A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010041

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

Part A

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
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Author:	A1 in Northumberland: Morpeth to Ellingham Project Team, Highways England

Version	Date	Status of Version
Rev 0	June 2020	Application Issue

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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 A: Morpeth to Felton (Part A) 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 the construction and operation of Part A and the subsequent residual effects.

10.1.3. This chapter is intended to be read alongside five standalone documents that are included as technical appendices within **Volume 7** of this Environmental Statement (ES) (**Application Document Reference: TR010041/APP/6.7**), 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: Geomorphology Report - River Coquet**
e. **Appendix 10.5: 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 A, 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 A 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 and Part B: Alnwick to Ellingham (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.

10.1.7. The future traffic levels for the assessment of Part A are based upon an opening year predicted to be in 2023. Since the assessments reported in this ES were completed, the Part A opening year has been put back to 2024. The assessment is based on traffic modelling for an opening year of 2023 and reported on that basis. However, as explained in **Section 4.1** in **Chapter 4: Environmental Assessment Methodology, Volume 1** of this ES (**Application Document Reference: TR010041/APP6.1**) it is considered that the assessments remain valid for an opening year of 2024.

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	Relevant Experience
Stephanie Haberfield	Author	- MSc Environmental Consultancy - BSc (Hons) Geography - Member of the Chartered Institution of Water and Environmental	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

Name	Role	Qualifications and Professional Membership	Relevant Experience
		Management (MCIWEM)	- 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
Sarah Hamilton	Author	- 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	Reviewer	- MEng (Hons) Civil Engineering Design and Management - Post Graduate Diploma - Water and Environmental Management - Post Graduate Diploma - Integrated Management of	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

Name	Role	Qualifications and Professional Membership	Relevant Experience
		Freshwater Environments - Chartered member of the Chartered Institution of Water and Environmental Management - Chartered Water and Environmental Manager (C.WEM)	- 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

LEGISLATION

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 with 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 or adjacent to their land, 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 A 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 polices from the former district areas of Castle Morpeth and Alnwick (which are relevant to Part A). The relevant saved policies are detailed below.

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

Policy	Relevant Policy Objectives	Significance of Part A 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 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 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) has been prepared which includes a **Drainage Strategy Report** (**Appendix 10.5**, **Volume 7** of this ES). The drainage strategy report 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 A. The potential impacts of spillages and routine runoff have been assessed in the standalone **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 7** of this ES). The assessment demonstrates how Part A 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 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) has been prepared to assess the risks of flooding to and from Part A and details the sequential suitability of Part A in terms of the Sequential and Exception Tests outlined in the NPPF (**Ref. 10.10**). 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 A would meet the requirements of the Highways England licence. This is detailed in the **FRA** (**Appendix 10.1**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) which considers the impacts of climate change and the **Drainage Strategy Report** (**Appendix 10.5**, **Volume 7** of this ES) which outlines measures to improve the environment through incorporating water quality mitigation measures into Part A.

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

Policy	Relevant Policy Objectives	Significance of Part A 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 A: 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 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). The assessment demonstrates how Part A would not impact water quality from surface water runoff.

Policy	Relevant Policy Objectives	Significance of Part A 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, considering 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 7** of this ES assesses Part A and its compliance with the WFD (**Ref. 10.1**). The assessment concludes that Part A has no detrimental impact or change to the WFD status of the four WFD catchments across the Study Area with the appropriate mitigation measures implemented. An **FRA** (**Appendix 10.1**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) has been prepared which details the mitigation measures that form part of Part A to ensure that there is no increase in flood risk as a result of Part A. The **Drainage Strategy Report** (**Appendix 10.5**, **Volume 7** 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 A.
Castle Morpeth District Local Plan (1991 – 2006) (**Ref. 10.14**)	There are two saved policies that apply to this assessment: Policy RE4 (Water quality) ensures that new development does not adversely affect the quality of surface water features and groundwater resources and promotes new development to seek opportunities for improvements to the local environment. Policy RE5 (Surface water runoff and flood defences) sets out to ensure that new development does not increase local flood risk through the application of the Sequential Test. It also states that appropriate mitigation measures should be in place to minimise the risk of flooding.	The potential impacts of spillages and routine runoff have been assessed in the standalone **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). The assessment demonstrates how Part A would not impact water quality from surface water runoff. An **FRA** (**Appendix 10.1**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) has been prepared to assess the risks of flooding to and from Part A and details the sequential suitability of Part A. It also details the embedded mitigation measures as part of Part A to ensure that there is no increase in flood risk as a result of Part A.
Alnwick District Wide Local Plan (1997) (**Ref. 10.15**)	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 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) details the mitigation measures that form part of Part A to ensure that there is no increase in flood risk as a result of Part A. A **Drainage Strategy Report** (**Appendix 10.5**, of **Volume 7** 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. 10.16**). 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 A on the road drainage and water environment, the guidelines within Annex IV of DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.16**) have been followed. Specifically, DMRB (HD 45/09) (**Ref. 10.16**) 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 used to inform **Appendix 10.3: Drainage Network Water Quality Assessment**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). 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 10.4.23** to **10.4.26**.

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 pollution 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. 10.17**). This includes assessing the outfall using Methods A, B and D as set out in DMRB (HD 45/09) (**Ref. 10.16**).

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. 10.18**).

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 a number of priority culverts along Part A and are detailed in the baseline section (**Section 10.7**).

Non-Statutory Technical Standards for Sustainable Drainage Systems 2015

10.3.22. The Non-Statutory Technical Standards for Sustainable Drainage Systems (**Ref. 10.19**), 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. 10.20**). 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. 10.21**) provides information and technical guidance on how flood risk will be managed within Northumberland. The LFRMS (**Ref. 10.21**) 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 A. 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. 10.22**) issued by the Environment Agency provides a framework for the protection and enhancement of the local water environment. The RBMP (**Ref. 10.22**) 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. 10.23**) 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. 10.23**)" 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. 10.24**) 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 A. 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. 10.24**) 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. 10.25**) provides guidance to ensure that the Examining Authority is able to report to the Secretary of State on the effects of Part A on the relevant RBMP and whether or not Part A 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. 10.26**).
b. An explanation of the relationship between the WFD Assessment, the Environmental Impact Assessment (EIA) and Habitats Regulations 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. 10.27**) and FD2321/TR2 (**Ref. 10.28**) 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/6.10**) for Part A and

Scoping Opinion (**Application Document Reference: TR010041/APP/6.12**) for Part A. **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/6.10**) for Part A, **Scoping Opinion** (**Application Document Reference: TR010041/APP/6.12**) for Part A 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 the 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 A and elsewhere as a result of Part A.

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/6.10**) for Part A, **Scoping Opinion** (**Application Document Reference: TR010041/APP/6.12**) for Part A and **Scoping Opinion Response Tracker** (**Appendix 4.1**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**)):

a. Direct effects to surface water features that are located further than 500 m from Part A and that are not hydraulically linked to watercourses within 500 m of Part A. It is considered unlikely that surface-borne pollutants would migrate overland or via groundwater flow to water features that are located further than 500 m from Part A.
b. Direct and indirect effects to groundwater features that are located greater than 500 m from Part A and groundwater abstractions that are located greater than 1 km from Part A. It is considered unlikely that surface-borne pollutants would migrate and pose notable effects at a distance greater than this.
c. 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.
d. 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 A 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 10.5: Drainage Strategy Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

Table 10-4 - Summary of Consultation

Consultee	Date and Type of Consultation	Summary of Consultation Response	Action
Environment Agency and NCC as LLFA	January 2018	Discussion regarding stakeholder requirements and review the available WFD information and agree (in principle) the methodology, appropriate mitigation and management options during both construction and operation.	Methodology for FRA and WFD Assessment (including HAWRAT) agreed – no further action required.
Environment Agency and NCC as LLFA	September 2018	Review of the methodology, Part A's proposals and proposed mitigation and discussion to address specific areas of concern.	Methodology, and proposed mitigation agreed in principal, no further action required.
Environment Agency	November 2018	Discussion regarding Part A's proposals for the new River Coquet bridge crossing.	Potential assessment methodologies to be taken to client and reviewed in subsequent meetings.
Environment Agency	December 2018	Two meetings to discuss the geomorphological assessment requirements for the new River Coquet bridge crossing.	Assessment methodology agreed in principal – no further action required.

METHOD 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 A conducted in June and December 2018, and February 2019).

a. Environment Agency's online Flood Map for Planning (accessed July 2018) (**Ref. 10.29**).
b. Environment Agency's online Long Term Flood Risk Map (accessed July 2018) (**Ref. 10.30**).
c. Environment Agency's groundwater data available on MAGIC online mapping (accessed July 2018) (**Ref. 10.31**).
d. Environment Agency's Catchment Data Explorer (accessed July 2018) (**Ref. 10.32**).
e. Northumbria River Basin Management Plan (dated December 2015) (**Ref. 10.22**).
f. Observations made from site walkovers (June 2018, December 2018 and February 2019).
g. **Ground Investigation Report** (**Appendix 11.2**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).
h. **Aquatic Ecology Survey Report** (**Appendix 9.3**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).
i. **Water Vole and Otter Survey Report** (**Appendix 9.17**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7).**
j. British Geological Survey (BGS) Geology of Britain viewer (accessed July 2018) (**Ref. 10.33**).
k. BGS Geoindex online dataset (accessed July 2018) (**Ref. 10.34**).
l. Cranfield University's Soilscapes (accessed July 2018) (**Ref. 10.35**).
m. Historic maps (accessed December 2018) (**Ref. 10.36**).
n. HADDMS (Accessed July 2018) (**Ref. 10.18**).
o. Aerial imagery (Google Earth) (accessed December 2018).
p. Ordnance Survey (OS) mapping.
q. MAGIC online mapping (accessed July 2018) (**Ref. 10.31**).
r. Topographic survey (undertaken April 2018).
s. Coal Authority's (CA) online screening tool (Accessed December 2018) (**Ref. 10.37**).
t. Hydrological and land use data (Centre for Ecology and Hydrology (CEH)) (accessed December 2018) (**Ref. 10.38**).
u. Geotechnical report undertaken by Halcrow (dated 2008) (**Ref. 10.39**).
v. Geomorphological assessment undertaken by CH2MHill (dated 2014) (**Ref. 10.40**).

10.4.7. The **Aquatic Ecology Survey Report** (**Appendix 9.3**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) and the **Water Vole and Otter Survey Report** (**Appendix 9.17**, **Volume 7**) of this ES were 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 A 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. 10.16**). The assessment of potential effects as a result of Part A has considered both construction and operation.

10.4.9. This chapter is supported by five standalone documents contained within **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**), 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: Geomorphology Report - River Coquet**
e. **Appendix 10.5: 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 Cotting Burn, the River Lyne, Fenrother Burn, Earsdon Burn and Longdike Burn.
b. A hydraulic assessment of the structures using Culvert Master. This approach was used for all remaining watercourses not listed above.

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)

10.4.13. Following consultation with the Environment Agency it was agreed that detailed hydraulic modelling of the River Coquet would not be required, as the proposed southern pier would be aligned with the existing pier. In order to assess the impact of Part A on the River Coquet a simple assessment of that design has been undertaken. The simple assessment

comprised a Manning's calculation using desktop based information and informed by previous assessments. Mannings is a coefficient which represents the roughness or friction applied to the flow by the watercourse channel.

10.4.14. The simple assessment provided an approximate peak water level where that design for Part A crosses the River Coquet.

Water Framework Directive Assessment

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

10.4.16. The general assessment process was as follows:

a. Identify WFD water bodies in the Study Area with potential to be affected by Part A.
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 A with potential to affect WFD water bodies, embedded mitigation included in the design of Part A proposals and consideration of further specific mitigation where necessary.
d. For those criteria where a potential adverse effect has been identified, assessment of Part A (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 A (including mitigation) to determine if Part A would impact upon the proposed mitigation measures and objectives for the water bodies and objectives for individual quality elements.
f. Assessment of Part A 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 7** of this ES (**Application Document Reference: TR10041/APP/6.7**)).

Drainage Network Water Quality Assessment

10.4.17. The assessment of risks to water quality during the operation of Part A has been undertaken in accordance with the methods outlined in DMRB (HD 45/09) (**Ref. 10.16**). The assessments use the Highways Agency [now Highways England] Water Risk Assessment Tool (HAWRAT).

10.4.18. The approach includes Method A and Method D of DMRB (HD 45/09) (**Ref. 10.16**):

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.

10.4.19. Method B, which is a more detailed quantitative assessment, was not used as Part A passes Method A, and so, it was not required. Method C has not been 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 11.2**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). All proposed attenuation features would be lined to prevent infiltration.

Geomorphological Assessment

10.4.20. The assessment methodology comprised a combination of desk study, field survey and data analysis and interpretation. The desk study information is supported by field survey data from two separate geomorphological surveys, one to undertake a river reconnaissance survey and the second to undertake sediment sampling. Hydraulic modelling was scoped out of the assessment due to the proposed construction methodology for the new River Coquet bridge. Consequently, existing data was used to determine stream power and sediment transport capability of the river.

Human Health

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

GUIDANCE

10.4.22. The guidance documents that have been used for the preparation of this chapter are set out in **paragraphs 10.3.17** to **10.3.28**.

Updated DMRB Guidance

10.4.23. 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. 10.16**).

10.4.24. This guidance document has been replaced by DMRB LA 113 Road Drainage and the Water Environment (**Ref. 10.41**), which was released in March 2020.

10.4.25. 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.

