A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010041

6.8 Environmental Statement – Appendix 9.10 Aquatic Ecology Assessment Report

Part B

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

June 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

The A1 in Northumberland: Morpeth to Ellingham

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Environmental Statement - Appendix

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1. INTRODUCTION

1.1. PROJECT BACKGROUND

1.1.1. The A1 in Northumberland: Alnwick to Ellingham (Part B) aims to increase capacity along an approximately 8 km section of the existing A1 between Alnwick and Ellingham, in Northumberland. Part B includes widening the existing A1 from single carriageway to a dual carriageway. Part B also includes improving the existing junction at Charlton Mires with a new grade-separated junction and a new accommodation overbridge at Heckley Fence. Part B aims to enhance resilience, improve safety and improve journey times along the route. Details of the Part B location are provided on **Location Plan** of this Environmental Statement (ES) (**Application Document Reference: TR010041/APP/2.1**).

1.1.2. Part B comprises dualling of the existing A1 single carriageway; a new southbound carriageway would be constructed to the east of the existing A1, and the existing A1 would act as a new northbound carriageway. A number of private means of access would need to be stopped up and replaced with new access routes including new roads for East and West Linkhall, and from the B6347 and Rock South Farm. To facilitate the construction of Part B, a length of an extra high voltage cable, utility pipes and telecommunication cables would need to be diverted. Additionally, a construction compound would be constructed within the Lionheart Enterprise Park adjacent to The Applicant's Gritting Depot, and a Main Compound constructed by Thirston. Part B also includes new drainage features, new and extended culverts, and temporary and permanent Public Right of Way (PRoW) diversions, together with new and/or improved ancillary features.

1.1.3. This appendix details the methods, results, impact assessment, and recommended mitigation to ameliorate adverse impacts upon aquatic species and habitats in respect of Part B.

1.1.4. Within this document, Part B comprises three elements. The Part B Main Scheme Area refers to the Order Limits north of Alnwick and south of Ellingham only. The Order Limits also includes the Lionheart Enterprise Park Compound (eastern and western sites), located to the south of Alnwick, and the Main Compound, which is located within the A1 in Northumberland: Morpeth to Felton (Part A).

1.2. ECOLOGICAL BACKGROUND

1.2.1. An extended Phase 1 habitat survey was undertaken in 2016 (**Ref. 1**). The assessment included desk-based studies and field surveys. An extended Phase 1 habitat survey was repeated in 2019 to determine any changes in ecological baseline to that recorded in 2016; results of which can be found in **Appendix 9.1: Habitats and Designated Sites** of this ES.

1.2.2. The 2019 Phase 1 Study Area predominantly comprised arable and improved grazing habitat with small extents of semi-natural habitats across the agricultural dominated landscape.

1.2.3. A total of seventeen watercourses and minor tributaries were identified throughout the Order Limits.

1.3. BRIEF AND OBJECTIVES

1.3.1. Surveys were undertaken to describe the baseline status of aquatic ecology receptors with potential to be affected by Part B. Aquatic ecology receptors and surveys included:

a. Aquatic habitat assessment
b. Aquatic macroinvertebrates
c. White-clawed crayfish *Austropotamobius pallipes*
d. River Habitat Survey (RHS)
e. Freshwater fish

1.3.2. This technical appendix details the methodology and results of aquatic ecology surveys and discusses potential impacts and effects associated with the construction and operational stages of Part B.

2. BASELINE IDENTIFICATION METHODOLOGY

2.1. AQUATIC HABITAT ASSESSMENT

2.1.1. A desk-based examination of OS mapping and the Environment Agency's Catchment Data Explorer (**Ref. 2**) was carried out to identify which watercourses crossed by the Order Limits were suitable for aquatic walkover survey.

2.1.2. The potential for each identified watercourse to support legally protected and notable aquatic species was considered based on field observations made during an aquatic walkover survey undertaken from 4 to 6 September 2018.

2.1.3. Surveyors walked stretches of each watercourse, 500 m upstream and 500 m downstream of the point at which the Order Limits crossed the watercourse or those located within the Order Limits, as shown in **Figure 9.21: Aquatic Walkover Survey Stretches, Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**).

2.1.4. An assessment of habitat suitability for protected and notable species was then made based on professional experience and judgement, by observing the habitat types present in each watercourse. This was supplemented by standard sources of guidance on habitat suitability assessment for key faunal groups including: white-clawed crayfish (**Ref. 3**) and salmonid fish (**Ref. 4**).

2.1.5. As part of the walkover component, surveyors also assessed the watercourse accessibility and safety for further survey.

2.2. DESK STUDY

2.2.1. The Environment Agency's National Fish Population Database (**Ref. 5**) was examined in October 2018 to obtain any fish survey data from the last 10 years, relating to the watercourses identified for further survey. A compliance check was conducted in September 2019, with no new data identified.

2.2.2. If classified, the Water Framework Directive (WFD) status of the watercourses identified for aquatic habitat assessment was obtained from the Environment Agency's Catchment Data Explorer (**Ref. 2**).

2.2.3. Data relating to protected and notable aquatic species within 2 km of the Order Limits (the Study Area) were extracted from desk study data provided by the Environmental Records Information Centre North East (ERIC NE) in 2019. Records older than 10 years were excluded as not being considered ecologically relevant.

2.3. AQUATIC MACROINVERTEBRATES

FIELD SURVEY

2.3.1. Aquatic macroinvertebrate surveys (hereafter referred to as macroinvertebrate surveys) were carried out on 8 May 2019. Samples were taken from one upstream and one downstream location, as shown in **Figure 9.22: Macroinvertebrate Sampling Locations,**

Fish Survey and RHS Stretches, Volume 6 of this ES (**Application Document Reference: TR010041/APP/6.6**).

2.3.2. Sample collection followed a standard three-minute kick sampling of all in-channel habitats in proportion to their occurrence, using a standard sampling net (1 mm mesh), with a one-minute timed hand search following the Environment Agency procedure (**Ref. 6**), which conforms to British Standard (BS) EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters (**Ref. 7**).

2.3.3. A standardised field sheet was completed to include details of channel and bank physical habitat (material of banks and substrates, flow types, physical processes, bank structure), riparian land use and potential sources of anthropogenic stress.

2.3.4. Samples were placed in one-litre sample pots, preserved in Industrial Denatured Alcohol and transported to a laboratory for sorting and identification of macroinvertebrates to Taxonomic Level 5, in adherence with Environment Agency (**Ref. 8**) procedures.

DATA ANALYSIS

2.3.5. The use of biological metrics allowed the assignation of ecological values to the macroinvertebrate communities observed and an assessment of pressures on those communities to be made.

BIOLOGICAL METRICS

River Invertebrate Classification Tool

2.3.6. The River Invertebrate Classification Tool (RICT) determines the ecological condition of a given location based on a comparison of macroinvertebrate communities observed at each study site, with macroinvertebrate communities observed at reference sites (**Ref. 9**)

2.3.7. RICT reference sites are taken to be as close as possible to pristine conditions and not impacted by environmental stressors such as pollution, habitat modification or flow stress. Reference sites provide an expected macroinvertebrate community score for that river type. The observed macroinvertebrate community score at a given study site is divided by the expected community score. Reference and bias adjustments are then applied to obtain the Ecological Quality Ratio (EQR).

2.3.8. RICT can derive EQR scores for a number of biological metrics. These metrics are discussed further below:

Whalley, Hawkes, Paisley and Trigg (WHPT)

2.3.9. The Whalley, Hawkes, Paisley and Trigg (WHPT) metric (**Ref. 10**) is based on the tolerance of different macroinvertebrates to organic pollution. Each macroinvertebrate family is assigned a score from -1.6 to 13, depending on their tolerance to pollution and abundance category (on a continuous scale, -1.6 is for highly abundant pollution-tolerant taxa, 13 is for highly abundant pollution-intolerant taxa) and an overall score is produced from the total.

The WHPT index is widely used to determine the ecological water quality of running waters and specifically the detection of organic pollution. As such, any extrapolation of other water quality pressures should be undertaken with caution.

2.3.10. The Average Score Per Taxon (ASPT) is derived from the WHPT index. By dividing the total WHPT score by the number of scoring taxa present (NTAXA), the ASPT can be calculated. This metric is more easily comparable with other sites and permits an assessment of biological water quality that is less influenced by the presence of a greater proportion of low scoring taxa or sampling effort than the overall WHPT score. In both the case of WHPT score and ASPT, higher scores indicate better ecological quality.

Lotic-invertebrate Index for Flow Evaluation (LIFE)

2.3.11. Macroinvertebrates have specific requirements for flow conditions and can be used to determine not only predominant flow types (**Ref. 11**) but also changes in flow character. The Lotic-invertebrate Index for Flow Evaluation (LIFE) metric uses abundance data to assign a flow preference score to macroinvertebrate families present in a sample and an overall score for a site can be interpreted as an abundance-weighted ASPT metric. The family-level LIFE score is calculated in RICT as a ratio of the observed/expected at reference sites (O/E) for the sample.

Proportion of Sediment-Sensitive Invertebrates (PSI)

2.3.12. The Proportion of Sediment-Sensitive Invertebrates (PSI) metric aims to act as a proxy for the quantity of fine sediment at a site (**Ref. 12**). Macroinvertebrate species are assigned a fine sediment sensitivity rating that ranges from highly insensitive to highly sensitive to fine sediment. The PSI score is calculated as the percentage of sensitive taxa in the sample and used to indicate how sedimented a watercourse is, from minimally sedimented/unsedimented to heavily sedimented (**Table 2-1**).

Table 2-1 - PSI Scores and Interpretation

PSI Score	River Bed Condition
81 – 100	Minimally sedimented/unsedimented
61 – 80	Slightly sedimented
41 – 60	Moderately sedimented
21 – 40	Sedimented
0 – 20	Heavily sedimented

Community Conservation Index (CCI)

2.3.13. The diversity and conservation interest of a macroinvertebrate community at each site can be represented interpreted by analysing species level data through the CCI. The CCI incorporates elements of taxon rarity and richness to summarise the conservation value of macroinvertebrate communities (**Ref. 13**). Scores are assigned to species within the sample to derive a total sample conservation score which infers a conservation value from the criteria listed in **Table 2-2**.

2.3.14. The raw data was also analysed for the presence of species with a Conservation Score (CS) of six (Regionally Notable) or above.

Table 2-2 - Community Conservation Index

Conservation score	Conservation Classification	Description
0 ≤ 5	Low	Sites supporting only common species and/or a community of low taxon richness.
5 ≤ 10	Moderate	Sites supporting at least one species of restricted distribution and/or a community of moderate taxon richness.
10 ≤ 15	Fairly high	Sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness.
15 ≤ 20	High	Sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness.
> 20	Very high	Sites supporting several rarities, including species of national importance, or at least one extreme rarity (e.g. taxa included in the British RDBs) and/or a community of very high taxon richness (potentially of national significance and may merit statutory protection).

Water Framework Directive (WFD) Classification

2.3.15. The WFD uses the pollution sensitivity (WHPT ASPT) and macroinvertebrate richness (WHPT NTAXA) EQR scores to determine whether a watercourse meets Good Ecological Status, as required under the Directive.

2.3.16. There are five ecological status classes: Bad, Poor, Moderate, Good and High.

2.3.17. Where a macroinvertebrate community is recorded at, or above Good Ecological Status, then biological or physical factors including flow and pollution are assumed not to adversely affect the aquatic ecological status.

2.3.18. Watercourses failing to meet Good Ecological Status for macroinvertebrates may be influenced by a variety of stresses, and EQRs can be interrogated to determine the likely cause of failure to meet Good Ecological Status.

2.3.19. For WFD classification the lower scoring of these EQR scores determines the macroinvertebrate classification of a given site.

2.4. WHITE-CLAWED CRAYFISH

2.4.1. The presence/absence of white-clawed crayfish was determined by the collection and analysis of eDNA samples from Shipperton Burn (Shipperton Burn the only watercourse considered suitable to support the species following habitat assessment). Samples were collected on 8 May 2019. eDNA is DNA that is collected from the environment in which an organism lives, rather than directly from the animals themselves. In aquatic environments, animals shed cellular material into the water via reproduction, saliva, urine, faeces, skin cells, etc. This DNA would persist in easily detectable levels for several weeks and can be collected within a water sample which is then analysed to determine if evidence of the target species is present.

2.4.2. The samples are tested for parts of mitochondrial DNA only found in each species. This ensures that DNA from other species present in the water is not tested.

2.4.3. This method has been extensively tested since 2015 in many different environments, habitats, conditions and ecological situations in order to successfully enable the full application of eDNA for the detection of crayfish species and the crayfish plague *Aphanomyces astaci*.

