# A428 Black Cat to Caxton Gibbet improvements

TR010044

Volume 6

6.1 Environmental Statement

Chapter 13: Road Drainage and Water Environment

Planning Act 2008

Regulation 5(2)(a)

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

26 February 2021

Infrastructure Planning

Planning Act 2008

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

# A428 Black Cat to Caxton Gibbet improvements

Development Consent Order 202[ ]

## Chapter 13: Road Drainage and the Water Environment

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|---|---|
| **Regulation Reference:** | Regulation 5(2)(a) |
| **Planning Inspectorate Scheme Reference** | TR010044 |
| **Application Document Reference** | TR010044/APP/6.1 |
| **Author** | A428 Black Cat to Caxton Gibbet improvements Project Team, Highways England |

| Version | Date | Status of Version |
|---|---|---|
| Rev 1 | 26 February 2021 | DCO Application |

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# 13 Road drainage and the water environment

## 13.1 Competent expert evidence

13.1.1 This chapter presents the results of an assessment of the likely significant effects of the construction and operation of the Scheme on road drainage and the water environment. The water environment includes water quality, hydromorphology, groundwater, flood risk and drainage.

13.1.2 The competent expert responsible for the assessment is an Associate Director who holds the qualifications of BSc (Hons) and an MSc in Geography and is a Chartered Environmentalist and a full Member of the Chartered Institution of Water and Environmental Management.

13.1.3 They have 16 years' experience of undertaking environmental impact assessments (EIAs) and environmental management, specialising in water science. This includes: river and lake water quality and sediment monitoring and analysis; water environment EIAs; Water Framework Directive (WFD) compliance appraisals; Highways England Water Risk Assessment Tool (HEWRAT) assessments; Sustainable Drainage System (SuDS) development and pond optimisation; and the identification of appropriate mitigation measures to protect the water environment from construction work.

## 13.2 Legislative and policy framework

13.2.1 The following legislation and planning policy are of direct relevance to the topic of road drainage and the water environment and have been considered as part of the assessment.

13.2.2 Compliance (or otherwise) with statute and policy relating to the water environment is addressed within the Case for the Scheme **[TR010044/APP/7.1]**.

**Legislation**

a. *Water Act 2014* (Ref 13-1).

b. *Flood and Water Management Act 2010* (Ref 13-2).

c. *Environment Act 1995* (Ref 13-3).

d. *Land Drainage Act 1991 (as amended)* (Ref 13-4).

e. *Water Resources Act 1991* (Ref 13-5).

f. *Environmental Protection Act 1990* (Ref 13-6).

g. *Salmon and Freshwater Fisheries Act 1975 as amended* (Ref 13-7).

a. *The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017* (Ref 13-8)

h. *The Environmental Permitting (England and Wales) Regulations 2016* (Ref 13-9).

i. *The Environmental Damage (Prevention and Remediation) (England) Regulations 2015* (Ref 13-10).

j. *The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015* (Ref 13-11).

k. *The Flood Risk Regulations 2009* (Ref 13-12).

l. *The Eels (England and Wales) Regulation 2009* (Ref 13-13).

m. *The Groundwater (England and Wales) Regulations 2009* (Ref 13-14).

n. *Control of Substances Hazardous to Health Regulations 2002* (Ref 13-15).

o. *The Control of Pollution (Oil Storage) (England) Regulations 2001* (Ref 13-16).

p. *Water Industry Act 1991* (Ref 13-17)

**Relevant consents**

13.2.3 The Consents and Agreements Position Statement **[TR010044/APP/3.3]** describes what consents and agreements would be required in relation to the topic of road drainage and the water environment, and identifies those consents which Highways England propose to disapply through the DCO **[TR010044/APP/3.1]** and the permits, consents and agreements that may need to be sought separately.

**National policy**

*National Policy Statement for National Networks*

13.2.4 Sections 5.90 – 5.115 and 5.219 – 5.231 of the *National Policy Statement for National Networks* (NPSNN) (Ref 13-18) specifically apply to flood risk and water quality respectively, and how impacts on the water environment affect the decision making process.

13.2.5 The *NPSNN* (Ref 13-18) states that flood risk must not be increased elsewhere as a result of a Scheme, and that development is only appropriate in areas at risk of flooding where it can be demonstrated that the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location; and development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning. Priority is given to the use of SuDS.

