A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010041

6.3 Environmental Statement – Chapter 10 Road Drainage and The Water Environment

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

Development Consent Order 20[xx]

Environmental Statement

Regulation Reference:	APFP Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010041
Application Document Reference	TR010041/APP/6.3
Author:	A1 in Northumberland: Morpeth to Ellingham Project Team, Highways England

Version	Date	Status of Version
Rev 0	June 2020	Application Issue

CONTENTS

TABLES

10 ROAD DRAINAGE AND THE WATER ENVIRONMENT

10.1 INTRODUCTION

10.1.1. This chapter presents the assessment of likely significant environmental effects as a result of Part B: Alnwick to Ellingham (Part B) on road drainage and the water environment.

10.1.2. The chapter identifies, where appropriate, proposed mitigation measures to prevent, minimise or control the likely adverse road drainage and the water environment effects arising from construction and operation of Part B and the subsequent residual effects.

10.1.3. This chapter is intended to be read alongside four standalone documents that are included as technical appendices within **Volume 8** of this Environmental Statement (ES) (**Application Document Reference: TR010041/APP/6.8**), as follows:

a. **Appendix 10.1: Flood Risk Assessment**
b. **Appendix 10.2: Water Framework Directive Assessment**
c. **Appendix 10.3: Drainage Network Water Quality Assessment** (using the Highways Agency [now Highways England] Water Risk Assessment Tool (HAWRAT))
d. **Appendix 10.4: Drainage Strategy Report**

10.1.4. This chapter should also be read together with **Appendix 4.2: Environmental Consultation, Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**) and the introductory chapters of this ES (**Chapters 1 to 4**), **Volume 1** of this ES.

10.1.5. A full description of Part B, along with the Scheme as a whole is provided in **Chapter 2: The Scheme, Volume 1** of this ES (**Application Document Reference TR010041/APP/6.1**). An assessment of combined effects of Part B is set out in **Chapter 15: Assessment of Combined Effects** of this ES and combined and cumulative effects of the Scheme are set out in **Chapter 16: Assessment of Cumulative Effects, Volume 4** of this ES (**Application Document Reference: TR010041/APP/6.4**).

10.1.6. **Section 4.3** of **Chapter 4: Environmental Assessment Methodology, Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**) identifies any differences in the assessment
methodology employed for Part A: Morpeth to Felton (Part A) and Part B. Further to this, there are other differences between the chapters for Part A and Part B. All key differences include:

a. There are differences between Part A and Part B that relate to the scoping process, for example elements that are scoped in and out of the assessment. Refer to the **Scoping Report** (**Application Document Reference: TR010041/APP/6.10**) and **Scoping Opinion** (**Application Document Reference: TR010041/APP/6.12**) for Part A, and the **Scoping Report** (**Application Document Reference: TR010041/APP/6.11**) and **Scoping Opinion** (**Application Document Reference: TR010041/APP/6.13**) for Part B.

b. The monitoring sections of this chapter for Part A and Part B are different due to main rivers in Part A needing additional monitoring and as there are no main rivers within the Study Area for Part B.

c. A geomorphological assessment was undertaken for Part A as a result of the proposed new River Coquet Bridge and the sensitivity of the River Coquet, and through consultation with the Environment Agency. This assessment was not required for Part B.

d. A FRAP would only be required for Part A as there are no main rivers crossed by Part B.

e. Part B contains detailed baseline information relating to existing drainage. Part A does not present the equivalent information as surveys of existing drainage will be undertaken at detailed design, although the information available is sufficient for the assessment.

f. Part A proposes numerous new or replacement culverts that have been designed with a natural gravel bed, whereas Part B would compromise the replacement of only one culvert (the remainder are extensions of existing culverts). As a result, the mitigation measures for each watercourse regarding natural beds to facilitate the movement of aquatic species for Part A (refer to **Section 10.9**) consider mammal ledges, baffles and low flow channels. These are not reported for Part B as they are not appropriate for the culverts.

10.2 COMPETENT EXPERT EVIDENCE

10.2.1. **Table 10-1** below demonstrates that the professionals contributing to the production of this chapter have sufficient expertise to ensure the completeness and quality of this assessment.

Table 10-1 – Relevant Experience

Name	Role	Qualifications and Professional Membership	Experience
Stephanie Haberfield	Author	MSc Environmental Consultancy BSc (Hons) Geography Member of the Chartered Institution of Water and Environmental Management (MCIWEM)	Water and Flood Risk Consultant 5 years' experience in water and flood risk impact assessment. Other recent relevant experience includes: - Discipline lead for Forder Valley Link Road - Discipline lead for small highway projects including A31 Ringwood and M4 J15 - Technical lead for Water Environment ES chapter for a new tourist facility in Wales

Name	Role	Qualifications and Professional Membership	Experience
Sarah Hamilton	Reviewer	Doctor of Philosophy MSc Geomorphology and Environmental Change Chartered member of the Chartered Institution of Water and Environmental Management Chartered Water and Environmental Manager (C.WEM) Chartered Environmentalist (CEnv)	Principal Water and Flood Risk Consultant 14 years' experience in water and flood risk impact assessment. Other recent relevant experience includes: - Discipline lead for Spalding North West Relief Road - Discipline lead for Corridor Highways Improvement Study at Dawsons Corner, Dyneley Arms and Fink Hill - Discipline lead for Water Environment ES chapter and Flood Risk Assessment for Dissington Garden Village including 2,000 dwellings
Joanna Goodwin	Approver	MEng (Hons) Civil Engineering Design and Management Post Graduate Diploma Water and Environmental Management Post Graduate Diploma Integrated Management of Freshwater Environments Chartered member of the Chartered Institution of Water and Environmental Management Chartered Water and Environmental Manager (C.WEM)	Water and Flood Risk Associate 16 years' experience in water and flood risk impact assessment. Other recent relevant experience includes: - Technical reviewer for Spalding North West Relief Road - Technical reviewer for Northampton North West Relief Road - Discipline lead for the Hereford Southern link road and Hereford Western Bypass - Discipline lead for the Smart Motorway Programme for the M27, A1 (M) and M62

10.3 LEGISLATIVE AND POLICY FRAMEWORK

LEGISLATIVE FRAMEWORK

10.3.1. The management of water resources is governed by a range of legislative guidance set out in international, national and regional policies and plans. This assessment has been prepared whilst taking these plans and policies into account.

10.3.2. The coordination of policies for the water environment is managed by the UK Government. Many flood risk and water quality requirements are set at European level, which are then transposed into UK law. The Environment Agency has a strategic overview regarding the management of all the sources of flooding and an operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries and tidal sources. The Lead Local Flood Authority (LLFA) is responsible for managing the risk of flooding from local sources, comprising surface water, groundwater and ordinary watercourses.

10.3.3. The legislative framework applicable to road drainage and the water environment is summarised as follows:

International

Water Framework Directive (2000/60/EC)

10.3.4. The overall objective of the Water Framework Directive (WFD) (**Ref. 10.1**) is to bring about the effective co-ordination of water environment policy and regulation across Europe. The main aims of the legislation are to ensure that all surface water and groundwater reaches 'Good' status (in terms of ecological and chemical quality and water quantity, as appropriate), promote sustainable water use, reduce pollution and contribute to the mitigation of flood and droughts.

10.3.5. The WFD (**Ref. 10.1**) also contains provisions for controlling discharges of dangerous substances to surface waters and groundwater and includes a 'List of Priority Substances'. Various substances are listed as either List I or List II substances, with List I substances considered the most harmful to human health and the aquatic environment. The purpose of the directive is to eliminate pollution from List I substances and reduce pollution from List II substances.

Groundwater Directive (2006/118/EC)

10.3.6. The Groundwater Directive (**Ref. 10.2**) aims to set groundwater quality standards and introduce measures to prevent or limit pollution of groundwater, including those listed within the 'List of Priority Substances'. The Directive has been developed in response to the requirements of Article 17 of the WFD (**Ref. 10.1**), specifically the assessment of the chemical status of groundwater and objectives to achieve 'Good' status.

Floods Directive (2007/60/EC)

10.3.7. The key objective of the Floods Directive (**Ref. 10.3**) is to coordinate the assessment and management of flood risks within Member States. Specifically, it requires Member States to

assess whether all watercourses and coastlines are at risk of flooding, map the flood extent, flood assets and humans at risk in these areas, and take adequate and coordinated measures to reduce this risk.

National

Flood and Water Management Act 2010

10.3.8. The Flood and Water Management Act 2010 (**Ref. 10.4**) extends the role of the LLFA (in this case Northumberland County Council (NCC)), set out in the Flood Risk Regulations 2009 (**Ref. 10.5**) to take responsibility for leading the co-ordination of local flood risk management in their areas. In accordance with the Flood and Water Management Act (**Ref. 10.4**) the Environment Agency is responsible for the management of risks associated with main rivers, the sea and reservoirs. LLFAs are responsible for the management of risks associated with local sources of flooding such as ordinary watercourses, surface water and groundwater.

Environmental Permitting (England and Wales) Regulations 2016

10.3.9. The Environmental Permitting (England and Wales) Regulations 2016 (**Ref. 10.6**) replaced the Water Resources Act 1991 (**Ref. 10.7**) as the key legislation for water pollution in the UK. Under the Environmental Permitting Regulations (**Ref. 10.6**), it is an offence to cause or knowingly permit a water discharge activity, including the discharge of polluting materials to freshwater, coastal waters, relevant territorial waters or groundwater, unless complying with an exemption or an environmental permit. An environmental permit is obtained from the Environment Agency. The Environment Agency sets conditions which may control volumes and concentrations of particular substances or impose broader controls on the nature of the effluent, taking into account any relevant water quality standards from EC Directives, as set out above.

10.3.10. The Environment Permitting Regulations (**Ref. 10.6**) also manages works that have the potential to affect a watercourse under the jurisdiction of the Environment Agency. Any works in, under or near a main river requires permission from the Environment Agency to ensure no detrimental impacts on the watercourse. Previously, this was a Flood Defence Consent; however, in April 2016 consent for flood risk activities was included under these Regulations.

Land Drainage Act 1991

10.3.11. Local Authorities and Internal Drainage Boards have additional duties and powers associated with the management of flood risk under the Land Drainage Act 1991 (**Ref. 10.8**). As Land Drainage Authorities, consent must be given for any permanent or temporary works that could affect the flow within an ordinary watercourse under their jurisdiction to ensure that local flood risk is not increased.

10.3.12. The Land Drainage Act (**Ref. 10.8**) specifies that the following works will require formal consent from the appropriate authority:

a. Construction, raising or alteration of any mill dam, weir or other like obstructions to the flow of a watercourse.
b. Construction of a new culvert.
c. Any alterations to an existing culvert that would affect the flow of water within a watercourse.

10.3.13. The Land Drainage Act (**Ref. 10.8**) also sets out the maintenance responsibilities that riparian owners have to reduce local flood risks. Riparian owners, who are land owners with a watercourse either running through their land or adjacent to, have the responsibility to ensure that the free flow of water is not impeded by any obstruction or build-up of material within the watercourse.

POLICY

National Planning Policy

10.3.14. The national policy relevant to the Road Drainage and the Water Environment assessment and the significance of Part B on the policy objectives is outlined in **Table 10-2** below.

Local Planning Policy

10.3.15. Local planning policy relevant to the road drainage and the water environment and the significance of Part B on the policy objectives is outlined in **Table 10-3** below. NCC are currently in the process of updating their Local Plan (**Ref. 10.9**). The Consolidated Planning Policy Framework (**Ref. 10.10**) details the saved policies from the former district area of Alnwick (which is relevant to Part B). The relevant saved policies are detailed below.

Table 10-2 – National Planning Policy Relevant to Road Drainage and the Water Environment

Policy	Relevant Policy Objectives	Significance of Part B on Policy Objective
National Policy Statement for National Networks (NPS NN) (2014) (**Ref. 10.11**)	Flood risk is covered as a generic impact in paragraphs 5.90 to 5.115, which outline that: - The scheme should be supported by a Flood Risk Assessment (FRA) in accordance with the National Planning Policy Framework (NPPF) (2019). - Surface water discharge should be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project. - Opportunities can be taken to lower flood risk by improving flow routes, flood storage capacity and using Sustainable Drainage Systems (SUDS). Road drainage and the water environment is also referred to in the following sections of the NPS NN: - Pollution control and other environmental protection regimes: paragraphs 4.48 to 4.56. - Water quality and resource is discussed in paragraphs 5.219 to 5.231.	A **Flood Risk Assessment** (**FRA**) (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) has been prepared which includes a **Drainage Strategy Report** (**Appendix 10.4**, **Volume 8** of this ES). The drainage strategy details the volumes and peak flow rates and demonstrates how they would not be increased as well as the SUDS components that have been incorporated into design of Part B. The potential impacts of spillages and routine runoff have been assessed in the **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 8** of this ES). The assessment demonstrates how Part B would not impact water quality from surface water runoff.
National Planning Policy Framework (NPPF) (2019) (**Ref. 10.12**)	Section 14 – "*Meeting the challenge of climate change, flooding and coastal change of the NPPF*" requires a FRA to be prepared to assess the potential impacts of flooding on and as a result of the scheme and ensure that the scheme is sequentially appropriate which may involve passing the exception test if required.	An **FRA** (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) has been prepared to assess the risks of flooding to and from Part B and details the sequential suitability of Part B in terms of the Sequential and Exception Tests set out in the NPPF (**Ref. 10.12**). The assessment also details how climate change has been taken into account.
Infrastructure Act and Highways England Licence (2015) (**Ref. 10.13**)	This outlines the requirements in terms of the water environment for: - Protecting and enhancing the environment. - Ensuring best practicable environmental outcomes. - Cumulative impacts and partnership working. This is covered in paragraph 5.23 which states that Highways England should protect the environment, mitigate any impacts and improve environmental performance along with adapting the network for a changing climate.	Part B would meet the requirements of the Highways England licence. This is detailed in the **FRA** (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) which considers the impacts of climate change and the **Drainage Strategy Report** (**Appendix 10.4**, **Volume 8** of this ES) which outlines measures to improve the environment through incorporating water quality mitigation measures into Part B.

Table 10-3 – Local Planning Policy Relevant to Road Drainage and the Water Environment

Policy	Relevant Policy Objectives	Significance of Part B on policy objective
Northumberland Local Plan: Draft Plan for Consultation (January 2019) (**Ref. 10.9**)	The following policies are considered relevant to the assessment of Part B: Policy WAT 1 (Water quality) sets out to ensure that development does not prevent the objectives of the WFD (**Ref. 10.1**) from being achieved, and where possible will improve the local water environment. The policy also states that development should avoid any reduction on 'high' status of surface water bodies.	The potential impacts of spillages and routine runoff have been assessed in the **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)). The assessment demonstrates how Part B would not impact water quality from surface water runoff.

Policy	Relevant Policy Objectives	Significance of Part B on policy objective
	Policy WAT 3 (Flooding) sets out to ensure that development proposals minimise local flood risk to people, property and infrastructure from all sources of flooding through the following principles: - Locating development in areas not at risk of flooding, taking into account future climate change, and if applicable using a sequential approach to locating development to areas at lowest risk of flooding. - Development proposals should be made resistant and resilient through appropriate mitigation measures. Built development proposals should minimise and control surface water runoff using SUDS. The hierarchy for surface water should be the following: - To a soakaway system, unless it can be demonstrated that this is not feasible due to poor infiltration due to the underlying ground conditions. - To a watercourse, unless there is no alternative or suitable receiving watercourse available. - To a surface water sewer; as a last resort once all other methods have been explored. Policy WAT 4 (Sustainable Drainage Systems) sets out to ensure that SUDS are considered to minimise and control surface water runoff. The policy also sets out a requirement for the management and maintenance of SUDS to be taken into consideration for the lifetime of the development.	A **WFD Assessment** (**Appendix 10.2**, **Volume 8** of this ES) assesses Part B and its compliance with the WFD (**Ref. 10.1**). The assessment concludes that Part B has no detrimental impact or change to the WFD status of the three WFD catchments across the Study Area with the appropriate mitigation measures implemented. An **FRA** (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) has been prepared which details the mitigation measures that form part of Part B to ensure that there is no increase in flood risk as a result of Part B. The **Drainage Strategy Report** (**Appendix 10.4**, **Volume 8** of this ES) details the volumes and peak flow rates and demonstrates how they would not be increased as well as the SUDS components that have been incorporated into the design of Part B.
Alnwick District Wide Local Plan (1997) (**Ref. 10.14**)	There is one saved policy that is applicable to this assessment: Policy CD33 sets out to ensure that new development is not located in areas of known flood risk and will not increase local flood risk elsewhere as a result of the development.	An **FRA** (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) details the mitigation measures that form part of Part B to ensure that there is no increase in flood risk as a result of Part B. A **Drainage Strategy Report** (**Appendix 10.4**, **Volume 8** of this ES) details the volumes and peak flow rates and demonstrates how they would not be increased.