10.4.26. The findings of the sensitivity test are detailed in **Appendix 10.6: Road Drainage and the Water Environment DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) and summarised in **Section 10.10** of this chapter and in **Appendix 4.5: DMRB Sensitivity Test, Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**).

ASSESSMENT CRITERIA

10.4.27. To assess the significance of effects from Part A 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. 10.16**) have been followed.

Importance of Receptor Criteria

10.4.28. The significance of identified effects has been assessed based on the magnitude of change due to Part A 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. 10.16**). **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

10.4.29. 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. 10.16**). **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). - 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).

Impact Magnitude	Criteria	Typical Examples
Moderate Beneficial	Results in moderate improvement of attribute quality	- HAWRAT assessment of both 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).
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

10.4.30. 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 be 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. 10.16**). **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

10.4.31. 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. 10.42**) on a range of

potential climate change allowances dependant on the relevant river basin district and climate change probability. Part A 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 A at risk of fluvial flooding.

10.4.32. 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 A. The Environment Agency provides guidance (**Ref. 10.42**) 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).

10.4.33. 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 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) and design of the proposed drainage system, as discussed in **Appendix 10.5: Drainage Strategy Report**, **Volume 7** of this ES.

10.4.34. Future sea level rise associated with climate change may decrease the distance between Part A and the tidal limit for the River Coquet. The Environment Agency provides guidance (**Ref. 10.42**) 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. As the 1 km Study Area is located between approximately 8 km and 9 km to the tidal limits, this indicates the future baseline at Part A is unlikely to be impacted by future sea level rise.

10.4.35. The **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) uses two-way 24-hour Annual Average Daily Traffic (AADT) flow data developed as part of the transport assessment for Part A. 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 A 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) contained within 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 A have also been assessed. This includes watercourses and other water environment receptors that are located downstream of Part A, 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 affect 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 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 A 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 5** of this ES (**Application Document Reference: TR010041/APP/6.5**) shows the alignment of Part A and the 0.5 km and 1 km Study Area for the assessment of the impacts resulting from the construction and operation of Part A.

10.7. BASELINE CONDITIONS

10.7.1. This section provides a description of the current baseline conditions with respect to the water environment. The main surface water features within the Study Area that may be affected by Part A are identified in **Figure 10.1 Water Constraints Plan**, **Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**). A location plan is also provided in **Figure 1.1: Location Plan: Part A**, **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.

EXISTING SURFACE WATER FEATURES

10.7.2. The main alignment would cross ten watercourses and associated tributaries that may be impacted by Part A. This are listed below from south to north:

a. Cotting Burn
b. Shieldhill Burn
c. Floodgate Burn
d. River Lyne
e. Fenrother Burn
f. Earsdon Burn
g. Longdike Burn
h. Unnamed tributary of Thirston Burn
i. River Coquet
j. Bradley Brook and Back Burn

Cotting Burn

10.7.3. The source of Cotting Burn is just upstream of the existing A1 alignment. The catchment of the watercourse is relatively flat with an approximate catchment area of 0.75 km², consisting primarily of agricultural land. Cotting Burn flows in a west to east direction underneath the existing A1 alignment at the junction with the A697. The Cotting Burn eventually discharges into the River Wansbeck approximately 3 km to the south-east of Part A. The Cotting Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

10.7.4. Cotting Burn flows through five existing culverts within close proximity of Part A as identified and numbered in **Image 10-1** below.

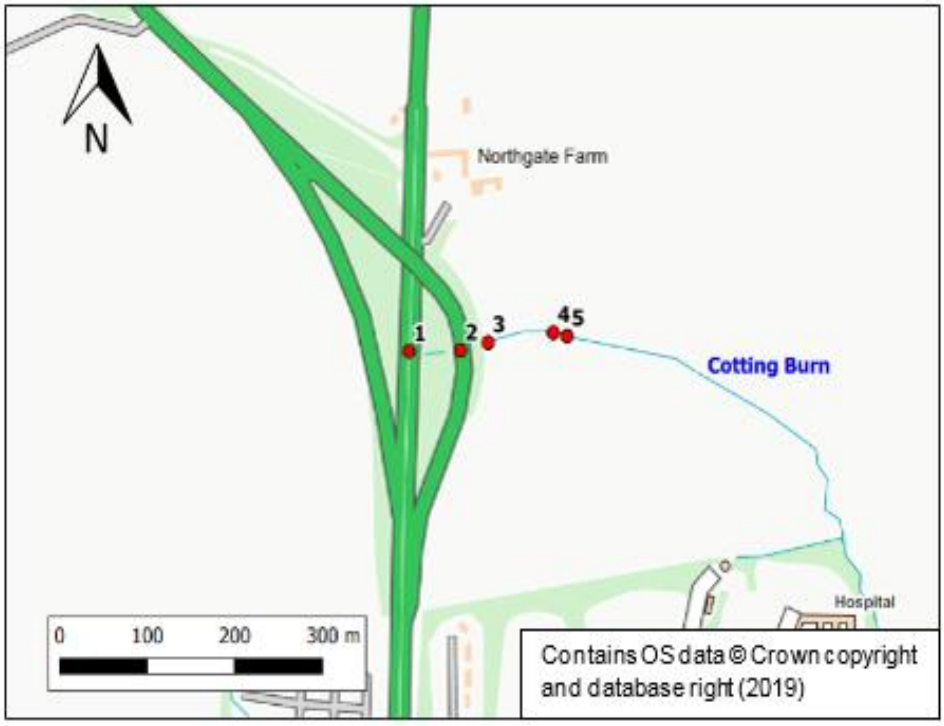

Image 10-1 - Location of Cotting Burn Culverts

10.7.5. Cotting Burn flows through a culvert underneath the existing A1, identified as number one within **Image 10-1**. **Image 10-2** shows the outlet of this circular concrete culvert, with a diameter of approximately 900 mm. The culvert is approximately 28 m in length.

10.7.6. Cotting Burn then flows through a culvert underneath the eastern slip road which joins with the A697, identified as number two within **Image 10-1**. **Image 10-3** shows this outlet of the circular 900 mm diameter concrete culvert, which is approximately 41 m in length.

10.7.7. **Image 10-4** shows the downstream face of the culvert underneath the farm access track just downstream of the crossing underneath the A697 slip road, identified as number three within **Image 10-1**. The culvert is a circular concrete pipe with a diameter of approximately 350 mm and approximately 7 m in length. There is approximately 80 m of open channel before Cotting Burn flows through another circular concrete 350 mm pipe underneath a farm access track, as shown in **Image 10-5**. This culvert is identified as number four within **Image 10-1**.

10.7.8. Cotting Burn then flows underneath an access track immediately downstream of culvert number four through a circular 450 mm diameter and 15 m long culvert, identified as number five within **Image 10-1**. **Image 10-6** shows the top of the access track. During the site visit it was noted that the culvert appeared to be blocked and assessed to be in a poor condition.

Image 10-2 - Outlet of Cotting Burn Culvert (1)

Image 10-3 - Outlet of Cotting Burn Culvert (2)

Image 10-4 - Outlet of Cotting Burn Culvert (3)

Image 10-5 - Inlet of Cotting Burn Culvert (4)

Image 10-6 - Cotting Burn Crossing (Upstream)

10.7.9. No fish surveys have been undertaken along Cotting Burn as it was determined that the watercourse was unsuitable as a habitat (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). This is assumed to be due to the presence of a septic tank along Cotting Burn that is assumed to be affecting water quality. During the site walkover the septic tank was identified adjacent to the outlet of culvert three. The outfall of the tank is assumed to discharge into the Cotting Burn just downstream of the culvert. No evidence of otters was identified during the mammal surveys (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES).

10.7.10. The Cotting Burn is monitored directly against the objectives of the WFD and is located within the Wansbeck from Font to Bothal Burn WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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 'heavily modified'.

Shieldhill Burn

10.7.11. The source of Shieldhill Burn is approximately 0.8 km to the west of the existing A1 alignment, adjacent to the A697. The catchment of the watercourse is relatively flat with an approximate catchment area of 0.94 km², consisting primarily of agricultural land. Shieldhill Burn flows in a west to east direction and flows underneath the existing A1 alignment approximately 1 km to the north of the A697 junction, as shown in **Image 10-7** below. The Shieldhill Burn discharges into Cotting Burn approximately 2.5 km downstream from the existing A1 crossing. The Shieldhill Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

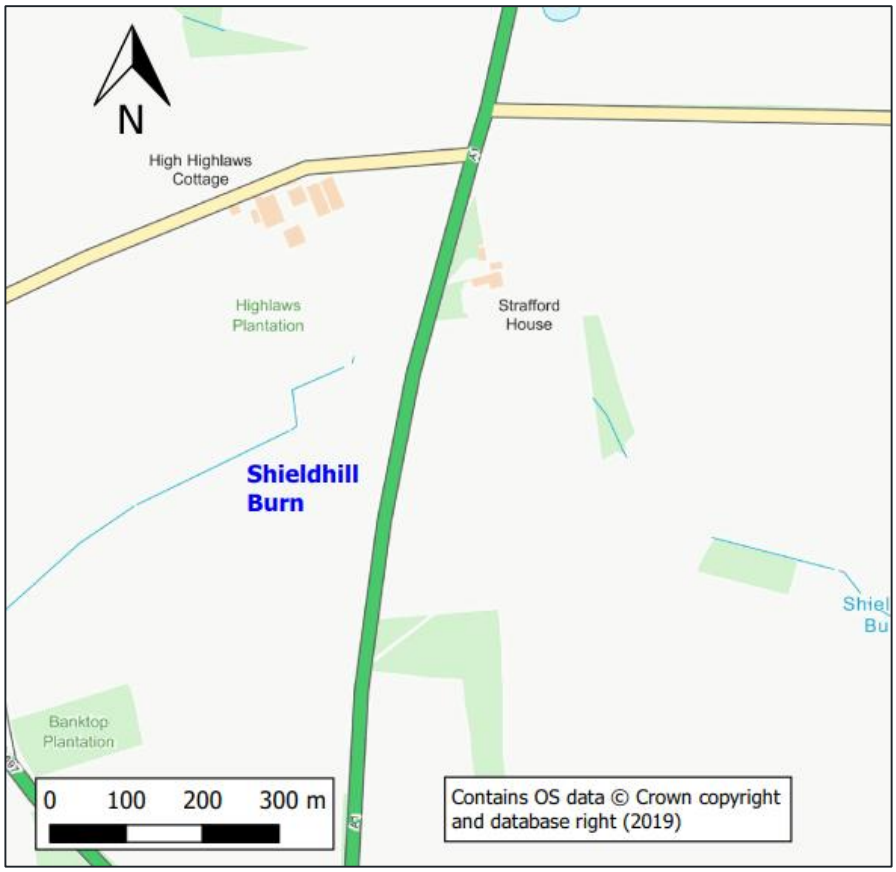

Image 10-7 - Shieldhill Burn Overview

10.7.12. Upstream of the existing crossing of the A1 the Shieldhill Burn enters a c.300 mm diameter below ground pipe that conveys the watercourse to the existing culvert. The culvert comprises an arch culvert approximately 1200 mm in width, 1000 mm in height and 30 m in length. **Images 10-8** and **10-9** below show the upstream and downstream ends of the culvert.

10.7.13. During the site walkover a c.300 mm pipe was observed at the outlet of the culvert. The watercourse enters this pipe immediately downstream of the culvert and is conveyed below ground for approximately 210 m at which point the watercourse returns to an open channel. Review of satellite imagery and flood mapping indicates that when the capacity of the pipe is exceeded the watercourse flows overland along what is assumed to be the natural alignment to re-join the open channel downstream. It is likely the amendments to the watercourse alignment (the addition of the c.300 mm pipes) were done by the local landowner to increase the area of usable land for agricultural purposes.

Image 10-8 - Shieldhill Burn Culvert, Upstream

Image 10-9 - Shieldhill Burn Culvert, Downstream

10.7.16. During the site walkover it was noted that the banks were heavily vegetated.

10.7.17. No fish surveys have been undertaken along Shieldhill Burn as it was determined that the watercourse was unsuitable as a habitat (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). This is due to the long-culverted and piped section along Shieldhill Burn. The watercourse also has very low flows, especially during the summer months. No evidence of otters was identified during the mammal surveys (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES).

10.7.18. Shieldhill Burn is not monitored against the objectives of the WFD but is located within the Wansbeck from Font to Bothal Burn WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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 'heavily modified'.