2.4.4. The laboratory testing adheres to protocols (**Ref. 14, 15** and **16**) and methodologies (**Ref. 17**) developed by SureScreen Scientifics for the detection of t white-clawed crayfish, signal crayfish *Pacifastacus leniusculus* and the crayfish plague.

SAMPLE COLLECTION

2.4.5. The location within the watercourse where 20 sub-samples were to be collected were identified. Samples were taken against the flow of the stream, working upstream in a diagonal pattern to ensure any disturbed ancient preserved DNA was not collected.

2.4.6. A ladle was used to collect 20 samples of 50 ml of water, from the middle of the water column, into a sterile Whirl-Pak bag. A vial of spiked DNA was then added to the bag, before closing the bag and shaking for 10 seconds to mix the DNA within the water sample.

2.4.7. Using a sterile syringe, 50 ml of the sample was removed from the Whirl-Pak and a filter attached to one end. Pressure was applied to the syringe to pass the liquid through the filter and the process repeated until no more liquid could be pushed through. The amount of liquid filtered was recorded.

2.4.8. The syringe was then emptied, and air pushed through the filter to free it of water. The syringe containing the filter was secured and returned to the laboratory with an ice pack to keep it chilled prior to analysis.

SAMPLE ANALYSIS

2.4.9. The analysis was conducted in two phases. The sample is first put through an extraction process where the filter is incubated in order to obtain any DNA within the sample.

2.4.10. The extracted sample is then tested via real time polymerase chain reaction (PCR) (also called q-PCR) for each of the species selected in the analysis. This process amplifies a select part of DNA allowing it to be detected and measured in 'real time' as the analytical process develops. qPCR combines amplification and detection of target DNA into a single step. With qPCR, fluorescent dyes specific to the target sequence are used to label targeted PCR products during thermal cycling. The accumulation of fluorescent signals during this reaction is measured for fast and objective data analysis.

2.4.11. True positive controls, negatives and blanks were included in every analysis. These were confirmed to be correct before any result is declared.

2.5. RIVER HABITAT SURVEY

FIELD SURVEY

2.5.1. River Habitat Surveys were carried out along Shipperton Burn on 8 May 2019 following the aquatic habitat assessment of watercourses.

2.5.2. A survey of habitats was undertaken in accordance with the standard RHS Field Survey Guidance Manual (**Ref. 18**). The method, which included the systematic collection of data associated with the physical structure of the watercourses, examines a 500 m reach of river channel so as to include a representative sample of the river habitats present in the area. Left and right river banks described in the RHS assessment are those observed when facing downstream.

2.5.3. Measurements were taken for the following variables as part of the survey:

a. General field survey details
b. Predominant valley form
c. Number of riffles, pools and point bars
d. Artificial features
e. Physical attributes of the left and right bank and channel
f. Bank top land-use and vegetation structure
g. Channel vegetation types
h. Land-use within 50 m of bank top
i. Bank profiles
j. Extent of trees and associated features
k. Extent of channel and bank features
l. Channel dimensions

m. Features of special interest
n. Choked channel
o. Notable nuisance plant species
p. Overall characteristics

2.5.4. The measurements of variables e., f. and g. were obtained from 10 spot-checks taken at 10 survey points along the river. The spot checks lay 50 m apart and covered a 1-10 m stretch of the river. Physical features (e.) were assessed using a 1 m wide transect across the river, while all other elements in Sections f. and g. were assessed within a 10 m wide transect. GPS coordinates for all spot check locations were recorded.

2.5.5. The remainder of the measurements (a. to d. and h. to p.) were taken either as part of a 500 m sweep-up, whilst walking back along the RHS site following the completion of the spot-checks, or at a single survey point at one location on a straight or uniform section of the river to measure more detailed physical attributes of the river.

2.5.6. Photographs were taken throughout the survey, both at the spot check locations and to record any other features of interest noted within the vicinity of the river corridor.

Indices

2.5.7. From the features recorded a number of indices were calculated, including Habitat Modification Score (HMS), Habitat Quality Assessment (HQA) and River Habitat Quality (RHQ).

2.5.8. The HMS is calculated by individually scoring all the modifications recorded on the RHS, i.e. those features that are not naturally formed. These modifications are graded depending on the level of alteration and impact they have on the watercourse, for example brick/laid stone scores 50 at each spot check where it is recorded. The modifications recorded in the RHS are totalled, giving the HMS score. The HMS is then converted into a Habitat Modification Class (HMC), ranging from a pristine or semi-natural habitat to severely modified (refer to **Table 2-3**).

Table 2-3 - Habitat Modification Score (HMS) for Level of Modification

HMS Score	HMC Class	Description
0-16	1	Pristine/semi-natural
17-199	2	Predominantly unmodified
200-499	3	Obviously modified
500-1399	4	Significantly modified
1400+	5	Severely modified

2.5.9. The HQA scoring system provides an indication of the diversity and 'naturalness' of the physical (habitat) structure of a site, including both the channel and river corridor. The HQA score was determined by the presence and extent of habitat features of known wildlife interest recorded during the field survey. Additional points reflect the variety of substrate, flow-types, in-channel vegetation (affected by the presence of fluvial features), and the extent of trees and semi-natural land-use adjacent to the river. Points are added together to provide the HQA (**Ref. 19**).

2.5.10. The RHQ is calculated by calibrating the HMS and HQA scores against data from Benchmark sites (i.e. site of outstanding quality) and assessing potential management impacts (**Ref. 20**) A description corresponding to each of the RHQ scores is shown in **Table 2-4.**

Table 2-4 - River Habitat Quality (RHQ), Condition and Level of Management

RHQ Score	Description	Management
1	Excellent	Protect
2	Good	Maintain and Improve
3	Moderate	Enhance
4	Poor	Rehabilitate
5	Extremely poor	Restore

2.6. FRESHWATER FISH

2.6.1. Electric fishing surveys were undertaken on 18 June 2019.

2.6.2. Electric fishing is the term applied to a process that establishes an electric field in the water in order to capture fish. When exposed to the field, most fish become oriented towards the anode and as the density of the electric field increases, they swim toward it. In close proximity to the anode, they are immobilised.

2.6.3. Electric fishing followed a standard electric fishing method and technique following guidelines developed by the Environment Agency (**Ref. 21, 22** and **23**) and which conformed to British Standard BS EN 14011:2003 Water Quality – Sampling of Fish with Electricity (**Ref. 24**).

2.6.4. Electric fishing was carried out between the points marked on **Figure 9.22: Macroinvertebrate Sampling Locations, Fish Survey & RHS Stretches, Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**). Three surveys were conducted to obtain a clear picture of the fish communities within the three distinct sections of the watercourse next to the A1 carriageway:

a. Upstream of the A1 carriageway crossing, hereafter referred to as Shipperton Burn US

b. Downstream of the A1 carriageway crossing, but upstream, of a bridge and culvert under a small side road, hereafter referred to as Shipperton Burn MID

c. Downstream of the A1 carriageway crossing and downstream of the smaller bridge, hereafter referred to as Shipperton Burn DS

2.6.5. Electric fishing was carried out by a two-person fishing team who waded the watercourse whilst sampling with a backpack machine and hand-held electrode. Three-run catch depletion surveys, whereby surveyors fish the same stretch of river three times, were carried out to provide estimates of fish density and biomass. The downstream and upstream extents of the stretch are enclosed by a stop-net at each end. The fishing team of two worked in an upstream direction, with one surveyor moving the anode side to side and up and down to draw fish towards the current. The second surveyor removed immobilised fish from the electrical field with the use of a dipnet.

2.6.6. Sampled fish were transferred to an aerated container from which they were identified to species level, weighed and measured from the tip of their snout to the end of the middle caudal fin rays (fork length); before being returned safely to the watercourse.

2.6.7. Minimum estimates of fish density and fish biomass were calculated for each survey stretch. The width of the watercourse is measured at 20 m intervals along the river length and is multiplied by the total length to obtain area (m^2). To estimate density, the total number of fish caught is divided by the area surveyed, to produce a minimum estimate for fish per unit area within the stretch. Similarly, for biomass, the total weight of all the fish caught in a survey stretch is divided by the area surveyed, producing a minimum estimate of fish biomass within the stretch.

2.7. ENVIRONMENTAL MEASUREMENTS

2.7.1. Measurements of conductivity, water temperature, dissolved oxygen, and pH were obtained at each macroinvertebrate and fish sampling location using a YSI ProDSS multiparameter meter. The turbidity and flow rate of the watercourse were also measured at the time of sampling.

3. ECOLOGICAL IMPACT ASSESSMENT METHODOLOGY

3.1. OVERVIEW

3.1.1. This section describes the methodology used to identify significant effects of impacts on the relevant ecological receptor. Following this, mitigation measures to ameliorate or remove such effects or impacts are considered. The Ecological Impact Assessment (EcIA) adopts guidance from Chartered Institute of Ecology and Environmental Management (CIEEM) (**Ref. 25**) and the Design Manual for Roads and Bridges (DMRB) Interim Advice Note (IAN) 130/10 'Ecology and Nature Conservation: Criteria for Impact Assessment' (**Ref. 26**).

3.1.2. Ecological receptors have been subject to nature conservation evaluation. The significance of effects has then been assessed taking into account the characterisation of potential impacts (including duration, extent and reversibility) and their consequent effects on important ecological receptors.

3.2. NATURE CONSERVATION EVALUATION

3.2.1. Ecosystems, habitats and species are assigned levels of importance for nature conservation based on the criteria detailed within CIEEM guidance (**Ref. 25**), Interim Advice Note (IAN) 130/10 (**Ref. 26**) and summarised in **Table 3-1** of this report. The rarity, ability to resist or recover from environmental change and uniqueness of an ecological receptor, function/role within an ecosystem and level of legal protection or designation afforded to a given ecological receptor are all factors considered in determining its importance. Consideration has also been given to the importance of the species or habitat and its conservation status at a geographic level taking population size, life cycle, rarity and/or distribution into account.

3.2.2. In addition, the importance of an ecological receptor takes into account any statutory or non-statutory designations, the intrinsic importance of the ecological receptor and whether it supports legally protected or notable species.

Table 3-1 - Importance Criteria

Importance	Criteria
International or European	Ecosystems and Habitats - Ecosystems or habitats essential for the maintenance of: – Internationally designated areas or undesignated areas that meet the criteria for designation; and/or – Viable populations of species of international conservation concern. Species: – Species whose presence contributes to the maintenance of qualifying habitats, communities and assemblages that occur

Importance	Criteria
	within internationally designated sites or within undesignated areas that meet the criteria for such designation. – Resident, or regularly occurring, populations of species that may be considered at an International or European level including those listed on Annexes II, IV and V of the Habitats Directive and Annex I of the Birds Directive, where: • The loss of the population would adversely affect the conservation status or distribution of the species at this geographical stage; or • The population forms a critical part of a wider population at this scale; or • The species is at a critical phase of its life cycle at this scale
UK or National	Ecosystems and Habitats - Ecosystems or habitats essential for the maintenance of: – Qualifying communities and assemblages that occur within nationally designated sites or within undesignated areas that meet the criteria for such designation; and/or – Viable populations of species of national conservation concern. – Areas of ancient woodland. – Habitats listed for their principal importance for biodiversity (Section 41 of the NERC Act 2006). Species: – Species whose presence contributes to: • The maintenance of qualifying habitats, communities and assemblages that occur within nationally designated sites or within undesignated areas that meet the criteria for such designation; or • The maintenance and restoration of biodiversity and ecosystems at a national level, as defined in the Natural Environment and Rural Communities (NERC) Act 2006 Section 41 requirements. – Resident, or regularly occurring, populations of species that may be considered at an International/European (as detailed above), National or UK level including those receiving legal protection (listed within Schedules 1, 5 and 8 of the WCA) or listed for their principal importance for biodiversity or conservation status, where:

Importance	Criteria
	• The loss of the population would adversely affect the conservation status or distribution of the species at this geographical stage; or • The population forms a critical part of a wider population at this scale; or • The species is at a critical phase of its life cycle at this scale
Regional	Ecosystems and Habitats - Ecosystems or habitats essential for the maintenance of: – Populations of species of conservation concern within the region. Species: – Species whose presence contributes to the maintenance and restoration of biodiversity and ecosystems within the region. – Resident, or regularly occurring, populations of species that may be considered at an International, European, UK or National level (as detailed above), where: • The loss of the population would adversely affect the conservation status or distribution of the species at this geographical stage; or • The population forms a critical part of a wider population at this scale; or • The species is at a critical phase of its life cycle at this scale.
County	Ecosystems and Habitats - Ecosystems or habitats essential for the maintenance of: – Populations of species of conservation concern within the authority area. Species: – Species whose presence contributes to the maintenance and restoration of biodiversity and ecosystems within a relevant area such as Northumberland. – Resident, or regularly occurring, populations of species that may be considered at an International, European, UK or National level (as detailed above), where: • The loss of the population would adversely affect the conservation status or distribution of the species at this geographical stage; or • The population forms a critical part of a wider population at this scale; or