GUIDANCE

10.3.16. The following guidance documents have been used during the preparation of this chapter:

Design Manual for Roads and Bridges (DMRB)

10.3.17. The assessment has been undertaken in accordance with the methodology detailed within DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.15**). This section of the DMRB sets out the recommended approach to the assessment of road schemes on the water environment. To assess the significance of effects from Part B on the road drainage and water environment, the guidelines within Annex IV of DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.15**) have been followed. Specifically, DMRB (HD 45/09) (**Ref. 10.15**) provides a framework for assessing risks associated with polluted surface water runoff (Method A), accidental spillages (Method D) and flood risk (Methods E and F) and provides guidance on mitigation to manage these risks. Methods A and D have been used to inform **Appendix 10.3: Drainage Network Water Quality Assessment**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**). Since the assessments reported in this ES were completed, a number of DMRB guidance documents have been superseded and updated with revised guidance, further information is provided in **paragraphs 10.4.20** to **10.4.23**.

Highways England Policies

10.3.18. Highways England is committed to reducing the risk of pollution to watercourses. The treatment of priority outfalls contributes to Highways England's Key Performance Indicator which is as follows:

"*Mitigate the potentially adverse impact of strategic roads and take the opportunity to enhance the environment taking into account value for money*".

10.3.19. If a new outfall is identified as posing a risk and is not on the Priority Outfalls Register, steps should be taken as outlined in 'Highways Agency [now Highways England] – Guidance for Assessing Priority Outfalls on Highways Agency [now Highways England] Roads' (**Ref. 10.16**). This includes assessing the outfall using Methods A, B and D as set out in DMRB (HD 45/09) (**Ref. 10.15**).

10.3.20. No priority outfalls have been identified within the Order Limits according to Highways Agency [now Highways England] Drainage Data Management System (HADDMS) (**Ref. 10.17**). It should be noted that there are a number of outfalls classified as 'not determined', these are discussed in **Section 10.7**.

10.3.21. Priority culverts on the drainage network that are undersized have the potential to lead to a flooding incident during heavy precipitation. Identifying a priority culvert allows remedial and improvement works to be undertaken, reducing the risk of flooding occurring. There are no priority culverts along Part B. There is one flooding hotspot located within the Study Area according to the HADDMS online database (**Ref. 10.17**). This is located adjacent to South Charlton and further information can be found in **paragraph 10.7.66**.

Non-Statutory Technical Standards for Sustainable Drainage Systems 2015

10.3.22. The Non-Statutory Technical Standards for Sustainable Drainage Systems (**Ref. 10.18**), published by Defra in March 2015, set out the core technical standards for SUDS proposed within England. These standards should be used in accordance with the NPPF (**Ref. 10.12**) and Planning Practice Guidance (**Ref. 10.19**). The standards include guidance on controlling flood risk within a development boundary and elsewhere, peak flow and runoff volume control, and the structural integrity of SUDS.

Northumberland Local Flood Risk Management Strategy 2015

10.3.23. Northumberland's Local Flood Risk Management Strategy (LFRMS) (**Ref. 10.20**) provides information and technical guidance on how flood risk will be managed within Northumberland. The LFRMS (**Ref. 10.20**) sets out five local objectives and details a number of measures and an action plan that will be implemented to achieve the objectives. Objective Two is considered relevant to the assessment of flood risk for Part B. The five local objectives are:

a. Improve knowledge and understanding of flood risk throughout Northumberland.
b. Promote sustainable development to reduce local flood risk with consideration to the anticipated impact of climate change.
c. Actively manage flood risk and drainage infrastructure to reduce likelihood of flooding throughout Northumberland.
d. Encourage communities to become more resilient to flooding by increasing public awareness and understanding their concerns.
e. Be better prepared for flood events and post flood recovery.

Northumbria River Basin Management Plan 2015

10.3.24. The Northumbria River Basin Management Plan (RBMP) (**Ref. 10.21**) issued by the Environment Agency provides a framework for the protection and enhancement of the local water environment. The RBMP (**Ref. 10.21**) contains the baseline classifications against the objectives of the WFD (**Ref. 10.1**), statutory objectives for both protected areas and water bodies and sets out measures to achieve the statutory objectives.

Environment Agency Groundwater Protection Guides

10.3.25. The Environment Agency is the statutory body responsible for the protection and management of groundwater resources in England. The groundwater protection guides (**Ref. 10.22**) published in March 2017 set out the framework for Environment Agency regulation and replaces Groundwater Protection: Principles and Practice GP3. Section C: Infrastructure of the Environment Agency's approach to groundwater protection guidance document (**Ref. 10.22**) is of key importance to transport proposals. In summary, Section C sets out the Environment Agency's position statements and approach to managing and protecting groundwater in relation to infrastructure developments.

Pollution Prevention Guidelines

10.3.26. The Pollution Prevention Guidelines (PPGs) (**Ref. 10.23**) issued by the Environment Agency have now been withdrawn, although a number of these guidelines are still considered best practice and are relevant to design and construction of Part B. In particular, PPG1 provides practical advice on site drainage, PPG5 provides guidance for works in, near, or liable to affect watercourses, and PPG6 provides guidance on the control of water pollution during construction and demolition stages of works. Compliance with these PPGs (**Ref. 10.23**) should be considered as part of the environmental management documentation developed for construction and occupation / operational stages of the development.

The Planning Inspectorate, Advice Note 18 The Water Framework Directive

10.3.27. Advice Note 18 (**Ref. 10.24**) provides guidance to ensure that the Examining Authority is able to report to the Secretary of State on the effects of Part B on the relevant RBMP and whether or not Part B has implications for the UK's obligations under the WFD (**Ref. 10.1**). The advice note therefore provides:

a. An introduction to the legal context and obligations placed on both the decision maker and the Applicant by the WFD (**Ref. 10.1**) and The Water Environment (WFD) (England and Wales) Regulations 2017 (**Ref. 10.25**).
b. An explanation of the relationship between the WFD Assessment, the Environmental Impact Assessment (EIA) and Habitat Regulation Assessment (HRA).
c. Advice regarding the relevant bodies that should be consulted by the Applicant during the process of preparing a DCO application in respect of the WFD (**Ref. 10.1**), and the suggested timing and level of that engagement.
d. A clarification of the process and information to be provided with a DCO application with respect to WFD (**Ref. 10.1**).
e. Advice on the presentation of the information using optional screening and assessment matrices.

Flood Risk to People

10.3.28. The Environment Agency and Defra produced the Flood Risks to People Methodology (FD2321/TR1 (**Ref. 10.26**) and FD2321/TR2 (**Ref. 10.27**) along with the supplementary note) to assist in improving flood risk management by enabling the completion of a multi-criteria assessment based on the concepts of flood hazard, area vulnerability and people vulnerability. This assists in raising awareness of the dangers of flood water, targeting flood warning, emergency planning, development control and flood mapping. The multi-criteria assessment is based upon factors that affect flood hazard, the chance of people in the floodplain being exposed to the hazard (area vulnerability) and ability of those affected to respond effectively to flooding (people vulnerability).

10.4 ASSESSMENT METHODOLOGY

10.4.1. This section sets out the scope of the assessment which has been determined via the **Scoping Report** (**Application Document Reference: TR010041/APP/6.11**) for Part B and

Scoping Opinion (**Application Document Reference: TR010041/APP/6.13**) for Part B. **Appendix 4.1: Scoping Opinion Response Tracker**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**) provides a summary of the Scoping Opinion comments received from the Planning Inspectorate, along with the responses which have informed the scope, methodology and assessment in this chapter.

SCOPE OF ASSESSMENT

10.4.2. As presented within the **Scoping Report** (**Application Document Reference: TR010041/APP/6.11**) for Part B, **Scoping Opinion** (**Application Document Reference: TR010041/APP/6.13**) for Part B and **Scoping Opinion Response Tracker** (**Appendix 4.1**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**)), the following topics have been assessed for both construction and operation in this chapter:

a. The chemical and hydromorphological status of surface water features such as watercourses and ponds.
b. Surface water abstractions that could be affected by changes to flow or water quality.
c. Groundwater quality and groundwater features that could be affected by surface-borne pollutants, such as Source Protection Zones (SPZs) and groundwater abstractions.
d. Flood risk to Part B, and elsewhere as a result of Part B.

10.4.3. The following aspects of the assessment have been scoped out of the assessment as detailed in the **Scoping Report** (**Application Document Reference: TR010041/APP/6.11**) for Part B, **Scoping Opinion** (**Application Document Reference: TR010041/APP/6.13**) for Part B and **Scoping Opinion Response Tracker** (**Appendix 4.1**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**)):

a. Effects on the quality, quantity and flow of groundwater resources not associated with surface-borne pollutants (such as surface water runoff and spillages). Risks to the quality, quantity and flow of groundwater resources associated with other aspects such as contaminated land or barriers to the flow of groundwater are discussed in **Chapter 11: Geology and Soils** of this ES.
b. Effects on ecology, including sensitive and/or important aquatic species and habitats. These effects are discussed in **Chapter 9: Biodiversity** of this ES.

10.4.4. Water voles *Arvicola amphibious* are not considered to be a constraint to Part B due to the absence of definitive field signs suggesting a resident population and the presence of American mink *Neovison vison*. For more information regarding water voles refer to **Chapter 9: Biodiversity** of this ES.

CONSULTATION

10.4.5. **Table 10-4** provides a summary of the consultation undertaken in support of the preparation of this chapter. The meeting minutes from the consultation meetings are provided in **Appendix 4.2: Environmental Consultation**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**). Consultation regarding the drainage strategy

is detailed in **Appendix 10.4: Drainage Strategy Report**, **Volume 8** of this ES. (**Application Document Reference: TR010041/APP/6.8**).

Table 10-4 – Summary of Consultation

Consultee	Date and Type of Consultation	Summary of Consultation Response	Action
Environment Agency and NCC as LLFA	1 November 2018 Meeting	Discussion regarding stakeholder requirements and review the available flood information and agree (in principle) appropriate mitigation and management options during construction and operation. Methodology for the FRA and WFD (including hydromorphological assessment) was discussed and it was agreed that consultation regarding the surface water drainage strategy would be through NCC as LLFA.	Methodology for FRA and WFD Assessment (including HAWRAT) agreed – no further action required.
NCC as LLFA	16 May 2019 Teleconference	Discussion regarding the results of the hydraulic modelling undertaken and review the proposals and proposed mitigation for Part B, and discuss and address specific areas of concern, in particular the proposals along the tributaries of Kittycarter Burn for Part B.	Complete the sensitivity testing for the tributaries of Kittycarter Burn. For details regarding the hydraulic modelling refer to the **FRA** (**Appendix 10.1, Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**))
NCC as LLFA	29 May 2019 Teleconference	Follow up discussion regarding the sensitivity testing hydraulic model results for the tributaries of Kittycarter Burn and appropriate mitigation measures.	Lowering of the bank has been included as part of the design of Part B and it would be remodelled as part of detailed design. This approach has been agreed with NCC via

Consultee	Date and Type of Consultation	Summary of Consultation Response	Action
			telephone on 5 December 2019.

METHODS OF BASELINE DATA COLLECTION

Desk Study

10.4.6. The baseline data collected and presented in this chapter were sourced by a desktop study informed by the data sources set out below including a site walkover of Part B (excluding compounds) conducted on 13 and 14 February 2019.

a. Environment Agency's online Flood map for Planning (accessed May 2019) (**Ref. 10.28**).
b. Environment Agency's online Long Term Flood Risk Map (accessed July 2018) (**Ref. 10.29**).
c. Environment Agency's groundwater data available on MAGIC online mapping (accessed July 2018) (**Ref. 10.30**).
d. Environment Agency's Catchment Data Explorer (accessed May 2019) (**Ref. 10.31**).
e. Northumbria River Basin Management Plan (dated December 2015) (**Ref. 10.21**).
f. Observations made from site walkovers (13 and 14 February 2019)
g. **Ground Investigation Report** (**Appendix 11.3**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)).
h. **Aquatic Ecology Assessment Report** (**Appendix 9.10**, **Volume 8** of this ES).
i. **Otter and Water Vole Report** (**Appendix 9.3**, **Volume 8** of this ES).
j. British Geological Survey (BGS) Geology of Britain viewer (accessed May 2019) (**Ref. 10.32**).
k. BGS Geoindex online dataset (accessed July 2018) (**Ref. 10.33**).
l. Cranfield University's Soilscapes (accessed July 2018) (**Ref. 10.34**).
m. Historical maps (accessed December 2018) (**Ref. 10.35**).
n. HADDMS (Accessed July 2018) (**Ref. 10.17**).
o. Aerial imagery (Google Earth) (accessed May 2019).
p. Ordnance Survey (OS) mapping.
q. MAGIC online mapping (accessed May 2019) (**Ref. 10.30**).
r. Topographic survey (undertaken November 2018).
s. Coal Authority's (CA) online screening tool (Accessed May 2019) (**Ref. 10.36**).

10.4.7. The **Aquatic Ecology Assessment Report** (**Appendix 9.10**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) and the **Otter and Water Vole Report** (**Appendix 9.3**, **Volume 8** of this ES) was required for the ecological assessment. During the initial ecological walkover surveys the habitat suitability to potentially support

specific species was identified. For more information regarding the ecological surveys refer to **Chapter 9: Biodiversity** of this ES.

METHODOLOGY

10.4.8. The methodology adopted for the assessment of impacts of Part B on the water environment is based on the principles set out in the methodology outlined within the DMRB Volume 11, Section 3, Part 10: Road Drainage and the Water Environment HD 45/09, November 2009 (**Ref. 10.15**). The assessment of potential effects as a result of Part B has considered both construction and operation.

10.4.9. This chapter is supported by four standalone technical reports contained within **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**), as follows:

a. **Appendix 10.1: Flood Risk Assessment**
b. **Appendix 10.2: Water Framework Directive Assessment**
c. **Appendix 10.3: Drainage Network Water Quality Assessment** (using the HAWRAT)
d. **Appendix 10.4: Drainage Strategy Report**

10.4.10. The methodologies undertaken for the appendices are detailed in the standalone reports, and an outline provided below.

Flood Risk Assessment

10.4.11. The hydraulic analysis of each culvert was agreed with the Environment Agency and NCC as the LLFA and was undertaken using one of the following methods:

a. A short 1D hydraulic model incorporating the local channel and other structures using Flood Modeller Pro. This approach was used for Denwick Burn and its tributaries, White House Burn, the tributaries of Kittycarter Burn and Shipperton Burn.
b. A hydraulic assessment of the structures using Culvert Master. This approach was used for all remaining watercourses not listed above, namely a culvert at Heckley Fence and a tributary of Embleton Burn.

10.4.12. Once the initial hydraulic analysis was complete, the geometry of the structure was assessed for the following:

a. Physical constraints – including the depth of cover to the carriageway and local utility service locations.
b. Mammal passage – the incorporation of a route that remains accessible in flood conditions.
c. Fish passage – low flow channels, baffles or a natural bed.
d. Access requirements – culverts greater than 12 m should be 1.2 m diameter (subject to flood risk and physical constraints).

Water Framework Directive Assessment

10.4.13. Determination of WFD compliance comprised a series of steps intended to establish the potential impacts of Part B at an appropriate level of detail using available information, and then to examine whether the identified impacts contravene the objectives of the WFD.

