the available habitat likely to be affected by the works.

5.1.8 If the area of habitat lost was important for fish spawning this would result in a high negative impact locally. On the basis that there are likely to be other suitable spawning habitats elsewhere in the watercourse this would only represent a medium negative impact on the fish populations of the whole watercourse.

5.1.9 Where bridges are used habitat would not be lost but there would be an increase in the degree of shading at sites which are currently open, with the affected area being slightly larger than the width of the road, depending on the height and length of the bridge or culvert. This would represent only a very small proportion of the total length of the watercourse. The impact of shading on fish is mainly indirect through the impact on the abundance of their invertebrate food. As most of the production in shaded upland streams stems from allocthonous (see glossary) inputs additional shading by a bridge or culvert would only carry a low negative local impact on fish.

5.1.10 At currently unshaded sites algal growth is a more important factor and the impact of shading by a bridge or culvert on aquatic invertebrates would be proportionally greater than if some degree of shading was already present. Total shading of an open section would be a high negative impact locally, but only a low negative impact on the fish populations of the watercourse as a whole.

5.1.11 Estimated areas of habitat loss of specific terrestrial habitat types including permanent and temporary habitat loss have been included in Table 11 of the Terrestrial Habitats report (Appendix A10.1).

Habitat Fragmentation and Isolation

5.1.12 In the operational phase of the scheme, watercourse crossing structures could prevent or hinder access to upstream reaches for migratory fish by the formation of a physical or behavioural barrier, or by significantly increasing water velocities or reducing water depth. Populations of diadromous species and their vital spawning habitat could be reduced or entirely lost from the section upstream of the crossing and this would represent a medium to high negative impact on migratory fish species during construction and operation, depending upon the area of potential habitat likely to become inaccessible and its value for salmonid spawning. This would also constitute an offence under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. Populations of potamodromous fish species could also become fragmented, representing a low negative impact on the population as a whole.

Disturbance

5.1.13 Fish are sensitive to a number of disturbances including sound, pressure, vibration and light, with the degree of sensitivity varying between species and lifestages. The potential for disturbance to some species and lifestages during the construction phase is high. If the construction works producing the noise and vibration are sited near salmonid spawning habitat then it is likely to cause death of young salmonid eggs which are sensitive to movement and vibration in the first phase of life. Later stages of salmonid development (alevins and fry especially) would also suffer as a result of the construction noise and vibration, potentially causing physical damage or death. Construction works could therefore have a high negative impact on the local salmonid population. The impact magnitude in the catchment overall would depend upon the suitability of the watercourse habitat for salmonid spawning and juveniles, and where little suitable habitat exists, the impact may be low.

5.1.14 Impacts may also be felt by resident fish of other species, some of which are territorial, which are likely to leave the area adjacent to the works and would need to find new territories, resulting in increased competition elsewhere. This disturbance would represent a medium negative impact on resident fish within the affected area but when considered across the whole watercourse catchment, it is likely that only a low negative impact would be felt by the population as a whole.

Pollution

5.1.15 In the case of increased turbidity and chemical spillage, the effects could have a high negative impact upon fish downstream of the construction site where the water is currently of excellent quality (A1). The overall impact of such a spillage or release would depend upon the proportion of the watercourse affected, the value of the habitat and the presence of fish populations in the vicinity and could range from medium to high negative. Where water quality is less than excellent, the impact is likely to be reduced accordingly, within reason. The release of large quantities of suspended sediments could also reduce the suitability of spawning gravels downstream of the site by blocking the flow of oxygenated water through the gravels and potentially suffocating the incubating eggs within. This would represent a major negative impact on the population downstream of the works. Increasing levels of turbidity can reduce the capacity of some fish species to successfully locate and capture prey items.

5.1.16 Migratory fish such as salmon, sea trout and eels may be prevented from passing the sites of construction due to disturbance from noise, which would constitute an obstacle and may reduce access to habitats upstream of the works. This would represent a high negative impact on migratory species and would constitute an offence under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003.

5.1.17 The potential for noise and vibration disturbance would be notably reduced once the construction phase is complete and the operational phase is underway, as the noise intensity would reduce to the low level background noise generally created by road traffic. As such, the ongoing potential for noise disturbance can be considered to be negligible.

5.1.18 Light from the road directed onto the water surface during the operational phase could affect the nocturnal behaviour of resident and migratory fish species, resulting in a low negative impact. If this prevented the migration of salmon or sea trout this could also constitute an offence under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003.

Sub-Lethal Pollution and Other Indirect Impacts

5.1.19 The European Inland Fisheries Advisory Commission (EIFAC) conducted a series of reviews on the effects of water pollutants on fish and established standards and guidelines that have been adopted by the European Commission. These refer to two levels of water quality, one (more stringent) pertaining to waters containing salmonid fisheries, the other to waters containing only cyprinid fisheries.