Importance	Criteria
	• The species is at a critical phase of its life cycle at this scale.
Local	Ecosystems and Habitats - Ecosystems or habitats essential for the maintenance of: – Populations of species of conservation concern within the local area (for example a Local Nature Reserve). Species: – Species whose presence contributes to the maintenance and restoration of biodiversity and ecosystems at a local level. – Resident, or regularly occurring, populations of species that may be considered at an International, European, UK or National level (as detailed above), where: • The loss of the population would adversely affect the conservation status or distribution of the species at this geographical stage; or • The population forms a critical part of a wider population at this scale; or • The species is at a critical phase of its life cycle at this scale.
Less than Local	Ecosystems or habitats that do not meet the above criteria, i.e., supporting at least populations of species of conservation concern within the local area

3.3. IMPACT ASSESSMENT

CHARACTERISATION OF POTENTIAL IMPACTS

3.3.1. CIEEM (**Ref. 25**) notes that impacts that are likely to be relevant in an assessment are those that are predicted to lead to significant effects (adverse or beneficial) on important ecological receptors. Significant effects are those that undermine the conservation status[1] of important ecological receptors. Knowledge and assessment of construction methods and operational activities, together with the ecological knowledge of ecologists with experience

1 Conservation status for habitats is determined by the sum of the influences acting on the habitat and its typical species that may affect its long-term distribution, structure and function as well as the long-term distribution and abundance of its population within a given geographical area. Conservation status for species is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its population within a given geographical area.

of similar large-scale infrastructure projects, has been used to identify the potential impacts of the project on ecological receptors.

3.3.2. Habitats and species that are considered to have a nature conservation importance of less than local are not considered important ecological receptors[2] in the context of this assessment. Any impact on such a feature as a result of Part B is considered unlikely to have a significant effect on the conservation status of such habitats or species on a local, regional, national or international scale. Therefore, features assessed to be of less than local nature conservation importance have been scoped out of the EcIA.

3.3.3. Characterisation of potential impacts has considered the processes that could lead to effects on ecological receptors, using the range of standard parameters from IAN 130/10, as well as others deemed appropriate (informed by CIEEM's Guidelines). These included whether the impact was positive (beneficial) or negative (adverse), the probability of the impact occurring (certain, probable, unlikely), its complexity (direct, indirect, cumulative), extent, size, duration, reversibility and timing/duration.

SIGNIFICANCE OF EFFECTS

3.3.4. Having characterised importance and potential impacts, proposals for mitigation have been considered, with the aim of avoiding, preventing, reducing or, if possible, offsetting any identified significant adverse effects. After the application of mitigation proposals, where significant effects are likely to occur, the overall significance of the effect has been assessed.

3.3.5. IAN 130/10 does not prescribe a method for determining the significance of ecological effects but does propose significant effect categories which are aligned with other topic areas in the DMRB. These are Neutral, Slight, Moderate, Large or Very Large (Table 3 of IAN 130/10) and are reproduced in **Table 3-2** below.

3.3.6. In all instances, when determining the level of significance of the ecological effect, **Table 3-2** has been used as a guide in association with professional judgement (this is consistent with guidance in IAN 130/10). For example, an effect on a receptor of county level importance could be considered Large if a particularly high proportion of the county resource were to be affected. To determine whether an effect is significant or not, CIEEM's Guidelines would also be considered (in lieu of comparable guidance in the DMRB).

2 An ecological receptor is considered important based on many factors including its rarity, diversity, naturalness, context in the wider landscape, size and distribution as set out in A Nature Conservation Review (Ratcliffe, 1977).

Table 3-2 - Significance Categories of Effects on Ecological Receptors

Significance Category	Typical Descriptors of Effect (Nature Conservation)
Very Large	An impact on one or more receptor(s) of International, European, UK or National importance.
Large	An impact on one or more receptor(s) of Regional importance.
Moderate	An impact on one or more receptor(s) of County or Unitary Authority Area importance.
Slight	An impact on one or more receptor(s) of Local importance.
Neutral	No significant impacts on key nature conservation receptors.

3.4. MITIGATION

3.4.1. The principles of the mitigation hierarchy have been applied when considering potential impacts and subsequent effects on ecological receptors through the following sequential actions:

a. Avoidance;
b. Mitigation;
c. Compensation; and
d. Enhancement.

3.4.2. For the purpose of this assessment, mitigation refers to measures that are considered essential to avoid and reduce adverse impacts of Part B. Compensation refers to measures taken to offset the loss of, or permanent damage to, biological resources through the provision of replacement areas.

3.4.3. The mitigation measures described within this EcIA have been incorporated into the design and construction programme and taken into account in the assessment of residual effects. The mitigation prescribed aims to avoid or negate impacts on ecological receptors in accordance with best practice guidance and UK, English and local government environmental impact, planning and sustainability policies. These mitigation measures include those required to achieve the minimum standard of established good practice together with additional measures to further reduce any adverse impacts of Part B. The mitigation measures include those required to reduce or avoid the risk of committing legal offences.

3.4.4. Mitigation is also designed to produce a net gain for biodiversity where practicable in line with policy and guidelines.

3.4.5. Mitigation measures set out in this ES would be specified as environmental commitments in the contract documents to ensure implementation by the main contractor.

3.4.6. Impacts that are not significant (including those where compliance with regulation is required) would be expected to be avoided or reduced through the application of a Construction Environmental Management Plan (CEMP) and best working practice (e.g. mitigation of potential pollution impacts through adherence to standard best practice and guidelines). Significant ecological impacts are expected to be mitigated through a combination of best practice and typical, proven mitigation methods along with mitigation targeted to specific locations as described in this assessment.

3.5. ASSUMPTIONS AND LIMITATIONS

3.5.1. Surveys were restricted to land for which permission was granted for survey from landowners. As a result, access to the downstream stretch of Shipperton Burn was not possible at the time of the aquatic habitat assessment surveys. Professional judgement was used to infer the likely conditions of the downstream stretch, based on the habitat observed in the upstream stretch, to infer the need for further survey.

3.5.2. Dense vegetation and steep banks limited access to much of White House Burn during the aquatic habitat assessment surveys, limiting the assessment of its suitability for aquatic species. However, an assessment was made based on where the watercourse was visible and whether further survey would be feasible with the limited access to the channel.

3.5.3. Access restrictions prevented surveys for white-clawed crayfish from being completed during the optimal period (mid-July to October), however, in lieu of traditional survey methods which are seasonally constrained, eDNA sampling was undertaken in order to provide a baseline assessment. It should be noted that eDNA sampling is not yet a standalone methodology for legally binding planning and building applications.

3.5.4. There are several limitations to the data obtained from external organisations:

a. Species presence and distribution information is relevant to the period that information was collected, and it is acknowledged that colonisation and movement of species can occur at any time during or after this period.
b. Species may be present in any given area but not necessarily recorded.
c. Data obtained from the government and scientific recording schemes come with good assurances of accuracy and in most cases, would have been verified, however there remains a possibility for errors in data provided.

3.5.5. Overall, the limitations above are not considered to have negatively impacted the results, conclusions or mitigation presented in this assessment.

4. RESULTS

4.1. AQUATIC HABITAT ASSESSMENT

4.1.1. A total of 14 watercourses were identified for walkover survey. Several sites were omitted from further survey, due to being recorded as dry or extremely shallow during the aquatic habitat assessment.

4.1.2. The results from each watercourse walkover survey and any recommended further surveys are provided shown in **Table 4-1**.

Table 4-1 – Results from Watercourse Walkover Surveys

Watercourse Name	Results	Recommended Further Survey
Shipperton Burn U/S	Suitable habitat for fish, aquatic macroinvertebrates	Electric fishing survey Macroinvertebrate survey River Habitat Survey
Shipperton Burn D/S	Access not possible at the time of survey, assumed to contain similar habitat to upstream	Electric fishing Macroinvertebrate survey River Habitat Survey
Kitty Carter Burn U/S	Watercourse dry	Unsuitable for further survey
Kitty Carter Burn D/S	Watercourse dry	Unsuitable for further survey
Tributary of Kitty Carter Burn U/S	Watercourse dry	Unsuitable for further survey
Tributary of Kitty Carter Burn D/S	Watercourse dry	Unsuitable for further survey
White House Burn D/S	Limited access to watercourse due to dense vegetation on banks. Shallow depth at time of survey indicates it is unlikely to support a notable fish or macroinvertebrate community	No further survey recommended
Tributary of White House Burn D/S	Watercourse dry	Unsuitable for further survey

Watercourse Name	Results	Recommended Further Survey
White House Burn U/S	Limited access to watercourse due to dense vegetation on banks. Shallow depth at time of survey making it unlikely to support a notable fish or macroinvertebrate community	No further survey recommended
Denwick Burn U/S	Watercourse dry	Unsuitable for further survey
Tributary of Denwick Burn U/S	Survey not possible due to extreme weather conditions	No further survey recommended – unlikely to contain water as main channel further upstream recorded as dry
Denwick Burn 1 D/S	Survey not possible due to extreme weather conditions	No further survey recommended
Denwick Burn 2 D/S	Watercourse dry	Unsuitable for further survey
Denwick Burn 3 D/S	Watercourse dry	Unsuitable for further survey

4.2. DESK STUDY

4.2.1. The desk study results provided by ERIC NE contained one unconfirmed record from 2016 of two white-clawed crayfish within the Study Area, at Alnwick Lion Bridge (at Ordnance Survey (OS) grid reference NU 18617 13811), approximately 1.9 km south-west of the Order Limits southern extent.

4.2.2. No other records of protected and notable aquatic species within the Study Area from the last 10 years were returned.

WATER FRAMEWORK DIRECTIVE (WFD) STATUS

4.2.3. Within the Order Limits, only one of the watercourses crossing the A1 carriageway was classified for WFD purposes, Kittycarter Burn, known as Embleton Burn from Source to North Sea (GB103022076370) in the Catchment Data Explorer. The Kittycarter Burn is a tributary and joins Embleton Burn approximately 3.9 km immediately east of where it passes under the A1 carriageway.

4.2.4. The 2016 WFD overall status for Embleton Burn was ‘Poor’. The reasons for not achieving good status are listed as a poor classification for fish (for unknown reasons, pending

investigation) and a poor classification for phosphate (caused by a combination of point sources of pollution from private sewage treatment and sewage discharge, and a diffuse source created by runoff of nutrients from surrounding agricultural and rural land).

ENVIRONMENT AGENCY FISH SURVEYS

4.2.5. Fish survey data records for Denwick Burn are summarised in **Table 4-2**. No records were returned for Kittycarter Burn, Whitehouse Burn or Shipperton Burn.

4.2.6. At Golden Moor Farm, less than 250 m east of the nearest point of the A1 carriageway and 500 m from the nearest point of the Order Limits, a total of 15 brown / sea trout *Salmo trutta* and two European eel *Anguilla anguilla* were caught in Denwick Burn.

4.2.7. Further downstream (around 2.8 km downstream, moving south away from the Order Limits) in Denwick Burn, five Atlantic salmon *Salmo salar*, 54 brown / sea trout and three European eel were caught.

Table 4-2 – Environment Agency Fish Survey Data

Site name	NGR	Date	Species name	Latin name	Number
Denwick Burn at Golden Moor Farm	NU2027014600	04/09/2012	Brown / sea trout	*Salmo trutta*	15
			European eel	*Anguilla anguilla*	2
			3-spined stickleback	*Gasterosteus aculeatus*	3
Denwick Burn	NU2136713441	04/09/2012	Atlantic salmon	*Salmo salar*	5
			Brown / sea trout	*Salmo trutta*	54
			European eel	*Anguilla anguilla*	3

4.3. AQUATIC MACROINVERTEBRATES

BIOLOGICAL METRICS

4.3.1. The biological metrics calculated for each individual survey site are presented in **Table 4-3**. A full taxa list is provided in **Appendix B** of this report.

4.3.2. The data indicates that across both sites, the macroinvertebrate assemblages on the Shipperton Burn are not adversely affected by stressors such as pollution, flow pressures

and anthropogenic activities. This is reflected in the WHPT NTAXA and WHPT ASPT EQR scores, which were either exceeding what would be expected under reference conditions or only slightly below.