13.2.6 With regard to water quality, *NPSNN* (Ref 13-18) states that the Secretary of State for Transport should be satisfied that a proposal has had regard to the River Basin Management Plans (RBMPs) and the requirements of the *WFD* (including Article 4.7) (Ref 13-8) which describes various tests that need to be met to justify new physical modification to a water body when that modification could lead to deterioration or prevent improvement) and its daughter directives.

13.2.7 The requirements of the *NPSNN* (Ref 13-18) in relation to assessing and mitigating the effects of the Scheme on pollution control, flood risk and water quality have been met by undertaking a comprehensive flood risk assessment of the Scheme, an assessment of its effects on the water environment, spillage risk assessments, and an assessment against the requirements of the WFD, in order to identify the likely significant effects that the Secretary of State for Transport needs to give due regard to in their decision-making.

*Overarching National Policy Statement for Energy (EN-1)*

13.2.8 The *Overarching National Policy Statement for Energy (EN-1)* (Ref 13-19) sets out the Government's policy on energy and infrastructure development.

13.2.9 In relation to pollution control, *EN-1* (Ref 13-19) notes that issues relating to discharges or emissions from a development which affect water quality may be subject to separate regulation under the pollution control framework or other consenting and licensing regimes.

13.2.10 Regarding flood risk, *EN-1* (Ref 13-19) sets out the criteria for when energy projects require a flood risk assessment to be undertaken and the minimum requirements for such assessments.

13.2.11 For water quality, *EN-1* (Ref 13-19) identifies that developments can affect the water environment through increased demand, discharges, and the spillage/leakage of pollutants. EN-1 (Ref 13-19) accordingly requires that applicants undertake an assessment of the existing status of, and impacts of the development on, water quality and water resources.

13.2.12 The requirements of *EN-1* (Ref 13-19) associated with the gas pipeline diversion within the Scheme have been accounted for in the assessment, in the manner described in paragraph 13.2.7.

*National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4)*

13.2.13 The *National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4)* (Ref 13-20) relates to gas supply and gas and oil pipelines and sits under *EN-1* (Ref 13-19).

13.2.14 *EN-4* (Ref 13-20) sets out specific requirements regarding pipeline developments and their potential impacts and effects on water quality and water resources, and identifies that applicants should undertake an assessment in line with the requirements of *EN-1* (Ref 13-19). Further, where a development is likely to give rise to effects on water quality, for example through siltation or spillages, discharges from maintenance activities or the discharge of disposals such as wastewater or solvents, the applicant should provide an assessment of those impacts.

13.2.15 The requirements of *EN-4* (Ref 13-20) associated with the gas pipeline diversion within the Scheme have been accounted for in the assessment, in the manner described in paragraph 13.2.7.

*National Planning Policy Framework*

13.2.16 The *National Planning Policy Framework* (NPPF) (Ref 13-21) contains a number of statements which are relevant to water resources and flood risk. These include: making use of undeveloped land in mitigating flood risk; taking a proactive approach to mitigating and adapting to climate change taking into account the long-term implications for flood risk, coastal change and water supply; taking full account of flood risk in the planning system including planning for climate change; and that development should not cause unacceptable levels of water pollution and should help improve water quality wherever possible.

13.2.17 The requirements of the *NPPF* (Ref 13-21) have been taken into account in the assessment, with particular regard given to potential impacts in relation to flood risk and water quality.

*Planning Practice Guidance*

13.2.18 Planning Practice Guidance for *Flood risk and coastal change* (Ref 13-22) provides guidance on assessing the significance of flood risk and coastal change, and sets out the steps to be taken for assessment of a proposed development in terms of flood risk.

13.2.19 Planning Practice Guidance for *Water supply, wastewater and water quality* (Ref 13-23) sets out how concerns related to water can be addressed and mainly focusses on residential and commercial developments.

13.2.20 This guidance has been considered in the assessment as part of the assessments of water quality and flood risk.

*Future water: the Government's water strategy for England*

13.2.21 *Future water: the Government's water strategy for England* (Ref 13-24) sets out the Government's long-term vision for water and the framework for water management in England, and includes advice and guidance for the sustainable management of the water environment and water quality to ensure no compromise in environmental quality of future generations.

*A Green Future: Our 25 Year Plan to Improve the Environment*

13.2.22 A *Green Future: Our 25 Year Plan to Improve the Environment* (Ref 13-25) includes specific goals to: reduce the environmental impact of water abstraction; meet the objectives of RBMPs under the *WFD* (Ref 13-8); reduce leakage from water mains; improve the quality of bathing waters; restore protected freshwater sites to a favourable condition; and do more to protect communities and businesses from the impact of flooding, coastal erosion and drought.