Floodgate Burn

10.7.19. The source of Floodgate Burn is approximately 1.5 km to the south-west of the existing A1 alignment within the Spruce Plantation. The catchment of the watercourse is relatively flat with an approximate catchment area of 2 km², consisting primarily of agricultural land. Floodgate Burn flows in a south-west to north-east direction underneath the existing A1 alignment through an arch culvert, as shown in **Image 10-10** below. Approximately 1.3 km downstream of the watercourse crossing, the Floodgate Burn discharges into the River

Lyne. The Floodgate Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

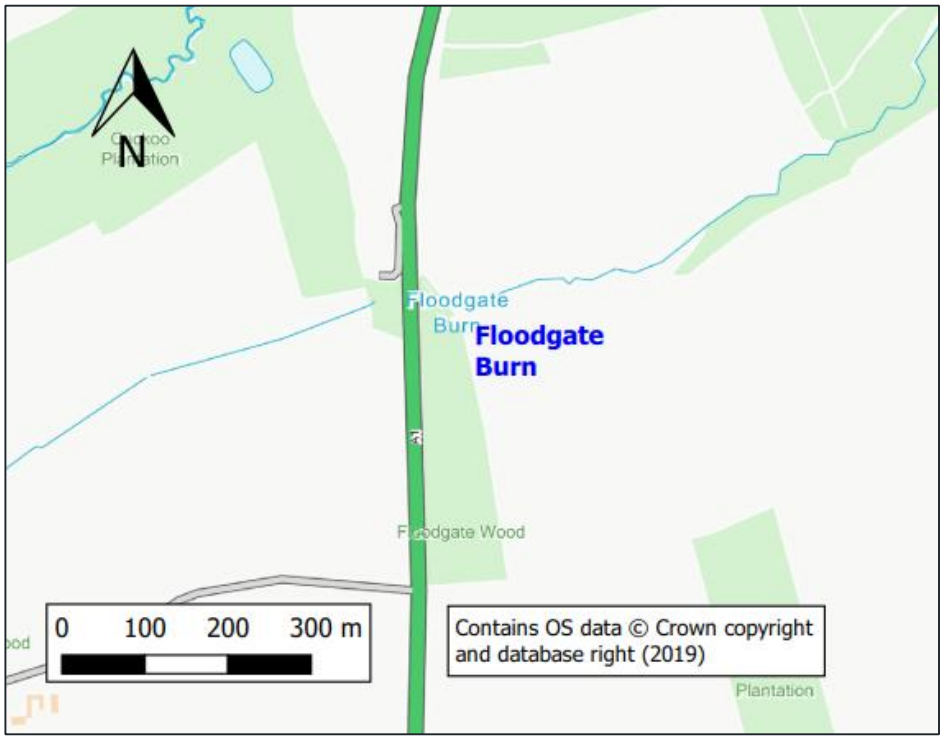

Image 10-10 - Floodgate Burn overview

10.7.20. Floodgate Burn flows under the A1 through an arch culvert (approximately 1.9 m wide and 1 m high) which is 26 m in length, as shown in **Image 10-11**. Approximately 50 m downstream of this culvert the watercourse flows underneath a farm access track through a circular 900 mm diameter culvert, which is 7 m in length. This is shown in **Image 10-12**.

Image 10-11 - Floodgate Burn Culvert Underneath the A1, Downstream

Image 10-12 - Floodgate Burn Culvert Underneath Farm access Track, Downstream

10.7.21. The HADDMS online database (**Ref. 10.18**) indicates that the culvert that flows beneath the A1 is a priority culvert, but a classification status has not been determined and no baseline assessment has been carried out.

10.7.22. The fish surveys identified the presence of 3-spined stickleback within Floodgate Burn, which are a common species (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). No evidence of otters was identified during the mammal surveys (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES).

10.7.23. Floodgate Burn is not monitored against the objectives of the WFD but is located within the Lyne from Source to Tidal Limit WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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'.

River Lyne

10.7.24. The source of the River Lyne is approximately 1.2 km to the west of the A1, near to Gorfenletch Wood. Gorfen Letch and Heronsclose Burn confluence together before becoming the River Lyne. The catchment of the River Lyne is gently sloping from the west to the east and has a catchment area of 8.27 km², consisting primarily of agricultural land and woodland. The River Lyne flows underneath the existing A1 alignment through a culvert at Priest's Bridge, flowing in a west to east direction, as shown in **Image 10-13** below. The River Lyne has a number of significant tributaries including Floodgate Burn and Fenrother Burn, before eventually discharging into the North Sea approximately 11.9 km to the east Part A. The River Lyne is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

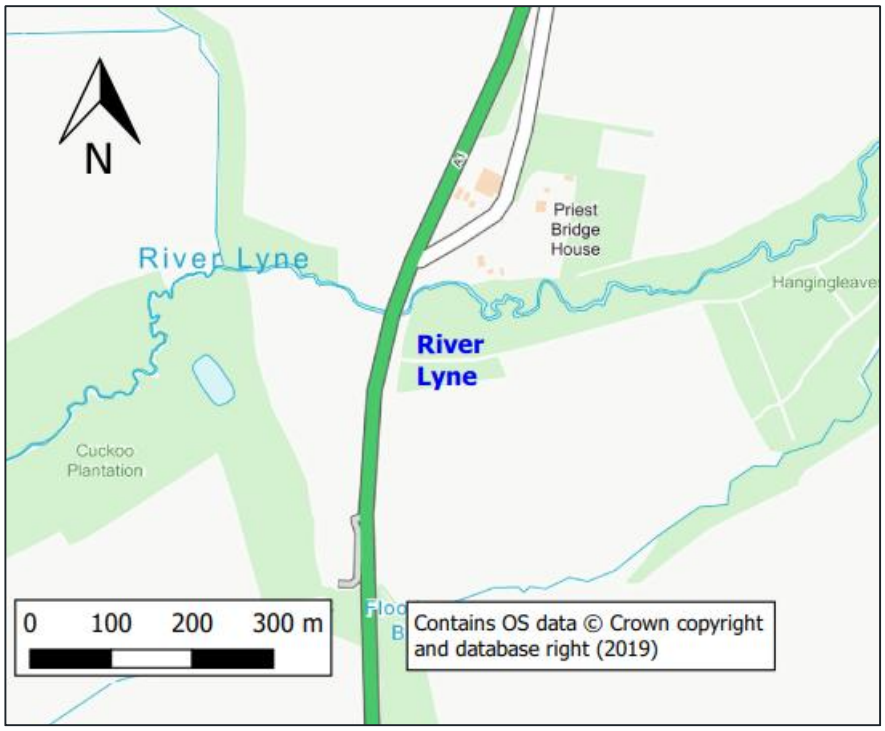

Image 10-13 - River Lyne Overview

10.7.25. The River Lyne flows underneath the existing A1 alignment through a concrete culvert. As shown in **Images 10-14** and **10-15**, the inlet of the culvert is circular, and the outlet is an arch structure. The culvert is 34 m in length and approximately 2 m wide and 2.6 m high.

Image 10-14 - River Lyne Culvert, Upstream

Image 10-15 - River Lyne Culvert, Downstream

10.7.28. The fish survey identified the presence of stickleback and bullhead within the River Lyne (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). Bullhead is considered to be an important species but is not a designated species under UK legislation. Stickleback is not a designated or important species. No evidence of otters was identified during the mammal surveys (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES).

10.7.29. The River Lyne is monitored against the objectives of the WFD and is located within the Lyne from Source to Tidal Limit WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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'.

Fenrother Burn

10.7.30. The source of Fenrother Burn is approximately 2.5 km to the west of where the Fenrother Burn discharges into the River Lyne, just to the south of Longhorsley Moor. The catchment of the watercourse gently slopes towards the east with an approximate catchment area of 3 km^2, consisting primarily of agricultural land. Fenrother Burn and its small tributary flow in a predominantly north to south direction Fenrother Burn flows underneath Fenrother Lane just to the west of the A1 and discharges into the River Lyne approximately 1 km downstream from the Fenrother Lane watercourse crossing, as shown in **Image 10-16** below. The Fenrother Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

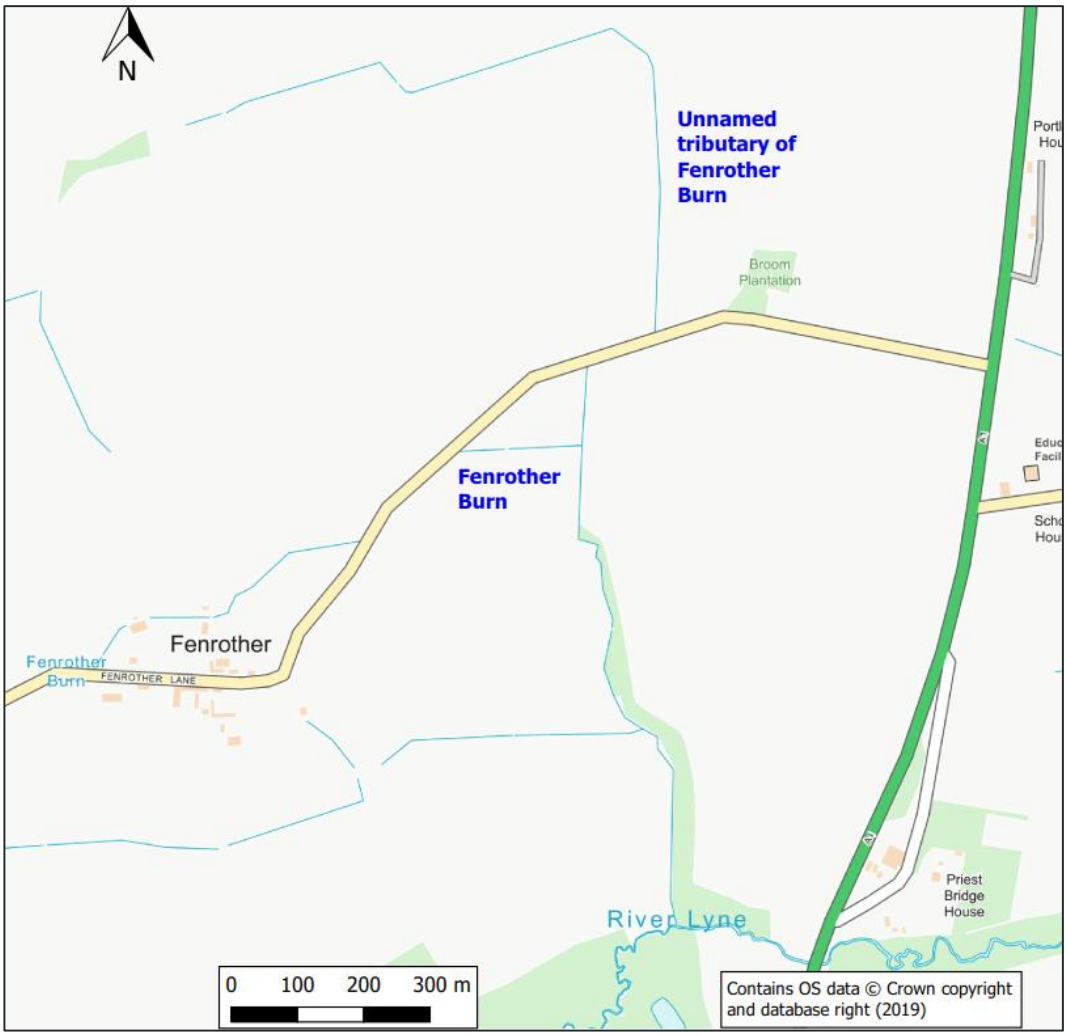

Image 10-16 - Fenrother Burn Overview

10.7.31. During the site walkover it was noted that the river bed comprised of clay, and the watercourse and its small tributaries act as field drainage ditches. Fenrother Burn flows underneath Fenrother Lane through a stone circular culvert, as pictured in **Image 10-17** below. The culvert has an approximate diameter of 500 mm and is approximately 120 m in length.

Image 10-17 - Fenrother Burn Culvert, Upstream

10.7.32. No fish surveys have been undertaken along Fenrother Burn as it was determined that the watercourse was unsuitable as a habitat for aquatic species due to heavily shaded areas and the small volume of water within the watercourse (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). No evidence of otters was identified during the mammal survey (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES).

10.7.33. Fenrother Burn is not monitored against the objectives of the WFD but is located within the Lyne from Source to Tidal Limit WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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'.

Earsdon Burn

10.7.34. The source of Earsdon Burn is approximately 2.5 km to the south-west of the existing A1 alignment, to the south of the village Fieldhead. The catchment of the watercourse is relatively flat with an approximate catchment area of 4.2 km², consisting primarily of agricultural land. Earsdon Burn and its tributaries flow in a predominantly west to east direction, beneath the existing A1 alignment at Causey Park Bridge and underneath the local side road to the west. Earsdon Burn eventually discharges into the River Lyne approximately 4.2 km downstream of the existing watercourse crossings. The Earsdon Burn is classified as an ordinary watercourse and under the jurisdiction of NCC as LLFA for this area.

10.7.35. During the site walkover it was noted that the river bed of Earsdon Burn and its tributaries comprised of gravels. Earsdon Burn has a number of smaller tributaries to the west of the existing A1 alignment. The nearest one to Part A discharges into Earsdon Burn

approximately 70 m upstream of the closest adjacent unnamed road. Earsdon Burn flows through two culverts and one bridge underneath the adjacent unnamed roads and the existing A1 alignment, as identified in **Image 10-18** below.