4.3.3. Both sites had a LIFE EQR score above the guideline threshold of 0.94 which is indicative of potential flow stress, and these sites also had PSI EQR scores greater than 0.7, which is indicative of potential fine sediment stress (**Ref. 27)**.

Table 4-3 - Biological Indices

Site	Date	WHPT-ASPT	WHPT-ASPT EQR	WHPT-NTAXA	WHPT-NTAXA EQR	LIFE	LIFE EQR	PSI	PSI EQR	CCI
Shipperton Burn Upstream A1	08/05/19	6.10	0.89	25	1.10	8.23	0.96	67.16	0.82	8.75
Shipperton Burn Downstream A1	08/05/19	6.09	0.89	31	1.37	8.33	0.98	66.20	0.81	12.17

River Invertebrate Classification Tool (RICT)

4.3.4. RICT analysis was performed on both sites and the data have been compared against the WFD classification scheme; WHPT (WFD Cycle 2). The results are displayed shown in **Table 4-4.**

4.3.5. Both sites achieved Good Ecological Status for the macroinvertebrate biological quality element. Given the single season sample, classification should be viewed as indicative only.

Table 4-4 – RICT Analysis Output

Site	Index	EQR	Class	Confidence of Class (%)	Overall classification
Shipperton Burn upstream A1	WHPT-ASPT	0.88	Good	57.18	**Good**
	WHPT-NTAXA	1.18	High	99.54	
Shipperton Burn downstream A1	WHPT-ASPT	0.88	Good	60.47	**Good**

Site	Index	EQR	Class	Confidence of Class (%)	Overall classification
	WHPT-NTAXA	1.45	High	100	

4.4. WHITE-CLAWED CRAYFISH

4.4.1. The results from the analysis of eDNA for the detection of crayfish and crayfish plague, provided by SureScreen Scientifics are displayed shown in **Table 4-5**.

Table 4-5 – Results from Analysis of Environmental DNA in Shipperton Burn

Site	Species / Receptor	Result
Shipperton Burn	White-clawed crayfish	Negative
Shipperton Burn	Signal crayfish	Negative
Shipperton Burn	Crayfish plague	Negative

4.5. RIVER HABITAT SURVEY

SHIPPERTON BURN UPSTREAM

4.5.1. The survey of the upstream section took place between Ordnance Survey Grid Reference (OSGR) NU1702021985 and NU1657922015. RHS indices can be found in **Appendix D** of this report and photographs of the general character and features of interest can be found in **Appendix E** of this report.

4.5.2. The watercourse upstream of the A1 carriageway was found to be influenced by a range of historical and present-day pressures, such as plantation and agricultural practices. This is reflected in the RHS HMC score of 3 (obviously modified).

4.5.3. The RHQ of the watercourse in this section was 3 (moderate), this is due to the lack of depositional features and limited riparian habitats recorded in the RHS survey.

SHIPPERTON BURN DOWNSTREAM

4.5.4. The survey of the downstream section took place between OSGR NU1706721981 and NU1742122061. RHS indices can be found in **Appendix D** of this report and photographs of the general character and features of interest can be found in **Appendix E** of this report.

4.5.5. The watercourse downstream of the A1 carriageway was found to be heavily impacted by a range of historical and present-day developments, such as infrastructure i.e. roads and bridges. Significant modifications in this reach included two culverts and two weir structures associated with the culverts.

4.5.6. Both historical and present-day development pressures have impacted the watercourse, highlighted by the RHS HMC scoring 5 (severely modified). Several spot checks reported some form of modification, from channel and bank reprofiling, to use of artificial bed materials in the culverts.

4.5.7. The RHQ of the watercourse in this section was 5 (extremely poor), this was due to limited flow types noted (dominated by unbroken standing waves), limited depositional features and a lack of riparian habitats recorded in the RHS survey.

4.6. FRESHWATER FISH

4.6.1. A total of eight brown trout were caught in the electric fishing surveys of Shipperton Burn; two in the upstream stretch, one in the middle stretch and five in the downstream stretch. Fork lengths of the trout ranged between 105 mm and 240 mm. Data from the three fish surveys are summarised in **Table 4-6**.

Table 4-6 – Fish Caught During the Electric Fishing Surveys of Shipperton Burn

Site	Length of survey stretch (m)	Run	Common name	Latin name	No. individuals caught	Fork lengths (mm)
Shipperton Burn US	100	1	Brown trout	*Salmo trutta*	1	181
		2	Brown trout	*Salmo trutta*	1	191
		3	-	-	0	-
Shipperton Burn MID	70	1	Brown trout	*Salmo trutta*	1	240
		2	-	-	0	-
		3	-	-	0	-
Shipperton Burn DS	100	1	Brown trout	*Salmo trutta*	3	105, 144, 170
		2	Brown trout	*Salmo trutta*	1	110
		3	Brown trout	*Salmo trutta*	1	111

4.6.2. The downstream stretch of Shipperton Burn was observed to have the greatest minimum density and biomass estimates of brown trout. The minimum density and biomass estimates of brown trout within the three survey sections are displayed shown in **Table 4-7**.

Table 4-7 – Minimum Density and Biomass Estimates of Brown Trout Within the Three Survey Sections

Site	Species	Density (n/m^2)	Biomass (g/m^2)
Shipperton Burn US	Brown trout	0.008	0.67
Shipperton Burn MID	Brown trout	0.005	0.54
Shipperton Burn DS	Brown trout	0.027	0.80

4.7. ENVIRONMENTAL MEASUREMENTS

4.7.1. The values of various environmental variables, as recorded at the time of sampling, are presented in **Table 4-8**.

Table 4-8 – Environmental Variables Recorded at Macroinvertebrate and Fish Survey Locations

Environmental Variable	Macroinvertebrate Upstream A1	Macroinvertebrate Downstream A1	Fish US	Fish MID	Fish DS
Conductivity (µS/cm)	467.2	497.6	396.0	405.9	406.3
Dissolved oxygen (mg/l)	11.21	11.22	10.45	10.24	10.19
Dissolved oxygen (% saturation)	93	92.6	95.6	96.2	96.4
pH	7.71	7.88	7.83	7.9	7.97
Turbidity	Slight	Slight	Slight	Slight	Slight
Water temperature (°C)	7.2	7.0	11.3	12.5	12.8
Flow	Normal	Normal	Normal	Normal	Normal

5. NATURE CONSERVATION EVALUATION

5.1.1. The receptor valuation and rationale for the fish population of Denwick Burn and fish and macroinvertebrate populations, and habitat of Shipperton Burn are described in **Table 5-1**.

5.1.2. Aside from a single record of two white-clawed crayfish south of the Order Limits returned in the desk study; no records of white-clawed crayfish were obtained for the Study Area. No evidence of white-clawed crayfish was found during targeted surveys and they are therefore considered likely absent from the Order Limits and subsequently scoped out from assessment.

Table 5-1 - Receptor Importance and Rationale

Feature	Importance	Rationale for Importance
Freshwater fish population of Shipperton Burn	Local	Low abundance of brown trout within Shipperton Burn is assessed to be of **Local** importance and is not thought to represent a key feature for fish populations at a county level. This is due to the presence of culverts within the burn presenting a barrier to fish migration, meaning that the connectivity with the rest of the catchment is poor.
Freshwater fish population of Denwick Burn	National	The presence of European protected species downstream of the Order Limits would indicate an International importance for the fish population in Denwick Burn. However, due to the fact that the nearest records are over 1 km downstream of the Order Limits, that the watercourse was recorded as ephemeral where it passes under the A1 carriageway, and the presence of pre-existing culverts under the A1 carriageway, the populations are unlikely to be adversely affected by Part B and are assessed as of **National** importance.
Macroinvertebrate species assemblage in Shipperton Burn	Local	No species of conservation interest were identified in Shipperton Burn, however both the upstream and downstream invertebrate assemblages were assessed as having Good Ecological Status. It is therefore afforded **Local** importance and does not represent a key feature to support macroinvertebrate biodiversity at county level.
Habitat of Shipperton Burn	Local	The riverine habitat of Shipperton Burn is assessed as of **Local** importance. The river was observed to contain many modifications,

Feature	Importance	Rationale for Importance
		especially in the downstream stretch, and presented a moderate to extremely poor habitat quality. However, the burn supports a population of brown trout and reasonably diverse macroinvertebrate assemblage.

6. POTENTIAL IMPACTS

6.1. CONSTRUCTION

6.1.1. During construction, fine sediments and other pollutants may be released into nearby watercourses as a result of direct disturbance to banks or from sediment being re-suspended. This could smother the habitats such as fish spawning grounds and the animals directly.

6.1.2. Light, noise and vibration during construction may result in avoidance behaviour that could result in a loss of refugia, feeding, and breeding habitat during the construction stage.

6.1.3. The use of concrete may raise the pH in nearby watercourses. Concrete is a highly alkaline and corrosive substance that can cause pollution to watercourses and aquatic organisms that is not often easy to detect (**Ref. 28**).

6.1.4. Installation and extension of culverts would result in the permanent loss of habitat, reducing the available niches for aquatic organisms within the river to occupy; in terms of physical space and feeding resources. In turn this could displace populations of certain fish and macroinvertebrate species present within each watercourse It may also cause the direct mortality of macroinvertebrates where culverts are installed/extended.

6.1.5. Construction affiliated impacts are summarised below:

a. Pollution of watercourses through sediment run-off and other pollutants. Potential to smother fish spawning grounds and impact animals directly
b. Disturbance through light, noise and vibration associated within construction activities may result in avoidance behaviour
c. Increase of pH through use of concrete, accidental pollution events or run-off into watercourses
d. Loss and/or degradation of habitat through installation and extension of culverts or watercourse realignment

6.2. OPERATION

6.2.1. The increased speed of the carriageway and potentially increased volume of traffic would result in increased noise and vibration. There may be increased run-off from the carriageway (fuel/oil spillages), polluting nearby watercourses and potentially deteriorating their water quality, causing changes to the aquatic ecology.

6.2.2. In order to extend the carriageway, existing culverts would be widened, and new culverts would be installed over minor watercourses. This would increase shading. This may negatively affect flora and fauna in watercourses by excluding light.

6.2.3. Poorly designed bridges and culverts can act as barriers to aquatic fauna moving up and downstream within river catchments, resulting in reduced populations or complete loss from an area. Elevation drops at either the inlet or outlet of a crossing structure can also present

physical barriers to many animal species, whilst oversized crossings can slow water speed and mean that water is too shallow to allow fish passage.

6.2.4. Installation of an undersized structure in relation to discharge levels in a watercourse may increase velocity and erosion and block animal passage. Constricting the natural flow can also impact processes such as sediment and woody debris transportation downstream, essential for the maintenance of diverse habitat within the river downstream.

6.2.5. Operational impacts can be summarised as follows:

a. Increased noise and vibration from traffic
b. Increased run-off from the carriageway (fuel/oil spillages) polluting nearby watercourses
c. Increased shading from culvert widening potentially causing negative effects to flora and fauna
d. Physical barriers to movement up and downstream through bridges, culverts and elevation drops
e. Water being too shallow to allow fish passage due to oversized crossings
f. Installation of an undersized structure in relation to discharge levels in a watercourse may increase velocity and erosion and block animal passage

7. MITIGATION

7.1. OVERVIEW

7.1.1. The below mitigation items feed into a larger list of prescribed measures to be adhered to through construction of Part B. A full list is provided in **Chapter 9: Biodiversity, Volume 3** of this ES (**Application Document Reference: TR010041/APP/6.3**); those measures of relevance to aquatic species and habitats have been extracted and are described in full below and summarised in **Table 7-2**.

7.1.2. Some of these mitigation measures are relevant to a number of species; all species are referred to in the tables below for consistency between **Chapter 9: Biodiversity, Volume 3** of this ES (**Application Document Reference: TR010041/APP/6.3**) and the other Appendices. Part B specific mitigation measures are illustrated in **Figure 7.10: Landscape Mitigation Plan, Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**).

7.1.3. All but one of the watercourses were assessed as unsuitable for further survey due to limited access to the channel or were dry or extremely shallow during the walkover survey (and therefore unsuitable for further survey). However, it should be noted that following heavy periods of rain, they may hold enough water to facilitate the upstream movement of fish and macroinvertebrates. Therefore, any of the outlined mitigation should be employed for any watercourses holding water at the time of construction and thereafter.

7.2. GENERAL MITIGATION AND AVOIDANCE

7.2.1. Aquatic environmental protection measures should be implemented during the construction stage of Part B in order to limit adverse effects on macroinvertebrates and fish. Such measures include best environmental practice guidance outlined in the Environment Agency's Pollution Prevention Advice and Guidance (**Ref. 28**) and those outlined by the Construction Industry Research and Information Association (CIRIA) guidance (**Ref. 29**).