5.1.20 Water quality standards for salmonids, based on the EIFAC water quality criteria, are covered under the Surface Waters (Fishlife) (Classification) (Scotland) Regulations 1997 (Table 10). These Regulations, however, make no mention of Finely Divided Solids (FDS) and therefore there are no universal regulatory standards for FDS in Scotland.

Table 11 – Summary of Surface Waters (Fishlife) (Classification) (Scotland) Regulations 1997

Parameter	Requirements for salmonid waters	Methods of analysis	Minimum sampling frequency	Observations
Temperature (^{o}C)	21.5 for 98% of the time	Thermometry	Weekly	Over-sudden variations in temperature must be avoided
pH	6 to 9	Electrometry calibration using two known standards	Monthly	
Dissolved oxygen (mg/l O2)	50% ≥ 9	Winkler's method or specific electrodes	Monthly	Twice per day where major daily variations are expected

Temperature & pH

5.1.21 It is unlikely that there would be any temperature increases as a consequence of construction or operation. It is also unlikely that the pH of the River Don or the tributaries would be altered during the construction phase, or as a result of road runoff or shading during operation.

Dissolved oxygen

5.1.22 Re-alignment and instream works in the tributaries could release organic material which, through increases in Biochemical Oxygen Demand (BOD), could result in local Dissolved Oxygen (DO) sag for short periods during construction. Such DO sags are likely to dissipate downstream as the oxygen is replenished from the atmosphere. This would potentially represent a high negative impact locally but only a medium or low negative impact on the fish populations of the whole watercourse, depending upon the fish species and biomass present.

Finely divided solids (FDS)

5.1.23 Alabaster & Lloyd (1982) list four ways in which excessive levels of FDS can be harmful to fish:

- by acting directly on the fish and either killing them, reducing their growth or resistance to disease;
- by preventing the successful development of fish eggs and larvae;
- by modifying natural movements and migrations of fish; and
- by reducing the abundance of food available to the fish.

5.1.24 Fish show varying tolerances to FDS content according to species. Although exposure to several thousand mg/l FDS may not kill fish during hours or days of exposure (Alabaster & Lloyd 1982), exposure to a very high FDS load for extended periods can be fatal.

5.1.25 Alabaster and Lloyd (1982) summarise that levels of FDS below 25mg l^{-1} will have no harmful effects on fish. 25-80 mg l^{-1} levels are acceptable as a rule of thumb, 80-400mg l^{-1} levels are unlikely to support good fisheries and levels over 400mg l^{-1} generally will not support substantial fish populations (see Table 12).

Table 12 – Summary of Effects of FDS on Fish and Their Habitat (after Alabaster & Lloyd, 1982)

FDS (mg/l)	Risk to Fish and Their Habitat
0	No risk
<25	No harmful effects
25-100	Generally acceptable
80-400	Unlikely to support good fisheries
>400	Not compatible with substantial fish populations

5.1.26 FDS released during the construction phase could settle over river bed gravels, killing invertebrates, fish eggs and alevins. Accumulations of fine sediments could also make habitats unsuitable for fish spawning. This could represent a high negative impact on the population at sites downstream of the works.

5.1.27 The impact of accidental spillages during the construction phase would depend on a wide range of variables including the nature and volume of the chemical and the volume of the receiving water (the dilution factor). Consequently, the magnitude of impact on sites downstream of the works could vary from low to high negative but is likely to decline with increasing distance from source. It is likely to be the smallest tributaries that could be impacted most heavily. Large volume drains with a high pollutant load adjoining small burns could have a high negative impact on the burn downstream of the inflow. Chemical spillages during the key migration period could prevent or delay migration beyond that point, potentially having a high negative impact on the population. This could also constitute an offence under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003.

5.1.28 Lamprey ammocoetes spend a period of five or more years buried in river bed sediments feeding on detritus, which may render them particularly sensitive to an accumulation of pollutants during the operational phase. This could have a high negative impact at localised sites downstream of the crossing points.

5.1.29 During operation, a major accident (fuel tanker, milk tanker etc.) close to one of the water crossings could result in a large scale runoff of toxic chemicals into the waterway. Depending on the nature of the release, the dilution factor and the timing of the event this could constitute a high negative impact on all species exposed.