**Local policy**

*Anglian river basin district river basin management plan*

13.2.23 The *Anglian river basin district river basin management plan* (Ref 13-26) sets out how organisations, stakeholders and communities should work together to improve the water environment.

13.2.24 Further details relating to this *RBMP* (Ref 13-26) and its relevance to the Scheme are presented in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]**.

*Huntingdonshire District Council*

13.2.25 *Huntingdonshire's Local Plan to 2036* (Ref 13-27) was adopted by Huntingdonshire District Council on 15 May 2019 and contains the following policies of relevance to the assessment:

a. LP 5 – Flood risk.

b. LP 15 – Surface water.

c. LP 30 – Biodiversity and geodiversity.

*South Cambridgeshire District Council*

13.2.26 *The South Cambridgeshire Local Plan 2018* (Ref 13-28) was adopted by South Cambridgeshire District Council on 27 September 2018 and contains the following policies of relevance to the assessment:

a. NH/5 – Sites of biodiversity or geological importance.

b. CC/1 – Mitigation and adaptation to climate change.

c. CC/7 – Water quality.

d. CC/9 – Managing flood risk.

*Bedford Borough Council*

13.2.27 The *Bedford Borough Local Plan 2030* (Ref 13-29) was adopted by Bedford Borough Council on 15 January 2020 and contains the following policies of relevance to the assessment:

a. 42S – Protecting biodiversity and geodiversity.

b. 47S – Pollution, disturbance and contaminated land.

c. 50S – Water resources.

d. 92 – Flood risk.

e. 93 – Sustainable drainage systems.

*Central Bedfordshire Council*

13.2.28 The *Central Bedfordshire Pre-submission Local Plan 2015 – 2035* (Ref 13-30) comprises Central Bedfordshire Council's draft local plan (dated January 2018) and is currently being examined by the Secretary of State for Transport. The following draft policies are of relevance to the assessment:

a. CC3 – Flood risk management.

b. CC5 – Sustainable drainage.

c. CC7 – Water quality.

d. CC8 – Pollution and land instability.

e. EE2 – Enhancing biodiversity.

f. EE3 – Nature conservation.

*Flood risk and sustainable drainage systems*

13.2.29 Consideration has also been given to the following local policy and guidance documents:

a. *Local Flood Risk Management Strategy: Bedford Borough Council* (Ref 13-31) – which sets out Bedford Borough Council's commitment to SuDS.

b. *Central Bedfordshire Sustainable Drainage Guidance* (Ref 13-32) – which outlines how SuDS can be considered through the planning process in Central Bedfordshire.

c. *Cambridgeshire County Council Flood and Water Supplementary Planning Guidance* (Ref 13-33) – which provides guidance on the approach that should be taken to design new developments to manage and mitigate flood risk, and include SuDS, on developments within Cambridgeshire.

13.2.30 In addition, the Strategic Flood Risk Assessments (SFRAs) prepared by *Huntingdonshire District Council* (Ref 13-34), *Central Bedfordshire Council* (Ref 13-35), *Bedford Borough Council* Ref 13-36), *South Cambridgeshire District Council and Cambridgeshire County Council* (Ref 13-37) info have also been considered as part of the assessment.

## 13.3 Assessment methodology

**Scope of the assessment**

13.3.1 A scoping exercise was undertaken in mid-2019 to identify the matters to be covered by the road drainage and water assessment and agree the approach with relevant statutory bodies.

13.3.2 The assessment scope was established at that time by comparing available design and land take details for the Scheme with available data, information and records relating to surface water, groundwater, hydromorphology and flood risk.

13.3.3 The scoping exercise was informed by the technical and reporting guidance contained in the *Design Manual for Roads and Bridges Volume 11: Environmental Assessment* (Ref 13-38) (DMRB) and *Interim Advice Note 125/15: Environmental Assessment Update* (Ref 13-39).

13.3.4 The outcomes of scoping were recorded in a *scoping report* (Ref 13-40), which was consulted upon as part of a formal request to the Inspectorate for a scoping opinion and included a summary of all assessment work undertaken as part of the design-development of the Scheme.

13.3.5 The Inspectorate's scoping opinion **[TR010044/APP/6.5]** identified a number of additional overarching EIA and topic-specific matters that were subsequently brought into the overall scope of the assessment. These further considerations are detailed in **Table 1** of **Appendix 4.3** of the Environmental Statement **[TR010044/APP/6.3]** and include a summary of how Highways England has responded to the points raised, and where this information is reported.