7.2.2. Construction materials should be stored and maintained away from watercourses. Silt fences or similar should be placed around exposed ground and stockpiles, and early revegetation of the completed elements of Part B should be undertaken to reduce erosion.

7.2.3. Chemicals and fuels should be stored in secure containers away from waterbodies (at least 10 m away if possible). No refuelling of plant and machinery should take place near watercourses.

7.2.4. Noise and vibration during construction should be controlled and kept to the minimum necessary level, to prevent risk of adverse effects on fish.

7.2.5. Lighting using for construction should be switched-off when not in use and, where possible, positioned so as not to spill on to watercourses.

7.3. SPECIFIC MITIGATION AND AVOIDANCE

PHYSICAL DISRUPTION

7.3.1. Where possible, works should be conducted from the bank, and tracking within the channel should be avoided. Should work need to be carried out within a watercourse, then tracking should be minimised and sediment trapping equipment (hessian mats or similar), should be deployed and appropriately maintained. Any displaced substrate should be returned to as close to its original condition as possible upon completion of the works.

USE OF CONCRETE

7.3.2. Water quality should be monitored throughout works involving concrete by suitably trained personnel. This should be carried out using a multi-parameter probe that can accurately detect changes in pH. Should a rise in pH be detected then work should stop until the cause has been identified and resolved.

7.3.3. Appropriate arrangements should be made for the cleaning of equipment that comes into contact with concrete and suitable arrangements should be made for the disposal of cementitious waste. No cementitious materials are to be allowed to enter watercourses.

7.3.4. Appropriate sediment management systems should be deployed and maintained throughout the works to prevent suspended sediment being transported downstream (potentially affecting spawning grounds or causing wider pollution).

WHITE-CLAWED CRAYFISH

7.3.5. Should a crayfish of any species be found during any subsequent works then work should cease until a suitably licensed ecologist is consulted, to identify any crayfish found to species level, and if necessary, to formulate a suitable mitigation plan, should the presence of white-clawed crayfish be confirmed.

MACROINVERTEBRATES

7.3.6. The habitat diversity within the stream should be maintained to continue to provide suitable habitat for the macroinvertebrate taxa recorded and maintain the good conservation value recorded in Shipperton Burn.

7.3.7. Maintaining existing patches of riffles, pools, glides and run habitats, with soft banks to allow for recolonization by emergent and bank vegetation post-works, would provide a variety of habitat for specialist macroinvertebrates to inhabit.

FISH

7.3.8. The proposed works are likely to impact the fish population of Shipperton Burn and therefore appropriate avoidance/mitigation measure should be implemented to prevent damage to or mortality of fish, particularly in relation to the population of native brown trout.

7.3.9. Carrying out works during the brown trout spawning season (recognised as between September and March inclusive) should be avoided.

7.3.10. In relation to Denwick Burn specifically, works should be avoided between September and May (inclusive), due to the desk study returning data for Atlantic salmon caught within 500 m of the Order Limits, when surveyed in 2012.

7.3.11. Should any part of any watercourse need to be impounded during the works, then a fish translocation should be carried out to remove fish from the impoundment. Fish translocation operations would require a permit from the Environment Agency in order to use electric fishing and ancillary equipment (such as hand nets). It should be noted that it can take as long as 20 days to obtain a permit. Such an operation would require careful planning to set-up and drain any coffer dam used.

CULVERT DESIGN RECOMMENDATIONS

7.3.12. With regards to improving fish passage, the design of new, replacement and extended culverts should ideally seek to reduce the impacts at stream crossings by using designs that simulate natural channel conditions.

7.3.13. To maintain habitat connectivity between upstream and downstream stretches of a new culvert location, care should be taken regarding the diameter of the proposed installation. To ensure the average water velocity remains sufficiently low, the culvert should span a width adequate to facilitate the development of a natural channel and bed characteristics within the structure. Ideally this would result in a structure that spans the channel itself and includes an amount of terrestrial land on either bank, to account for especially high flow.

7.3.14. Where a culvert of natural channel width is not possible, structures should be considered to modify the current characteristics, to emulate natural channel conditions. Roughened beds, baffles and refuge areas (such as masonry with cavities), may also increase opportunities for movement through a highly restricted culvert.

7.3.15. Energy dissipaters at box culvert outlets should be installed to reduce harmful impacts to the receiving channel and for minimising natural substrate loss through scour and erosion. Dissipaters include riprap, vegetated ditches and concrete and steel baffles. This would prevent the culvert outlet becoming ‘perched’ above a lowered streambed, presenting a barrier for fish passage. Notching the lip of existing perched culverts may also reduce the barrier for fish passage.

7.3.16. Periodic removal of debris from culverts should take place to ensure they continue to effectively pass water, sediment and debris, and do not present a barrier to animal movement.

7.3.17. In line with recommendations made in the WFD Assessment conducted for Part B (**Appendix 10.2: Water Framework Directive Assessment** of this ES), one of the culverts would maintain a naturalised channel (refer to **Table 7-1**). The design of the culvert along the southern tributary of Kittycarter Burn (proposed culvert 10.1) has taken hydromorphological considerations into account where feasible and appropriate. The culvert would tie into the existing channel and a gravel bed; if appropriate, a low flow channel would be created throughout the length of the new culvert. Further analysis of flow dynamics

would be undertaken during the detailed design stage to inform the selection of the most appropriate material size and grading.

Table 7-1 Mitigation Measures

Culvert	Chainage	Natural Bed
Denwick Burn (1.1)	53470	No
Denwick Burn (2.1)	53850	No
Denwick Burn (3.1)	54080	No
Denwick Burn (5.1)	54600	No
Heckley Fence (6.1)	55300	No
White House Burn (8.1)	56920	No
Kittycarter Burn (9.2)	58600	No
Kittycarter Burn (10.1)	58840	Yes
Linkhall Culvert (13.1)	59275	No
Shipperton Burn (14.1)	60385	No
Rock Culvert (15.1)	58100	No

7.3.18. The replacement of culverts would offer opportunity to improve the performance of certain culverts, for example, where no natural bed is currently provided. This is relevant to the southern tributary of Kittycarter Burn. Baffles would be used to retain the natural bed along the base of the culverts and to create a natural low flow channel.

KITTYCARTER BURN REALIGNMENT

7.3.19. In line with recommendations made in the WFD assessment for Part B (**Appendix 10.2: WFD Assessment** of this ES), the realignment of the tributary of Kittycarter Burn should maintain a similar channel profile and dimensions to the existing watercourse. The design would be further developed during the detailed design stage alongside further consultation with the Environment Agency.

7.3.20. Baffles and a low flow channel with resting areas should be placed within the new channel to provide varied substrate features and flow dynamics within the watercourse channel and to assist the movement of aquatic species.

SURFACE WATER RUNOFF

7.3.21. A surface water drainage system should be installed to compensate for increased runoff from the larger impermeable surface that the carriageway would present. A robust treatment system using filter drains, grassed detention basins, swales and reed beds would achieve sufficient sediment and pollutant removal.

7.4. ECOLOGICAL ENHANCEMENT OPPORTUNITIES

7.4.1. It is recommended that remedial measures are implemented to alleviate the fish passage issues presented on both the box culvert at the A1 carriageway crossing of Shipperton Burn, and the box culvert at the crossing of the side road to the east of the A1 carriageway (connecting the A1 to Charlton Hall Road). Both currently present a significant barrier to movement.

7.4.2. Modifications to existing culverts within the Order Limits should aim to improve fish passage for salmon, trout, eel and lamprey as best possible within the design constraints. This would support a wider Environment Agency project aimed to improve fish passage within the Aln catchment.

7.4.3. Installation of natural substrates like rocks and boulders into existing large culverts can improve the opportunity for passage through improving the roughness of the bed, whilst maintaining the necessary hydraulic capacity.

Table 7-2 - Part B Mitigation Commitments

Measure Type	Measure Reference	Approximate Location	Timing of Measure	Description	Mitigation Purpose or Objective	Specific Consultation or Approval Required
Delivery Mechanisms and Preliminary Activities						
Delivery Mechanism and Preliminary Activity	EC01	Throughout Part B	Pre-Construction	All permits and assents would be requested and granted prior to the commencement of works. This may include for example, but not limited to, an Environment Agency Permit for works in and around watercourses.	To protect sites, habitats and fauna.	Natural England/Environment Agency
Delivery Mechanism and Preliminary Activity	EC02	Throughout Part B	Pre-Construction	Pre-construction surveys would be undertaken to verify and, where required, update the baseline ecological conditions set out in this ES. The scope of the pre-construction surveys would be discussed with Natural England prior to being undertaken and would be specific to each ecological receptor under consideration.	To update the baseline ecological conditions set out in this ES.	Natural England
Delivery Mechanism and Preliminary Activity	EC03	Throughout Part B	Pre-Construction	Prior to construction a suitably qualified (or team of suitably qualified) Ecological Clerk of Works (ECoW) and a named bat licensed ecologist would be appointed and would be responsible for implementation of the Ecological Management Plan (EMP) and measures within the **Outline Construction Environmental Management Plan** (**Outline CEMP**) (**Application Document Reference: TR010041/APP/7.3**) and subsequent CEMP prepared by the main contractor. The ECoW would: – Provide ecological advice over the entire construction programme, at all times as required; – Undertake or oversee pre-construction surveys for protected species in the areas affected by Part B; – Monitor ecological conditions during the construction stage to identify additional constraints that may arise as a result of natural changes to the ecological baseline over time.; – Provide an ecological toolbox talk to site personnel to make them aware of ecological constraints and information, identify appropriate mitigation developed do minimise impacts and make site personnel	To ensure the implementation of the EMP.	None required

Measure Type	Measure Reference	Approximate Location	Timing of Measure	Description	Mitigation Purpose or Objective	Specific Consultation or Approval Required
				aware of their responsibility with regards to wildlife. The toolbox talk would include, as required, all ecological receptors considered within this ES; – Monitor the implementation of mitigation measures during the construction stage to ensure compliance with protected species legislation and commitments within this ES. The ECoW would have previous experience in similar ECoW roles, be approved by the Applicant, and be appropriately qualified for the role. The ECoW would be appointed in advance of the main construction programme commencing to ensure pre-construction surveys are undertaken and any advance mitigation measures required are implemented.		
Delivery Mechanism and Preliminary Activity	EC04	Throughout Part B	Pre-Construction	The main contractor would obtain and comply with the requirements of any protected species derogation licences in respect of works that have the potential to breach applicable conservation legislation necessary to construct Part B. Licensing may be for UK and/or European protected species.	To comply with conservation legislation.	Natural England
Delivery Mechanism and Preliminary Activity	EC05	Throughout Part B	Pre-Construction & Construction	Any tree felling would be carried out by experienced contractors to reduce direct mortality of protected species according to agreed felling methods between contractors and the ECoW.	To protect fauna during removal of habitat.	None required
Delivery Mechanism and Preliminary Activity	EC06	Throughout Part B	Pre-Construction	A pre-commencement inspection by the ECoW would be undertaken within woodland prior to any felling to confirm the absence of dreys between February to September. Where deemed necessary, felling would be supervised by the ECoW.	To protect red squirrel.	None required
Delivery Mechanism and Preliminary Activity	EC07	Throughout Part B	Pre-Construction and Construction	Implementation of and adherence to the measures contained within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) that details efforts taken to avoid, minimise and reduce impacts as a result of Part B construction. This is considered particularly important for works in and around watercourses. This includes measures to avoid	To protect flora and fauna.	None required

Measure Type	Measure Reference	Approximate Location	Timing of Measure	Description	Mitigation Purpose or Objective	Specific Consultation or Approval Required
				disturbance of sensitive species and habitats by noise, dust and air pollution. A pre-commencement walkover survey would be undertaken to confirm the absence of invasive non-native species. Should invasive species be recorded within the construction area, this would be addressed through implementation of the Biosecurity Method Statement (EC08), to be developed at detailed design. These measures have been included within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**).		
Delivery Mechanism and Preliminary Activity	EC08	Throughout Part B	Construction	Given the presence of Schedule 9 invasive non-native species, a Biosecurity Method Statement would be developed and implemented throughout construction. The Method Statement would detail the location and extent of any invasive species or other biosecurity concerns, appropriate measures to control or eradicate the species from an area (if applicable), measures to prevent the spread of the species and good site hygiene practices (such as 'Check, Clean, Dry') (**Ref. 30**).	To prevent the spread of invasive species.	None required
General Mitigation						
General	EC09	Throughout Part B	Pre-Construction & Construction	Site/ vegetation clearance and tree felling would be kept to a minimum and only where essential to facilitate construction, to reduce the impacts of habitat loss and fragmentation. Areas of clearance, particularly those within temporary works, shall be identified within a method statement and agreed with the ECoW. Site clearance of dense vegetation would be undertaken carefully (use of hand tools) and by experienced contractors to reduce the risk of mortality to wildlife. Care should be afforded to dense stands of bramble or similar vegetation, which may be used by sheltering hedgehog or other wildlife, particularly during the winter months.	To reduce the impact to fauna and flora.	None required
General	EC10	Throughout Part B	Pre-Construction, Construction & Post-Construction	Plant and personnel would be constrained to a prescribed working corridor through the use of, where practicable, temporary barriers to minimise damage to habitats and potential direct mortality and disturbance to animals located within and adjacent to the Order Limits.	To protect habitats and fauna.	None required