Table 13 – Key Impact Significance for Watercourses

Section & Evaluation	Watercourse & Evaluation	Crossing(s)	Realignment	Road Drainage	Potential Impact		Impact significance	
					Description	Magnitude	Construction	Operation
Section NL1 Less than local	Kepplehill Burn Less than local	154m long culvert at ch315200	No realignment of burn	No road drainage discharge to burn	Release of sediment during culvert construction would affect the whole downstream catchment	Medium negative	Negligible adverse	n/a
					Risk of fish stranding during culvert construction	Medium negative	Negligible adverse	n/a
Section NL2 County	Gough Burn County	66m long culvert at ch316390 and 32.5m long culvert on the A96	Realigned length 232m resulting in lengthening the burn by 48m	2565m Length of road drainage to discharge to burn at ch316330.	Release of sediment during culvert construction	Medium negative	Moderate adverse	n/a
					Input of sediment or pollutants from road runoff would affect the currently excellent water quality	Medium negative	n/a	Moderate adverse
					Risk of fish stranding during culvert construction	Medium negative	Moderate adverse	n/a
	Craibstone Burn County	106m long culvert at ch316990	Minimal realignment planned	Length of road drainage to discharge to burn pending	Release of sediment during culvert construction	Medium negative	Moderate adverse	n/a
					Risk of fish stranding during culvert construction	Medium negative	Moderate adverse	n/a
					Input of pollutants or sediment via road runoff would affect the currently excellent water quality	Medium negative	n/a	Moderate adverse
	Green Burn County	Three culverts: 113m long culvert at ch317330 (AWPR mainline); 29m long culvert at A96 (A96 mainline); 23m long culvert at A96 (Kirkhill Industrial Estate Link Road)	Realigned length 702m resulting in lengthening of burn by 40 m	4855m Length of road drainage to discharge to burn at ch317470. pending	Physical barriers to fish migration likely due to the 3 culverts	Medium negative	Moderate adverse	Moderate adverse
					Release of fine sediments during culvert construction and realignment	Medium negative	Moderate adverse	n/a
					Re-alignment shortens the watercourses and removes a notable proportion of the habitat available to the receptors	Low negative	Minor adverse	Minor adverse
					Risk of fish stranding during culvert construction and realignment as a notable proportion of the tributary would be affected by the three culverts	Medium negative	Moderate adverse	n/a
					Input of fine sediments and pollution via road runoff would affect the currently excellent water quality	Medium negative	n/a	Moderate adverse

Section & Evaluation	Watercourse & Evaluation	Crossing(s)	Realignment	Road Drainage	Potential Impact		Impact significance	
					Description	Magnitude	Construction	Operation
Section NL3 County	Bogenjoss Burn County	Six culverts: 9m long culvert at ch320100; 8m long culvert at ch320215; 11m long culvert at ch320260; 10m long culvert at 320475 (all along the Kirkhill Access Track); 56m long culvert at ch320500 (AWPR Mainline); 160m long culvert at ch320870 and 120m long culvert at ch320870 (AWPR Mainline Bridge).	Realignment of 889m length resulting in substantial straightening of the channel and shortening of burn by 140m	980m Length of road drainage to discharge to burn at ch320805.	Input of pollutants or sediment during construction of the bridge and six culverts and re-alignment	Medium negative	Moderate adverse	n/a
					Habitat loss would result from re-alignment	Low negative	Minor adverse	Minor adverse
					Risk of fish standings during re-alignment and construction of six culverts would affect a large proportion of the fish population within this burn	Medium negative	Moderate adverse	n/a
					Input of pollutants or sediment from road runoff would affect the currently good (A2) water quality	Medium negative	n/a	Moderate adverse
Section NL4 National	River Don National	Bridge spanning river and floodplain at ch323100	No realignment	2200m Length of road drainage to discharge to river at ch322930.	Any physical impediment to migration would impact on migratory fish and may cause direct habitat loss as any upstream spawning habitat can no longer be used	High negative	Major adverse	Major adverse
					Disturbance from noise and vibration during bridge construction could damage fish hearing, impede migration or kill young eggs	High negative	Major adverse	n/a
					Release of sediments and pollutants during construction could kill salmonid eggs or alevins, and could reduce the suitability of spawning gravels	High negative	Major adverse	n/a
					Input of pollutants and sediments with road drainage will affect the currently good (A2) water quality	Medium negative	n/a	Major adverse