10.4.14. The general assessment process was as follows:

a. Identify WFD water bodies in the Study Area with potential to be affected by Part B.
b. Obtain information to identify the current status and objectives for the water bodies, important features such as linked protected areas and relevant habitats, and improvement measures set out in the RBMP.
c. Identify the aspects of Part B with potential to affect WFD water bodies, embedded mitigation included in the design proposals for Part B and consideration of further specific mitigation where necessary.
d. For those criteria where a potential adverse effect has been identified, assessment of Part B (including mitigation) against the individual quality elements to determine if these effects are sufficient to cause a deterioration in the quality status of each element.
e. Assessment of Part B (including mitigation) to determine if Part B would impact upon the proposed mitigation measures and objectives for the water bodies and objectives for individual quality elements.
f. Assessment of Part B against the wider catchment objectives and aims of the WFD (**Ref. 10.1**).
g. Where applicable, application of the Article 4.7 test. The Article 4.7 test sets out the conditions a scheme must meet if it is predicted to cause deterioration in water body status or prevent the water body from meeting any of its objectives. For more information regarding Article 4.7 refer to the **WFD Assessment** (**Appendix 10.2**, **Volume 8** of this ES (**Application Document Reference: TR10041/APP/6.8**)).

Drainage Network Water Quality Assessment

10.4.15. The assessment of risks to water quality during the operation of Part B has been undertaken in accordance with the methods outlined in DMRB (HD 45/09) (**Ref. 10.15**). The assessments use the Highways Agency [now Highways England] Water Risk Assessment Tool (HAWRAT).

10.4.16. The approach includes Method A and Method D of DMRB (HD 45/09) (**Ref. 10.15**):

a. Method A was used to assess pollution impacts from routine runoff to surface waters.
b. Method D was used to assess pollution impacts from accidental spillage.

10.4.17. Method B, which is a more detailed quantitative assessment, was not used as Part B passes Method A and so it was not required. Method C was not used as there is no proposed discharge of runoff to ground due to high groundwater levels, based on the results of the **Ground Investigation Report** (**Appendix 11.3**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)). All proposed attenuation features would be lined to prevent infiltration.

Human Health

10.4.18. Further consideration of human health impacts are set out in **Chapter 12: Population and Human Health** of this ES.

GUIDANCE

10.4.19. The guidance documents that have been used for the preparation of this chapter are set out in **paragraphs 10.3.16** to **10.3.28**.

Updated DMRB Guidance

10.4.20. Since the assessments reported in this ES were completed, a number of DMRB guidance documents have been superseded and updated with revised guidance. For the Road Drainage and the Water Environment assessment the following guidance document, which was used in the preparation of this assessment, has been superseded:

a. DMRB HD 45/09 Road Drainage and the Water Environment (**Ref. 10.15**).

10.4.21. This guidance document has been replaced by DMRB LA 113 Road Drainage and the Water Environment (**Ref. 10.37**), which was released in March 2020.

10.4.22. To determine the implications of the updated guidance to the conclusions of the ES, a sensitivity test has been undertaken to identify key changes in the assessment methodology and determine whether there would be changes to the significant effects reported in this ES if the updated guidance had been used for the assessment.

10.4.23. The findings of the sensitivity test are detailed in **Appendix 10.5: Road Drainage and the Water Environment DMRB Sensitivity Test**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**) and is summarised in **Section 10.10** and in **Appendix 4.5: DMRB Sensitivity Test, Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**).

ASSESSMENT CRITERIA

10.4.24. To assess the significance of effects from Part B on the road drainage and the water environment, the guidelines within Annex IV of DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.15**) have been followed.

Importance of Receptor Criteria

10.4.25. The significance of identified effects has been assessed based on the magnitude of change due to Part B and the importance of the affected receptor. The importance of the affected receptor is assessed on a scale of very high, high, medium and low. Guidance for estimating the importance of water environment attributes and receptors is provided in Table A4.3 in the DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.15**). **Table 10-5** below summarises the criteria as applicable to this assessment.

Table 10-5 – Criteria used to Estimate the Importance of Receptors

Importance	Criteria	Typical Examples
Very High	Attribute has a high quality and rarity on regional or national scale	- Water Framework Directive Class 'High' - Site protected/designated under EC or UK habitat legislation (SAC, SPA, SSSI, SPZ, Ramsar site, salmonid water) - Species protected by EC legislation - Provides a regionally important water supply resource
High	Attribute has a high quality and rarity on local scale	- Water Framework Directive Class 'Good' - Species protected under EC or UK habitat legislation - Provides a locally important water supply resource
Medium	Attribute has a medium quality and rarity on local scale	- Water Framework Directive Class 'Moderate' - Provides water for agricultural or industrial use
Low	Attribute has a low quality and rarity on local scale	- Water Framework Directive Class 'Poor' - Does not provide water supply

Magnitude of Impact Criteria

10.4.26. The magnitude of impact is assessed on a scale of major adverse, moderate adverse, minor adverse, negligible, minor beneficial, moderate beneficial and major beneficial. Guidance for estimating the magnitude of an impact on an attribute or receptor is provided in Table A4.4 in the DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.15**). **Table 10-6** below summarises the criteria as applicable to this assessment.

Table 10-6 - Criteria used to Estimate the Magnitude of an Impact on Receptors

Impact Magnitude	Criteria	Typical Examples
Major Adverse	Results in loss of attribute and / or quality and integrity of the attribute	- Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A) and compliance failure with environmental quality standard values (Method B).

Impact Magnitude	Criteria	Typical Examples
		- Calculated risk of pollution from a spillage > 2% annually (Method D).
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	- Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A) but compliance with environmental quality standard values (Method B). - Calculated risk of pollution from spillages > 1% annually and < 2% annually (Method D).
Minor Adverse	Results in some measurable change in attribute's quality or vulnerability	- Failure of either soluble or sediment-bound pollutants in HAWRAT (Method A). - Calculated risk of pollution from spillages > 0.5% annually and < 1% annually (Method D).
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use of integrity	- No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants) (Method A). - Risk of pollution from spillages < 0.5% (Method D).
Minor Beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring	- HAWRAT assessment of either soluble or sediment-bound pollutants becomes a Pass from an existing site where the baseline was a Fail condition. - Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is < 1% annually).
Moderate Beneficial	Results in moderate improvement of attribute quality	- HAWRAT assessment of both soluble and sediment-bound pollutants becomes a Pass from an existing site where the baseline was a Fail condition. - Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is > 1% annually).

Impact Magnitude	Criteria	Typical Examples
Major Beneficial	Results in major improvement of attribute quality	- Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring.

Significance of Effects

10.4.27. The significance of the effect is assessed on a scale of neutral, slight, slight/moderate, moderate, moderate/large, large, large/very large and very large. The potential effects can be either positive or negative. Guidance for estimating the significance of an impact is provided in Table A4.5 in the DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.15**). **Table 10-7** below summarises the criteria as applicable to this assessment.

Table 10-7 - Criteria used to Estimate the Significance of Potential Effects

		Magnitude of Potential Impact			
		Negligible	**Minor**	**Moderate**	**Major**
Importance of Receptor	**Very High**	Neutral	Moderate or Large	Large or Very Large	Very Large
	High	Neutral	Slight or Moderate	Moderate or Large	Large or Very Large
	Medium	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Slight	Slight or Moderate

FUTURE BASELINE

10.4.28. The most likely change in the baseline conditions in the future would be associated with an increase in peak river flows and peak rainfall intensity associated with the potential effects of climate change. The Environment Agency provide guidance (**Ref. 10.38**) on a range of potential climate change allowances dependant on the relevant river basin district and climate change probability. Part B is located within the Northumbria River Basin District. In this region it is predicted that by 2115 peak river flows could increase by 20% (central allowance), 25% (higher central allowance) and 50% (upper end allowance). This may

increase the frequency of flood risk to identified receptors and increase the extent of Flood Zones 2 and 3, resulting in a greater area of Part B at risk of fluvial flooding.

10.4.29. The peak rainfall intensity may also increase as a result of climate change, which could potentially increase the risk of surface water flooding to Part B. The Environment Agency provides guidance (**Ref. 10.38**) on the central and upper end allowances for all of England. The total potential change anticipated up to 2115 is 20% (central allowance) and 40% (upper end allowance).

10.4.30. Increases in peak rivers flows and peak rainfall intensity have been taken into account in the assessment of flood risk as discussed within **Appendix 10.1: FRA**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**) and design of the proposed drainage system, as discussed in **Appendix 10.4: Drainage Strategy Report, Volume 8** of this ES.

10.4.31. Future sea level rise associated with climate change may decrease the distance between Part B and the tidal limit for the River Aln, Embleton Burn and Long Nanny. The Environment Agency provides guidance (**Ref. 10.38**) on the cumulative sea level rise for 2115 in the North West and North East using 1990 as a baseline, indicating a rise of 0.99 m in sea level. The minimum Scheme elevation is approximately 60.09 mAOD at the southern part of Part B. The tidal limit for the River Aln, Embleton Burn and Long Nanny are approximately between 5 and 25 mAOD, this indicates the future baseline at Part B is unlikely to be impacted by future sea level rise.

10.4.32. The **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) uses two-way 24-hour Annual Average Daily Traffic (AADT) flow data developed as part of the transport assessment for Part B. The traffic model has considered the future baseline as part of the assessment presented in this chapter and has taken into consideration future developments that are likely to be progressed along the affected road network. Further details on the transport assessment undertaken can be found in **Chapter 4** of the **Case for the Scheme** (**Application Document Reference: TR010041/APP/7.1**).

10.5 ASSESSMENT ASSUMPTIONS AND LIMITATIONS

10.5.1. This assessment is based on the current design of the proposed surface water drainage system and watercourse crossings which is the basis for the detailed design stage. Whilst it is considered unlikely that the design would change, further modelling of the surface water drainage system and the hydraulic models used to inform the design of the watercourse crossings would be undertaken as the detailed design stage of Part B progresses.

10.5.2. An **Outline Construction Environmental Management Plan** (**Outline CEMP**) (**Application Document Reference: TR010041/APP/7.3**) has been produced and accompanies the DCO application. The Register of Environmental Actions and Commitments (REAC) in **Chapter 3** of the **Outline CEMP** would ensure that mitigation measures identified during this assessment are delivered.

10.6 STUDY AREA

10.6.1. The Study Area encompasses surface water features up to 0.5 km from the Order Limits. Based on professional judgement using knowledge and experience of similar schemes and current knowledge of the area this distance is considered appropriate for the assessment of direct effects (i.e. associated with overland migration of pollutants directly to surface features, pollutants conveyed in drainage systems, and works within a river channel) due to the relatively flat and vegetated topography, vegetation removing sediment pollutants and upper soil filtration.

10.6.2. Surface water features that have hydraulic connectivity with Part B have also been assessed. This includes watercourses and other water environment receptors that are located downstream of Part B, and that could be affected by pollutants conveyed by watercourses. A 1 km Study Area is typical for the assessment of water environment features however, this has been refined based on the sensitivity of downstream receptors and the likelihood of these being affected by the proposed works.

10.6.3. The Study Area encompasses groundwater features and groundwater abstractions up to 1 km from the Order Limits. This distance is appropriate for the assessment of surface-borne pollutants migrating to groundwater features as there are unlikely to be any significant impacts beyond this distance due to underlying geology and the majority of the underlying soils being slowly permeable, loamy and clayey.

10.6.4. The Study Area for the assessment of flood risk has been defined by the extent by which flood risk may be influenced and the extent of the relevant Flood Zones. This is driven by the need to consider the impact of Part B to people and property elsewhere, regardless of their location, although for a scheme such as this it is typical to consider risks up to 1 km from the Order Limits, as there are unlikely to be any impacts beyond this distance. If the assessment indicated an increased risk at a distance further than 1 km from the Order Limits, the Study Area would be extended accordingly, but as a result of this assessment this was not required.

10.6.5. **Figure 10.1: Water Constraints Plan**, **Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**) shows the alignment of Part B and the 0.5 km and 1 km Study Areas for the assessment of the impacts resulting from the construction and operation of Part B.

10.7 BASELINE CONDITIONS

10.7.1. This section provides a description of the current baseline conditions with respect to the water environment and has been divided into the Part B Main Scheme Area including the Charlton Mires Site Compound, the Lionheart Enterprise Park Compound (eastern site and western site) and the Main Compound. The main surface water features within the Study Area that may be affected by Part B are identified in **Figure 10.1: Water Constraints Plan**, **Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**). A location plan is also provided in **Figure 1.1: Location Plan: Part B**, **Volume 1** of this ES

(**Application Document Reference: TR010041/APP/6.1**) and **Location Plan** (**Application Document Reference: TR010041/APP/2.1**) that accompanies the DCO application.

PART B MAIN SCHEME AREA INCLUDING CHARLTON MIRES SITE COMPOUND

Existing Surface Water Features

10.7.2. The main alignment would cross five watercourses and associated tributaries that may be impacted by the Part B Main Scheme Area. These are listed below from south to north:

a. Denwick Burn and its tributaries
b. White House Burn
c. Tributaries of Kittycarter Burn
d. Tributary of Embleton Burn
e. Shipperton Burn

Denwick Burn and Tributaries

10.7.3. The source of Denwick Burn is just to the west of the existing A1 alignment to the south of Heckley Fence. The catchment of the watercourse is gently sloping towards the watercourse from both the east and west. It has an approximate upstream catchment area of 3.8 km² and consists primarily of agricultural land. Denwick Burn and its tributaries flow in a north to south-east direction underneath the existing A1 alignment at four locations to the north of the village of Denwick. Denwick Burn discharges into the River Aln approximately 4.4 km downstream from the alignment in the Part B Main Scheme Area. The watercourse is classified as an ordinary watercourse under the jurisdiction of NCC as LLFA.

10.7.4. Denwick Burn and its tributaries flow through a number of crossings underneath the A1, farm access tracks and a public right of way, as labelled in **Image 10-1** below.

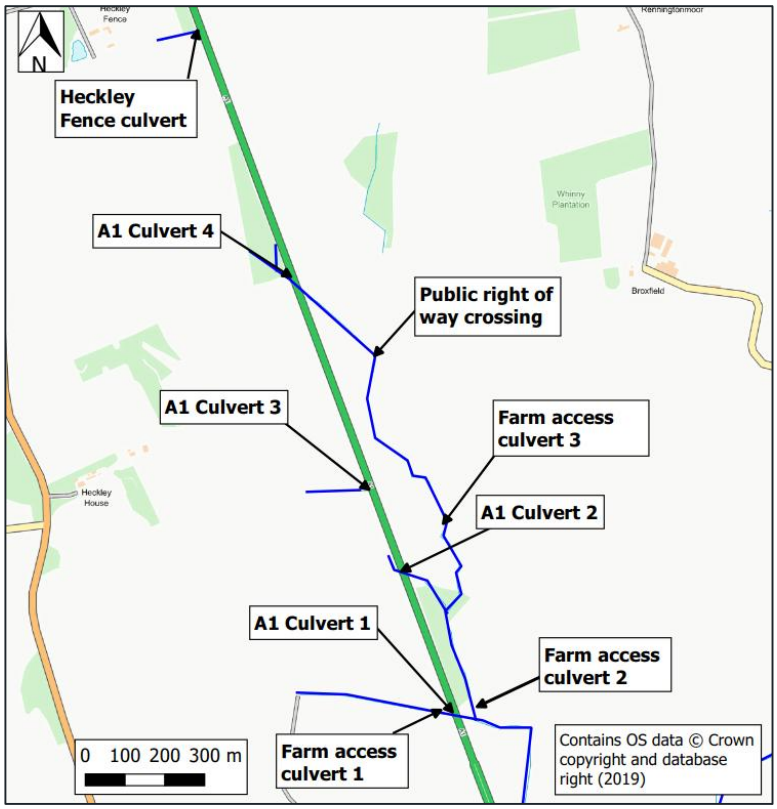

Image 10-1 - Denwick Burn and Tributaries Existing Structures

10.7.5. A detailed description of these crossings (from north to south) is provided below.

10.7.6. A small field ditch at Heckley Fence flows adjacent to the A1 and into a 36 m long circular culvert with a diameter of 300 mm as shown in **Image 10-2** below. The culvert then discharges into another culvert which runs parallel to the A1 for approximately 580 m to the south and discharges into the Denwick Burn.

10.7.7. During the site walkover a small inlet on the eastern side of the A1 was observed in line with the Heckley Fence culvert. It is assumed that this collects surface water runoff from fields to the east of the A1 and connects into the Heckley Fence culvert as no separate ditch or watercourse was observed during the walkover.