Measure Type	Measure Reference	Approximate Location	Timing of Measure	Description	Mitigation Purpose or Objective	Specific Consultation or Approval Required
General	EC11	Throughout Part B	Pre-Construction & Construction	Stand-off distances around watercourses and other sensitive habitats (such as woodland) would be implemented prior to commencement of works and clearly demarked on site through the use of physical barriers (fencing, tape or similar). The buffer around trees/ woodland/ hedgerows would be in accordance with good practice to take into account root protection zones.	To protect habitats and fauna.	None required
General	EC12	Throughout Part B	Construction	Works during the construction period would be undertaken during daylight hours (07:00 to 19:00), Monday to Friday to reduce the impact to nocturnal and crepuscular species; particularly bats, barn owl and badger. However, extended hours, including nighttime, would be required for some construction operations. Should night working be required, this would be discussed with the ECoW and appropriate mitigation put in place (particularly concerning lighting). Appropriate mitigation would be determined by the ECoW but is likely to include: – Avoidance of direct lighting on any buildings or trees that contain bat roosts or barn owl nest/ roost sites; – Avoidance of artificial lighting of watercourses, particularly during the hours of darkness to prevent impacts to fish behaviour or passage; – Avoidance of light spill using directional and or baffled lighting; – The use of movement triggers, thus lighting only turns on when people (large objects) move through the area (use within compound); – Reducing the height of lighting columns to reduce light spill onto adjacent habitats; – Variable lighting regimes (VLR) - switching off when human activity levels are low i.e. 21:00 to 05:30; – Avoid use of blue-white short wavelength lights and high UV content. Work during hours of darkness would be avoided as far as practicable and where necessary directed	To reduce disturbance impacts during construction.	None required

Measure Type	Measure Reference	Approximate Location	Timing of Measure	Description	Mitigation Purpose or Objective	Specific Consultation or Approval Required
				lighting would be used to minimise light pollution/glare; – Temporary lighting used for construction would be switched-off when not in use and positioned so as not to spill on to adjacent land, sensitive receptors or retained vegetation within the area surrounding the works; – Directed lighting would be used to minimise light pollution/glare, including for construction compounds; and – Lighting levels would be kept to the minimum necessary for security and safety.		
General	EC13	Throughout Part B	Construction	To prevent entrapment of wildlife, any trenches or voids would be excavated and infilled within the same working day. If this is not possible, the void would be securely covered overnight, or a suitable means of escape provided (such as a ramp at no greater than a 45º angle). Any void would then be visually inspected prior to re-starting works to confirm the absence of entrapped wildlife. All escape measures would be discussed and agreed with the ECoW to ensure they are suitable for the size of void and wildlife that may become trapped. If deemed appropriate, the ECoW may enforce additional measures, such as the installation of temporary amphibian/reptile fencing around the void to prevent entry.	To protect wildlife.	None required
General	EC14	Throughout Part B	Construction & Post-Construction	Planting of detention basins to include a diverse floral community and enhance their attraction to wildlife. A diverse floral community refers to providing a range and mixture of floral species, including flowering plants and grasses, that provide resources and niches to a variety of invertebrates which in turn provide a resource for species that prey on the invertebrates. This would be achieved using a native and locally appropriate seed mix.	To improve the value of detention basins to support biodiversity.	None required
General	EC15	Throughout Part B	Operation	Implementation of an Ecological/Environmental Management Plan to detail the monitoring and maintenance of habitat and mitigation/compensation	To maintain the ecological value of retained and created habitats long-term.	None required

Measure Type	Measure Reference	Approximate Location	Timing of Measure	Description	Mitigation Purpose or Objective	Specific Consultation or Approval Required
				features following creation and installation. The Ecological/Environmental Management Plan would be developed at detailed design. The requirement for an Ecological/Environmental Management Plan is captured within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**).		
Ecological Receptor Specific Mitigation						
Aquatics	AQ01	In or in close proximity to waterbodies/watercourses	Construction	Construction materials would be stored and maintained away from watercourses and waterbodies. Silt fences or similar would be placed around exposed ground and stockpiles, and early re-vegetation of the completed elements of Part B would be undertaken to reduce erosion.	To protect aquatic habitats and species from pollution.	None required
Aquatics	AQ02	In or in close proximity to waterbodies/watercourses	Construction	Chemicals and fuels must be stored in secure containers located away from watercourses and waterbodies. No refuelling of plant and machinery would take place near watercourses.	To protect aquatic habitats and species from chemical and fuel pollution.	None required
Aquatics	AQ03	In or in close proximity to waterbodies/watercourses	Construction	Lighting used for construction would be switched-off when not in use and, where possible, positioned so as not to spill on to watercourses.	To protect aquatic habitats and species from light pollution.	None required
Aquatics	AQ04	In or in close proximity to waterbodies/watercourses	Construction	Any construction works (including enabling works) would be conducted from the bank and tracking within the channel would be avoided. Where work needs to be carried out within a watercourse, then tracking would be minimised and sediment trapping equipment (hessian mats or similar), would be deployed and appropriately maintained. Any displaced substrate would be returned to as close to its original condition as possible upon completion of the works.	To protect aquatic habitats and species from pollution through physical disruption of sediments.	None required
Aquatics	AQ05	In or in close proximity to waterbodies/watercourses	Construction	Water quality would be monitored throughout construction works where working with concrete in or within close proximity (within 10 m) to waterbodies or watercourses is required. Monitoring would be undertaken by suitably trained personnel, with the use of a multiparameter probe that can accurately detect	To protect aquatic habitats and species from concrete pollution.	None required

Measure Type	Measure Reference	Approximate Location	Timing of Measure	Description	Mitigation Purpose or Objective	Specific Consultation or Approval Required
				changes in pH. Should a rise in pH be detected then work would stop until the cause has been identified and resolved. Appropriate arrangements would be made for the cleaning of equipment that comes into contact with concrete and suitable arrangements would be made for the disposal of cementitious waste. No cementitious materials would enter watercourses. Appropriate sediment management systems would be deployed and maintained throughout the works to prevent suspended sediment being transported downstream (potentially affecting spawning grounds or causing wider pollution).		
Aquatics	AQ06	In or in close proximity to waterbodies/watercourses	Construction	Carrying out construction works (including enabling works) within waterbodies during the brown trout spawning season, between September and March, would be avoided. For works within or in close proximity to Denwick Burn (within 10 m), this period would be extended to the end of May[3] (September to May inclusive).	To protect fish species of conservation importance.	None required
Aquatics	AQ07	Waterbodies/watercourses	Construction	Should any part of any watercourse need to be impounded during the works, then a fish translocation would be carried out to remove fish from the impoundment. Fish translocation operations would require a permit from the Environment Agency in order to use electric fishing and ancillary equipment (such as hand nets). It should be noted that it can take as long as 20 days to obtain a permit. Such an operation would require careful planning to set-up and drain any coffer dam used.	To protect fish species of conservation importance and to adhere to Environmental Permitting best practice.	Environment Agency electric fishing authorisation
Aquatics	AQ08	Waterbodies/watercourses	Construction	Should a crayfish of any species be found during any subsequent works then work would cease and a suitably	To protect species of conservation importance and to	None required

[3] Owing to the known presence of brown trout and salmon records in this watercourse as provided by the EA.

Measure Type	Measure Reference	Approximate Location	Timing of Measure	Description	Mitigation Purpose or Objective	Specific Consultation or Approval Required
				licensed ecologist be consulted, to identify any crayfish found to species level, and if necessary, to formulate a suitable mitigation plan, should the presence of white-clawed crayfish be confirmed.	comply with conservation legislation.	
Aquatics	AQ09	Culverts	Construction	New culvert structures (including the Kittycarter Burn) would be designed and installed to modify the current characteristics, to produce a variable flow rate and reduce overall speed of water flow. Roughened beds (addition of rocks and boulders), baffles and refuge areas (such as masonry with cavities) would achieve this.	To facilitate the movement of fish, macroinvertebrates and other aquatic species through the culverts.	None required
Aquatics	AQ10	Culverts	Operation	Periodic removal of debris from culverts would be undertaken.	To prevent blockage and ensure maintenance of hydraulic capacity and movement of animals, sediment and woody / large debris downstream.	None required
Aquatics	AQ11	Throughout Part B	Operation	A surface water drainage system would be installed with a robust treatment system using filter drains, grassed detention basins, swales and reed beds would achieve sufficient sediment and pollutant removal.	Prevent pollution of watercourse by hydrocarbons and sediments from carriageway.	None required
Aquatics	AQ12	Throughout Part B	Pre-Construction and Construction	To minimise the impact to fish from disturbance (including noise, light and vibration), works outside of watercourses would be set back from the watercourse by a minimum of 10 m, where possible.	To reduce the impacts on fish.	None required

8. RESIDUAL IMPACTS

8.1. OVERVIEW

8.1.1. This impact assessment assumes the adoption of the mitigation measures detailed in **Table 7-2** and as such detailed assessment is only provided on residual impacts. Pre-mitigation impact characterisation is provided for clarity, whilst those features assessed as of 'less than local' importance have not been assessed further.

8.1.2. A summary of specific impacts, mitigation and residual impacts (if any) is provided within **Table 8-1**.

8.2. CONSTRUCTION

8.2.1. The significance of effect in relation to direct loss of habitat on watercourses is detailed within **Appendix 9.1: Habitats and Designated Sites** of this ES.

MACROINVERTEBRATES

8.2.2. Mitigation would minimise the volume of sediment entering water courses and settling on substrate. However, it is likely that construction would result small quantities of sediment being deposited in water courses, potentially smothering the macroinvertebrates themselves and micro-habitats and feeding resources within the watercourses that macroinvertebrates occupy and use. As macroinvertebrates can relocate within a watercourse to unaffected areas any effects arising from sediment deposition within watercourses are considered to be **Neutral (not significant).**

8.2.3. The extension of culvert stretches would cause direct loss of habitat (loss of light would reduce growth of their feeding resources (macrophytes and algae) and reduce the availability of suitable cover currently available (rough substrate and macrophytes) for macroinvertebrates. A reduction in feeding resources and physical areas to occupy would be a permanent effect but is assessed as only a **Slight** adverse effect (**not significant**), given that it would simply displace species to suitable habitat elsewhere in the watercourses and is unlikely to impact population sizes.

FISH

8.2.4. Small amounts of sediment entering the watercourse during the construction stage of Part B may temporarily impair feeding resources and cover for fish where any sediment settles. Given that this is likely to be a small quantity and that it would be temporary in nature, the effects are assessed as **Neutral (not significant)** during construction.

8.2.5. Noise from construction in or near to watercourses would likely result in fish moving away from the noise source and vacating otherwise suitable habitat. Providing noise levels are kept to a minimum it is likely that fish would simply relocate up or downstream of the works location and would return once works cease. This impact is therefore assessed to have a **Slight** temporary adverse effect (**not significant**) during construction.

8.2.6. Extension of culverts would cause direct loss of habitat for fish, both in terms of feeding resources (macroinvertebrates) and suitable cover (macrophytes and rough substrate). This would be permanent, however, given that fish would simply be displaced to suitable areas of each watercourse and population size is unlikely to be impacted, the impact is assessed as a **Slight** adverse effect (**not significant**) during construction.

8.2.7. Long culverts, even if appropriately designed, can form barriers to fish due to their reluctance to swim through long unlit sections of watercourse (**Ref. 31, 32** and **33**). The length of the proposed new and extended culverts means that their installation would result in adverse impacts on fish. Due to the design constraints associated with the culvert extensions, the hydraulics indicate a velocity sufficient to prevent the formation of a naturalised bed. Whilst a natural bed is always advised, in this case it is not feasible to incorporate it into the design of the culverts. Therefore, the installation of these structures is likely to adversely affect the distribution and abundance of fish. This may fragment populations and prevent the genetic mixing necessary to maintain healthy and robust populations of fish.