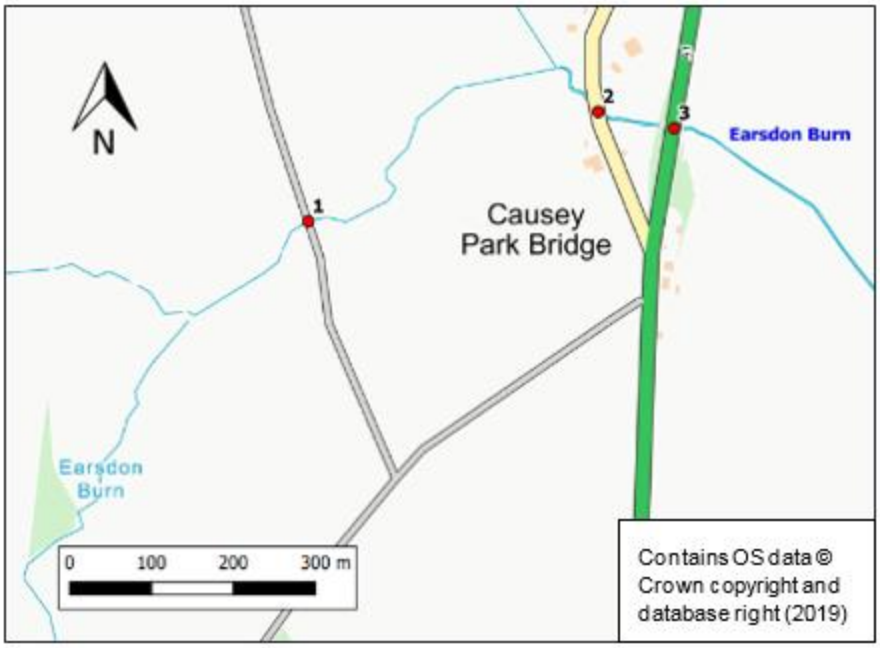

Image 10-18 - Earsdon Burn Existing Structures

10.7.36. Earsdon Burn flows through a culvert underneath an unnamed road to the west of the A1, identified as number one within **Image 10-18**. **Image 10-19** below shows the inlet of the triple circular parallel concrete culverts. The diameter of each culvert (from left to right) is approximately 450 mm, 650 mm and 650 mm respectively. The culvert is approximately 10 m in length.

10.7.37. **Image 10-20** shows the bridge crossing over Earsdon Burn underneath the unnamed road to the west of the existing A1, identified as number two within **Image 10-18**. The bridge crossing is approximately 5.8 m wide and 29 m in length. The walls of the bridge are made of concrete.

10.7.38. Earsdon Burn flows underneath the existing A1 alignment through a 3 m wide and 32 m long concrete culvert, as identified as number three within **Image 10-18**. **Image 10-21** shows the inlet of the culvert.

Image 10-19 - Earsdon Burn Culvert (1)

Image 10-20 - Earsdon Burn Crossing (2)

Image 10-21 - Earsdon Burn Culvert (3)

10.7.39. No fish surveys have been undertaken along Earsdon Burn or any of its tributaries as it was determined that the watercourses were unsuitable as a habitat for aquatic species due to the relatively shallow water depth (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). The mammal survey identified the presence of otters along the Earsdon Burn (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES). Otters are a European protected species, are listed under Section 41 of the Natural Environment and Rural Communities Act (2006) (**Ref. 10.43**) and are considered to be of principal importance.

10.7.40. Earsdon Burn and its tributaries are not monitored against the objectives of the WFD but are located within the Lyne from Source to Tidal Limit WFD catchment. Review of the

Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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'.

Longdike Burn

10.7.41. The source of Longdike Burn is approximately 5.9 km to the south-west of the existing A1 alignment just to the west of Longhorsley Moor. The catchment of the watercourse gently slopes towards the north-east with an approximate catchment area of 23.4 km², consisting primarily of agricultural land. Eshott Airfield is located to the north-east of Part A where it crosses Longdike Burn. Longdike Burn flows in a predominantly south-west to north-east direction, flowing underneath the existing A1 alignment just downstream of where the Bywell Letch discharges into Longdike Burn, as shown in **Image 10-22** below. Approximately 2.7 km downstream of the existing A1 watercourse crossing Longdike Burn discharges into Thirston Burn. The Longdike Burn is classified as a main river and under the jurisdiction of the Environment Agency.

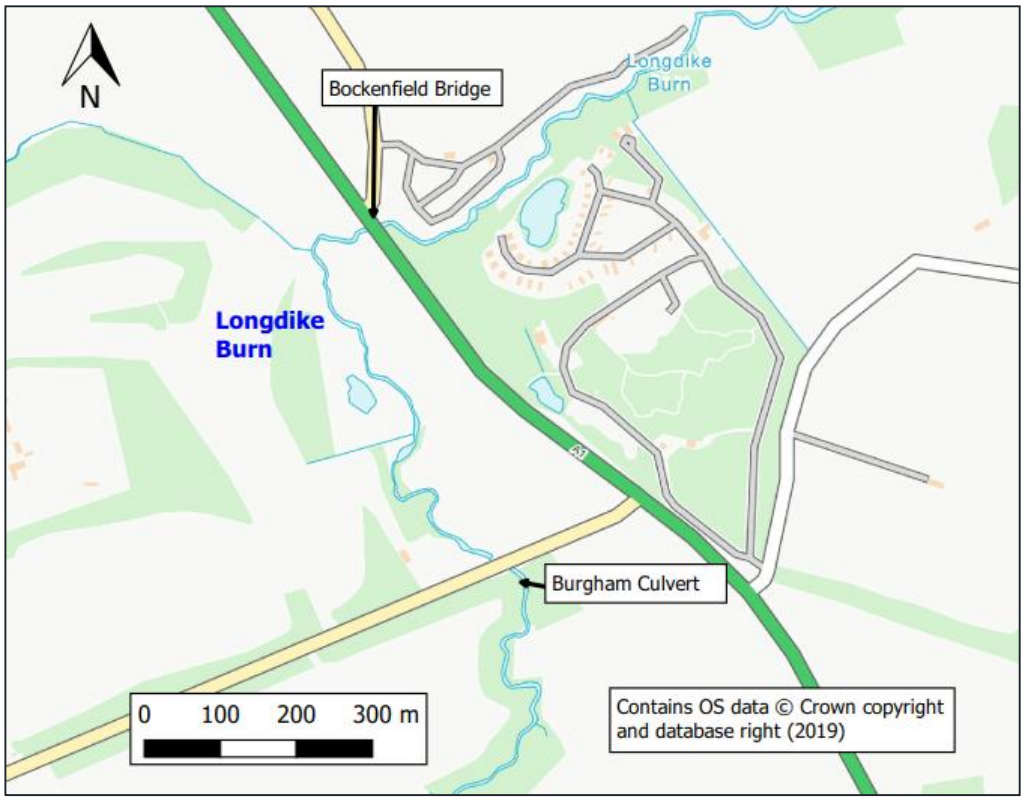

Image 10-22 - Earsdon Burn Existing Structures

10.7.42. Approximately 0.5 km upstream of the existing A1 watercourse crossing the Longdike Burn flows underneath Burgham Park Road to the south of Burgham Park Golf Club through a concrete arch culvert known as Burgham culvert. **Image 10-23** below shows the outlet of the culvert; as shown in the photograph there are wooden baffles along the base of the

culvert to facilitate fish passage. The culvert is approximately 3.4 m wide and 4.8 m high, and approximately 30 m in length. The base of the culvert is set above the adjacent bed level creating a potential obstruction to fish passage, as seen in the photograph below.

10.7.43. **Image 10-24** below shows Longdike Burn flowing underneath the existing A1 alignment through Bockenfield Bridge. The concrete arch bridge is approximately 6.6 m wide and 2.4 m high, and approximately 30.6 m in length.

10.7.44. Downstream of Bockenfield Bridge, during the site walkover there was evidence of fluvial erosion, as seen in **Image 10-25**. The erosion is located along outer edge of the meander and the presence of vegetation denotes it did not occur recently.

10.7.45. The A1 also crosses a tributary of Longdike Burn approximately 850 m to the north of Bockenfield Bridge. The structure inlet or outlet was not found during the site walkover. It is assumed that there is an existing structure at this location. Further investigation would be required during detailed design to determine the form and alignment of the structure, as a new structure (which is referred to as Blackwood Hall, refer to **Chapter 2: The Scheme**, **Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**)) is proposed in this location.

Image 10-23 - Burgham Culvert, Outlet

Image 10-24 - Bockenfield Bridge

Image 10-25 – Evidence of Erosion along Longdike Burn

10.7.49. Fish surveys identified a number of aquatic species within Longdike Burn (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) of this ES). Brown trout, lamprey and European eel were identified during the survey and all are protected species listed under Section 41 of the NERC Act (2006) (**Ref. 10.43**) and are considered to be of principal importance. Brown trout and European eel are also listed in the Northumberland Local Biodiversity Action Plan (LBAP) (**Ref. 10.44**). Other freshwater species identified along Longdike Burn were stone loach, stickleback and minnow. The mammal survey identified the presence of otters along Longdike Burn (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES). Otters are a European protected species and are listed under Section 41 of the NERC Act (2006) (**Ref. 10.43**).

10.7.50. Longdike Burn is directly monitored against the objectives of the WFD and is located within the 'Longdike Burn Catchment (tributary of Coquet)' WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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'.

Unnamed Tributary of Thirston Burn

10.7.51. The source of the unnamed tributary of Thirston Burn is approximately 0.5 km to the west of the existing A1 alignment. The catchment of the watercourse is relatively flat with an approximate catchment area of 0.7 km^2, consisting of agricultural land. The unnamed tributary of Thirston Burn flows in a west to east direction and underneath the existing A1 alignment 0.7 km to the south of the existing River Coquet bridge, as shown in **Image 10-26** below. Approximately 2.1 km downstream of the existing A1 watercourse crossing, the unnamed tributary discharges into the Thirston Burn. The Thirston Burn and its tributaries are classified as ordinary watercourses and under the jurisdiction of NCC as LLFA for this area.

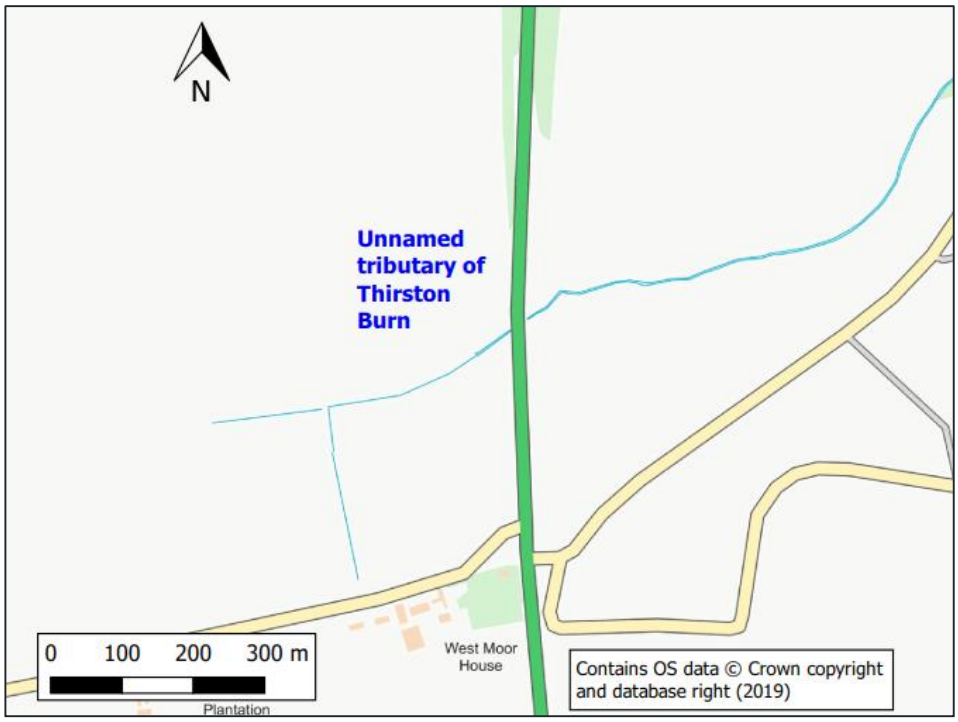

Image 10-26 – Unnamed Tributary of Thirston Burn Overview

10.7.52. **Image 10-27** shows the precast concrete circular culvert that conveys the watercourse beneath the A1 with a diameter of approximately 1200 mm and 24.3 m in length. The base of the culvert has been reinforced with concrete and a cover slab.

Image 10-27 - Unnamed Tributary of Thirston Burn Culvert

10.7.53. The HADDMS online database (**Ref. 10.18**) indicates that the culvert that flows beneath the A1 is a priority culvert, but a classification status has not been determined.

10.7.54. No fish surveys have been undertaken along Thirston Burn as it was determined that the watercourse was unsuitable as a habitat for aquatic species due to an abundance of terrestrial grasses and low water levels (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). No evidence of otters was identified during the mammal surveys (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES).

10.7.55. The unnamed tributary of Thirston Burn is not monitored directly against the objectives of the WFD but is located within the Longdike Burn Catchment (tributary of Coquet) WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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'.

River Coquet

10.7.56. The River Coquet rises at Coquet Head within the Cheviot Hills, in Northumberland National Park at 440 m AOD, which is approximately 40 km to the north-west of the existing A1 alignment. The catchment is characterised by a steep, deep valley with land use dominated by agricultural, woodland and upland vegetation with a number of small rural communities. Urban land use occupies less than 1 % of the catchment with grassland being the dominant land use (**Ref. 10.38**). The catchment area is approximately 486 km². The river has a flashy hydrological regime in the Study Area, typically rising and falling within a four-hour period following rainfall (**Ref. 10.38**).

10.7.57. Within the Study Area, the River Coquet flows under the existing A1 bridge and flows in a predominantly south-west to north-east direction, as shown in **Image 10-28** below. It discharges into the North Sea approximately 17 km downstream of the bridge by the town of Amble. The River Coquet is classified as a main river and under the jurisdiction of the Environment Agency. The study reach lies within a deep v-shaped valley, with heavily vegetated steep slopes with managed coniferous and deciduous woodland on the northern face and ancient woodland dominating the southern face (Dukes Bank Wood).