Section & Evaluation	Watercourse & Evaluation	Crossing(s)	Realignment	Road Drainage	Potential Impact		Impact significance	
					Description	Magnitude	Construction	Operation
	Goval Burn Regional	Two burried structures: 147.5m long at ch323610 (B977 West Goval Burn Underbridge); 92m long culvert at ch324400 (A947). One 49m long, offline, A947 Mill Lade Underbridge)	Realignment length 202m resulting in substantial straightening and shortening watercourse by 138m	2430m length of road drainage to discharge to river at ch323900	Any physical impediment to migration (such as velocity increases due to bridge footings or concrete apron) would impact on migratory fish and may cause direct habitat loss (especially re-alignment proposed) as both the juvenile and adult habitat in the locality, and the upstream spawning habitats can no longer be used	High negative	Major adverse	Major adverse
					Disturbance from noise and vibration during bridge and culvert construction could damage fish hearing, impede migration or kill young eggs	High negative	Major adverse	n/a
					Release of fine sediments or pollution during bridge and culvert construction could kill salmonid eggs or alevins, and could reduce the suitability of spawning gravels	Medium negative	Moderate adverse	n/a
					Input of sediment or pollution from road run off will affect the currently good (A2) water quality	Medium negative	n/a	Moderate adverse
	Mill Lade Aqueduct Less than local	Aqueduct section of approximately 100m to be dismantled during construction and reinstated over the AWPR mainline following construction	Minimal realignment proposed	Aqueduct not proposed to receive road drainage	Fish stranding during dewatering	Medium negative	Negligible adverse	n/a
	Corsehill Burn Less than local	Three culverts: one of 77m on the mainline at ch325085 and two of 32m and 55m on the Goval junction link roads	Realignment of 505m length resulting in substantial straightening of the channel and lengthening of burn by 19m	2765m Length of road drainage to discharge to burn at Goval Junction South ch20 (roundabout)	Release of sediment and pollutants during construction of culverts and realignment	Medium negative	Negligible adverse	n/a
					Habitat loss will result from realignment	Low negative	Negligible adverse	Negligible adverse
					Stranding of fish during construction of culverts and re-alignments will affect a substantial proportion of the fish population in this burn	Medium negative	Negligible adverse	n/a

Section & Evaluation	Watercourse & Evaluation	Crossing(s)	Realignment	Road Drainage	Potential Impact		Impact significance	
					Description	**Magnitude**	**Construction**	**Operation**
					Accumulation of pollutants from road runoff	Medium negative	n/a	Negligible adverse
Section NL5 Local	Red Moss Burn Local	One 96.5m culvert proposed at ch327500	No realignment proposed	1260m length of road drainage to discharge to burn at ch327240	Release of sediment and pollutants during culvert construction	Medium negative	Minor adverse	n/a
					A potentially permanent obstruction to local migration of resident trout and those from Corby Loch	Medium negative	Minor adverse	Minor adverse
					Stranding of fish during culvert construction	Medium negative	Minor adverse	n/a
					Input of pollutants from road runoff	Low negative	n/a	Minor adverse
	Blackdog Burn Local	Two culverts: one of 139m on the mainline at ch329500 and 38m on the side access road at the A90 North. 50m of existing culvert may be upgraded at the A90 pending	n/a	3965m Length of road drainage to discharge to burn at ch329940 and A90 North Junction ch375	Sediment release during culvert construction	Medium negative	Minor adverse	n/a
					Fish stranding during re-alignment	Medium negative	Minor adverse	n/a
					Input of pollutants and sediment from road runoff would affect the currently good (A2) water quality	Medium negative	n/a	Minor adverse

6 Mitigation

6.1 Introduction

6.1.1 The term mitigation refers to 'measures taken to reduce adverse impacts' (IEEM) and mitigation measures largely aim to avoid potentially significant effects, reduce any unavoidable effects, offset negative impacts and deliver any added value. In general, in order to avoid potentially significant effects, where impact significance is considered to be greater than or equal to 'moderate', specific mitigation will be required in order to ameliorate the impact significance to acceptable levels (minor or negligible significance), by avoiding, reducing or offsetting the impact. Where minor negative impacts are identified, realistic attempts to reduce any unavoidable effects and deliver any added value should be made.

Direct Mortality

6.1.2 De-watering sections of tributaries, re-alignments and in-river works should be avoided where possible. Electric fishing must be carried out to check for the presence of protected species in the section to be affected. Fish should be removed from sections to be de-watered, re-aligned or excavated, using electric fishing, and translocated to an appropriate alternative site. The electric fishing methodology (e.g. single anode, twin anodes) should be selected to suit the habitat. Fishing should continue until no more fish are found. De-watering or re-alignment should not be carried out during the spawning or egg incubation seasons (October to May inclusive for salmonids, see Table 2). Any fish translocation should be agreed in advance with the relevant DSFB.

6.1.3 Where temporary diversions are to be created, e.g. during the installation of culverts, the same protocol for de-watering must be followed with the additional requirement that electric fishing is also carried out within the temporary diversion before the watercourse is returned to its original route.

6.1.4 Construction activities should be carried out with reference to sensitive periods for fish (see Table 2). At sites adjacent to salmonid spawning grounds noise and vibration should be avoided during the first third of the egg incubation period (October to March).