8.2.8. The extension of culverts at Shipperton Burn (proposed culvert 14.1); Kittycarter Burn tributary (proposed culvert 9.2), Kittycarter Burn tributary (proposed Linkhall culvert 13.1) and the tributary of Embleton Burn (proposed culvert 15.1) may prevent watercourses from reaching future 'Good' status for fish under the WFD, by preventing fish passage through these sections of watercourse.

8.2.9. Shipperton Burn was found to contain brown trout, which would suffer directly from loss of feeding habitat. However, the proposed culvert design is an extension of an existing culvert that already presents a barrier to movement. Additionally, downstream of the main culvert (14.1) lies a second smaller culvert with a significant perch, meaning that the impact of extending the main culvert would be minimal on fish migration in the watercourse as a whole.

8.2.10. The proposed culverts on Kittycarter Burn (9.2 and 13.1) are significantly increasing the lengths of the existing culverts, however the watercourse was observed to be dry during the walkover survey, suggesting an ephemeral nature, and both existing culverts already extend over 20 m in length.

8.2.11. A new culvert in the tributary of Embleton Burn (15.1) would create a new barrier through direct loss of light to 17 m of the watercourse. The extension and construction of culverts in Shipperton burn, Kittycarter burn and tributary of Embleton burn represent permanent direct impacts and are collected assessed to result in a **Moderate** adverse effect upon fish.

8.2.12. Denwick Burn (proposed culvert 3.1), Denwick Burn (proposed culvert 5.1), Heckley Fence (proposed culvert 6.1) and White House Burn (proposed culvert 8.1) are assessed as having a '**Slight**' residual impact from loss of light. This is based on the fact that the culverts are already either significant in length and likely to currently pose a significant barrier to any fish in the watercourses, or they are only being extended by a small amount.

8.3. OPERATION

Run-off and spray from the carriageway, from fuel and oil spillages, is likely to enter nearby watercourses where the A1 carriageway crosses them. However, given the pre-existence of a carriageway, the residual impact on aquatic fauna is assessed as **Neutral** (not significant) as it is unlikely to differ significantly from existing conditions.

Table 8-1 - Summary of Specific Impacts, Mitigation, and Residual Impacts (Construction)

Feature	Potential Impact	Characterisation of Impact (Pre-mitigation)	Mitigation	Significance Category
Fish	Disturbance through noise, light and vibration	Extent: – Culverted sections of watercourses Effect: Direct negative Duration: Temporary Frequency and timing: One-time event Reversibility: Reversible Likelihood: Certain Impact descriptor: Low	EC01, EC03, EC07, EC10, EC11, EC12, AQ03, AQ06, AQ12	Slight adverse (Not significant)
Macroinvertebrates	Loss of habitat	Extent: – Culverted sections of watercourses Effect: Direct negative Duration: Permanent Frequency and timing: One-time event Reversibility: Irreversible Likelihood: Certain Impact descriptor: Low	EC01, EC02, EC03, EC07, EC10, EC11, EC15, AQ04, AQ05, AQ07, AQ09	Slight adverse (Not significant)
Fish	Loss of habitat	Extent: – Culverted sections of watercourses, resulting in permanent loss of light Effect: Direct negative Duration: Permanent Frequency and timing: One-time event Reversibility: Irreversible Likelihood: Certain Impact descriptor: Low	EC01, EC02, EC03, EC07, EC10, EC11, EC15, AQ04, AQ05, AQ07, AQ09	Slight adverse (not significant)

Feature	Potential Impact	Characterisation of Impact (Pre-mitigation)	Mitigation	Significance Category
Fish	Loss of light – barrier to movement	Extent: – Culverted sections of watercourses, resulting in permanent loss of light - Shipperton Burn (proposed culvert 15.1); Kittycarter Burn tributary (proposed culvert 9.2); Kittycarter Burn tributary (proposed Linkhall culvert 13.1); Tributary of Embleton Burn (proposed culvert 15.1) Effect: Direct negative Duration: Permanent Frequency and timing: One-time event Reversibility: Irreversible Likelihood: Certain Impact descriptor: Medium	EC01, EC02, EC07, EC10, EC11, EC15	Moderate adverse
Fish	Loss of light – barrier to movement	Extent: – Culverted sections of water course - Denwick Burn (proposed culvert 3.1); Denwick Burn (proposed culvert 5.1); Heckley Fence (proposed culvert 6.1); White House Burn (proposed culvert 8.1) Effect: Direct negative Duration: Permanent Frequency and timing: One-time event Reversibility: Irreversible Likelihood: Certain Impact descriptor: Low	EC01, EC02, EC07, EC10, EC11, EC15	Slight adverse (not significant)

9. CONCLUSIONS

9.1.1. During the construction stage of Part B, there may be increased risk of pollution by chemicals/fuels, disturbed sediments and cementitious materials entering nearby watercourses. Such impacts may reduce the water quality of watercourses and cause a change to the aquatic flora and fauna present. Light pollution, noise and vibration levels may also increase during construction and potentially cause temporary avoidance behaviour by aquatic organisms.

9.1.2. Part B would result in the direct loss of aquatic habitat, through the construction of a series of new culverts and extension of existing culverts, preventing light reaching watercourses. This would directly reduce the amount of feeding and possible breeding habitat available for macroinvertebrates and fish at the location of each extension/new culvert. More significantly, the extensions may adversely affect fish passage through the culverts through these extensions and installation of new culvert structures. However, impacts are assessed to be limited by the fact that extant culverts are proposed to be extended, and already likely act as barriers to fish passage. The inclusion of a single new culvert downstream of an existing culvert is unlikely to further restrict fish passage issues beyond those already posed by the extant culvert.

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Appendix A

RELEVANT LEGISLATION AND PLANNING POLICY

This report has been compiled with reference to relevant wildlife legislation and planning policy.

The Wildlife and Countryside Act 1981, (as amended) (WCA)

Protected birds, animals and plants are listed under Schedules 1, 5, 8 and 9 respectively of the WCA, a description of these Schedules and their meaning is provided below.

Schedule 5

Species listed in Schedule 5 can either be fully protected or be partially protected under Section 9, which makes it unlawful to intentionally:

- Part 1: kill, injure or take;
- Part 2: possess or control (live or dead animal, part or derivative);
- Part 4 (a): damage or destruct any structure used for shelter or protection;
- Part 4 (b): disturb them in a place of shelter or protection;
- Part 4 (c): obstruct access to place of shelter or protection;
- Part 5 (a): sell, offer for sale, possess or transport for the purpose of sale (live or dead animal, part or derivative);
- Part 5 (b): advertise for buying or selling.

Schedule 8

The Act makes it an offence (subject to exceptions) to pick, uproot, trade in, or possess (for the purposes of trade) any wild plant listed in Schedule 8, and prohibits the unauthorised intentional uprooting of such plants.

Schedule 9

Invasive species listed under Schedule 9 are prohibited from release into the wild and the Act prohibits planting or "*causing to grow*" in the wild of any plant species listed in Schedule 9. It should be noted that certain bird species listed on Schedule 1 of the WCA are also listed on Schedule 9 to prevent release of non-native and captive individuals, this includes barn owl, red kite, goshawk and corncrake.

Salmon and Freshwater Fisheries Act 1975

This Act covers regulation of fisheries in England and Wales and includes legislation that covers the introduction of polluting effluents, the obstruction of fish passage (screens, dams, weirs, culverts etc) illegal means of fishing, permitted times of legal fishing and fishing licencing (which covers electric fishing).

Under this act any person who causes or knowingly permits to flow, or puts or knowingly permits to be put, into any waters containing fish or into any tributaries of waters containing fish, any liquid or solid matter to such an extent as to cause the waters to be poisonous or injurious to fish or the spawning grounds, spawn or food of fish, shall be guilty of an offence.

The act also requires that fish passes are installed on new and rebuilt barriers that affect waters frequented by salmon or migratory trout. In the future, it is likely that fish passage facilities would need to be designed to accommodate all fish species and life stages, with nature-like bypass channels being the most appropriate solution currently available.

Natural Environment and Rural Communities (NERC) Act 2006

Species and Habitats of Principal Importance in England and Wales are listed under Section 41 and Section 42 respectively of the NERC Act. The Section 41 and 42 lists detail species that are of principal importance for the conservation of biodiversity in England and Wales and should be used to guide decision-makers such as local and regional authorities when implementing their duty to have regard for the conservation of biodiversity in the exercise of their normal functions – as required under Section 40 of the NERC Act 2006.

Countryside Rights of Way Act 2000 (CRoW Act)

The CRoW Act has amended the WCA in England and Wales strengthening the protection afforded to Sites of Special Scientific Interest (SSSI) and the legal protection for threatened species. It adds the word 'reckless' to the wording of the offences listed under Section 9(4) of the WCA. This alteration makes it an offence to recklessly commit an offence, where previously an offence had to be intentional to result in a breach of legislation.

The UK Post-2010 Biodiversity Framework (2011-2020) (JNCC and DEFRA, 2012)

This Framework lists the UK's most threatened species and habitats and sets out targets and objectives for their management and recovery. The UK Biodiversity Action Plan (BAP) process is delivered nationally, regionally and locally and should be used as a guide for decision-makers to have regards for the targets set by the framework and the goals they aim to achieve. The UK BAP has now been replaced by the UK Post-2010 Biodiversity Framework, however, it contains useful information on how to characterise important species assemblages and habitats which is still relevant (UK Post-2010 Biodiversity Framework, 2012).

The Conservation of Habitats and Species Regulations 2017

The Conservation of Habitats and Species Regulations 2017 consolidate the Conservation of Habitats and Species Regulations 2010 with subsequent amendments. The Regulations transpose Council Directive 92/43/EEC, on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive), into national law. The Regulations came into force on 30 November 2017 and extend to England and Wales (including the adjacent territorial sea) and to a limited extent in Scotland (reserved matters) and Northern Ireland (excepted matters). In Scotland, the Habitats Directive is transposed through a combination of the Habitats Regulations 2010 (in relation to reserved matters) and the Conservation (Natural Habitats &c.) Regulations 1994. The Conservation (Natural Habitats, &c) Regulations

(Northern Ireland) 1995 (as amended) transpose the Habitats Directive in relation to Northern Ireland.

All species listed under Annex IV of the Habitats Directive require strict protection and are known as European Protected Species (EPS). Under Regulation 42 of the Habitats Regulations it is unlawful to:

- Deliberately kill, capture or disturb;
- Deliberately take or destroy the eggs of; and
- Damage or destroy the breeding site/resting place of any species protected under this legislation.

If the Ecologist determines that impacts to an EPS are unavoidable then the works may need to be carried out under a site-specific mitigation licence from Natural England (NE) or Natural Resources Wales (NRW). Low Impact Class licences are also available in both England and Wales for bats and great crested newts. This enables Registered Low Impact Consultants to undertake certain low impact activities reducing the EPS application paperwork and process length.

Certain EPS are also listed under Annex II of the Habitats Directive and are afforded protection by the establishment of core areas of habitat known as Special Areas of Conservation. This means these species are a relevant.

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003

The purpose of the WFD is to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater and for water all waterbodies (unless artificial or heavily modified) to achieve 'good' ecological status.

Ecological Status is expressed in terms of five classes (high, good, moderate, poor or bad). These classes are established on the basis of specific criteria and boundaries defined against biological, physico-chemical and hydromorphological elements. Biological assessment uses numeric measures of communities of plants and animals (for example, fish and rooted plants). Physico-chemical assessment looks at elements such as temperature and the level of nutrients, which support the biology. Hydromorphological quality looks at water flow, sediment composition and movement, continuity (in rivers) and the structure of physical habitat.

The overall Ecological Status of a water body is determined by whichever of these assessments is the poorer. For example, a water body might pass 'Good Status' for chemical and physico-chemical assessments but be classed as 'Moderate Status' for the biological assessment: In this case it would be classed overall as 'Moderate Ecological Status'. To achieve the overall aim of good surface water status, the Directive requires that surface waters be of at least Good Ecological Status and Good Chemical Status. To

achieve High Status, the Directive requires that the hydromorphological Quality Elements are also in place.

When considering the effect of a development or activity on a waterbody it is a regulatory requirement under the WFD to assess if it would cause or contribute to a deterioration in status or jeopardise the waterbody achieving good status in the future.

Animal Welfare Act 2006

If under the control of humans, all fish are classified as protected animals under this act which therefore makes it an offence to cause unnecessary suffering to fish. Considerations as to whether any suffering would be classed as 'unnecessary' include whether or not the suffering could be reasonably avoided/reduced and whether there was any legitimate reason as to why suffering was caused (for example, for the benefit of the animal, compliance with other legislation, the protection of a person or their property).