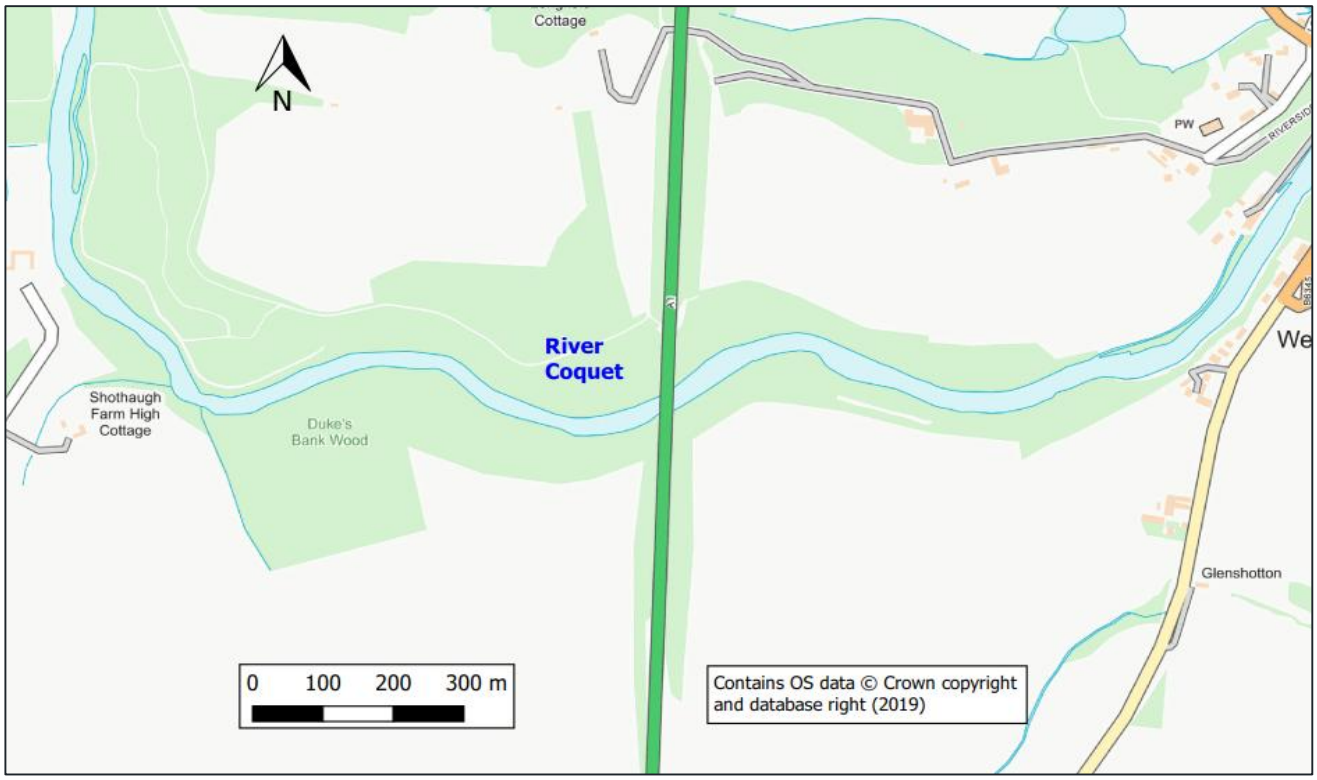

Image 10-28 - River Coquet Overview

10.7.58. Sediment sampling undertaken to inform the geomorphological assessment of the River Coquet indicates that the river substrate is dominated by a bedrock channel, with a mix of poorly graded very coarse substrates comprised of boulders and cobbles.

10.7.59. **Image 10-29** shows a photograph of the bridge facing downstream. The as-built drawing for the existing River Coquet bridge is presented in **Figure 10.2: River Coquet As-Built Drawing**, **Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**).

Image 10-29 – River Coquet, Looking Downstream

10.7.60. The River Coquet is designated as part of the River Coquet and Coquet Valley Woodlands Site of Special Scientific Interest (SSSI). The SSSI was last surveyed in August 2010 and SSSI Unit five 'rivers and stream' habitat was found to be in an 'unfavourable – recovering' condition. This is due to sources of diffuse pollution affecting water quality, woodland management practices and deer grazing. The site is designated for Atlantic salmon, brook lamprey and sea lamprey. The citation for the River Coquet and Coquet Valley Woodland SSSI states that the riverside shingle habitats support an important assemblage of ground beetles with several nationally scarce species.

10.7.61. No fish surveys have been undertaken along the River Coquet as river flows were too high to undertake fish surveys during the survey period (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). It was deemed unnecessary to assess fish populations as part of the assessment due to the assumed presence of migratory species able to reach the spawning grounds in the tributaries and the large size of the River Coquet. For further information regarding fish population refer to **Chapter 9: Biodiversity** of this ES.

10.7.62. Data obtained during consultation returned the following records of fish in the River Coquet from the Environment Agency's monitoring sites:

a. Atlantic salmon
b. Brown/sea trout
c. European eel
d. Stone loach
e. Minnow
f. 3-spined stickleback
g. Lamprey species

10.7.63. Atlantic salmon, brown/sea trout and European eel are all protected species listed under Section 41 of the NERC Act (2006) (**Ref. 10.43**) and are of principal importance. Brown trout and European eel are also listed in the LBAP (**Ref. 10.44**).

10.7.64. The mammal survey identified the presence of otters along the River Coquet (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of the ES (**Application Document Reference: TR010041/APP/6.7**)). Otters are a European protected species, are listed under Section 41 of the NERC Act (2006) (**Ref. 10.43**) and are of principal importance.

10.7.65. The River Coquet is monitored against the objectives of the WFD and is located within the Coquet from Forest Burn to Tidal Limit WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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 as having a hydromorphological designation of 'not designated artificial or heavily modified'. The hydromorphological status and the hydrological regime currently 'Supports Good'.

10.7.66. Additional baseline information in relation to the geomorphology of the River Coquet is available in **Appendix 10.4: Geomorphology Assessment – River Coque**t, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

Bradley Brook and Back Burn

10.7.67. The source of Bradley Brook is approximately 0.3 km to the west of the existing A1 alignment within Park Wood. The catchment of the watercourse is small with a catchment area of less than 0.5 km², consisting primarily of woodland. Bradley Brook flows in a west to east direction and flows underneath the existing A1 alignment through a culvert within Park Wood. Bradley Brook discharges into Back Burn approximately 0.9 km downstream of the existing culvert, as shown in **Image 10-30**. Bradley Brook and Back Burn are classified as ordinary watercourses and under the jurisdiction of NCC as LLFA for this area.

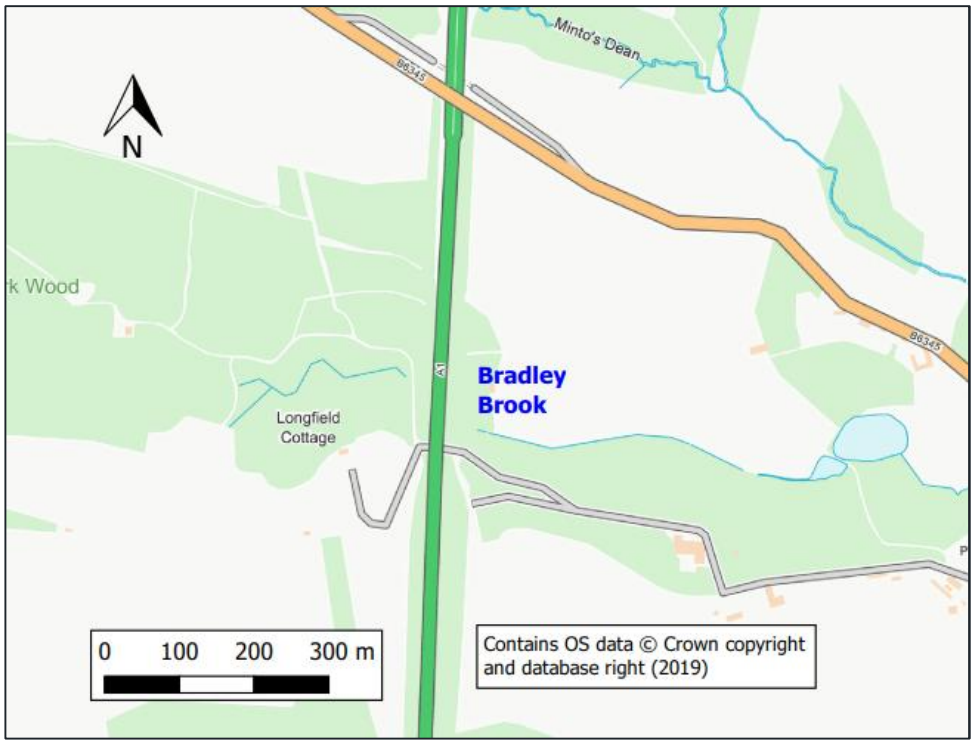

Image 10-30 – Bradley Brook Overview

10.7.68. During the site walkover it was noted that the river bed comprised of silt and gravels and the watercourse is located within a heavily wooded area. Bradley Brook flows underneath the existing A1 alignment through a precast concrete circular culvert as shown in **Images 10-31** and **10-32**. The culvert has a diameter of approximately 1200 mm at the inlet and is 125 m in length. The base of the culvert has been reinforced with concrete and a cover slab. At the outlet of the culvert the diameter is reduced to 900 mm for approximately 20 m. It is assumed that the culvert was previously extended to enable construction of an above ground attenuation area. There is a smaller circular pipe just above the main culvert as shown in **Image 10-32**, which has an approximate diameter of 300 mm.

Image 10-31 - Bradley Brook Culvert, Inlet

Image 10-32 - Bradley Brook Culvert, Outlet

10.7.69. The HADDMS online database (**Ref. 10.18**) indicates that the culvert that flows beneath the A1 is a priority culvert, but a classification status has not been determined.

10.7.70. Fish surveys did not identify the presence of any fish in the watercourse (refer to **Appendix 9.3: Aquatic Ecology Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). No evidence of otters was identified during the mammal surveys (refer to **Appendix 9.17: Water Vole and Otter Survey Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

10.7.71. Bradley Brook is not directly monitored against the objectives of the WFD but is located within the Coquet from Forest Burn to Tidal Limit WFD catchment. Review of the Environment Agency's Catchment Data Explorer (2016 results) (**Ref. 10.32**) 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 as having a hydromorphological designation of 'not designated artificial or heavily modified'.

Other Surface Water Features

10.7.72. Review of OS mapping indicates that there are nine other surface water features located within the Study Area, as identified in **Figure 10.1: Water Constraints Plan**, **Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**). The surface water features are located within predominantly rural areas and have no known significant recreational value or value to the economy. Although they have no known designations, during baseline ecological surveys great crested newts were identified in five ponds within 0.5 km of Part A. For more information regarding the ecological quality of the surface water ponds refer to **Chapter 9: Biodiversity** of this ES.

10.7.73. A review of OS mapping indicates that there are two covered reservoirs within the Study Area. The Hebron Reservoir is located to the north of Hebron, approximately 1 km to the east of the existing A1. An unnamed covered reservoir is located to the north-east of Helm, approximately 0.9 km to the east of the existing A1.

Surface Water Abstractions

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

GEOLOGY AND HYDROGEOLOGY

10.7.75. Review of the British Geological Survey (BGS) 1:50,000 data (**Ref. 10.33**) indicates that the majority of Part A is underlain by bedrock geology of the Stainmore Formation comprising mudstone, siltstone and sandstone. A seam of the Northern England Late Carboniferous Tholeiitic Dyke-Swarm (Quartz-microgabbro) comprising igneous bedrock is located to the north of Causey Park. There is also a small deposit of Corbridge Limestone located along the River Coquet to the north of Part A.

10.7.76. A review of the Environment Agency Groundwater data available on MAGIC online mapping (**Ref. 10.31**) indicates that the majority of the bedrock geology is 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 forming an important source of base flow to rivers. The seam of Tholeiitic Dyke-Swarm is classified as Secondary B Aquifer, described as predominantly lower permeability layers which may store and yield amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

10.7.77. A review of BGS 1:50,000 data (**Ref. 10.33**) indicates that superficial deposits within the 1 km Study Area are mostly glacial till with an area of glacial sands and gravels located to the north of Part A area surrounding the River Coquet. There are also alluvium deposits consisting of clay, silt, sand and gravel associated with the Longdike Burn and the Earsdon Burn.

10.7.78. A review of the Environment Agency's Groundwater data available on MAGIC online mapping (**Ref. 10.31**) indicates that the majority of the superficial deposits are classified as a Secondary (Undifferentiated) Aquifer. The sands and gravels are classified as a Secondary A Aquifer along the River Coquet and Longdike Burn.

10.7.79. A review of the Cranfield University Soilscapes database (**Ref. 10.35**) indicates that soils within the 1 km Study Area are slowly permeable loamy and clayey soils.

10.7.80. A review of the Environment Agency's Groundwater data available on MAGIC online mapping (**Ref. 10.31**) indicates that the southern section of the Study Area, just to the north of Morpeth, is located within a total catchment (Zone 3) groundwater Source Protection Zone (SPZ). Total catchment (Zone 3) is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. SPZs are typically used to protect abstractions for public water supply. The quality of surface water runoff discharged to ground within designated SPZs is of key importance.

10.7.81. Groundwater quality has been assessed against the objectives of the WFD. Part A 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. 10.32**) 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.

10.7.82. Two licenced groundwater abstractions have been identified within the 1 km Study Area during consultation with the Environment Agency. These are identified on **Figure 10.1: Water Constraints Plan**, **Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**). The abstractions are for private water supply, agricultural purposes and industrial, commercial and public services.