Image 10-2 - Heckley Fence Culvert Inlet

10.7.8. Denwick Burn flows underneath the A1 through culvert 4 as labelled in **Image 10-1**. **Image 10-3** and **Image 10-4** show the inlet and outlet of the structure. The circular culvert has a diameter of approximately 1.2 m and is approximately 72.3 m in length.

Image 10-3 - Denwick Burn A1 Structure 4 Culvert Inlet

Image 10-4 - Denwick Burn A1 Structure 4 Culvert Outlet

10.7.9. Approximately 230 m downstream of culvert 4, Denwick Burn flows beneath a public right of way (PRoW) through a bridge as shown in **Image 10-5** below. The watercourse crossing is approximately 700 mm in width and approximately 895 mm in height. The bridge is approximately 4.5 m in length. During the site walkover it was noted that downstream of the crossing the channel banks were concrete walls for approximately 20 m.

Image 10-5 - Public Right of Way Denwick Burn Crossing

10.7.10. Approximately 500 m downstream of the PRoW bridge Denwick Burn flows beneath a farm access track, labelled as farm access culvert 3 in **Image 10-1**. **Image 10-6** below shows the concrete inlet of the concrete circular pipe which is approximately 600 mm in diameter and 10 m in length.

Image 10-6 - Farm Access Denwick Burn Crossing 3

10.7.11. Another tributary of Denwick Burn flows beneath the A1 through a concrete circular pipe labelled as A1 culvert 3 in **Image 10-1**. The culvert has an approximate diameter of 600 mm and is approximately 21.25 m in length and is shown in **Image 10-7** below. At the outlet of the culvert there is approximately 2 m of open channel before the watercourse enters another culvert. It is assumed that the watercourse discharges into Denwick Burn to the south-east of the A1, however during the site walkover the outlet of the downstream culvert was not identified.

Image 10-7 - Denwick Burn A1 Structure 3 Culvert Inlet

10.7.12. A tributary of Denwick Burn flows beneath the A1 labelled as culvert two in **Image 10-1**. The culvert, shown in **Image 10-8** below, is circular with a diameter of approximately 300 mm and is approximately 86.9 m in length. The tributary discharges into Denwick Burn approximately 100 m downstream from the watercourse crossing.

Image 10-8 - Denwick Burn A1 Structure 2 Culvert Inlet

10.7.13. Denwick Burn flows beneath a farm access track, labelled farm access culvert 2 in **Image 10-1** and as shown in **Images 10-9** and **10-10** below. **Image 10-9** shows the inlet of the culvert which is located underneath a footbridge and **Image 10-10** shows the outlet of the culvert. The circular concrete culvert is approximately 61.17 m in length and has a diameter of approximately 600 mm.

Image 10-9 - Farm Access Culvert 2 Inlet

Image 10-10 - Farm Access Culvert 2 Outlet

10.7.14. The most southern tributary of Denwick Burn within the Study Area flows beneath the A1 through a circular culvert labelled as culvert one in **Image 10-1**. The inlet of the culvert is shown in **Image 10-11** below. The culvert has a diameter of approximately 500 mm and is approximately 49.59 m in length. Immediately upstream of the A1 culvert the tributary flows beneath a farm access track as shown in **Image 10-12** below. The crossing consists of twin

150 mm pipes and is approximately 20 m in length. The outlet of culvert one discharges into the Denwick Burn at the same location as the farm access culvert two.

Image 10-11 - Denwick Burn A1 Structure 1 Culvert Inlet

Image 10-12 - Farm Access Culvert 1 Inlet

10.7.15. No fish surveys have been undertaken along Denwick Burn and its tributaries as during the aquatic walkover survey the ecologists did not identify the watercourses to have the potential to support any legally protected or notable aquatic species (refer to **Appendix 9.10: Aquatic Ecology Assessment Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)). No evidence of otters or water voles were identified during the mammal surveys (refer to **Appendix 9.3: Otter and Water Vole Report**, **Volume 8** of this ES).

10.7.16. Denwick Burn is not monitored directly against the objectives of the WFD (**Ref. 10.1**) but is located within the 'Aln from Edlingham Burn to Tidal Limit' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.31**) indicates an overall quality of 'Poor' with the ecological quality assessed as 'Poor' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'.

White House Burn

10.7.17. The source of White House Burn is located approximately 1.3 km upstream of the A1 crossing within the Wisplaw Whin plantation. The catchment of the watercourse is relatively flat with an approximate upstream catchment area of 1.22 km^2. White House Burn flows in an east to south-west direction beneath the existing A1 alignment to the west of Rock South Farm as shown in **Image 10-13** below. Approximately 4.3 km downstream from the B6341 culvert White House Burn discharges into the River Aln adjacent to the remains of Hulne Priory, located to the south-west of the alignment of Part B Main Scheme Area. White House Burn is classified as an ordinary watercourse under the jurisdiction of NCC as LLFA.

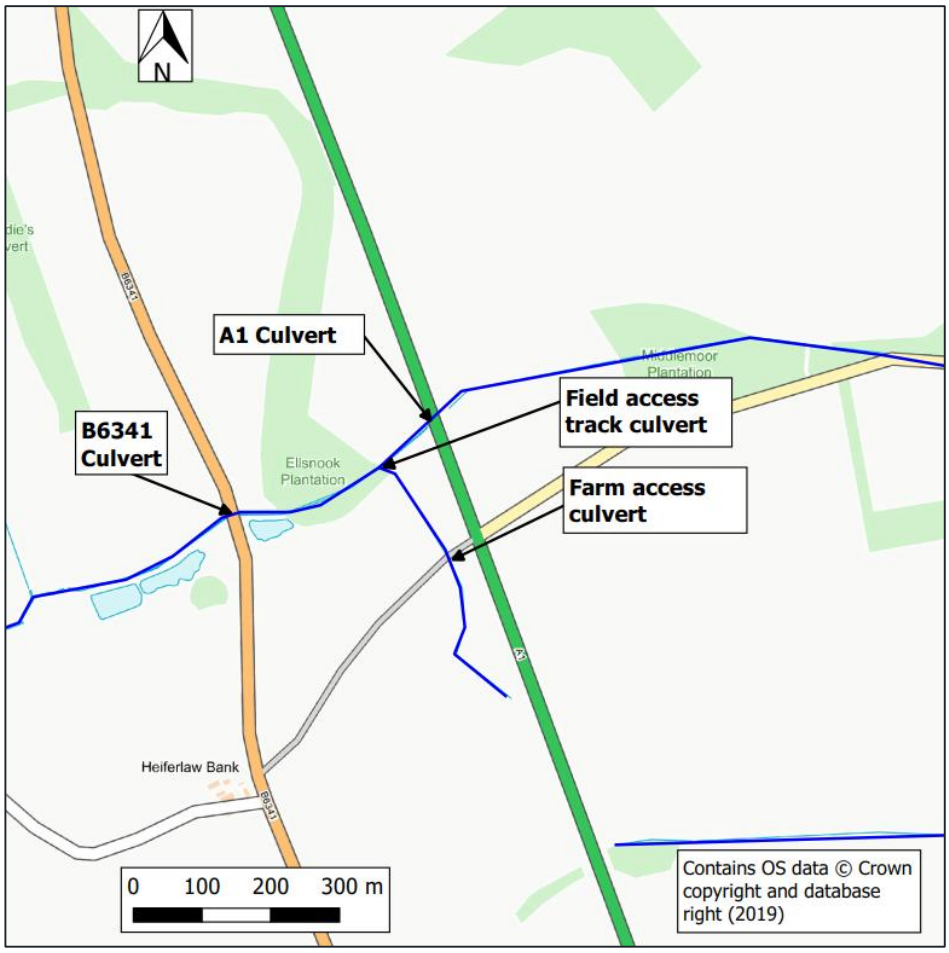

Image 10-13 - White House Burn Existing Structures

10.7.18. **Image 10-14** shows White House Burn flowing beneath the A1 through an oversized concrete box culvert which is thought to also be used as a passage underneath the road for animals between fields. To prevent animals from entering the watercourse there is a fence running through the culvert as evident in the photograph. The culvert is approximately 3.25 m wide, 3.45 m high and approximately 21.9 m long.

10.7.19. White House Burn then flows through a concrete circular culvert underneath a field access track approximately 80 m downstream from the A1 watercourse crossing. **Image 10-15** shows the culvert underneath the field access track. The culvert has a diameter of approximately 1.5 m and is approximately 5.3 m in length.

Image 10-14 – White House Burn A1 Culvert (Outlet)

Image 10-15 – White House Burn Field Access Culvert (Outlet)

10.7.20. A small unnamed tributary of White House Burn flows in a south to north direction adjacent to the A1 and discharges into White House Burn immediately downstream of the field access culvert. Approximately 160 m upstream of where the tributary discharges into White House Burn the tributary flows underneath a farm access track through a culvert. A circular pipe discharges into a masonry box culvert as shown in **Image 10-16** below. There are also a number of outfalls discharging into the culvert as can be seen in the photograph.

Image 10-16 – Farm Access Track Culvert Along Tributary of White House Burn (Outlet)

10.7.21. Approximately 315 m downstream from the A1 culvert, White House Burn flows underneath the B6341 through a concrete box culvert, as shown in **Image 10-17** below.

Image 10-17 – Culvert Underneath the B6341 (Inlet)

10.7.22. No fish surveys have been undertaken along White House Burn as during the aquatic walkover survey the ecologists did not identify the watercourse to have the potential to support any legally protected or notable aquatic species (refer to **Appendix 9.10: Aquatic Ecology Assessment Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)). No evidence of otters or water voles were identified during the mammal surveys (refer to **Appendix 9.3: Otter and Water Vole Report**, **Volume 8** of this ES).

10.7.23. White House Burn is not monitored directly against the objectives of the WFD (**Ref. 10.1**) but is located within the 'Aln from Edlingham Burn to Tidal Limit' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.31**) indicates an overall quality of 'Poor' with the ecological quality assessed as 'Poor' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'.

Tributaries of Kittycarter Burn

10.7.24. Two tributaries of Kittycarter Burn flow beneath the existing A1 alignment. The source of the unnamed southern tributary of Kittycarter Burn is just upstream of the alignment in the Part B Main Scheme Area within the South Charlton Bog. The source of the unnamed western tributary of Kittycarter Burn is approximately 1.7 km to the north-west of the alignment in the Part B Main Scheme Area adjacent to Victory Wood. The catchment where the two tributaries meet is relatively flat with an approximate upstream catchment area of 3.98 km^2.

10.7.25. **Image 10-18** below identifies the two tributaries (southern and western) and locations of existing structures. The southern tributary flows in a south-west to north east direction beneath the A1 and two adjacent side roads, and the western tributary flows in a west to east direction beneath the A1. Kittycarter Burn and its tributaries are classified as ordinary watercourses under the jurisdiction of NCC as LLFA.

10.7.26. Approximately 2 km downstream from the alignment of Part B Main Scheme Area, the unnamed tributaries of Kittycarter Burn discharge into the Kittycarter Burn by the Kittycarter Plantation.

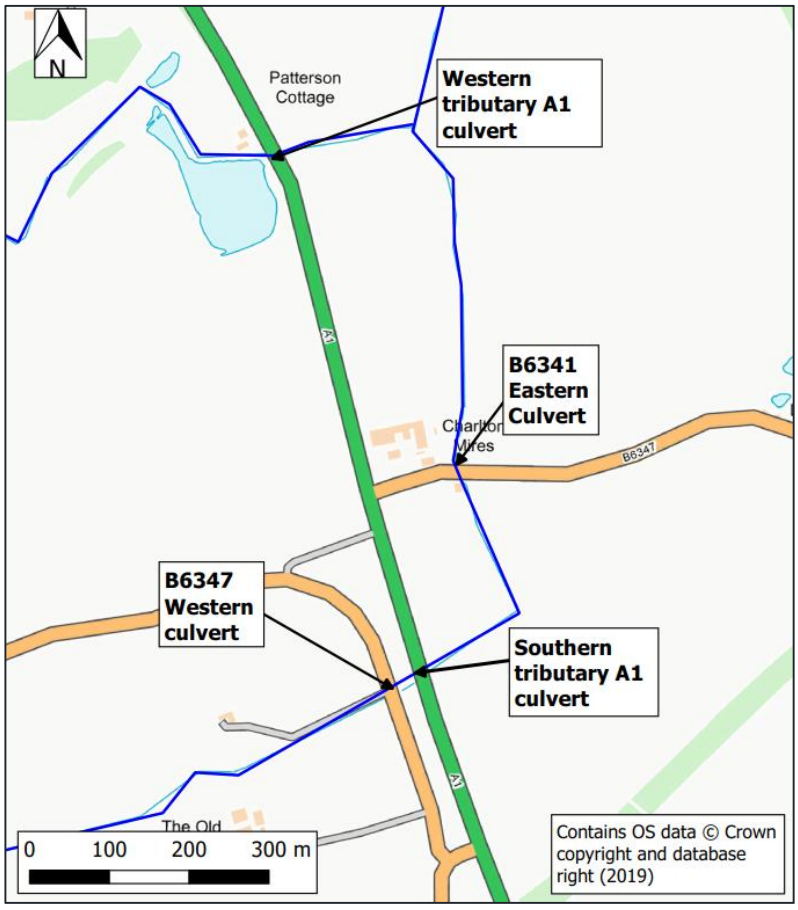

Image 10-18 – Tributaries of Kittycarter Burn Existing Structures

10.7.27. The unnamed southern tributary of Kittycarter Burn flows beneath the western section of the B6347 through a circular concrete culvert, as shown in **Image 10-19**. The culvert is approximately 21.2 m in length with a diameter of 0.45 m. Approximately 25 m downstream of this culvert the unnamed southern tributary flows beneath the A1 through another circular concrete culvert. **Image 10-20** shows the inlet of the culvert which has an approximate diameter of 0.6 m and is approximately 25.5 m in length. During the topographic survey it was noted that there was approximately 0.15 m deep silt deposit at the base of the culvert.

10.7.28. Approximately 315 m downstream of the A1 watercourse crossing the unnamed southern tributary of Kittycarter Burn flows beneath a small farm access track as shown in **Image 10-21** below. The crossing is a circular concrete pipe with a diameter of approximately 0.6 m and approximately 3 m in length. Approximately 10 m downstream of the farm access track the unnamed southern tributary of Kittycarter Burn flows beneath the eastern section of the B6341 through a circular culvert. As shown in **Image 10-22** below there is a brick headwall at the inlet. The culvert has an approximate diameter of 0.6 m and is approximately 15 m in length.

Image 10-19 – B6347 Western Culvert (Inlet)

Image 10-20 – Southern Tributary A1 Culvert (Inlet)

Image 10-21 – Small Access Track Culvert (Outlet)

Image 10-22 – B6347 Eastern Culvert (Inlet)

10.7.29. The unnamed western tributary of Kittycarter Burn flows beneath the A1 through a box culvert as shown in **Image 10-23** below. There are wooden debris fences just upstream and downstream of the culvert as shown in **Image 10-24** below. A fence runs through the culvert and it is considered likely that the fence is to facilitate animal passage between fields when required. The culvert has an approximate width of 21.4 m and height of 22.5 m and is approximately 20 m in length. In the adjacent field to the south-west of the culvert there is a pond as shown on the OS mapping. Consultation with the LLFA identified that the pond is ephemeral and floods when the water level exceeds the banks of the watercourse.

Image 10-23 – Western Tributary of Kittycarter Burn Culvert Underneath A1 (inlet)

Image 10-24 – Debris Fence along Unnamed Western Tributary of Kittycarter Burn

10.7.30. No fish surveys have been undertaken along the tributary of Embleton Burn as during the aquatic walkover survey the ecologists did not identify the watercourse to have the potential to support any legally protected or notable aquatic species (**Appendix 9.10: Aquatic Ecology Assessment Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)). No evidence of otters or water voles were identified during the mammal surveys (refer to **Appendix 9.3: Otter and Water Vole Report**, **Volume 8** of this ES).

10.7.31. The northern tributary of Kittycarter Burn is monitored directly against the objectives of the WFD (**Ref. 10.1**) and both tributaries are located within the 'Embleton Burn from Source to North Sea' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.31**) indicates an overall quality of 'Poor' with the ecological quality assessed as 'Poor' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'.