Habitat Loss, Fragmentation and Isolation

6.1.5 Bridge piers and culverts should not act as physical barriers to migration, should not restrict water flow even during floods, and should not result in local increases in water velocity or scour. Where bridges are required piers in the channel should be avoided. Where culverts are required these should be oversized, allowing for fish passage even during flood flows, and have a substrate similar to the semi-natural channel.

6.1.6 The Scottish Executive have issued guidelines (Highways Agency 1998) giving a number of 'cases' for water crossings requiring culverts:

- Case 1 : Culvert barrel with dimensions derived for flood flow conditions;
- Case 2 : Culvert with depressed invert to allow for inclusion of stream bed material;
- Case 3 : Provision of a bottomless arch culvert to retain the natural stream bed;
- Case 4 : Provision of a low flow channel within the culvert invert;
- Case 5: Provision of baffles within the culvert.

6.1.7 Bridges, without channel piers, and depressed invert culverts (Case 2) should be used as a minimum to permit the re-instatement of suitable habitat within the culvert to ensure a contiguous substrate, channel structure and flow regime, such that no habitat is lost.

6.1.8 It is proposed to use depressed invert culvert structures for all river crossings other than the River Don crossing and the three crossings of the Goval Burn which will require a high bridge without channel piers and three low bridges without channel piers, respectively.

Disturbance

6.1.9 Specific activities (such as piling) resulting in particular disturbances (such as noise and vibration) should be avoided during sensitive periods (e.g. the first third of salmonid egg incubation). This will apply to all watercourses where salmonids may be present (see Table 9).

6.1.10 Any works that have the potential to generate high levels of noise (e.g. piling) should be initiated using a soft start approach, allowing sensitive animals to move away from the sound source prior to the noise reaching peak volumes.

6.1.11 Night working should be avoided, allowing a quiet period for migratory fish to pass the construction site. Lights on the construction sites should be directed off the water.

6.1.12 It is not anticipated that piling will be required for the tributary burns but there will still be some construction-related vibration produced. The same procedure of a soft start should be followed.

6.1.13 During the operational phase road lighting should be designed so that it is not directed onto the water.

Pollution and Other Indirect Impacts

6.1.14 During the construction phase care should be taken to ensure pollutants from the construction site, such as oil and vehicle fuel, cannot run directly into rivers or tributary streams.

6.1.15 During the operational phase runoff from the road drains should not go directly into the rivers or tributary streams and appropriate measures will be discussed with the engineers. The use of reed-bed traps, Sustainable Urban Drainage Schemes (SUDS) or similar should be considered to remove pollutants and sediments from runoff before entry to the watercourse. The capacity of such measures needs to be sufficient to prevent heavy rainfall washing the accumulated pollutants into the river. These measures should also be monitored and maintained.

6.1.16 Reed-bed traps and SUDS should be used to reduce the impact of a major accidental spillage.

6.1.17 In-stream works that have the potential to release FDS should not be carried out during sensitive periods (Table 2) and efforts should be made to prevent the ingress of fine sediments to the watercourse at all other times.

6.1.18 During the construction phase ‘best practice’ should be used to minimise the risk of fine sediments from being released into any watercourse. This would include, for example, the use of textile matting to minimise ground disturbance by tracked vehicles.

6.1.19 The runoff from the construction sites should be routed in such a way that fine sediment is intercepted.

6.1.20 It is inevitable that some fine sediment will be released from any tributary streams where re-alignment is necessary. Re-alignments should be carried out with reference to the sensitive periods for fish (Table 2). Gravel coring work carried out at sites downstream of the proposed crossing point would reveal to what extent sediment accretion has occurred and gravel washing can be carried out to restore areas where fine sediment has accumulated.

6.1.21 Reed-bed traps and SUDS should be used to reduce the impact of a major accidental spillage.

7 Residual Impacts

7.1.1 Where mitigation measures are not completely effective in dealing with the source of potential adverse impacts, residual impacts may be evident. The potential for such residual impacts is outlined below.

Direct Mortality

7.1.2 If spawning and egg incubation periods are avoided and resident fish are translocated before any de-watering or dredging operations, the magnitude of the local impact would be reduced to low negative and the overall impact would be Negligible.

7.1.3 By avoiding sensitive periods direct mortality from vibration during construction can be prevented, such that residual impacts on direct mortality are Negligible

Habitat Loss

7.1.4 By using depressed invert culverts and single span bridges a near-natural river bed and channel structure can be retained and habitat loss minimised. Shading by these structures could result in a slight negative impact on fish at currently unshaded sites through reduced food availability, but the overall impact is likely to be minor but where many culverts are used for one watercourse the residual impact is likely to be Moderate adverse.