This act would apply if water was drained from a section of river (cofferdams) or a lake after which fish are left in-situ to asphyxiate. In this instance an offence would be committed unless the person responsible for the site could demonstrate that the removal of the fish prior to drainage was not practical.

This act applies to all fish species although it should be noted that anything that occurs during the normal course of a legal fishing activity is excluded from this act.

The Eels (England and Wales) Regulations 2009

The Eels (England and Wales) Regulations 2009 implement Council Regulation (EC) No 1100/2007 of the Council of the European Union, which required Member States to establish measures for the recovery of the stock of European eel. The regulations apply to England and Wales. They came into force on 15 January 2010 and are to be enacted by 1 January 2015.

They give powers to the regulators (the Environment Agency and Natural Resources Wales) to implement recovery measures in all freshwater and estuarine waters in England and Wales. The aim of the regulations is to achieve 40 per cent escapement of adult eels relative to escapement levels under pristine conditions. The measures, as set out in the legislation, by which this is to be achieved is to reduce fishing pressures, improve access and habitat quality and reduce the impact of impingement and entrainment.

Under the Regulations, the regulators can serve notice to companies detailing their legal obligation to screen intakes and outfalls for eel and/or to remove or modify obstructions to eel migration. However, it is possible for companies to be granted with exemptions if the costs of works greatly exceeds the benefits. In such a situation it is likely the regulator would seek a package of more cost-effective, "*alternative measures*".

Global International Union for Conservation of Nature (IUCN) Red List

Species status assessments are a globally recognised way of identifying conservation priorities. The principles underpinning such assessments are that they should be objective and based on scientific information, and that information on species conservation status and distribution should provide the foundation for making informed decisions about preserving biodiversity at local to global levels.

The IUCN Red List of Threatened Species is the world's most comprehensive inventory of the global conservation status of plant and animal species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. With its strong scientific base, the IUCN Red List is recognized as the most authoritative guide to the status of biological diversity.

Appendix B

AQUATIC MACROINVERTEBRATE TAXA LIST AND CONSERVATION SCORES

Table B-1 - Taxa Lists for Macroinvertebrate Samples, Abundance and Conservation Scores

Taxa	Conservation Score	Shipperton Burn U/S	Shipperton Burn D/S
Amphinemura sulcicollis	2	1	0
Ancylus fluviatilis	1	45	30
Baetis rhodani	1	122	84
Baetis sp.	N/A	34	7
Brachyptera risi	3	1	0
Ceratopogonidae	N/A	0	1
Chironomidae	N/A	303	419
Crunoecia irrorata	3	0	1
Curculionidae	N/A	1	1
Dicranota sp.	N/A	0	1
Dytiscidae	N/A	0	2
Ecdyonurus sp.	N/A	1	4
Ecdyonurus torrentis	2	1	10
Elmis aenea	1	144	193
Eloeophila sp.	N/A	1	1
Empididae	N/A	0	5
Ephemera danica	1	1	3
Ephemera sp.	N/A	9	18
Gammaridae	N/A	0	16
Gammarus pulex	1	200	273
Gammarus pulex/fossarum agg.	N/A	122	101
Glossiphonia complanata	1	1	1
Habrophlebia fusca	2	0	1
Helobdella stagnalis	1	1	0
Hydracarina	N/A	1	3

Taxa	Conservation Score	Shipperton Burn U/S	Shipperton Burn D/S
Hydraena gracilis	1	60	60
Hydropsyche instabilis	4	25	102
Hydropsyche siltalai	1	1	5
Hydropsyche sp.	N/A	19	20
Leptoceridae	N/A	0	1
Leptophlebiidae	N/A	5	0
Limnephilidae	N/A	0	1
Limnephilus lunatus	1	3	3
Limnius volckmari	2	37	21
Limoniidae	N/A	0	1
Lymnaeidae	N/A	2	0
Nemoura sp.	N/A	1	0
Nemurella pictetii	2	2	1
Oligochaeta	N/A	147	79
Oreodytes sanmarkii	2	10	23
Oulimnius tuberculatus	2	4	0
Pisidium sp.	N/A	152	132
Plectrocnemia conspersa	2	0	4
Polycelis felina	3	161	176
Polycentropodidae	N/A	3	0
Potamophylax cingulatus	2	1	0
Potamopyrgus antipodarum	1	219	155
Psychodidae	N/A	1	1
Radix balthica	1	2	3

Taxa	Conservation Score	Shipperton Burn U/S	Shipperton Burn D/S
Rhithrogena semicolorata	2	0	9
Rhithrogena sp.	N/A	0	1
Rhyacophila obliterata	4	1	4
Rhyacophila sp.	N/A	7	11
Scirtidae	N/A	0	1
Sialis lutaria	1	0	1
Simuliidae	N/A	1	2
Simulium sp.	N/A	1	5
Stictotarsus duodecimpustulatus	2	1	0
Tricladida	N/A	51	55
Velia sp.	N/A	0	1

Table B-2 – Conservation Scores for freshwater Invertebrate Species in Great Britain

Conservation Score	Definition
10	RDB1 (Endangered)
9	RDB2 (Vulnerable)
8	RDB3 (Rare)
7	Notable (but not RDB status)
6	Regionally Notable
5	Local
4	Occasional (species not in categories 10-5, which occur in up to 10% of all samples from similar habitats)
3	Frequent (species not in categories 10-5, which occur in > 10-25% of all samples from similar habitats)

2	Common (species not in categories 10-5, which occur in > 25-50% of all samples from similar habitats)
1	Very Common (species not in categories 10-5, which occur in > 50-100% of all samples from similar habitats)

JNCC THREAT CATEGORY DEFINITIONS AND CRITERIA

Endangered (RDB1)

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Taxa whose numbers have been reduced to a critical level or whose habitats have been so dramatically reduced that they are deemed to be in immediate danger of extinction. Included are taxa that are known only as a single population in only one 10 km square, taxa that only occur in habitats known to be especially vulnerable, or taxa that have shown a continuous decline over the last 20 years and now exist in five or fewer 10 km squares.

Vulnerable (RDB2)

Taxa believed likely to move into the Endangered category in the near future. Included are taxa of which most or all of the populations are decreasing because of overexploitation, extensive destruction of habitat or other environmental disturbance, taxa with populations that have been seriously depleted and whose ultimate security is not yet assured; and taxa with populations that may still be abundant, but which are under threat from serious adverse factors throughout their range.

Rare (RDB3)

Taxa with small populations, which are not at present Endangered or Vulnerable, but which are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. Usually, such taxa are not likely to exist in more than 15 10 km squares of the National Grid. This criterion may be relaxed where populations are likely to exist in more than 15 10 km squares but occupy small areas of especially vulnerable habitat.

Notable

Taxa that do not fall within RDB categories 1-3, but which are nonetheless scarce in Great Britain and though to occur in fewer than 100 10 km squares of the National Grid. For some well-recorded groups of invertebrates (e.g. Coleoptera), Notable has been subdivided into Notable A (30 or fewer 10 km squares) and Notable B (31-100 10 km squares).

Regionally Notable

Taxa that are too common nationally to fall within the Notable category, but which are uncommon in some parts of the country. ‘Uncommon’, in this case, means found in five or fewer localities. The region to which this status applies is described for each species.

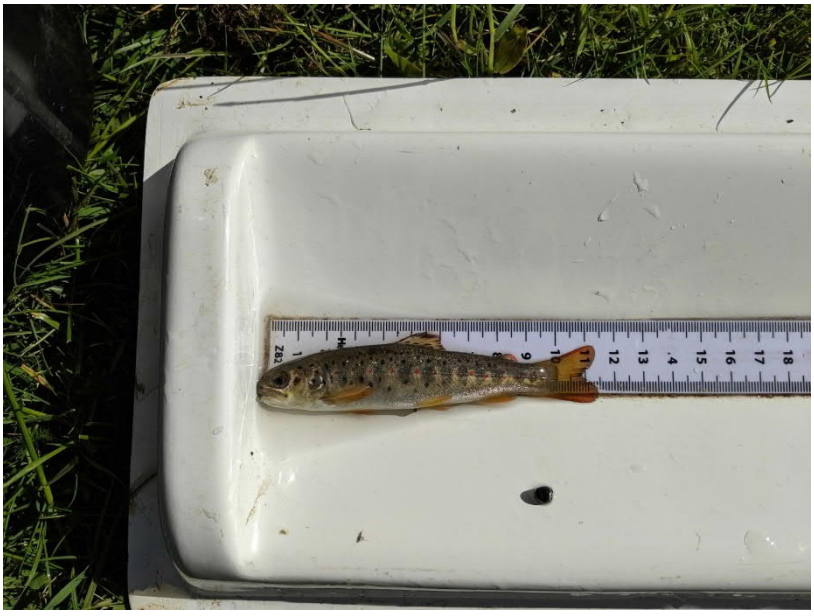
Local

Those species not uncommon enough to fall within any of the preceding categories, but which are nonetheless of some interest. A species may qualify, for example, by being very widely distributed but nowhere common, by being restricted to a specialised habitat such as brackish pools but being a common component of this habitat, or simply by being uncommon but not uncommon enough to be Notable. Species with few records but which are suspected of being badly under-recorded are likely to be placed in the Local category. Local species may also be Regionally Notable.

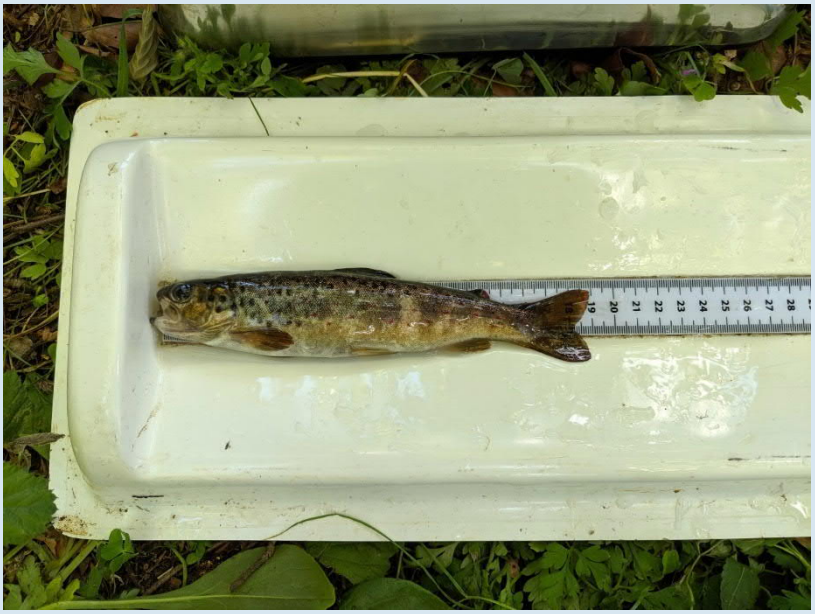
Appendix C

FISH SURVEY – PHOTOGRAPHS

Table C-1 – Fish Survey Photographs

Description	Fish Survey Photographs
Brown trout Shipperton Burn DS	
Brown trout Shipperton Burn DS	

Description	Fish Survey Photographs
Brown trout Shipperton Burn MID	
Brown trout Shipperton Burn US	

Description	Fish Survey Photographs
Brown trout Shipperton Burn US	

Appendix D

RIVER HABITAT SURVEY – INDICES

Table D-1 – RHS indices for Shipperton Burn

Site	Survey Reach	HQA	HMS Score	HMS Class	RHQ Class
Shipperton Burn Upstream A1	U/S: NU1657922015 D/S: NU1702021985	46	365	3	3
Shipperton Burn Downstream A1	U/S: NU1706721981 D/S: NU1742122061	53	1990	5	5

Appendix E

RIVER HABITAT SURVEY – PHOTOGRAPHS

Table E-1 – RHS Photographs: Shipperton Burn Upstream A1

Description	RHS Photographs
General Character 1 – downstream extent	
General Character 2 – middle extent	

Description	RHS Photographs
General Character 3 – upstream extent	
Intermediate weir	

Description	RHS Photographs
Debris dam	
Eroding cliff	

Description	RHS Photographs
Unvegetated side bar	

Table E-2 - RHS Photographs: Shipperton Burn Downstream A1

Description	RHS Photographs
General Character 1 – upstream extent	

Description	RHS Photographs
General Character 2 – middle extent	
General Character 3 – downstream extent	

Description	RHS Photographs
Culvert and major weir (1)	
Culvert and major weir (2)	

Description	RHS Photographs
Minor outfall	
Eroding cliff	

Description	RHS Photographs
Unvegetated point bar	
Unvegetated mid-channel bar	

Description	RHS Photographs
Bedrock	

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