10.7.83. The ground investigation work undertaken in 2018 (**Appendix 11.2: Ground Investigation Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) was to improve understanding of baseline conditions included groundwater monitoring of sixteen locations where groundwater strikes had previously been recorded during investigation work. The groundwater monitoring indicated that groundwater levels are relatively stable between 0.5 m and 1 m below ground level (bgl). The glacial deposits along Part A within the Study Area recorded groundwater levels between 1.5 m and 2.5 m bgl. All the groundwater monitoring results therefore indicate that that groundwater levels are relatively high across the 1 km Study Area.

10.7.84. Sections of Part A to the north and to the east are located within the Coal Authority (CA) reporting area. The online CA's screening tool (**Ref. 10.37**) indicates that Part A is not located within a constraint area that requires further investigation regarding surface water drainage development proposals as identified by the CA in regard to specific mining or groundwater.

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

EXISTING DRAINAGE SYSTEMS

10.7.86. Information regarding the existing highway drainage infrastructure that currently serves the A1 has been collated from the HADDMS online database (**Ref. 10.18**). A summary of the existing highway drainage infrastructure is provided below.

10.7.87. Surface water runoff from the existing A1 is currently collected by a system of gullies and combined kerb drainage and transported to a number of outfalls to various watercourses along Part A through an underground piped system. The location and condition of the existing outfalls is currently uncertain at the time of this assessment, however review of the features on the HADDMS online database (**Ref. 10.18**) indicates that there are no priority outfalls along Part A, existing flow controls or pollution prevention measures in place. However, there are catchpits downstream of the two existing outfalls on the existing River

Coquet bridge providing a level of treatment prior to discharging into the watercourse. There are indications that the existing A1 highway drainage infrastructure has a number of defects classified as Internal Condition Grade (ICG) categories four and five based on a high-level review of the HADDMS online database (**Ref. 10.18**). The ICG categories are defined in the Sewer Rehabilitation Manual (4th Edition) (**Ref. 10.45**) as the following:

a. Category five: Collapsed or collapse imminent
b. Category four: Collapse likely in foreseeable future
c. Category three: Collapse unlikely in near future but further deterioration likely
d. Category two: Minimal collapse likelihood in short term but potential for further deterioration
e. Category one: Acceptable structural condition

10.7.88. Surveys of the existing outfalls located along the de-trunked section of Part A would be undertaken during detailed design, to identify their condition and any need for repairs.

10.7.89. For more detailed information regarding the existing highway drainage infrastructure refer to **Appendix 10.5: Drainage Strategy Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

FLOOD RISK

10.7.90. An **FRA** (**Appendix 10.1**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) has been completed in accordance with the NPS NN (**Ref. 10.11**), the NPPF (**Ref. 10.12**) and the Planning Practice Guidance (**Ref. 10.20**). A summary of identified flood risks is provided below.

10.7.91. Consultation with NCC has highlighted fluvial flooding incidents from ordinary watercourses relating to:

a. Flooding issues in Morpeth relating to the Cotting Burn
b. Flooding issues in Felton relating to the Bradley Brook, Back Burn and other watercourses
c. Performance of attenuation features associated with the existing alignment of the A1 near Felton

10.7.92. Historic flood incidents were identified during the November 2016 public consultation:

a. An existing outfall from the A1 surface water drainage system is understood to discharge into the Back Burn via a settlement pond but without any attenuation. Anecdotal evidence suggests that the discharge has contributed to flooding at nearby properties.
b. Another historic flooding issue was highlighted to have occurred approximately 500 m to the west of the existing A1. Anecdotal reports suggest that this flooding event occurred along the length of the field north from Fenrother Lane and was associated with the unnamed tributary of Fenrother Burn.

10.7.93. The 2018 statutory consultation identified further anecdotal flooding information. A natural spring is located just to the south of the A697 slip road which has previously caused flooding to the centre of the A1.

10.7.94. The NCC Level 1 Strategic Flood Risk Assessment (SFRA) (**Ref. 10.46**) indicates significant flooding within the North East Northumberland river catchments from fluvial and pluvial sources since 1744. Several significant flood events are attributed to the River Coquet and impacted settlements and roads within the 0.5 km Study Area.

10.7.95. A review of the Environment Agency's Flood Map for Planning (Rivers and Sea) (**Ref. 10.29**) indicates that the majority of the Part A alignment is located in the low-risk Flood Zone 1. However, Part A does include sections located in the medium risk Flood Zone 2, and the high-risk Flood Zone 3. The identified fluvial flood risk is associated with the following watercourses: River Lyne; Earsdon Burn; Longdike Burn (and the Poxtondean Burn that discharges into the Longdike Burn); and River Coquet.

10.7.96. Part A is not at risk of tidal flooding as the tidal limits for the River Coquet is downstream of the 1 km Study Area. The tidal limit for the River Coquet is on the outskirts of Warkworth which is located approximately 9 km to the east of Part A. The lowest elevation along Part A alignment is at the River Coquet which is in a deep valley at approximately 35 m AOD, but the majority of Part A is between 80 to 150 m AOD.

10.7.97. A review of the Environment Agency's Flood Risk from Surface Water map (**Ref. 10.30**) indicates that sections of Part A 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.

10.7.98. The HADDMS online database (**Ref. 10.18**) indicates that the Part A section of the existing A1 has eight documented historical surface water flood events of which two are detailed as high severity events resulting in the total closure of the carriageway. The two high severity flood events were associated with blocked highway gullies.

10.7.99. The HADDMS online database (**Ref. 10.18**) also indicates that the offline and online sections of Part A have been denoted as category 'C' Moderate hotspot areas. Baseline assessments for hotspot ID 210 (located adjacent to Morpeth and is approximately 5 km in length) and hotspot ID 245 (located between Morpeth and Felton and is approximately 18 km in length) have been carried out. No information regarding the need for remedial measures has been provided. Hotspot ID 210 is reported to be attributable to two recorded flood events that occurred during July 2018 and November 2017 and that are both of low severity. Hotspot ID 245 is reported to be attributable to 23 recorded flood events dating from June 2008 to December 2018, all of which are of low severity.

10.7.100. A review of the Environment Agency's Flood Risk from Reservoirs map (**Ref. 10.30**) indicates that the River Coquet is located at the downstream extent of the area identified to be at risk of flooding from the potential failure of Rayburn Lake located approximately

9.3 km to the south-west of where the existing A1 crosses the River Coquet. As Part A is located a significant distance from the reservoir, and the likelihood of reservoir failure is considered to be very small, the risk to Part A is not deemed to be significant.

10.7.101. The Environment Agency's Flood Risk from Reservoirs map (**Ref. 10.30**) does not show any areas within 0.5 km identified as being at risk of flooding from potential failure from the two covered reservoirs identified above.

SENSITIVE RECEPTORS

10.7.102. **Table 10-8** 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 allocated through consultation with the Environment Agency and the LLFA and in accordance with the criteria set out in Table A4.3 in the DMRB Volume 11, Section 3, Part 10 (HD 45/09) (**Ref. 10.16**) as set out in **Table 10-5**.

Table 10-8 - Importance of Baseline Receptors

Receptor	Criteria	Importance
Cotting Burn	Ordinary watercourse No fish/mammal species identified Classified as having 'moderate' ecological value and 'Good' chemical value under WFD	Medium
Shieldhill Burn	Ordinary watercourse No fish/mammal species identified Located within a 'moderate' ecological value and 'Good' chemical value WFD catchment	Medium
Floodgate Burn	Ordinary watercourse Stickleback identified (common species), but no mammal species identified Located within a 'poor' ecological value and 'Good' chemical value WFD catchment	Medium
River Lyne	Ordinary watercourse Stickleback (common species) and bullhead (important but not designated) identified Classified as having a 'poor' ecological value and 'Good' chemical value WFD catchment	Medium
Fenrother Burn	Ordinary watercourse No fish/mammal species identified	Low

Receptor	Criteria	Importance
	Located within a 'poor' ecological value and 'Good' chemical value WFD catchment	
Earsdon Burn	Ordinary watercourse No fish species identified Otter (European protected species) identified Located within a 'poor' ecological value and 'Good' chemical value WFD catchment	High
Longdike Burn	Main river Brown trout, lamprey and European eel species identified (all protected species) Otter (European protected species) identified Classified as having a 'moderate' ecological value and 'Good' chemical value WFD catchment	High
Tributary of Thirston Burn	Ordinary watercourse No fish/mammal species identified Located within a 'Moderate' ecological value and 'good' chemical value WFD catchment	Medium
River Coquet	Main river Designated as part of the River Coquet and Coquet Valley Woodlands SSSI Otter (European protected species) identified Atlantic salmon, brown/sea trout, European eel, stone loach, minnow and stickleback species identified (principal importance) Classified as having a 'Good' ecological value and 'Good' chemical value WFD catchment	Very High
Bradley Brook and Back Burn	Ordinary watercourse No fish/mammal species identified Located within a 'good' ecological value and 'Good' chemical value WFD catchment	High
Floodplain of the River Lyne, Earsdon Burn,	Fluvial floodplain within Study Area Relatively narrow floodplain extents within rural agricultural land	Low

Receptor	Criteria	Importance
Longdike Burn and the River Coquet		
Ponds	Number of ponds which appear to not be hydraulically connected to nearby watercourses Five ponds recorded presence of great crested newts No known amenity value	High
Groundwater resources	Classified as having 'Poor' chemical quality under WFD Two licenced groundwater abstractions used for water supply, agriculture and commercial uses SPZ 3 at southern extent of Part A	Medium
Flood risk receptors	Surrounding rural agricultural land	Low
	Part A (would be classified as essential infrastructure in accordance with NPPF, as it would provide an important transport link that should remain operational in times of flooding)	High

10.8. POTENTIAL IMPACTS

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.

Geomorphology

10.8.7. The standalone assessment of the River Coquet in **Appendix 10.4: Geomorphology Report – River Coquet**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) details the geomorphologically related potential impacts associated with construction on the River Coquet. Given the proposed construction activities would be located outside of the bankfull channel identified for the geomorphology assessment, the key impacts on fluvial geomorphology would likely occur during flows that exceed bankfull. Bankfull width within this confined v-shaped valley has been determined based upon the evidence of bank undercutting observed on the site walkover and the point where terrestrial vegetation begins to dominate, given that terrestrial vegetation would not be tolerant of frequent inundation.

10.8.8. **Table 10-9** below provides a summary of the potential impacts on fluvial geomorphology of the River Coquet during construction.

Table 10-9 - Potential Impacts on Fluvial Geomorphology during Construction

Source of impact	Potential impact	Description
Suspended solids	Sediment regime	A possible increase in water turbidity and siltation of channel substrate may occur due to a potential increase in fine sediments. The introduction of fine sediments due to the removal of vegetation resulting in exposed earth, earthworks and excavation would contribute to the release of sediment. This sediment may be carried considerable distances downstream, altering the sediment regime with potential detrimental impacts on important aquatic habitats.
	Channel morphology	Smothering of bedforms with fine sediment as a result of increased fine sediment supply. This may settle between the cobbles and boulders and, where the water is shallow or the sediment is exposed during baseflow conditions, in-channel vegetation may establish. Any spawning gravels may also be smothered. These impacts could be far-reaching, extending beyond the downstream extent of the Study Area.
	Natural fluvial processes	Increased bare surfaces could result in changes to the quantity of flow entering the channel due to more rapid runoff, which has the potential to locally alter flow dynamics.
Vegetation clearance	Sediment regime	An increase in supply of fine sediment through exposed valley sides and loss of the riparian zone and increased exposed bare earth surfaces. The reduced roughness during out-of-bank flows also increases the sediment transport capability of the river and its erosive power for eroding the bare exposed earth that is composed of finer particle sizes (sand, silt and clay).
	Channel morphology	Reduced morphological diversity due to loss of tree roots, large wood and the loss of riparian vegetation. The potential smothering of the bed by silt as a result of increased fine sediment supply due to exposed valley sides and construction

Source of impact	Potential impact	Description
		activities may cause a loss in the morphological diversity of the channel bed.
	Natural fluvial processes	Vegetation clearance could reduce river bank stability, increasing the rates of erosion which could increase the rate at which channel changes shape in response to flow variation.
Clear Span Bridge (no in-channel piers)	Sediment regime	Construction of the piers and associated haul road could increase the volume of fine sediment directly entering the channel and consequently increase turbidity. The restriction of flow and reduced channel width during out-of-bank high flows that encroach into the construction zone may alter the sediment transport capability of the river enabling the transport of small cobbles. In addition, flood-water contained within the excavation for the pier would be laden with fine sediment, which may be released to the watercourse.
	Channel morphology	The construction of the piers would alter the cross-sectional area and water depth during out-of-bank flows within the construction zone, thus impacting on channel shape with a response change in flow velocity, stream power and sediment transport capability.
	Natural fluvial processes	The construction processes could alter the dynamics of flow during out-of-bank flows, which could result in increased erosion and sediment transport rates.

OPERATION

Polluted Surface Water Runoff

10.8.9. 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

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

Catchment Hydrology

10.8.11. 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

10.8.12. 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

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

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

Geomorphology

10.8.15. The standalone assessment of the River Coquet in **Appendix 10.4: Geomorphology Report – River Coquet**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) details the geomorphologically related potential impacts associated with the operation stage to the River Coquet. **Table 10-10** below provides a summary of the potential impacts on fluvial geomorphology of the River Coquet during the construction stage.