13.3.6 Within the scoping opinion **[TR010044/APP/6.5]**, the Inspectorate agreed with Highways England that activities associated with the future maintenance of the Scheme would have limited potential to result in significant effects on the water environment. Accordingly, the effects associated with the maintenance/management phase of the Scheme were scoped out of the assessment and are not considered further.

13.3.7 Subsequent to the publication of the scoping opinion **[TR010044/APP/6.5]**, Highways England published a series of new DMRB standards relating to sustainability and the environment (Ref 13-41), resulting in the phased withdrawal of the guidance used to inform the scoping exercise (Ref 13-40) from July 2019.

13.3.8 A decision was made by Highways England to adopt the new DMRB standards (Ref 13-41) part way into the assessment process, the details of which are summarised in **Chapter 4, Environmental assessment methodology** of the Environmental Statement **[TR010044/APP/6.1]**.

13.3.9 **Table 2** of **Appendix 4.3** of the Environmental Statement **[TR010044/APP/6.3]** sets out the changes to the scope and methodology of the road drainage and water environment assessment resulting from the adoption of the new DMRB standards (Ref 13-41).

13.3.10 In addition to the matters raised in the scoping opinion [**TR010044/APP/6.5**] and through adoption of the new *DMRB standards* (Ref 13-41), the final assessment scope has also been shaped by the following:

a. The outcomes of consultation with statutory bodies, non-statutory organisations and other stakeholders with an interest in road drainage and the water environment.

b. Design changes made to the Scheme in respect of its form and extent, and the area of land required for its construction and operation.

c. The outcomes of field surveys undertaken to establish the baseline conditions of the water environment.

d. Project specific criteria on potential impacts to navigation on the River Great Ouse has been added to the assessment.

13.3.11 The assessment has focused on identifying the: effects on water quality, surface water and groundwater from construction and operation of the Scheme; the potential for increased volume and rate of surface water runoff from new impervious areas leading to an impact on flood risk; the potential for changes in surface water drainage patterns; and effects on hydraulic processes and hydromorphology of potentially affected water bodies.

13.3.12 The assessment has been informed by the following related assessments:

a. A WFD assessment – which considers compliance of the Scheme with relevant *WFD* objectives for designated water bodies that may be affected. The WFD assessment includes whether the Scheme might cause deterioration or prevent the improvement in the overall status (or potential for heavily modified and artificial water bodies) of these water bodies. Although this considers issues similar to this water environment impact assessment,

the test for compliance is different from the determination of the significance of effects and is applied at a waterbody level. The WFD assessment is presented in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]**.

b. A Flood Risk Assessment – which assesses the flood risk impact of Scheme construction and operation. This has been prepared in accordance with the requirements contained in the *NPSNN* (Ref 13-18) and the *NPPF* (Ref 13-21), and is presented in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**.

**Assessment standards and guidance**

13.3.13 The following standards and guidance have been used to inform the scope and content of the assessment, and to assist the identification and mitigation of likely significant effects. This builds upon the overarching EIA methodology and guidance presented in **Chapter 4, Environmental assessment methodology** of the Environmental Statement **[TR010044/APP/6.1]**.

*Design Manual for Roads and Bridges*

13.3.14 The following DMRB standards and tools has been applied have been applied in the assessment to identify the value of water resources within the study area, and to identify and evaluate the impacts and effects that construction and operation of the Scheme would likely have on these resources:

a. *LA 104 Environmental assessment and monitoring (Revision 1)* (Ref 13-42).

b. *LA 113 Road Drainage and the Water Environment (Revision 1)* (Ref 13-43).

c. *Highways England Water Risk Assessment Tool (HEWRAT) version 2.0.4* (2020).

*Sustainable drainage systems design*

13.3.15 The following DMRB standards and best practice guidance have been used to inform the development of SuDS incorporated into the design of the Scheme:

a. *CD 532 Vegetated drainage systems for highway runoff (Revision 0)* (Ref 13-44).

b. *CG 501 Design of highway drainage systems (Revision 2)* (Ref 13-45).

c. *CIRIA C753: The SuDS Manual* (Ref 13-46).

**Establishment of the baseline**

13.3.16 Establishment of the baseline has involved reference to existing data sources, consultation with statutory bodies and other organisations, and fieldwork surveys.