Habitat Fragmentation and Isolation

7.1.5 If channel modifications are minimised by the use of depressed invert culverts and/or single span bridges no physical barriers would be created and water velocities would remain unaltered. Although might be temporarily deferred, migratory fish would generally be able to pass in either direction resulting in a Minor impact on fish migration.

Disturbance

7.1.6 Avoidance of particular sources of disturbance during sensitive periods (e.g. spawning and the first one third of egg incubation) would result in a Negligible impact.

7.1.7 As adult salmon are known to enter the River Don system throughout much of the year it would not be practical to carry out all construction outside the migration period. Use of a soft start approach to any procedures likely to generate high noise / vibration levels will allow resident fish to move away and reduce the impact but there could still be a slight residual impact magnitude on migrating adult salmon. This would result in an overall adverse impact of Negligible.

Pollution and Other Indirect Impacts

7.1.8 The use of reed-bed traps to remove pollutants and sediments from runoff will minimise the risk of pollution during the operational phase, reducing the risk of accumulation of pollutants in silts which may be utilised by lamprey species, resulting in a Negligible impact.

7.1.9 Gravel coring work will reveal the extent of any accumulation of fine sediments from unavoidable in-river works and appropriate remediation (e.g. gravel washing) can be carried out. With appropriate remediation the impact magnitude on fish of the release of fine sediments can be reduced to low negative. This results in a residual adverse impact of Moderate significance for the River Don.

7.1.10 Reed-bed traps and SUDS will reduce the impact of a major accidental spillage but there would still potentially be an impact magnitude of low negative to fish populations as a whole. This results in a residual adverse impact of Moderate significance for the River Don.

Table 14 – Residual Impact Significance for Watercourses

Watercourse & Evaluation	Crossing(s)	Re-alignment	Road Drainage	Potential Impact		Mitigation	Residual Impact Significance	
				Description	Significance		Construction	Operation
Kepplehill Burn Less than local	154m long culvert at ch315200	No realignment of burn	No road drainage discharge to burn	Release of sediment during culvert construction	Negligible	Use best practice on construction site.	Negligible	n/a
				Risk of fish stranding during culvert construction	Negligible	Fish to be removed prior to dewatering,	Negligible	n/a
Gough Burn County	66m long culvert at ch316390 and 32.5m long culvert on A96	Realigned length 232m resulting in lengthening of burn by 48m	2565m Length of road drainage to discharge to burn at ch316330.	Input of pollutants or sediment during culvert construction	Moderate	Best practice on construction site.	Negligible	n/a
				Input of sediment or pollutants from road runoff	Moderate	No outfall into watercourse. Road drainage to be routed via treatment ponds.	n/a	Negligible
				Risk of fish stranding during culvert construction	Moderate	Fish to be removed prior to dewatering. Depressed invert culverts to be installed.	Minor adverse	n/a
Craibstone Burn County	106m long culvert at ch316990	Minimal realignment planned	Length of road drainage to discharge to burn	Input of pollutants or sediments during bridge construction	Moderate	Use best practice on construction site.	Negligible	n/a
				Input of pollutants of sediment via road drainage	Moderate	No outfall into watercourse. Road runoff not to drain directly to burn, but via treatment ponds.	n/a	Negligible
				Risk of fish stranding during culvert construction	Moderate	Fish to be removed prior to dewatering.	Minor adverse	n/a
Green Burn County	Three culverts: 113m long culvert at ch317330 (AWPR Mainline); 29m long culvert at A96 (A96 mainline); 23m long culvert at A96 (Kirkhill Industrial Estate Link Road)	Realigned length 702m resulting in lengthening of burn by 40m	4855m Length of road drainage to discharge to burn at ch317470	Physical barriers to fish migration	Moderate	Culvert design to allow fish passage even at flood flows.	n/a	Negligible
				Release of fine sediments during culvert construction and realignment	Moderate	Use best practice on construction site.	Minor adverse	n/a
				Risk of fish stranding during culvert construction and realignment	Moderate	Fish to be removed prior to any dewatering.	Minor adverse	n/a
				Input of fine sediments and pollution via road runoff	Moderate	Road drainage to be routed via treatment ponds.	n/a	Negligible