Tributary of Embleton Burn

10.7.32. The source of the unnamed tributary of Embleton Burn is just upstream of the access track watercourse crossing. The catchment of the watercourse is relatively flat with an approximate upstream catchment area of 0.58 km². The unnamed tributary of Embleton Burn flows in a west to east direction beneath an access track approximately 0.95 km to the east of the A1 through a kiln plantation as shown in **Image 10-25** below. Embleton Burn and its tributaries are classified as ordinary watercourses under the jurisdiction of NCC as LLFA.

10.7.33. Approximately 4.1 km downstream of the access track crossing the unnamed tributary of Embleton Burn discharges into the Embleton Burn by Prickley Bridge.

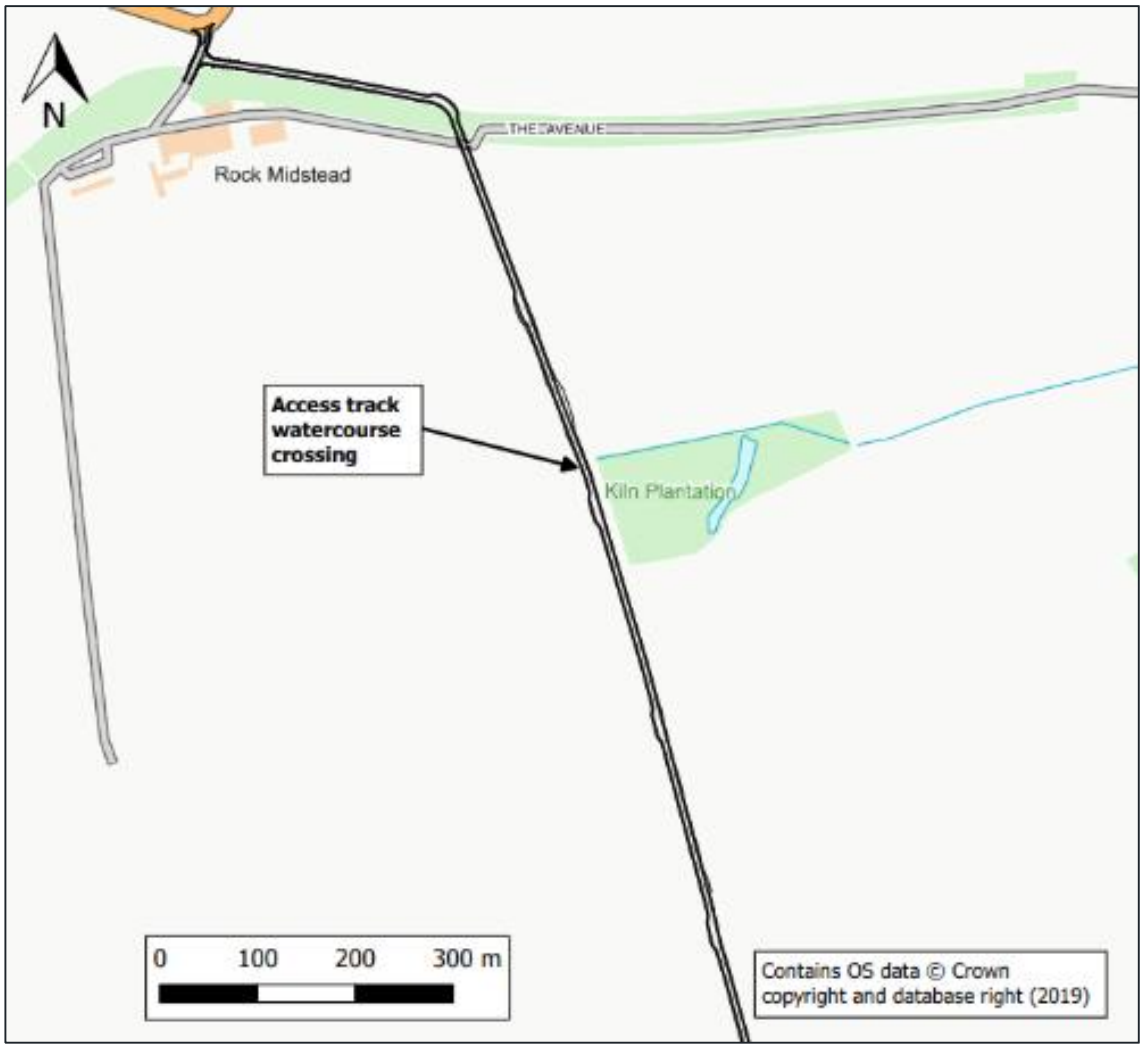

Image 10-25 – Tributary of Embleton Burn

10.7.34. **Image 10-26** below shows the watercourse crossing that conveys the watercourse beneath the access track with a diameter of approximately 450 mm, height of approximately 310 mm and length of approximately 5.7 m. During the site walkover it was observed the culvert was submerged. Upstream of the watercourse crossing the channel was heavily vegetated.

Image 10-26 – Tributary of Embleton Burn Culvert (Outlet)

10.7.35. No fish surveys have been undertaken along the tributary of Embleton Burn as during the aquatic walkover survey the ecologists did not identify the watercourse to have the potential to support any legally protected or notable aquatic species (refer to **Appendix 9.10: Aquatic Ecology Assessment Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)). No evidence of otters or water voles were identified during the mammal surveys (refer to **Appendix 9.3: Otter and Water Vole Report**, **Volume 8** of this ES).

10.7.36. The tributary of Embleton Burn is not monitored directly against the objectives of the WFD (**Ref. 10.1**) but is located within the 'Embleton Burn from Source to North Sea' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.31**) indicates an overall quality of 'Poor' with the ecological quality assessed as 'Poor' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'.

Shipperton Burn

10.7.37. The source of Shipperton Burn is approximately 2.7 km to the north-west of the A1 crossing, to the north of Middlemoor Wind Farm. The catchment of the watercourse is gently sloping from the north-west to the south-east with an approximate upstream catchment area of 3.09 km^2. Shipperton Burn flows in a west to east direction and flows beneath the existing A1 alignment through the Lodge Plantation, and then under Shipperton Bridge just downstream underneath a local private road as shown in **Image 10-27** below. Shipperton Burn is classified as an ordinary watercourse under the jurisdiction of NCC as LLFA.

10.7.38. Shipperton Burn eventually discharges into Doxford Lake and becomes Mill Burn approximately 2.7 km downstream of the existing A1 crossing, to the north east of the alignment of Part B Main Scheme Area.

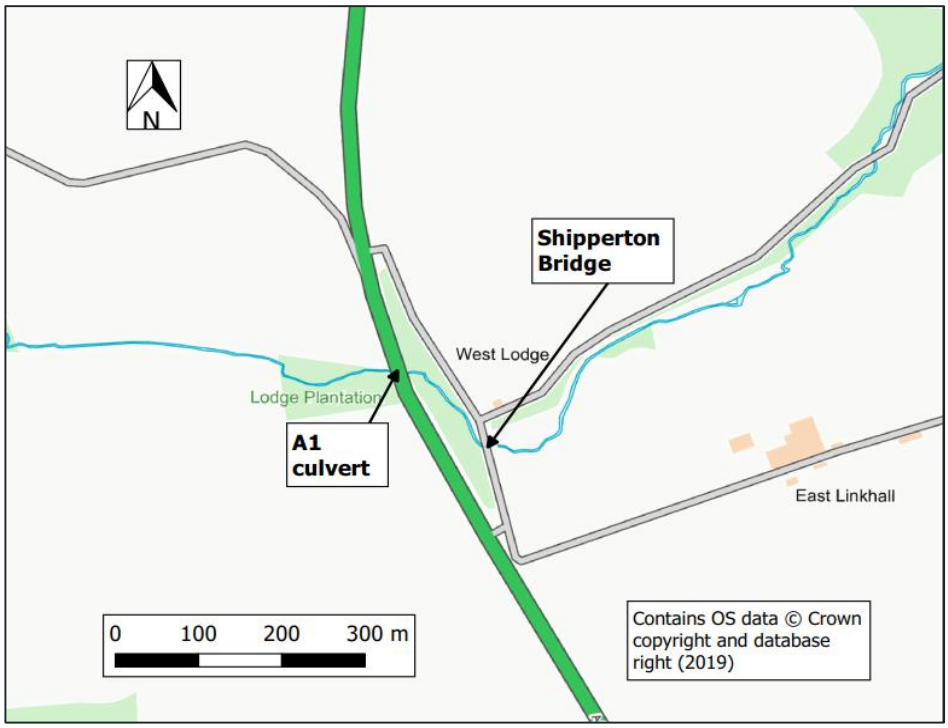

Image 10-27 – Shipperton Burn Existing Structures

10.7.39. Shipperton Burn flows beneath the A1 through a rectangular culvert (approximately 2.1 m wide and 1.2 m high) which is 18.3 m in length with the inlet and outlet shown in **Images 10-28** and **10-29** below. Approximately 100 m downstream of this culvert the watercourse flows under Shipperton Bridge beneath a local private road, as shown in **Images 10-30** and **10-31** below. The bridge has a width of approximately 1.9 m, a height of approximately 1.1 m and length of approximately 21 m.

Image 10-28 – Shipperton Burn A1 Culvert (Inlet)

Image 10-29 – Shipperton Burn A1 Culvert (Outlet)

Image 10-30 – Shipperton Bridge (Inlet)

Image 10-31 – Shipperton Bridge (Outlet)

10.7.40. The electric fish surveys undertaken identified brown trout along Shipperton Burn. Brown trout are a protected species listed under Section 41 of the Natural Environment and Rural Communities Act (2006) (**Ref. 10.39**) and are considered to be of principal importance (refer to **Appendix 9.10: Aquatic Ecology Assessment Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**) for further details). No evidence of otters or water voles were identified during the mammal surveys (refer to **Appendix 9.3: Otter and Water Vole Report**, **Volume 8** of this ES).

10.7.41. Shipperton Burn is monitored directly against the objectives of the WFD (**Ref. 10.1**) and is located within the 'Brunton Burn from Source to North Sea' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.31**) indicates an overall quality of 'Good' with the ecological quality assessed as 'Good' and the chemical quality assessed as 'Good'. The catchment has been assessed by the Environment Agency as having a hydromorphological designation of 'not designated artificial or heavily modified'.

Other Surface Water Features

10.7.42. Review of OS mapping indicates that there are ten other surface water features (ponds) located within the Study Area as identified in **Figure 10.1: Water Constraints Plan**, **Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**). The surface water features are located within predominantly rural areas and have no known significant recreational value or value to the economy. During baseline ecological surveys no, great crested newts were identified in any of the ponds within the Study Area (refer to

Appendix 9.8: Great Crested Newt Survey Report, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)).

10.7.43. A review of OS mapping indicates that there is an unnamed covered reservoir within the Study Area. It is located approximately 0.1 km to the west of the existing A1 near Craggy Wood. Although the covered reservoir is not visible on satellite imagery, due to the spatial constraints around the site, it is likely that the reservoir will be small in size.

Surface Water Abstractions

10.7.44. There are no known surface water abstractions located within the Study Area.

Geology and Hydrogeology

10.7.45. A review of the British Geological Survey (BGS) 1:625,000 data (**Ref. 10.32**) indicates that the majority of the land located to the east of the proposed Part B main alignment is underlain by bedrock geology of the Yoredale Group comprising limestone and argillaceous rocks. Land located to the west of the Part B main alignment is underlain by bedrock geology of the Yoredale Group and the Border Group consisting of limestone, sandstone and argillaceous rocks.

10.7.46. A review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that the bedrock geology is classified as a Secondary A Aquifer. This is described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forms an important source of base flow to rivers.

10.7.47. A review of BGS 1:625,000 data (**Ref. 10.32**) indicates that superficial deposits within the Study Area are mostly glacial till with areas of glacial sands and gravels located to the north of South Charlton and to the south-west of Denwick. There is also a small peat deposit located to the south of South Charlton.

10.7.48. A review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that the majority of the superficial deposits are classified as a Secondary (Undifferentiated) Aquifer. The areas of glacial sands and gravels identified above are classified as Secondary A Aquifer. This is described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forms an important source of base flow to rivers.

10.7.49. A review of the Cranfield University Soilscapes mapping (**Ref. 10.34**) indicates that the majority of the soils within the Study Area are slowly permeable loamy and clayey soils. Freely draining slightly acid and loamy soils are located in the areas of glacial sands and gravels identified above.

10.7.50. A review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that there are no SPZs located within the Study Area.

10.7.51. Groundwater quality has been assessed against the objectives of the WFD. Part B Main Scheme Area is located within the Northumberland Carboniferous Limestone and Coal Measures groundwater catchment area. A review of the Environment Agency's Catchment

Data Explorer (2016 results) (**Ref. 10.31**) indicates an overall quality of 'Poor', with the quantitative quality assessed as 'Poor' and the chemical quality assessed as 'Poor'. The Environment Agency identifies the reason for not achieving 'Good' overall status as point source pollution from an abandoned mine.

10.7.52. Three licenced groundwater abstraction licences have been identified within the 1 km Study Area during consultation with the Environment Agency. Due to the surrounding land use and the geological baseline information it is assumed that the abstractions are for agricultural use. These are identified on **Figure 10.1: Water Constraints Plan**, **Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**).

10.7.53. The ground investigation work undertaken in 2019 (refer to **Appendix 11.3: Ground Investigation Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) was to improve understanding of baseline conditions. Groundwater was encountered in 21 trial pits and six boreholes during their construction typically between depths of 1 m below ground level (bgl) and 3.5 m bgl. The groundwater is considered to be relatively shallow along the alignment in the Part B Main Scheme Area due to the presence of low permeability glacial materials overlying bedrock.

10.7.54. Sections of the alignment in the Part B Main Scheme Area, to the north and south are located within the Coal Authority (CA) reporting area. The online CA's screening tool (**Ref. 10.36**) indicates that the alignment in Part B is not located within a constraint area with regards to groundwater.

10.7.55. For more information regarding geology and hydrogeology refer to **Chapter 11: Geology and Soils** of this ES.

Existing Drainage Systems

10.7.56. Information regarding the existing highway drainage infrastructure that currently serves the A1 has been collated from the HADDMS online database (**Ref. 10.17**). A summary of the existing highway drainage infrastructure is provided below.

10.7.57. Surface water runoff from the existing A1 is currently collected by a system of gullies and combined kerb drainage transported to a number of outfalls to various watercourses along the alignment in the Part B Main Scheme Area through an underground piped system. For more information regarding the existing highway drainage infrastructure refer to **Appendix 10.4: Drainage Strategy Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**). **Table 10-8** below details the information collated from the HADDMS online database (**Ref. 10.17**) regarding the existing outfalls.

Table 10-8 – Information on Existing Highway Drainage

Outfall	HADDMS Reference	Receiving Watercourse
1	NU1915_6357b	Denwick Burn

Outfall	HADDMS Reference	Receiving Watercourse
2	NU1916_3914a	Tributary of Denwick Burn
3	NU1916_2162a	Denwick Burn
4	NU1916_1668c	Denwick Burn
5	NU1818_3778c	White House Burn
6	NU1721_5701b	Tributary of Kittycarter Burn
7	NU1720_8163a	Tributary of Kittycarter Burn
8	NU1721_0697a	Shipperton Burn

10.7.58. **Image 10-32** below shows the location of the existing outfalls along the alignment in the Part B Main Scheme Area. Although no detailed survey of outfall structures has been completed at this stage, a review of the features on the HADDMS online database (**Ref. 10.17**) indicates that there are no existing flow controls or pollution prevention measures in place.