Table 10-10 - Potential Impacts on Fluvial Geomorphology during Operation

Source of Impact	Potential Impact	Description
Clear Span Bridge (no in-channel piers)	Sediment regime	Potential for increase fine sediment delivery due to the potential for bare earth exposed by vegetation clearance on the valley sides and due to shading impacts from the new bridge.
	Channel morphology	Alteration of channel cross-sectional area at the location of the new piers, which would potentially cause localised changes to stream power, channel velocity and sediment transport capability.

Source of Impact	Potential Impact	Description
	Natural fluvial processes	Loss of mature riparian vegetation. Increase runoff locally due to immature vegetation and the potential for bare ground around the new bridge piers.
Reinstated Made-ground	Sediment regime	Potential for erosion of reinstated Made-ground during out-of-bank flows around the southern pier during operation, which may increase fine sediment delivery to the river.
	Channel morphology	The potential for erosion of the reinstated Made-ground may result in increased fine sediment delivery, which may cause localised fine sediment deposits within the shallow sections of the channel, altering the bed morphology.
	Natural fluvial processes	May result in increased erosion during high flow conditions.

10.9. DESIGN, MITIGATION AND ENHANCEMENT MEASURES

DESIGN

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

a. Watercourse crossings (refer below)
b. Surface Water Drainage Strategy (**Appendix 10.5: Drainage Strategy Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

Construction

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

Increased Sedimentation

10.9.3. An **Outline CEMP** (**Application Document Reference: 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. 10.24**) 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 Number: TR010041/APP/7.3**) for managing risks associated with increased sedimentation 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. Works, in particular any excavation or piling, within the SPZ to the south of Part A would need to take into account the SPZ and appropriate mitigation measures implemented. However general good site practice would reduce this risk and it is considered unlikely that pollution of groundwater resources would occur.

10.9.6. All site works and 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 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.

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**). The construction methodology for the River Coquet is discussed separately below.

10.9.8. For both online (located along a watercourse) and offline (not 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 unfeasible 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. Offline structures would be constructed offline to the watercourses to reduce the potential for increased sedimentation and pollution risks to the watercourses.

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

10.9.11. For the Longdike Burn where flows are considered to be too large for a temporary sump and due to the presence of important aquatic species, an individual construction plan would be developed during detailed design, in consultation with the Environment Agency during the application for a Flood Risk Activities Permit (FRAP). This would ensure that an appropriate method of construction commensurate with the sensitivity of the watercourse can be developed. Works within ordinary watercourses may require consent from the LLFA, this would be developed further during detailed design.

10.9.12. 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 River Lyne, Fenrother Burn, Earsdon Burn, Longdike Burn and the River Coquet.

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 installation/extension of culverts along Longdike Burn and the River Lyne would be undertaken outside the period of March to May (inclusive), to avoid the optimal spawning period for lamprey. The extension of culverts along Longdike 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 A. 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 A.

River Coquet

10.9.14. Construction access would be via haul roads down the valley sides on both banks. Tower cranes located at the top of bank as defined by the normal river level would be used to construct the pier-base and stem construction and for servicing the deck construction. Haul routes and laydown areas would not encroach on the adjacent SSSI and environmental measures would be in place to avoid potential impacts from construction activities; these measures are detailed in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) as detailed below.

10.9.15. A sheet-piled cofferdam would be installed to construct the southern pier base, which would avoid entering the watercourse under normal flow conditions. This would be installed using a tracked piling rig; some pre-augering may be required to drive the piles to the required level, depending on the quality of the underlying rock. The bore piled rig wall would be installed to bedrock level.

10.9.16. An FRAP would be required prior to the start of any construction.

10.9.17. In addition to the general embedded mitigation measures set out above in **paragraph 10.9.12** the following mitigation measures are also applicable to the River Coquet due to the importance of the receptor:

a. Provide sediment barriers between earth works and the construction zone and the watercourse to prevent sediment from washing into the river. Silt management would be implemented not only adjacent to the watercourse, but also up the valley sides and at the valley top to minimise fine sediment input into the watercourse. An exclusion zone for the construction works of 8 m from the watercourse and top of the valley sides would be maintained as far as practicable.
b. Use a sediment trap to treat surface runoff.
c. Avoid works during high flow events to reduce the risk of fine sediment release.
d. Use seeded biodegradable fibre matting to encourage re-vegetation after works on, or near, the banks.
e. During construction, vegetation would be maintained for roughness during flows that exceed the assumed bankfull channel. This would potentially reduce the flow velocities and stream power through the construction zone compared with total vegetation clearance.
f. The creation of a dry-working area outside of the assumed bankfull channel would minimise the risk of potential impacts on flow during construction. Impacts on flow would only be incurred should out-of-bank flows that encroach on the construction zone occur.
g. In river works would be restricted to daylight hours to reduce the impacts to fish including salmon and brown trout.
h. In river works would not occur during high flows.
i. Monitoring of flows and rainfall within the upstream catchment would be undertaken and action taken to halt works should high flows be anticipated due to prevailing weather conditions. The frequency and type of monitoring would be developed during detailed design.
j. The main contractor would monitor water quality prior to and during construction and take appropriate action if water quality deteriorates.

Flood Risk During Construction

10.9.18. A detailed assessment of flood risk is provided within the **FRA** provided in **Appendix 10.1**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

10.9.19. The **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) would set 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.
d. Creating safe working areas for the storage of plant and materials if a flood warning is received during construction.

10.9.20. Due to the size and nature of the proposed works along the River Coquet it is recommended that the main contractor sign up to receive the Environment Agency's flood warnings.

10.9.21. Monitoring of local river levels is also recommended for the Longdike Burn given the relatively large catchment and flood flow of this watercourse.

Consents

10.9.22. A summary of the water related consents and licences that would be required as part of the construction of Part A 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.
d. Environment permit (FRAP) for works within 8 m from watercourses designated as main rivers (the River Coquet and Longdike Burn) from the Environment Agency.

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

Watercourse Crossings

10.9.24. With specific regards to the water environment, Part A would comprise (from south to north) the following watercourse crossing works (as shown on the **General Arrangement Plans** (**Application Document Reference: TR010041/APP/2.4**). It should be noted that the wildlife culverts are not listed below and are detailed in **Chapter 9: Biodiversity** of this ES:

a. The replacement of the three existing circular culverts along Cotting Burn, downstream of the existing A1 and slip road with two new box culverts.
b. The replacement of the existing culvert along Shieldhill Burn with a new circular culvert.
c. The replacement of the existing arch culvert along Floodgate Burn with a new circular culvert.
d. The construction of a new culvert where Part A crosses the River Lyne.
e. The removal of the existing culvert along the tributary of Fenrother Burn, and the construction of two new culverts where Fenrother Burn crosses Fenrother Lane. The Fenrother Burn would be diverted along the west side of the Scheme between the two new culverts.
f. Construction of two new box culverts where Part A crosses the Earsdon Burn, the first situated beneath the new A1 alignment and the second beneath a new access road that runs along the western side of the A1.
g. The diversion and channel realignment of an unnamed watercourse to a new confluence with the Earsdon Burn. This would include a new circular culvert beneath a new access

road upstream of the realignment and culverting of the downstream half of the diversion via the construction of a new circular culvert adjacent to the main A1 alignment.

h. Modification of the headwall of the existing culvert along Longdike Burn.
i. The extension of the existing culvert at Longdike Burn (and the Poxtondean Burn that discharges into the Longdike Burn).
j. Construction of a new circular culvert where Part A would cross a surface water flow path south of Felmoor Park.
k. Replacement of the culvert that drains agricultural land to the west of Eshott Airfield.
l. Extension of the existing culvert on an unnamed watercourse which drains to the Thirston Burn.
m. New bridge crossing the River Coquet to the immediate east of the existing bridge.
n. Extension of the existing culvert on Bradley Brook.
o. Installation of new drainage infrastructure to accommodate increased runoff rates and volume from the increase in impermeable area and construction of runoff detention basins to manage surface water flow from the drainage network.

10.9.25. For more detailed information regarding the design of Part A 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 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) which has informed the dimensions of the watercourse crossings (except for the River Coquet).

Surface Water Drainage Strategy

10.9.26. The **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) details the different stages of treatment provided at each proposed outfall along Part A.

10.9.27. For more detailed information regarding the surface water drainage strategy refer to **Appendix 10.5: Drainage Strategy Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

MITIGATION MEASURES

Construction

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

Operation

10.9.29. The design of the culverts has taken hydromorphological considerations into account, where appropriate. All culverts would tie into the existing channel and a gravel bed would be created throughout the length of the new culverts. 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 additional mitigation measures for each watercourse regarding mammal passage through the culverts and baffles to facilitate the movement of aquatic species is provided in **Table 10-11** below. Further details

regarding the hydromorphological considerations of the watercourse crossings and watercourse realignments are available in **Appendix 10.2: WFD Assessment**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

Table 10-11 - Summary of Mitigation Measures

Culvert	Natural Gravel Bed	Mammal Ledge	Baffles	Low Flow Channel
West Cotting Burn Culvert (1.4)	Yes	No	No	No
East Cotting Burn Culvert (1.5)	Yes	No	No	No
Shieldhill Culvert (1A)	Yes	Adjacent wildlife culvert	No	No
Paradise Culvert (3)	Yes	Yes	No	No
Priest's Bridge Culvert (4)	Yes	Yes	Yes (retrofitted to existing culvert)	Yes
North Fenrother Burn Culvert (5.2)	Yes	Adjacent wildlife culvert	No	No
South Fenrother Burn Culvert (5.3)	Yes	Adjacent wildlife culvert	No	No
Causey Park Culvert (6.2)	Yes	Yes	No	No
Earsdon Burn Culvert (6.3)	Yes	Yes	No	No
New Houses Farm Culvert (7.1)	No	No	No	No
Little Causey Park Culvert (7.2)	No	No	No	No

Culvert	Natural Gravel Bed	Mammal Ledge	Baffles	Low Flow Channel
Tiny Causey Park Culvert (8.2)	No	Adjacent wildlife culvert	No	No
Burgham Culvert (12)	Yes	No	Yes (replacing existing wooden baffles with more robust arrangement)	No
Bockenfield Culvert (12)	Yes	Yes	No	No
South Longdike Culvert (9.1)	No	No	No	No
Blackwood Hall Culvert (13.1)	No	No	No	No
Glenshotton Culvert (14)	No	No	No	No
Parkwood Culvert (7)	Yes	No	No	No

10.9.30. There would be marginal and wetland areas across Part A in the detention basins. For more information refer to **Figure 7.8: Landscape Mitigation Masterplan**, **Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**).

River Coquet

10.9.31. The main contractor would ensure any backfill and Made-ground following construction of the proposed piers is composed of cohesive clay, sandy loam and suitably sized, compacted angular material. Made-ground would be planted with vegetation following construction. Where vegetation is unlikely to establish due to shading from the structure, coarse, angular and compacted coarse stones would be used for the surface horizon. The sizing would be sufficient to resist sediment transport during out-of-bank flows. The analyses presented in the Geomorphology Assessment for the River Coquet (**Appendix 10.4: Geomorphology Assessment – River Coquet**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) suggests a minimum substrate size of greater than 40 mm up to small cobble size.

ENHANCEMENT

10.9.32. 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 A, 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. For the Longdike Burn which has slightly larger river flow compared to the other watercourses located along Part A, sediment is likely to settle quickly during normal flow conditions but may be dispersed during larger flood flow events. The higher flows of the River Coquet would likely disperse sediment quickly, although some settlement may occur during normal flow conditions at channel margins or localised raised bed areas.

10.10.5. 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 and further consultation with the Environment Agency during the development of the FRAP applications 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.

10.10.6. **Table 10-12** below provides a summary of the likely significant effects associated with increased sedimentation during construction to each relevant receptor identified in **Table 10-8**. 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 10-12 - Effects during Construction Arising from Increased Sedimentation

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Fenrother 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 - Slight Adverse (not significant)
Cotting Burn Shieldhill Burn Floodgate Burn River Lyne Unnamed tributary of Thirston Burn	Medium	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)
Earsdon Burn Longdike Burn Bradley Brook and Back 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)
River Coquet	Very High	River Coquet specific mitigation measures in **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) would ensure minimal impact.	Negligible	Neutral (not significant)

10.10.7. For a more detailed assessment of the potential effects associated with increased sedimentation refer to the **WFD Assessment** (**Appendix 10.2**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

Pollution Risks

10.10.8. 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.

10.10.9. The nearest Zone One SPZ is located approximately 1.3 km to the east of Part A from Cotting Burn. There are no piling works proposed within the Zone Three SPZ within the Study Area.

10.10.10. **Table 10-13** below provides a summary of the likely significant effects associated with pollution risks during construction to each relevant receptor identified in **Table 10-8**.

Table 10-13 - Effects during Construction Arising from Pollution Risks

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
Cotting Burn Shieldhill Burn Floodgate Burn Fenrother Burn River Lyne Earsdon Burn Longdike Burn Unnamed tributary of Thirston Burn River Coquet Bradley Brook and Back Burn	Low – Very 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	Negligible	Neutral (not significant)

Receptor	Importance	Comments	Magnitude of Impact	Significance of Effect
		volumes of harmful substances unlikely to occur.		

Works within Watercourses

10.10.11. The extension, replacement and construction of new culverts, bridge crossings 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.

10.10.12. 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 majority of watercourses within the Study Area this is not considered likely to have a notable effect on upstream or downstream morphological conditions.