Watercourse & Evaluation	Crossing(s)	Re-alignment	Road Drainage	Potential Impact		Mitigation	Residual Impact Significance	
				Description	Significance		Construction	Operation
Bogenjoss Burn County	Seven culverts:9m long culvert at ch320100; 8m long culvert at ch32215; 11m long culvert at ch320260; 10m long culvert at 320475 (all along the Kirkhill Access Track); 56m long culvert at ch320500 (AWPR Mainline);15m long culvert at ch320150; 160m long culvert at ch320870 (AWPR Mainline Bridge).	Realignment of 889m length resulting in substantial straightening of the channel and shortening of burn by 140m	980m Length of road drainage to discharge to burn at ch320805.	Input of pollutants or sediment during culvert construction and re-alignment	Moderate	Use best practice on construction site.	Minor adverse	n/a
				Habitat loss would result from re-alignment	Moderate	Mitigation in the form of replacement riparian planting (see Table A10.17)	n/a	Moderate adverse
				Risk of fish standings during re-alignment and culvert construction	Moderate	Fish to be removed prior to any de-watering.	Minor adverse	n/a
				Input of pollutants or sediment from road runoff	Moderate	Drainage to be routed via treatment ponds.	n/a	Negligible
River Don National	Bridge spanning River and floodplain	No realignment	2200m Length of road drainage to discharge to river at ch322930.	Any physical impediment to migration would impact on migratory fish	Major	Bridge to completely span river and floodplain with no piers.	n/a	Negligible
				Disturbance from noise and vibration during construction could damage fish hearing or impede migration	Major	No impact piling to be used. Agree noise threshold, avoid sensitive periods, use 'soft start' and no night working.	Negligible	n/a
				Release of sediments and pollutants during construction could kill eggs or alevins, and could reduce the suitability of spawning gravels	Major	Avoid sensitive periods. Use best practice on construction site. Use sediment traps for road drainage.	Negligible	n/a
				Input of pollutants and sediments with road drainage	Major	Road drainage to be routed through large treatment ponds, residual impact minor	n/a	Negligible
Goval Burn Regional	Two buried structures: 147.5m long at ch323610 (B977 West Goval Burn Underbridge); 92m long culvert at ch324400 (A947). One 49m long, offline, A947 Mill Lade Underbridge)	Realignment length 202m resulting in substantial straightening and shortening watercourse by 138m	2430m length of road drainage to discharge to river at ch323900	Any physical impediment to migration would impact on migratory fish	Major	Bridge to completely span river and floodplain with no piers.	n/a	Negligible
				Release of fine sediments or pollution during culvert and bridge construction	Moderate	Avoid sensitive periods, use best practice on construction site.	Negligible	n/a
				Input of sediment or pollution from road off	Moderate	Road runoff to be routed via treatment ponds.	n/a	Negligible

Watercourse & Evaluation	Crossing(s)	Re-alignment	Road Drainage	Potential Impact		Mitigation	Residual Impact Significance	
				Description	Significance		Construction	Operation
				would affect the currently good (A2) water quality				
Mill Lade Aqueduct Less than local	Aqueduct section of approximately 100m to be dismantled during construction and reinstated over the AWPR mainline following construction	Minimal realignment proposed	Aqueduct not proposed to receive road drainage	Fish stranding during dewatering	Negligible	Fish to be removed prior to de-watering.	Negligible	n/a
Corsehill Burn Less than local	Three culverts: one of 99m on the mainline at ch325005 and two of 32m and 27.5m on the Goval junction link roads	Realignment of 505m length resulting in substantial straightening of the channel and lengthening of burn by 19m	2765m Length of road drainage to discharge to burn at Goval Junction South (roundabout).	Release of sediment and pollutants during construction of culverts and realignment	Negligible	Use best practice on construction site.	Negligible	n/a
				Habitat loss would result from re-alignment	Negligible	No mitigation identified.	n/a	Negligible
				Stranding of fish during construction of culverts and realignments	Negligible	Fish to be removed prior to any de-watering.	Negligible	n/a
				Accumulation of pollutants from road runoff.	Negligible	Road runoff not to go directly to burn.	n/a	Negligible
Red Moss Burn Local	One 39m culvert proposed at ch327500.	No realignment proposed	1260m length of road drainage to discharge to burn at ch327240.	Release of sediment and pollutants during culvert construction	Minor	Refer to sensitive periods. Use best practice on site.	Negligible	n/a
				Stranding of fish during culvert construction	Minor	Fish to be removed prior to dewatering.	Minor adverse	n/a
				Obstruction to migration of resident trout and those from Corby Loch	Minor	Water crossing structure to allow unimpeded access to upstream reaches.	n/a	Negligible
				Input of pollutants from road runoff	Minor	Road runoff not to go directly to burn.	n/a	Negligible
Blackdog Burn Local	Two culverts: one of 74m on the mainline at ch329950 and 39m on the side access road at the A90 North 50m of existing culvert may be upgraded at the A90 pending	n/a	3965m Length of road drainage to discharge to burn at ch329940 and A90 North Junction.	Sediment release during culvert construction	Minor	Risk of sediment release will be minimised through best practise.	negligible	n/a
				Fish strandings during re-alignment	Minor	Fish to be removed prior to de-watering.	Minor adverse	n/a
				Input of pollutants and sediment from road runoff	Minor	Road runoff not to go directly to burn.	n/a	Negligible

8 Post Project Appraisal

8.1.1 The success of methods used and mitigation measures employed should be determined where possible by surveys as outlined below.