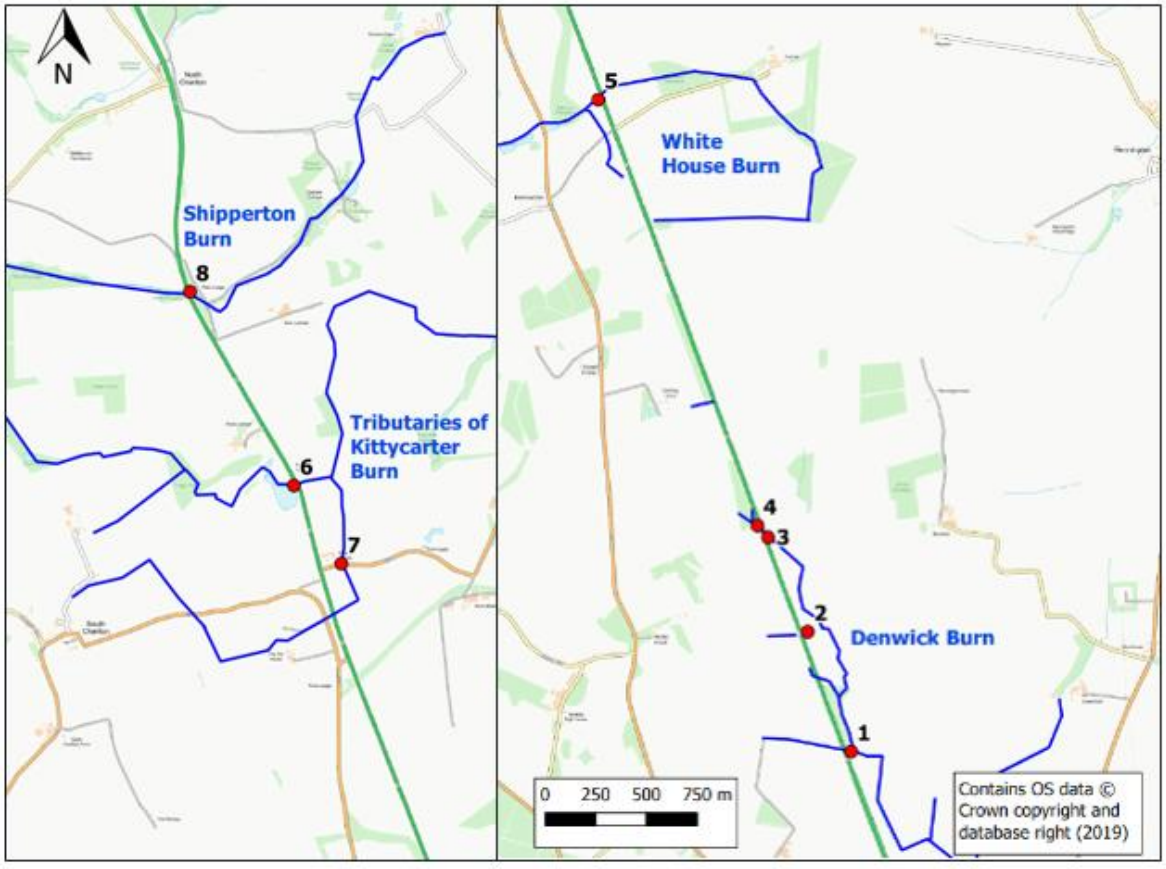

Image 10-32 – Location of Existing Outfalls

10.7.59. For more detailed information regarding the existing highway drainage infrastructure refer to **Appendix 10.4: Drainage Strategy Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**).

Flood Risk

10.7.60. An **FRA** (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) has been completed in accordance with the NPS NN (**Ref. 10.11**), the NPPF (**Ref. 10.12**) and the Planning Practice Guidance (**Ref. 10.19**). A summary of identified flood risks is provided below.

10.7.61. Consultation with NCC, has highlighted an existing flooding issue regarding fluvial flooding from the tributaries of Kittycarter Burn. NCC state that a lack of maintenance along the watercourses has led to local flooding issues affecting isolated properties. NCC also state that the existing culvert underneath the A1 along the western tributary of Kittycarter Burn is also not conveying flow through the structure efficiently due to the lack of maintenance. This was also highlighted in the responses collated from the public during the 2019 statutory consultation. The key receptor of concern upstream of the alignment in Part B is a property on the left bank of the western tributary. This is further explained in **Section 5** of **Appendix 10.1: FRA**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**). Elsewhere the upstream catchments are predominantly rural, and the only other receptor identified is a property located on the right bank at the upstream limit of the southern tributary.

10.7.62. The NCC Level 1 Strategic Flood Risk Assessment (SFRA) (**Ref. 10.40**) indicates significant flooding within the North East Northumberland river catchments from fluvial and pluvial sources since 1744. A number of significant flood events are attributed to the River Aln which is located downstream of the Study Area.

A review of the Environment Agency Flood Map for Planning (Rivers and Sea) (**Ref. 10.28**) indicates that the majority of the Order Limits is located in the low-risk Flood Zone 1. However, within the Order Limits there are two areas located within the medium risk Flood Zone 2, and the high-risk Flood Zone 3. There is one area located to the south within the Part B Main Scheme Area and the identified fluvial flood risk is associated with Denwick Burn. The other area is located to the north within the Part B Main Scheme Area and the identified fluvial flood risk is associated with Shipperton Burn. The Flood Zones are illustrated in **Figure 10.1: Water Constraints Plan**, **Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**).

10.7.63. The alignment in the Part Main Scheme Area is not at risk of tidal flooding as the tidal limit for all watercourses are downstream of the Study Area and are located at a lower elevation than the minimum elevation (60.09 mAOD at the southern part of the alignment in the Part B Main Scheme Area). The tidal limit for the River Aln is at Lesbury is located approximately 5.7 km to the east of the alignment in the Part B Main Scheme Area and at an elevation of approximately 20 mAOD. The tidal limit for Long Nanny is located approximately 7.2 km to the north east of the alignment in the Part B Main Scheme Area at Tughall Mill and at an

elevation of approximately 5 mAOD. The tidal limit for Embleton Burn located approximately 6.5 km to the east of the alignment in the Part B Main Scheme Area to the east of Embleton, and at an elevation of approximately 25 mAOD.

10.7.64. A review of the Environment Agency's Flood Risk from Surface Water map (**Ref. 10.29**) indicates that sections of the alignment in the Part B Main Scheme Area are at high, medium and low risk of flooding from surface water sources. Flooding from surface water is typically associated with natural overland flow paths (including the watercourses discussed above) and local depressions in topography where surface water runoff can accumulate during or following heavy rainfall events.

10.7.65. The HADDMS online database (**Ref. 10.17**) indicates that the existing A1 within the Order Limits has two documented surface water flood events. These are not classified as severe flood events and have a severity index of less than one. The flooding was associated with blocked gullies.

10.7.66. The HADDMS online database (**Ref. 10.17**) also indicates one flooding hotspot located within the Study Area, denoted as category 'C' Moderate hotspot areas. A baseline assessment for hotspot 2144 (located adjacent to South Charlton) has been carried out. No information regarding the need for remedial measures have been provided. Hotspot 2144 is reported to be attributable to between two and five recorded flood events since 2017, all of which are classified as low severity.

10.7.67. A review of the Environment Agency's Flood Risk from Reservoirs map (**Ref. 10.29**) indicates that the Part B Main Scheme Area is not at risk of flooding from potential failure of reservoirs located upstream of the Study Area.

10.7.68. The Environment Agency's Flood Risk from Reservoirs map (**Ref. 10.29**) does not show any areas within 0.5 km identified as being at risk of flooding from potential failure from the covered reservoir identified above.

LIONHEART ENTERPRISE PARK COMPOUND

Existing Surface Water Features

10.7.69. A review of OS mapping indicates that the Lionheart Enterprise Park Compounds are located within 0.5 km to two watercourses; the Willow Burn and Cawledge Burn which are both located to the south of the Lionheart Enterprise Park Compounds. These are shown on **Page 3** of **Figure 10.1: Water Constraints Plan**, **Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**)**.** The watercourses flow in a south-west to north east direction and both discharge into the River Aln. Both are classified as ordinary watercourses under the jurisdiction of NCC as LLFA.

10.7.70. Cawledge Burn is monitored directly against the objectives of the WFD (**Ref. 10.1**) and is located within the 'Cawledge Burn (Trib. of Aln)' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (**Ref. 10.31**) (2016 results) indicates an overall quality of 'Good', with both ecological and chemical quality assessed as 'Good'.

10.7.71. Willow Burn is located in the 'Aln from Edlingham Burn to tidal limit' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (**Ref. 10.31**) (2016 results) indicates an overall quality of 'Poor', with ecological quality assessed as 'Poor' and chemical quality assessed as 'Good'. A review of OS mapping indicates that there are no other surface water features located within 0.5 km of the Lionheart Enterprise Park Compounds.

Geology and Hydrogeology

10.7.72. A review of the BGS 1:625,000 data (**Ref. 10.32**) indicates that the Lionheart Enterprise Park Compounds are underlain by bedrock geology of the Yoredale Group comprising limestone with subordinate and argillaceous rocks. A review of the Environment Agency's groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that the bedrock geology is classified as a Secondary A Aquifer, described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

10.7.73. A review of the BGS 1:625,000 data (**Ref. 10.32**) indicates that superficial deposits underlying the Lionheart Enterprise Park Compounds consist of glacial sand gravel deposits. A review of the Environment Agency's groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that the superficial deposits are classified as a Secondary A Aquifer. A review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that there are no SPZs.

Flood Risk

10.7.74. A review of the Environment Agency's Flood Map for Planning (Rivers and Sea) (**Ref. 10.28**) indicates that the Lionheart Enterprise Park Compounds are located within the low-risk Flood Zone 1. A review of the Environment Agency's Flood Risk from Surface Water map (**Ref. 10.29**) indicates that the Compound is at low risk of flooding from surface water sources.

MAIN COMPOUND

Existing Surface Water Features

10.7.75. A review of OS mapping indicates that the Main Compound, near West Thirston, is located in close proximity to one watercourse; an unnamed tributary of the Thirston Burn which flows along the northern boundary of the compound. This is shown on **Page 4** of **Figure 10.1: Water Constraints Plan**, **Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**). The unnamed tributary of Thirston Burn discharges into the Thirston Burn approximately 2 km downstream of the Main Compound. The unnamed tributary of Thirston Burn is classified as an ordinary watercourse under the jurisdiction of NCC as LLFA.

10.7.76. The unnamed tributary of Thirston Burn is not monitored directly against the objectives of the WFD (**Ref. 10.1**) but is located within the 'Longdike Burn Catchment (tributary of Coquet)' WFD catchment. A review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.31**) indicates an overall quality of 'Moderate', with the ecological

quality assessed as 'Moderate' and the chemical quality assessed as 'Good'. The catchment has been assessed as having a hydromorphological designation of 'not designated artificial or heavily modified'.

10.7.77. A review of OS mapping indicates that there is one other surface water feature located within 0.5 km of the Main Compound. A surface water pond is located approximately 0.4 km to the south-east of the Main Compound. There are no known designations and is located within a predominantly rural area and has no known significant recreational value or value within the economy.

Geology and Hydrogeology

10.7.78. A review of the BGS 1:625,000 data (**Ref. 10.32**) indicates that the Main Compound is underlain by bedrock geology of the Yoredale Group consisting of limestone, sandstone siltstone and mudstone. A review of the Environment Agency's Groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that the bedrock geology is classified as a Secondary A Aquifer, described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

10.7.79. A review of the BGS 1:625,000 data (**Ref. 10.32**) indicates that superficial deposits are glacial sand and gravel. A review of the Environment Agency's Groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that the superficial deposits are classified as a Secondary A Aquifer. Review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.30**) indicates that there are no SPZs.

Flood Risk

10.7.80. A review of the Environment Agency's Flood Map for Planning (Rivers and Sea) (**Ref. 10.28**) indicates that the Main Compound is located within the low-risk Flood Zone 1 where the risk of flooding from fluvial sources is less than 1 in 1000 (0.1%) in any year. A review of the Environment Agency's Flood Risk from Surface Water map (**Ref. 10.29**) indicates that the Main Compound is at low risk of flooding from surface water sources.

SENSITIVE RECEPTORS

10.7.81. **Table 10-9** below summarises the importance of the receptors that have been assessed, as identified in the baseline conditions (**Section 10.7**). The importance of these receptors has been established through consultation with the Environment Agency and the LLFA and in accordance with the criteria set out in Table A4.3 in DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.15**) as set out in **Table 10-5**.

Table 10-9 – Importance of Baseline Receptors

Receptor	Criteria	Importance
Denwick Burn and its tributaries	Ordinary watercourses No fish or mammal species identified Located within a 'Poor' ecological value and 'Good' chemical value WFD catchment	Low
White House Burn	Ordinary watercourse No fish or mammal species identified Located within a 'Poor' ecological value and 'Good' chemical value WFD catchment	Low
Tributaries of Kittycarter Burn	Ordinary watercourses No fish or mammal species identified Located within a 'Poor' ecological value and 'Good' chemical value WFD catchment	Low
Tributary of Embleton Burn	Ordinary watercourse No fish or mammal species identified Located within a 'Poor' ecological value and 'Good' chemical value WFD catchment	Low
Shipperton Burn	Ordinary watercourse Brown trout identified No mammal species identified Located within a 'Good' ecological value and 'Good' chemical value WFD catchment	High
Tributary of Thirston Burn	Ordinary watercourse No fish or mammal species identified Located within a 'Moderate' ecological value and 'good' chemical value WFD catchment	Medium
Cawledge Burn	Ordinary watercourse No fish or mammal species identified Located within a 'Good' ecological value and 'Good' chemical value WFD catchment	High
Willow Burn	Ordinary watercourse No fish or mammal species identified	Low

Receptor	Criteria	Importance
	Located within a 'Poor' ecological value and 'Good' chemical value WFD catchment	
Floodplain of Denwick Burn	Fluvial floodplain within Study Area Relatively narrow floodplain extent within rural agricultural land	Low
Ponds	Number of ponds which appear to not be hydraulically connected to nearby watercourses No known amenity value	Low
Groundwater resources	Classified as having 'Poor' chemical quality under WFD Three licenced groundwater abstractions	Medium
Flood risk receptors	Surrounding rural agricultural land	Low
	Part B would be classed as essential infrastructure in accordance with NPPF (**Ref. 10.12**), as it would provide an important transport link that should remain operational in times of flooding	High

10.8 POTENTIAL IMPACTS

PART B MAIN SCHEME AREA INCLUDING CHARLTON MIRES CONSTRUCTION COMPOUND

Construction

Sedimentation

10.8.1. Temporary increased sedimentation within watercourses caused by surface water runoff containing elevated levels of suspended particles may result from land clearance, excavation, dewatering of excavations, wheel washings, areas of bare earth, construction materials such as aggregate and stockpiles of topsoil substances associated with temporary works.

10.8.2. Runoff with high sediment loads may have direct adverse impacts on adjacent water bodies through increasing turbidity (thus reducing light penetration and reducing plant growth), and by smothering vegetation and bed substrates (thus impacting on invertebrate and fish communities through the destruction of feeding areas, refuges and breeding and/or spawning areas). Organic sediments can also have indirect effects on physico-chemical properties such as dissolved oxygen demand and pH.

Pollution risk

10.8.3. Increased pollution risks from spillage of fuels or other harmful substances associated with temporary works may migrate to local surface water and groundwater receptors. Hydrocarbons form a film on the surface of the water body, deplete oxygen levels and may be toxic to fish. Even at very low concentrations, the film may negatively affect the visual appearance of the water body. If materials and activities are not stored and carried out in designated areas, runoff and washdown may enter a water body, adversely affect the aquatic environment or contaminate surface and groundwater water abstractions.

10.8.4. The most common source of pollution is from leaks and spillages of hydrocarbons from mechanical plant or storage vessels. Concrete and cement products can also pose a significant risk to the water environment and are highly alkaline and corrosive. Fish may be physically damaged, and their gills blocked, and both vegetation and the bed of the receiving water body may be smothered. For the most part, it is only when large quantities of hazardous substances are spilled, or the spillage is directly into the water body, that a significant risk of acute toxicity would arise in the receiving water.

Construction Activities within Watercourses

10.8.5. Impacts to the hydromorphological, chemical and ecological quality of watercourses associated with temporary works within or in close proximity to watercourses such as the installation and alteration of culverts, bridges and outfalls as well as realignment of watercourses. The works would be associated with pollution spillages, removal of existing bankside habitat, damage to existing substrate, changes to the hydraulic profile of the watercourse, and longer-term changes associated with sediment deposition.

Flood Risk

10.8.6. Increased flood risk associated with temporary works within areas of fluvial flood storage, works to existing watercourse alignments and culverts, and associated changes to catchment permeability and hydrology, including surface water runoff.

Operation

Polluted Surface Water Runoff

10.8.7. Permanent impacts associated with polluted surface water runoff containing silts and hydrocarbons that are washed off vehicular areas that may migrate or be discharged to surface water features or groundwater resources via the proposed highway drainage system. These can increase water turbidity, deplete oxygen levels and be toxic to the aquatic environment. Uncontrolled discharge via infiltration to ground can also cause permanent deterioration of groundwater quality.