10.10.13. The Longdike Burn has a larger catchment and greater flows, and as a result a temporary diversion or over-pumping may not be feasible. Specific mitigation for Longdike Burn would be developed to go above and beyond the measures previously described contained within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**) during the detailed design stage in line with consultation with the Environment Agency during the FRAP application. The alternative construction methodology that could be proposed if over-pumping is not deemed appropriate during the FRAP application would be to install a temporary structure along the proposed watercourse alignment around which the proposed structure can be built. This could, for example, comprise temporary precast concrete box culverts that sit on top of the proposed natural bed of the realigned watercourse channel. The flow from the existing watercourse can be diverted through the temporary structure along the new alignment, with baffles placed within the temporary structure to assist fish passage if deemed required by the Environment Agency. The use of a temporary structure would allow the permanent bridge to be constructed around the temporary structure in a dry construction area and significantly reduce risk to water quality. On completion of the works the temporary structure can be removed and the watercourse allowed to flow through the permanent structure.

10.10.14. 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 1 to 2 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**).

10.10.15. A detailed assessment for potential impacts to the River Coquet can be found in the standalone **Geomorphology Assessment – River Coquet** (**Appendix 10.4**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). The assessment concluded that the potential impacts would result from suspended solids, vegetation clearance and impacts resulting from the clear span bridge structure. These impacts would be short-term. Through design and construction methodology iteration, many of the potential impacts on the fluvial geomorphology of the River Coquet have been eliminated. The proposed bridge design construction methodology eliminates the requirement for a temporary pier. The locations of the proposed piers are also aligned with the existing piers to minimise any potential impacts on flow dynamics.

10.10.16. **Table 10-14** below provides a summary of the likely significant effects associated with the works within watercourses during construction to each relevant receptor identified in **Table 10-8**. Permanent effects to hydromorphology associated with proposed amendments to watercourses are discussed as operational effects.

Table 10-14 - Effects during Construction Arising from Works within Watercourses

Receptor	Importance	Comments	Magnitude of Impact	Significance of effect
Cotting Burn	Medium	Demolition of three existing culverts and construction of two new culverts.	Minor Adverse	Slight Adverse (not significant)
Shieldhill Burn	Medium	Replacement of existing culvert.	Minor Adverse	Slight Adverse (not significant)
Floodgate Burn	Medium	Replacement of existing culvert.	Minor Adverse	Slight Adverse (not significant)
River Lyne	Medium	Construction of new culvert.	Minor Adverse	Slight Adverse (not significant)
Fenrother Burn	Low	Realignment of channel and construction of two new culverts.	Minor Adverse	Neutral - Slight Adverse (not significant)
Earsdon Burn	High	Four new culverts and realignment of channel.	Minor Adverse	Slight Adverse (not significant)

Receptor	Importance	Comments	Magnitude of Impact	Significance of effect
Longdike Burn	High	Replacement of baffles in existing culvert and culvert extension.	Minor Adverse	Slight Adverse (not significant)
Unnamed tributary of Thirston Burn	Medium	Existing culvert to be extended.	Minor Adverse	Slight Adverse (not significant)
River Coquet	Very High	New bridge crossing.	Negligible	Neutral (not significant)
Bradley Brook and Back Burn	High	Existing culvert to be extended.	Minor Adverse	Slight Adverse (not significant)

Increased Flood Risk Associated During Construction

10.10.17. A detailed assessment of flood risk is provided within the **FRA** (**Appendix 10.1**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

10.10.18. Whilst the proposed works may cause a localised increase in flood risk during construction particularly associated with in-channel works, it should be noted that there are no properties located in close proximity to the proposed construction areas. 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.

10.10.19. It is considered unlikely that Part A 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.

10.10.20. **Table 10-15** below provides a summary of the likely significant effects associated with increased flood risk during construction to each relevant receptor identified in **Table 10-8**.

Table 10-15 - 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

10.10.21. The HAWRAT assessment tool has been used to assess the risks to water quality during the operation of Part A in line with the methods A and D outlined in DMRB (HD 45/09) (**Ref. 10.16**). 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 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) of this ES. The results are summarised below.

Method A

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

10.10.23. The assessment of long term pollution impacts to the receiving water environment considers the annual average pollutant concentrations associated with Part A 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 0.00 µg/l to 0.45 µg/l for copper and from 0.00 µg/l to 1.76 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

10.10.24. The results of the Method D assessments for outfalls 1 to 17 and for outfall 19 indicate an annual probability of a significant pollution risk occurring in the event of spillage of between 0.019 % and 0.005 %, taking the proposed mitigation measures into account, which is well below the recommended threshold of 1 %. The Method D assessment for outfall 18 (that discharges to the River Coquet) indicates an annual probability of 0.01 %, taking into account the proposed mitigation measures, which is well below the recommended threshold of 0.5 % for outfalls that discharge to a sensitive water environment.

10.10.25. For more detailed information regarding the short term and long term assessment of pollution impacts during the operation of Part A refer to the standalone **Drainage Network Water Quality Assessment** (**Appendix 10.3**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

10.10.26. **Table 10-16** below provides a summary of the likely significant effects associated with pollution risks during operation to each relevant receptor identified in **Table 10-8**.

Table 10-16 - Effects during Operation Arising from Pollution Risks

Receptor	Importance	Comments	Magnitude of Impact	Significance of effect
Cotting Burn Shieldhill Burn Floodgate Burn Fenrother Burn River Lyne Earsdon Burn Longdike Burn Unnamed tributary of Thirston Burn River Coquet Bradley Brook and Back Burn	Low – Very 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	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)

Works within Watercourses

10.10.27. 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 10-11** previously, throughout the length of the new culverts that would naturalise over time where fish passage (or potential future fish passage) is expected. **Table 10-11** 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.

10.10.28. As outlined in the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**), the replacement of the existing culverts offers an opportunity to improve the performance of certain culverts, for example where no natural bed is currently provided, and where the base of some culverts is perched above the bed of the watercourses. Additionally, some culverts were identified to be blocked during the site walkover and this would be addressed as part of the works. As summarised in **Section 10.9** under works within watercourses, the culverts proposed for Cotting Burn, Shieldhill Burn, Floodgate Burn, River Lyne and Longdike Burn are likely to improve fish passage and / or otter passage.

10.10.29. To compensate for the direct loss of riparian habitat along Longdike Burn as part of the Bockenfield Bridge extension, the length of the watercourse that falls within the Order Limits shall be enhanced. This would include nutrient management measures to address adverse impacts of run-off from agricultural land, aquatic planting and bankside stabilisation. Measures would be developed further at detailed design, supported by a target walkover survey to confirm appropriateness of improvement opportunities. For more information regarding the opportunities to improve the watercourse refer to **Chapter 9: Biodiversity** of this ES.

10.10.30. Hydromorphological impacts to the River Coquet are assessed to be negligible with any long-term effects localised to footprint of the new River Coquet bridge pier that may cause very localised (but still negligible) impact on stream power and flow velocity. The additional shading of the new River Coquet bridge may result in a greater extent of bare earth in comparison to the baseline condition, although this is considered to be negligible in the context of the wider reach. A detailed assessment for potential impacts to the River Coquet can be found in the standalone **Geomorphology Assessment – River Coquet** (**Appendix 10.4**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

10.10.31. 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 A along each of the watercourses in the Study Area, except for the River Coquet where a clear span bridge is proposed. Although connectivity and a natural bed would be maintained there is likely to be a direct and long-term effect on the watercourses.

10.10.32. The significance of effect for the River Coquet is assessed to be Neutral as the proposed bridge would be clear span with no structures located within the normal flows within the watercourse channel and no loss of riparian habitat or natural bed is expected.

10.10.33. **Table 10-17** below provides a summary of the likely significant effects associated with works within watercourses during operation to each relevant receptor identified in **Table 10-8**.

Table 10-17 - Effects during Operation Arising from Works within Watercourses

Receptor	Importance	Comments	Magnitude of Impact	Significance of effect
Cotting Burn	Medium	Demolition of three existing culverts and construction of two new culverts.	Minor Adverse	Slight Adverse (not significant)
Shieldhill Burn	Medium	Replacement of existing culvert.	Minor Adverse	Slight Adverse (not significant)
Floodgate Burn	Medium	Replacement of existing culvert.	Minor Adverse	Slight Adverse (not significant)
River Lyne	Medium	Construction of new culvert.	Minor Adverse	Slight Adverse (not significant)
Fenrother Burn	Low	Realignment of channel and construction of two new culverts.	Minor Adverse	Neutral - Slight Adverse (not significant)
Earsdon Burn	High	Four new culverts and realignment of channel.	Minor Adverse	Slight Adverse (not significant)
Longdike Burn	High	Replacement of baffles in existing culvert and culvert extension.	Minor Adverse	Slight Adverse (not significant)
Unnamed tributary of Thirston Burn	Low	Existing culvert to be extended.	Minor Adverse	Neutral (not significant)
River Coquet	Very High	New bridge crossing.	Negligible	Neutral (not significant)
Bradley Brook and Back Burn	High	Existing culvert to be extended.	Minor Adverse	Slight Adverse (not significant)

Increased Flood Risk

10.10.34. A detailed assessment of the effects associated with flood risk is provided in the **FRA** in **Appendix 10.1**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

Flood Risk

10.10.35. Detailed 1D hydraulic modelling has been undertaken for the Cotting Burn, River Lyne, Fenrother Burn, Earsdon Burn and Longdike Burn. Hydraulic assessment using Culvert Master 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. The identified fluvial floodplains associated with The River Coquet, Longdike Burn (and the Poxtondean Burn that discharges into the Longdike Burn), Earsdon Burn, the River Lyne and Floodgate Burn are largely contained within the watercourse channels. As a result, any loss of floodplain has been accounted for within the hydraulic modelling and design of the watercourse crossings.

Increase in Surface Water Runoff Rate and Volume

10.10.36. A detailed description of the surface water drainage strategy is provided in **Appendix 10.5: Drainage Strategy Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). The surface water drainage system has been designed according to DMRB (HA 107/04) (**Ref. 10.47**).

10.10.37. 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 10.5: Drainage Strategy Report**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

10.10.38. The surface water drainage strategy is summarised below:

a. Runoff from Part A (online and offline sections) would be discharged into the existing watercourses via storage swales/detention basins/tanks, where required.
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.
d. Drainage discharge from highways remaining part of the local road network is kept separate from discharge associated with Part A, as agreed with NCC. This strategy includes separate detention basins or SUDS features where appropriate. However, controlled runoff from both trunk and non-trunk detention basins/features would discharge to a common outfall to minimise the overall project footprint.

10.10.39. 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 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

10.10.40. **Table 10-18** below provides a summary of the likely significant effects associated with flood risk during operation to each relevant receptor identified in **Table 10-8.**

Table 10-18 - Effects during Operation Stage Arising from Flood Risk

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

10.10.41. The **FRA** (**Appendix 10.1**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) also provides a summary of where the size of existing culverts would be increased (replaced) to improve flood conveyance due to inadequate capacity.

WFD Summary

10.10.42. A summary of the assessment and conclusions from the **WFD Assessment** (**Appendix 10.2**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) is provided below.

10.10.43. 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 A is compliant with WFD objectives.

10.10.44. There are opportunities for Part A to improve the performance of certain existing structures, for example, where no natural bed is provided within the existing culverts or the base of the culvert is perched above the bed of the watercourse. As a result, Part A would not prevent the WFD catchments from achieving the status objectives for each catchment.

ASSESSMENT PARAMETERS

10.10.45. The Assessment Parameters, as 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.

10.10.46. As Parameter 10 would enable the location of the proposed River Coquet bridge piers in relation to the existing piers, an additional geomorphology assessment has been undertaken to assess the impacts of this parameter on the River Coquet, as found in **Appendix 10.7: Geomorphology Assessment – River Coquet Parameter 10**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**). This concludes that this Parameter would not 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

10.10.47. Refer to **Appendix 10.6: Road Drainage and the Water Environment DMRB Sensitivity Test**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**) for further details of the sensitivity test as discussed in **Section 10.4**. The findings of the sensitivity test are summarised below.

10.10.48. The updated guidance LA 113 (**Ref. 10.41**) includes a number of key changes in the assessment methodology compared to DMRB HD 45/09 (**Ref. 10.16**) 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.

10.10.49. As part of the sensitivity testing, a hydrogeological assessment and a sheet piling assessment for the operation of Part A have therefore been undertaken. These assessments are provided in **Appendix 10.6: Road Drainage and the Water Environment DMRB Sensitivity Test**, **Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7)** and a summary of the findings provided below.

Detention Basins

10.10.50. 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 for 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. 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

10.10.51. 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)

10.10.52. There are six 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 A, the piles penetrating below the water table and the spacing of the piles reducing the cross section for groundwater flow by approximately 50%.

10.10.53. 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).

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

10.11. MONITORING

10.11.1. The monitoring requirements during construction of Part A would be confirmed during the detailed design stage through further consultation with the Environment Agency and as part of the FRAP application (where required) and are detailed within the **Outline CEMP** (**Application Document Reference: TR010041/APP/7.3**).

10.11.2. Monitoring of local river levels would be undertaken for the Longdike Burn given the relatively large catchment and flood flow of this watercourse. The details regarding the monitoring would be decided during detailed design stage, and during the FRAP application. For information regarding the ecological monitoring requirements refer to **Chapter 9: Biodiversity** of this ES.

10.11.3. No monitoring during operation is required.

REFERENCES

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