8.1.2 Baseline gravel coring work should be carried out downstream of in-river works where protected species are present, such that post-construction impacts can be assessed. A series of freeze cores should be taken from likely fish spawning sites, downstream of the proposed crossing point. The precise locations of the cores should be recorded, preferably with GPS, referenced to fixed landmarks and with photographic monitoring to allow repeatability. Appropriate remediation (gravel washing) can be carried out and its effectiveness monitored.

8.1.3 The effectiveness of measures employed, such as reed bed filtration systems or SUDS should be regularly monitored and maintained subsequent to commissioning.

8.1.4 The status of sensitive species, notably salmon, once the proposed road scheme becomes operational should be monitored to ensure that no reduction in spawning success is evident as a result of construction works. Monitoring of spawning success can be monitored in a number of ways, and a mixture of all techniques is advisable. Spawning activity is determined through redd mapping during late November to late January whereby evidence of spawning of activity is mapped. Emergent success is then monitored using fry traps (fine mesh nets) which are placed over identified redds in order to catch emerging fry. Finally survival success is monitored through electric fishing for juvenile fish.

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Glossary

Alevin – recently hatched salmonid before emerging from the gravel

Allochthonous – of rocks/deposits; found in a place other than where they/their constituents were formed

Fry – young fully-formed fish (in salmonids not yet having parr markings)

Parr – young salmon or trout with distinctive thumbprint markings on flanks

Smolt – young salmon migrating to the sea. Fish take on a silvery colouration with a black tip to the tail

Springer – multi sea winter salmon that return to the river in winter and spring

Summer salmon – usually fish that have spent two winters at sea

Grilse – salmon which have spent only one full winter at sea

Glide – even paced section of river or stream with laminar flow

DDSFB – Dee District Salmon Fishery Board

DSFT – Dee Salmon Fishery Trust

DonDSFB –Don District Salmon Fishery Board

Redd – distinctive river bed gravel feature created by spawning salmonids

Definitions of migratory status (after McDowall, 1988)

Diadromous – migrate between freshwater and the sea

Anadromous – spawn in freshwater, live and feed in the sea

Catadromous – spawn in the sea, live and feed in freshwater

Amphidromous – move back and forwards between freshwater and the sea

Potamodromous – migrate entirely within freshwater to spawn, live and feed in freshwater.

Local – probably migrate locally to spawn, but are not generally considered to be actively migratory

Relative abundances

Abundant – widespread and in high numbers

Common – widespread but may only be present in small numbers

Present – only found in specific areas or habitats

Rare – known to be in the system but distribution scattered and in low numbers

Absent – not known to be found in that part of the system

Annex 1

Section from the SFFA 2003

It is an offence under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003 to carry out any of the following:

- to intentionally introduce any salmon or salmon eggs into inland waters in a salmon fishery district for which there is a district salmon fishery board unless the district salmon fishery board for the salmon fishery district in which the waters are situated have previously consented in writing; or the waters constitute or are included in a fish farm.
- to knowingly take, injure or destroy; any smolt, parr, salmon fry or alevin.
- to buy, sell, expose for sale or be in possession of; or place any device or engine for the purpose of obstructing the passage of, any smolt, parr, salmon fry or alevin
- to injure or disturb any salmon spawn during the annual close time.
- to obstruct or impede salmon in their passage to any spawning bed or any bank or shallow in which the spawn of salmon may be.

(4) Subsections (1) to (3) above shall not apply to acts done in the course of cleaning or repairing any dam or mill-lade, or in the exercise of rights of property in the bed of any river or stream.

A person shall not, in respect of any act or omission relating to salmon or salmon roe or eggs, be guilty of a contravention of an enactment prohibiting or regulating that act or omission if the act or omission is for-

- some scientific purpose;
- the purpose of protecting, improving or developing stocks of fish; or
- the purpose of conserving any creature or other living thing; and
- that person has obtained the previous permission in writing-

If the act or omission is one to which this sub-paragraph applies, of the district salmon fishery board for the salmon fishery district in which it takes place or of the Scottish Ministers; and in any other case, of the Scottish Ministers, to, without legal right, or without written permission from a person having such right, fishes for or takes salmon in any waters, including any part of the sea within 1.5 kilometres of mean low water springs.