*Desk study*

13.3.17 A desk study has been undertaken to establish baseline information which included a review of the following data sources:

a. Topographical data, site reports and consultations.

b. Data requests received from the Environment Agency (EA) on 10 January 2019 and 16 January 2019 (EAN/2018/110217), 2 May 2019 (EAN/2019/123609), 20 March 2020 (EAN/2020/162997) and 15 June 2020 (EAN/2020/170528).

c. *Online Ordnance Survey (OS) and aerial maps* (Ref 13-47 and Ref 13-48).

d. *Met Office website* (Ref 13-49).

e. *British Geological Survey (BGS) GeoIndex website* (Ref 13-50).

f. *EA Catchment Data Explorer website* (Ref 13-51).

g. *EA Flood map for planning website* (Ref 13-52).

h. *EA Areas Susceptible to Groundwater Flooding website (AStGwF)* (Ref 13-53).

i. *Highways England Drainage Data Management System (HADDMS)* (Ref 13-54).

j. The *Anglian river basin district RBMP* (Ref 13-26).

k. The findings of the Scheme specific geotechnical ground investigation comprising boreholes (Ref 13-69), trial pits and window sampling probe holes completed between October 2019 and June 2020 and subsequent groundwater monitoring between October 2019 and August 2020 (see **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3])**.

l. The EA's *Upper Ouse and Bedford Ouse Abstraction Licensing Strategy* (Ref 13-55).

m. *SFRAs* (Ref 13-34; Ref 13-35; Ref 13-36; Ref 13-37).

n. Details of Private Water Supplies (PWS) supplied by: 3C Shared Services (on behalf of South Cambridgeshire District Council, Cambridge City Council and Huntingdonshire District Council); Bedford Borough Council; and Central Bedfordshire Council.

*Consultation*

13.3.18 Details regarding the statutory consultation undertaken as part of the Scheme, and its outcomes in relation to the topic of road drainage and the water environment are presented in the Consultation Report **[TR010044/APP/5.1]**.

13.3.19 In addition to statutory consultation, non-statutory consultation has been undertaken with a number of organisations to discuss and agree the assessment scope and methodology, and to inform the identification and development of mitigation measures.

13.3.20 The EA was consulted on the approach for establishing baseline conditions, including surface and groundwater abstractions, groundwater aquifer status, surface water quality, ecology data, active discharge consents, water pollution incidents and confirmation of WFD water bodies.

13.3.21 Drainage strategy proposals and preliminary structures design information was also discussed with the EA through meetings held between May 2019 and October 2020.

13.3.22 A Technical Working Group comprising of the following organisations was set up by Highways England to share information relating to hydrology and flood risk: Bedford Borough Council; Cambridgeshire County Council; Cambridge City Council; Central Bedfordshire Council; Huntingdonshire District Council; South Cambridgeshire District Council; the Association of Drainage Authorities; Bedford Group of drainage boards, the EA; and the Inland Waterways Association. Technical Working Group meetings were held between October 2019 and June 2020.

*Field surveys*

13.3.23 A field survey was undertaken on 29 November 2017 to identify water receptors in the study area (see Section 13.5) and assess their character, morphology and connectivity in the context of the surrounding topography and receptors (for example nearby sites of ecological importance). This survey was undertaken in overcast but dry conditions following several days without rain, meaning that the watercourses were at low flow conditions.

13.3.24 A further site visit was undertaken on 3 September 2019 following changes made to the preliminary design of the Scheme during the design-development process, and to visit additional watercourses for inclusion within the assessment. This survey was undertaken in dry, sunny conditions following several days without rain, meaning watercourses were at low flow conditions.

*Water quality monitoring*

13.3.25 Water quality monitoring was undertaken in September 2017, January 2018, April 2018 and August 2018 to better understand baseline conditions and provide input data to the quantitative assessment of road runoff impacts. The seasonal water quality programme assessed general physico-chemical parameters that provide an indicator of water quality.

13.3.26 A total of six watercourses were sampled as part of the programme. The sampling locations are illustrated on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]** and are located at the following grid references:

a. WQ1: TL 15509 55071 (Rockham Ditch).

b. WQ2: TL 16280 55799 (South Brook).

c. WQ3: TL 16177 54231 (River Great Ouse).

d. WQ4: TL 20096 58563 (Hen Brook).

e. WQ5: TL 22846 60269 (Fox Brook).

f. WQ6: TL 24439 60697 (Gallow Brook).