Hydromorphological Quality of Water Features

10.8.8. Permanent impact that may affect the hydromorphological quality of water features associated with works within or in close proximity to water features such as the installation

and extension of culverts, bridges and outfalls as well as realignment of watercourses, including longer term changes to geomorphology.

Catchment Hydrology

10.8.9. Permanent impacts to catchment hydrology caused by the introduction of a barrier to natural overland flow and changes to natural catchment dynamics associated with the proposed highway drainage system and proposed watercourse diversions.

Increased Surface Water Runoff

10.8.10. Increased rates and volumes of surface water runoff from an increase in impermeable area or changes to the existing drainage regime leading to a potential increase in flood risk.

Flood Risk

10.8.11. A permanent increase in flood risk to Part B and to people and property elsewhere caused by displacement of flood water storage or crossing of watercourses (culverts) thus impacting flood flow conveyance. Climate change would also increase flows through existing structures.

10.8.12. The potential impacts associated with future climate change have been assessed in **Chapter 14: Climate** of this ES.

LIONHEART ENTERPRISE PARK COMPOUND

Construction

10.8.13. Increased pollution risks from spillage of fuels or other harmful substances associated with temporary works may migrate to local surface water and groundwater receptors. Hydrocarbons form a film on the surface of the water body, deplete oxygen levels and may be toxic to fish. Even at very low concentrations, the film may negatively affect the visual appearance of the water body. If materials and activities are not stored and carried out in designated areas, runoff and washdown may enter a water body, adversely affect the aquatic environment or contaminate surface and groundwater water abstractions. The most common source of pollution is from leaks and spillages of hydrocarbons from mechanical plant or storage vessels.

10.8.14. Concrete and cement products can also pose a significant risk to the water environment and are highly alkaline and corrosive. Fish may be physically damaged, and their gills blocked, and both vegetation and the bed of the receiving water body may be smothered. For the most part, it is only when large quantities of hazardous substances are spilled, or the spillage is directly into the water body, that a significant risk of acute toxicity would arise in the receiving water.

10.8.15. Increased flood risk associated with temporary works within small area of fluvial flood storage, and associated changes to catchment permeability and hydrology, including surface water runoff.

MAIN COMPOUND

10.8.16. The Main Compound would be used by both Part A and Part B and is located within the Order Limits of Part A. As detailed in **Section 2.8** in **Chapter 2: The Scheme**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**), the use of the Main Compound for Part B would lead to additional activities. However, due to the limited number of additional activities that would increase sedimentation or pollution to adjacent watercourses, there would be a negligible effect on the unnamed tributary of Thirston Burn.

10.8.17. Appropriate mitigation measures detailed in the **Outline CEMP** (**Application Document Number: TR010041/APP/7.3**) would be implemented during construction therefore ensuring negligible impact upon other water environment receptors. As there would be a negligible effect on the water environment as a result of using the Main Compound for Part B, this is not discussed further within this chapter. The effects of the Main Compound on the water environment are reported in Part A **Chapter 10: Road Drainage and Water Environment**, **Volume 2** of this ES (**Application Document Reference TR010041/APP/6.2**).

10.9 DESIGN, MITIGATION AND ENHANCEMENT MEASURES

DESIGN

10.9.1. The following are considered as embedded measures form part of the Part B design:

a. Watercourse crossings (see below)
b. Surface Water Drainage Strategy (**Appendix 10.4**: **Drainage Strategy Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**))

Construction

10.9.2. The **Outline CEMP (Application Document Number: TR010041/APP/7.3**) details a number of mitigation measures; more detail is provided below.

Increased Sedimentation

10.9.3. An **Outline CEMP** (**Application Document Number: TR010041/APP/7.3**) has been produced and accompanies the DCO application. It details mitigation measures that would manage environmental impacts during construction. The **Outline CEMP** sets out how construction activities would be undertaken in accordance with appropriate good practice guidance, such as CIRIA's control of water pollution from construction sites (C532). Although withdrawn, the Pollution Prevention Guidelines (PPG) (**Ref. 10.23**) published by the Environment Agency still provide good practice guidance, particularly PPG1 - General guide to the prevention of water pollution; PPG 5 - Works in, near or liable to affect watercourses; and PPG 6 - Working at construction and demolition sites.

10.9.4. Measures in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) for managing risks associated with increased sedimentation would include:

a. Locating topsoil stores and construction compounds away from the banks of watercourses and within fluvial floodplains.
b. Covering and or seeding topsoil stores to further prevent sediment entering the watercourses during periods of heavy rainfall.
c. Cover stockpiles when not in use.
d. All loose materials would be covered so as not to increase sediment load to the drainage network.
e. Installing cut off ditches around the perimeter of the construction area to prevent sediment entering the watercourses during periods of heavy rainfall.
f. Do not wash vehicles within 10 m of watercourses.
g. Dewatering working areas to maintain a dry construction area and passing any water generated by the dewatering process through silt busters or sediment tanks prior to returning this water to the watercourses.
h. Dewatering as shallow groundwater is encountered (there may be a need to pass the water through a silt buster or settlement pond if the groundwater has a high sediment load). If the main contractor abstracts more than 20 cubic metres a day, an abstraction licence from the Environment Agency would be required.

Pollution Risks

10.9.5. All site ground works would be undertaken in accordance with the measures set out in the **Outline CEMP** (**Application Document Number: TR010041/APP/7.3**) to ensure the risk of contamination during construction is mitigated. Measures in the **Outline CEMP** for managing risks to the water environment would include:

a. Management of surface water runoff to intercept and, where necessary, treat runoff to prevent the migration of pollutants to receiving water features, particularly within site construction compounds and storage areas.
b. Management of polluting substances that are being brought on site and used as part of the construction process.
c. Where practicable, all works, and mechanical plant would remain at least 8 m from the watercourse and from the top of the valley sides.
d. Storing mechanical plant such as generators in bunded areas when not in use.
e. Similar mitigation measures to that discussed above to control overland flow that could migrate to the watercourses to ensure that flow would be maintained along the watercourses as discussed above which would assist in the dispersion of pollution.

10.9.6. No cement or mechanical plant would be stored within the Charlton Mires Site Compound within the Part B Main Scheme Area to reduce pollution risk due to the close proximity to the southern tributary of Kittycarter Burn.

Works within Watercourses

10.9.7. The draft culvert construction methodology has been included in **Appendix 2.3: Culvert Construction Methodology**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**).

10.9.8. For online (located along a watercourse) structures a dry construction area would be created. This would be done by diverting flows through an adjacent culvert, pipe or drainage channel. If this is deemed infeasible by the main contractor due to local conditions, then a temporary sump is proposed. The sump would be excavated on the upstream side of the existing structure, and a pump would be used to divert flows through a pipe suspended above the base of the culvert.

10.9.9. The new sections of culvert would be made from precast concrete or pipes to reduce the potential for polluting the watercourses.

10.9.10. Provision for the first flush through the structures would be mitigated as summarised below.

10.9.11. Works within ordinary watercourses may require consent from the LLFA, this would be developed further during detailed design.

10.9.12. Embedded mitigation measures are detailed in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) and include the following:

a. Measures to deal with the first flush once flows are diverted through the new culverts, such as capturing and treating the first flush, relocating fish from the downstream reach, allowing vegetation to establish, providing a gravel bed to reduce fine sediment erosion, or filtering sediment from the water column.
b. Minimise works in the watercourse channels and locate plant, stockpiles and other materials 8 m from the watercourse.
c. Avoid works during high flow events and intense rainfall to reduce the risk of fine sediment release and undertake works during lower flow conditions as detailed below,
d. Limit the clearance of vegetation on the channel banks and riparian zone.
e. Use seeded biodegradable fibre matting to encourage re-vegetation after works on, or near, the banks. This is more applicable to the larger watercourses such as the Denwick Burn and its tributaries and Shipperton Burn.
f. Maintaining, where possible, vegetation cover on the banks close to the rivers and prompt reinstatement of vegetation to minimise the impact of reduced roughness, thus potentially reducing stream power, flow velocity and sediment transport capability through the construction zone.
g. Avoid critical periods for fish migration and spawning. The window for undertaking works in or near rivers is typically towards the end of May to October. This is important for the watercourses where notable species of fish have been identified. The extension of the culvert along Shipperton Burn would be undertaken outside the period September to April to avoid the spawning period for migratory and non-migratory brown trout.
h. Fish capture would be undertaken if pumping is required to create a dry working area within watercourses along Part B. For more information on this refer to **Chapter 9: Biodiversity** of this ES**.**
i. Best practice measures associated with storage of oils and fuels.
j. Locating concrete mixing and washing areas more than 10 m from any watercourse
k. Have settlement and re-circulation systems for water reuse.

l. Have a contained area for washing out of concrete batching plant or ready-mix lorries, and collect wash-waters and, where necessary, contain wash-water for authorised off-site disposal.
m. Wash-water from concrete would not be discharged into the watercourse.

10.9.13. The main contractor would need to consult with the Environment Agency regarding any environmental permits such as for temporary discharge runoff during construction. This would be developed further during the detailed design stage of Part B.

Flood Risk During Construction

10.9.14. A detailed assessment of flood risk is provided within the **FRA** (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)).

10.9.15. The **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) sets out the measures for managing flood risks during construction. Measures would include:

a. Ensuring that flood conveyance routes are maintained during construction.
b. Moving any plant away from the banks of watercourses following heavy rainfall events.
c. Monitoring of Environment Agency's flood warnings. Although there are no flood warning areas located within the Study Area, a general awareness of flood warnings elsewhere is recommended (particularly downstream along Denwick Burn and Shipperton Burn) as it is likely that this would also equate to mean high flows within the Study Area.
d. Creating safe working areas for the storage of plant and materials if a flood warning is received during construction.

Consents

10.9.16. A summary of the water related consents and licences that would be required as part of the construction of Part B is provided below:

a. Ordinary Watercourse Land Drainage Consent for works along watercourses classified as ordinary watercourses from the LLFA.
b. Environmental permit if the main contractor discharges contaminated wastewater into watercourses.
c. Abstraction licence if more than 20 cubic metres a day of water is abstracted from the Environment Agency.

10.9.17. Further details are available in the **Consents and Agreements Position Statement** (**Application Document Reference: TR010041/APP/3.3**).

Watercourse Crossings

10.9.18. With specific regards to the water environment, Part B would comprise (from south to north) the following watercourse crossing works (as shown on the **General Arrangement Plan** (**Application Document Reference: TR010041/APP/2.4**):

a. There are no proposed works to the existing culvert Denwick Burn (Proposed culvert 17.1) at chainage 53470 as the existing culvert is of sufficient length.

b. There are no proposed works to the existing culvert Denwick Burn (Proposed culvert 18.1) at chainage 53850 as the existing culvert is of sufficient length.
c. The extension of the existing culvert Denwick Burn (Proposed culvert 19.1) at chainage 54080.
d. The extension of the existing culvert Denwick Burn (Proposed culvert 21.1) at chainage 54600.
e. The replacement of the existing culvert at Heckley Fence (Proposed culvert 22.1) at chainage 55300. The small drainage ditch upstream of the culvert would be realigned to discharge into the new culvert.
f. The extension of the existing culvert White House Burn (Proposed culvert 23.1) at chainage 56920.
g. The extension of the existing culvert Kittycarter Burn (Proposed culvert 24.2) at chainage 58600.
h. The removal of the existing culvert along the southern tributary of Kittycarter Burn and the construction of a new circular culvert (Proposed culvert 25.1) underneath the B6347 at chainage 58840.
i. The diversion and channel realignment of the southern tributary of Kittycarter Burn to reduce the length of culvert required.
j. The extension of the existing Linkhall Culvert (Proposed culvert 26.1) along the western tributary of Kittycarter Burn at chainage 59275.
k. The extension of the existing culvert Shipperton Burn (Proposed culvert 27.1) at chainage 60385.
l. The construction of a new circular culvert called Rock Culvert (Proposed culvert 28.1) at chainage 58100 upstream of the existing culvert along the unnamed tributary of Embleton Burn.
m. Installation of new drainage infrastructure to accommodate increased runoff rates and volumes from the increase in impermeable area and construction of runoff detention basins to manage surface water flow from the drainage network.

10.9.19. The new sections of culvert would be made from precast concrete or pipes to reduce the potential for polluting the watercourses.

10.9.20. For more detailed information regarding the design of Part B in relation to the water environment refer to **Chapter 2: The Scheme**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**) and **Appendix 10.1: FRA**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**) which has informed the dimensions of the watercourse crossings.

Surface Water Drainage Strategy

10.9.21. The **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) details the different stages of treatment provided at each proposed outfall along Part B.

10.9.22. For more detailed information regarding the surface water drainage strategy refer to **Appendix 10.4: Drainage Strategy Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)).

MITIGATION MEASURES

Construction

10.9.23. No specific mitigation measures would be required further to those to be included as part of the design of Part B.

Operation

10.9.24. The design of the culverts has taken hydromorphological considerations into account, where appropriate. The proposed culvert 25.1 along the southern tributary of Kittycarter Burn would tie into the existing channel and a gravel bed would be created throughout the length of the culvert by setting the base of the culvert below bed level. 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. A summary of the mitigation measures for each watercourse regarding natural beds to facilitate the movement of aquatic species is provided in **Table 10-10** below. Further details regarding the hydromorphological considerations of the watercourse crossings and watercourse realignments are available in **Appendix 10.2: WFD Assessment**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**).

Table 10-10 - Summary of Mitigation Measures

Culvert	Natural Gravel Bed
A1 culvert 1 (Proposed culvert 17.1)	No
A1 culvert 2 (Proposed culvert 18.1)	No
A1 culvert 3 (Proposed culvert 19.1)	No
A1 culvert 4 (Proposed culvert 21.1)	No
Heckley Fence culvert (Proposed culvert 22.1)	No
A1 culvert (Proposed culvert 23.1)	No

Culvert	Natural Gravel Bed
Southern tributary A1 culvert (Proposed culvert 24.2)	No
B6347 eastern culvert (Proposed culvert 25.1)	Yes
Western tributary A1 culvert (Proposed Linkhall culvert 26.1)	No
Rock Culvert (Proposed culvert 28.1)	No
A1 culvert (Proposed culvert 27.1)	No

10.9.25. There would be marginal planting and wetland areas across Part B in the detention basins. For more information refer to **Figure 7.10: Landscape Mitigation Plan**, **Volume 6** of this ES (**Application Document Reference: TR010041/APP/6.6**)).

ENHANCEMENT

10.9.26. There are no opportunities for enhancement identified beyond the above design and mitigation measures.

10.10 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

CONSTRUCTION

Increased Sedimentation

10.10.1. The magnitude of the impact is likely to be greater when working in areas adjacent to the identified surface water features, and in periods of heavy rainfall. Notwithstanding the in-channel works discussed separately, the greatest risk to increased sedimentation is most likely to be associated with runoff from earth stockpiles or occur during the construction of Part B, drainage detention basins and outfalls that are located within circa 10 m of any watercourses.

10.10.2. Some increase in sedimentation contained within overland flow from the construction working areas is likely to occur due to the proximity of the works to the river channels. The measures proposed within the **Outline CEMP** (**Application Document Reference**: **TR010041/APP/7.3**) would greatly reduce this effect and the volume of sediment that enters the watercourses is therefore likely to be minimal.

10.10.3. Any sediment that enters the smaller watercourses is likely to settle quickly due to the relatively flat channel gradients and small catchments of the watercourses.

10.10.4. The effects of increased sedimentation in construction runoff would reduce shortly after completion of the works when exposed areas of earth are resurfaced, reseeded or replanted. The mitigation measures detailed in **Section 10.9** above would ensure the risk of increased sedimentation and potential effects to the watercourses is low. The effects would be direct and temporary, with no long term or permanent impacts expected.

10.10.5. **Table 10-11** below provides a summary of the likely significant effects associated with increased sedimentation during construction to each relevant receptor identified in **Table 10-9**. Note that these effects are related to increased sediment associated with construction works located outside of the river channel. Potential effects associated with works in the river channel, such as culvert replacement or channel realignment, are discussed separately below. The magnitude of impact ranges from negligible to minor adverse as minor adverse impacts are associated with periods of heavy rainfall.

Table 10-11 - Effects during Construction Arising from Increased Sedimentation

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Denwick Burn and its tributaries White House Burn Tributaries of Kittycarter Burn Tributary of Embleton Burn Willow Burn	Low	Some increase in sedimentation is likely to occur due to the proximity of the works. Impacts would be temporary.	Negligible – Minor Adverse	Neutral (Not significant)
Shipperton Burn Cawledge Burn	High	Some increase in sedimentation is likely to occur due to the proximity of the works. Impacts would be temporary.	Negligible - Minor Adverse	Neutral - Slight Adverse (Not significant)

10.10.6. For a more detailed assessment of the potential effects associated with increased sedimentation refer to the **WFD Assessment** (**Appendix 10.2**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)).

Pollution Risks

10.10.7. With the implementation of mitigation measures outlined within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) in the previous section, it is considered unlikely that pollution of watercourses and groundwater resources would occur. Any effects would be direct and long term.

10.10.8. **Table 10-12** below provides a summary of the likely significant effects associated with pollution risks during construction to each relevant receptor identified in **Table 10-9**.

Table 10-12 - Effects during Construction Arising from Pollution Risks

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Denwick Burn and its tributaries White House Burn Tributaries of Kittycarter Burn Tributary of Embleton Burn Shipperton Burn Cawledge Burn Willow Burn	Low – High	Robust mitigation and spill containment measures proposed in **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**). Discharge of significant volumes of harmful substances unlikely to occur.	Negligible	Neutral (Not significant)
Groundwater resources	Medium	Robust mitigation and spill containment measures proposed in **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**). Discharge of significant volumes of harmful substances unlikely to occur.	Negligible	Neutral (Not significant)

Works within Watercourses

10.10.9. The extension and replacement of culverts and channel realignments would pose risk of increased sedimentation within the watercourse and increased risk of pollutant spillage, as well as temporary loss of riparian vegetation, damage to existing substrate and changes to flow dynamics.

10.10.10. The measures proposed within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) would greatly reduce these risks and minimise the time required for the watercourses to recover. Temporary over-pumping may be required and some change to flow dynamics during construction would be inevitable which may alter sediment processes upstream and downstream of the works but given the small size of the watercourses within the Study Area this is not considered likely to have a notable effect on upstream or downstream morphological conditions.

10.10.11. Potential impacts associated with construction works within the watercourse channels are considered to be direct and temporary as water quality within the watercourses would improve over time as sediments settle and pollutants are treated by entrapment, dilution and natural processes. In sections of natural channel, vegetation would re-establish over time and natural bed substrates would be maintained. New bankside vegetation is likely to take in the region of one to two years to establish. The removal of riparian habitats would be minimised as much as possible as detailed in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**).

10.10.12. **Table 10-13** below provides a summary of the likely significant effects associated with the works within watercourses during construction to each relevant receptor identified in **Table 10-9**. Permanent effects to hydromorphology associated with proposed amendments to watercourses are discussed as operational effects.

Table 10-13 - Effects during Construction Arising from Works within Watercourses

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Denwick Burn and its tributaries	Low	Two existing culverts to be extended, new culvert arrangement at the proposed Heckley Fence Accommodation Overbridge and no works to two existing culverts due to sufficient length	Minor Adverse	Neutral (Not significant)
White House Burn	Low	Existing culvert to be extended	Minor Adverse	Neutral (Not significant)

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Tributaries of Kittycarter Burn	Low	Two existing culverts to be extended and one new culvert crossing	Minor Adverse	Neutral (Not significant)
Tributary of Embleton Burn	Low	Construction of new culvert upstream of existing culvert	Minor Adverse	Neutral (Not significant)
Shipperton Burn	High	Existing culvert to be extended	Minor Adverse	Slight Adverse (Not significant)
Cawledge Burn	Low	No works proposed within watercourse	Negligible	Neutral (Not significant)
Willow Burn	Low	No works proposed within watercourse	Negligible	Neutral (Not significant)

Increased Flood Risk Associated During Construction

10.10.13. A detailed assessment of flood risk is provided within the **FRA** at **Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**).

10.10.14. The land immediately adjacent to the culverts and watercourse crossings are considered to have a low vulnerability in terms of flood risk. Any effects would be very localised due to the small working areas.

10.10.15. It is considered unlikely that Part B would have a notable effect on flood risk during the construction works, although it is recognised that the works would affect flow conveyance and surface water runoff during the construction programme. Connectivity of the watercourses would be maintained during construction by maintaining existing watercourse alignments where possible. This would not result in a great change to the size or gradient of the watercourse that would increase downstream flood risk.

10.10.16. **Table 10-14** below provides a summary of the likely significant effects associated with increased flood risk during construction to each relevant receptor identified in **Table 10-9**.

Table 10-14 - Effects during Construction Arising from Increased Flood Risk

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Surrounding rural agricultural land	Low	Agricultural land has low vulnerability in terms of flood risk. Increased flood risk very unlikely.	Negligible	Neutral (Not significant)

OPERATION

Pollution Risks

10.10.17. The HAWRAT assessment has been used to assess the risks to water quality during the operation of Part B in line with the methods A and D outlined in DMRB (HD 45/09) (**Ref. 10.15**). Method A assessed the pollution impacts from routine runoff to surface waters and Method D assessed the pollution impacts from accidental spillage. For more information regarding the HAWRAT assessment refer to **Appendix 10.3: Drainage Network Water Quality Assessment**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**). The results are summarised below.

Method A

10.10.18. All the single and cumulative assessments pass the HAWRAT assessment for acute and chronic impacts when proposed attenuation and treatment measures are considered.

10.10.19. The assessment of long term pollution impacts to the receiving water environment considers the annual average pollutant concentrations associated with Part B against the Environmental Quality Standards (EQS) threshold values set out under the WFD (**Ref. 10.1**). All the annual average pollutant concentrations for each assessed outfall, for both zinc and copper, are below the EQS threshold values. The values range from 0.26 µg/l to 0.5 µg/l for copper and from 1.04 µg/l to 1.96 µg/l for zinc, taking into account proposed attenuation and treatment measures. This shows that the proposed mitigation measures go beyond the minimum standards required to pass the HAWRAT Method A assessment.

Method D

10.10.20. The results of the Method D assessments for all outfalls indicate an annual probability of a significant pollution risk occurring in the event of spillage of between 0.006% and 0.003%, taking the proposed mitigation measures into account, which is well below the recommended threshold of 1%.

10.10.21. For more detailed information regarding the short term and long term assessment of pollution impacts during the operation of Part B refer to the **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)).

10.10.22. **Table 10-15** below provides a summary of the likely significant effects associated with pollution risks during operation to each relevant receptor identified in **Table 10-9**.

Table 10-15 – Effects during Operation Arising from Pollution Risks

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Denwick Burn and its tributaries White House Burn Tributaries of Kittycarter Burn Tributary of Embleton Burn Shipperton Burn Cawledge Burn Willow Burn	Low – High	The results of the HAWRAT assessment indicate that the proposed surface water drainage system would provide appropriate treatment prior to discharge.	Negligible	Neutral (Not significant)
Groundwater resources	Medium	There would be no discharge to ground and the detention basins would be lined.	Negligible	Neutral (Not significant)

Works within Watercourses

10.10.23. All culverts would tie into the existing channel, apart from where the watercourse has been realigned, and a gravel bed would be created, where deemed appropriate as discussed in **Table 10-10** previously, throughout the length of the extended culverts that would naturalise over time where fish passage (or potential future fish passage) is expected. **Table 10-10** summarises the mitigation proposed for each watercourse crossing where appropriate flows have been calculated. Further analysis of flow dynamics would be undertaken during the detailed design to inform the selection of the most appropriate bed material size, grading and the need for baffles to ensure that the material is not mobilised during high flow conditions.

10.10.24. As outlined in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**), the replacement of the existing culvert along the southern tributary of Kittycarter Burn offers an opportunity to improve the performance of the culvert, for example, by providing a natural bed. Additionally, some culverts were identified to be blocked or submerged during the site walkover and this would be addressed as part of the works.

10.10.25. Overall, there is an increase in the total length of culverts and as a result there would be a permanent loss of natural channel associated with Part B along each of the watercourses in the Study Area. Although connectivity and a natural bed would be maintained there is likely to be a direct and long-term effect on the watercourses.

10.10.26. **Table 10-16** below provides a summary of the likely significant effects during operation to each relevant receptor identified in **Table 10-9**.

Table 10-16 - Effects during Operation Arising from Works within Watercourses

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Denwick Burn and its tributaries	Low	Two existing culverts to be extended, new culvert arrangement at the proposed Heckley Fence Accommodation Overbridge and no works to two existing culverts due to sufficient length	Minor Adverse	Neutral (Not significant)
White House Burn	Low	Existing culvert to be extended	Minor Adverse	Neutral (Not significant)
Tributaries of Kittycarter Burn	Low	Two existing culverts to be extended and one new culvert crossing	Minor Adverse	Neutral (Not significant)
Tributary of Embleton Burn	Low	Construction of new culvert upstream of existing culvert	Minor Adverse	Neutral (Not significant)
Shipperton Burn	High	No change to any culverts	Negligible	Neutral (Not significant)

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Cawledge Burn	High	No change to any culverts	Negligible	Neutral (Not significant)
Willow Burn	Low	No change to any culverts	Negligible	Neutral (Not significant)

Increased Flood Risk

10.10.27. A detailed assessment of the effects associated with flood risk is provided in the **FRA** (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)).

Flood Risk

10.10.28. Detailed 1D hydraulic modelling has been undertaken for Denwick Burn and its tributaries, White House Burn, tributaries of Kittycarter Burn and Shipperton Burn. Hydraulic assessment has been undertaken for the other watercourses and surface water flow paths. The modelling shows that there would be no increase in fluvial flood risk to any upstream or downstream receptors taking into consideration mitigation measures. At Linkhall Culvert (Culvert 26.1) along the northern tributary of Kittycarter Burn, Part B changes the flooding mechanism but does not increase flood risk.

Increase in Surface Water Runoff Rate and Volume

10.10.29. A detailed description of the surface water drainage strategy is provided in **Appendix 10.4: Drainage Strategy Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**). The surface water drainage system has been designed according to DMRB (HA 107/04) (**Ref. 10.41**).

10.10.30. The surface water drainage strategy has been designed using a 20% climate change allowance as agreed through consultation with the LLFA. Sensitivity testing for the 40% climate change allowance was also undertaken and is detailed in **Appendix 10.4: Drainage Strategy Report**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**).

10.10.31. The surface water drainage strategy is summarised below:

a. Runoff from Part B would be discharged into the existing watercourses via grassed detention basins.

b. Highway drainage is designed to accommodate a 1 in 1 year design flow without surcharging; and a 1 in 5 year flow without surface flooding of the running carriageways (with a 20% allowance for climate change).
c. Attenuation controls would be provided for the 1 in 1, 30 and 100 year events plus climate change to match the equivalent greenfield runoff rates during these events.

10.10.32. The assessment of significance of effect presented below considers the 1 in 100 year plus 25% climate change allowance as agreed with the LLFA and as detailed within the **FRA** (**Appendix 10.1**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)).

10.10.33. **Table 10-17** below provides a summary of the likely significant effects associated with flood risk during operation to each relevant receptor identified in **Table 10-9**.

Table 10-17 - Effects during Operation Arising from Flood Risk

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Part B	High	The hydraulic analysis indicates no increase in flood risk that would affect Part B including an allowance for climate change.	Negligible	Neutral (Not significant)
Surrounding rural agricultural land	Low	The hydraulic analysis indicates no increase in flood risk including an allowance for climate change that would affect any vulnerable flood risk receptors.	Negligible	Neutral (Not significant)

WFD Summary

10.10.34. A summary of the assessment and conclusions from the **WFD Assessment** (**Appendix 10.2**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**)) is provided below.

10.10.35. The assessment indicates that there would be no detrimental impact or change to the WFD status of the surface water or groundwater catchments with the appropriate mitigation measures implemented, as detailed within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) and embedded within the design of the new culverts and extended culverts and the proposed surface water drainage system. As a result, Part B is compliant with WFD objectives.

10.10.36. There are opportunities for Part B to improve the performance of certain existing structures, for example, where no natural bed is provided within the existing culverts. As a result, the Part B would not prevent the WFD catchments from achieving the status objectives for each catchment.

ASSESSMENT PARAMETERS

10.10.37. The Assessment Parameters are presented in **Chapter 2: The Scheme**, **Volume 1** of this ES (**Application Document Reference**: **TR010041/APP/6.1**). The parameters are not considered to alter the findings or significance of effects of the road drainage and water environment assessment. This is due to the parameters not increasing the works in or adjacent to the water environment receptors.

UPDATED DMRB GUIDANCE

10.10.38. Refer to **Appendix 10.5: Road Drainage and the Water Environment DMRB Sensitivity Test**, **Volume 8** of this ES (**Application Document Reference: TR010041/APP/6.8**) for further details of the sensitivity test as discussed in **Section 10.4**. The findings of the sensitivity test are summarised below.

10.10.39. The updated guidance LA 113 (**Ref. 10.37**) includes a number of key changes in the assessment methodology compared to DMRB HD 45/09 (**Ref. 10.15**) which it replaces. A number of the identified changes are considered unlikely to affect the conclusions of the road drainage and the water environment assessment presented in this chapter. However, the following identified changes were considered to warrant further assessment:

a. An assessment of the impacts on groundwater levels and flows, previously not required.

10.10.40. As part of the sensitivity testing, a hydrogeological assessment and a sheet piling assessment for the operation of Part B have therefore been undertaken. These assessments are provided in **Appendix 10.5: Road Drainage and the Water Environment DMRB Sensitivity Test**, **Volume 8** (**Application Document Reference: TR010041/APP/6.8**) and a summary of the findings provided below.

Detention Basins

10.10.41. The detention basins would be mostly based within low permeability deposits; lined and situated close to or below the water table. There is therefore the potential the basins to act as a barrier to groundwater flow, which, due to the generally shallow groundwater in the superficial deposits could cause groundwater upwelling beneath or around the basins, in particular for DB22 which extends well below the groundwater table. Higher permeability material would be placed beneath or around the detention basins to allow groundwater to move freely around the lined basins. With the implementation of this mitigation, it is considered that there would be a permanent minor adverse magnitude of impact upon groundwater level and flows and the overall significance of effect would be **slight adverse** (not significant).

Culverts

10.10.42. These structures locally reduce the interaction between groundwater and surface water. However, the culverted sections would be shallow (the outlet level being at or close to that of the water table, based on limited information at many locations), of limited length (most being <50 m) and would be located beneath the proposed carriageway; an area of hardstanding which would reduce groundwater recharge locally. A granular layer would be placed beneath proposed culverts in order to ensure groundwater can flow beneath them unimpeded thereby preventing potential groundwater rise and flooding. With the implementation of this mitigation it is considered that there would be a permanent minor adverse magnitude of impact upon groundwater levels and flows and the overall significance of effect would be **slight adverse** (not significant).

Bridge Foundations (Piles)

10.10.43. There are two proposed structures which incorporate piling into their design. Due to the shallow water table along much of the route these structures terminate up to 15 m below the water table. The piles have the potential to cause changes to groundwater flow or levels due to the shallow water table across much of Part B, the piles penetrating below the water table and the spacing of the piles reducing the cross section for groundwater flow by approximately 50%.

10.10.44. Shallow drains either side of the foundations would be installed, which feed into the overall surface water or drainage system to mitigate against groundwater rise. With the implementation of this mitigation, there would be a permanent minor adverse magnitude of impact upon groundwater levels and flows and the overall significance of effect would be **slight adverse** (not significant).

10.10.45. Therefore, with the application of the updated guidance, the significant effects reported within this ES would remain unchanged.

10.11 MONITORING

10.11.1. No monitoring is required over and above that which is included in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) which would be developed into the CEMP by the main contractor prior to the commencement of construction of Part B. The CEMP, once developed, will provide a review, monitoring and audit mechanism to determine the effectiveness of and compliance with environmental control measures, which include the consideration of surface water and groundwater features.

10.11.2. No monitoring during operation is required.

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If you have any enquiries about this document A1inNorthumberland@highwaysengland.co.uk or call **0300 470 4580***.

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