13.3.27 Further details of the water quality monitoring undertaken presented in **Appendix 13.5** of the Environmental Statement **[TR010044/APP/6.3]**.

13.3.28 The sampling programme provided site specific data not available through EA water quality monitoring data.

*Habitat walkover surveys*

13.3.29 Aquatic habitat walkover surveys were undertaken in July 2017. Ponds were surveyed between September 2018 and August 2019 and included a range of invertebrate sampling, Environmental DNA (eDNA) sampling, fish surveys, and white clawed crayfish surveys. More information is provided within **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**.

13.3.30 Further information regarding the habitat walkover surveys is presented in **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**.

*River channel topographical surveys*

13.3.31 River channel topographic surveys were undertaken for the River Great Ouse and all ordinary watercourse crossing locations, the purpose of which was to gather suitably detailed data to inform the construction of hydraulic models used in the assessment.

13.3.32 Further details of these surveys are presented in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**.

*Drainage surveys*

13.3.33 Drainage surveys have not been undertaken as part of the assessment. CCTV surveys of the existing assets would be undertaken at the detailed design stage to determine the condition and connectivity of any existing drainage assets which would be retained as part of the Scheme.

13.3.34 Further information regarding future drainage surveys is presented in **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**.

**Assessment of routine road runoff and accidental spillages**

13.3.35 An assessment of the potential impacts of routine runoff on surface water has been undertaken following the HEWRAT methodology, as described in *LA 113* (Ref 13-43).

13.3.36 The HEWRAT was developed for this purpose and the methodology has been derived from a collaborative research programme undertaken by Highways England and the EA. The methodology combines various risk factors including the volume of traffic flows in a 24-hour period, the percentage of heavy goods vehicles, and the risk attributed to different types of road to determine the probability of an accident resulting in a serious pollution incident. The acceptable standard is measured as a return period with 1 in 100 years (i.e. the probability of an event occurring in any given year is 1%), as the minimum threshold for non-sensitive water environments. This increases to 1 in 200 years for sensitive receptors (for example a Site of Special Scientific Interest (SSSI)).

13.3.37 The assessment has been undertaken to determine the risk of routine runoff pollution and spillage risk to receiving waterbodies, and to inform the identification of treatment measures required to mitigate these risks, as reported within **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]**.

### Evaluation of receptor importance

13.3.38 The importance of potentially affected water environment features has been established using a four-point scale (low, medium, high, very high) developed on the basis of Table 3.70 within *LA 113* (Ref 13-43). This four-point scale is presented in **Table 13-1**.

13.3.39 As the criteria presented in *LA 113* (Ref 13-43) do not include navigation, project specific criteria have been included in **Table 13-1** based on professional judgement.

13.3.40 For the purpose of this assessment, receptor 'importance' has been identified rather than receptor 'value'. This is because when considering the water environment, the availability of dilution means that there can be a difference in the sensitivity and importance of a water body. For example, a small drainage ditch of low conservation value and biodiversity with limited other socio-economic attributes, is very sensitive to impacts, whereas an important regional scale watercourse, that could have conservation interest of international and national significance and support a wider range of important socio-economic uses, is less sensitive by virtue of its ability to assimilate discharges and physical effects. Irrespective of importance, all controlled waters in England are protected by law from being polluted.

## Table 13-1. Criteria to determine receptor importance

| Importance[1] ^ | Type of Receptor | | | | |
|---|---|---|---|---|---|
| | Groundwater | Surface Water | Morphology[2] | Flood Risk[3] | Navigation |
| Very High | Principal aquifer providing a regionally important resource and/or supporting a site protected under European Commission (EC) and UK legislation Ecology and Nature Conservation<br>Groundwater locally supports GWDTE*<br>SPZ 1 | Watercourse having a WFD classification shown in a RBMP and Q95 ≥1.0 $m^3/s$.<br>Site protected/designated under EC and UK legislation Ecology and Nature Conservation. | Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river type | Essential infrastructure or highly vulnerable development. | Corridor is a navigation route of principal importance (e.g. used daily by a large number and a wide range of vessels and purposes) |
| High | Principal aquifer providing locally important resource or supporting river ecosystem.<br>Groundwater supports a GWDTE<br>SPZ 2 | Watercourse having a WFD classification shown in a RBMP and Q95 m3/s <1.0 $m^3/s$.<br>Species protected under EC or UK legislation Ecology and Nature Conservation. | Conforms closely to natural, unaltered state and would often exhibit well-developed and diverse geomorphic forms and processes characteristic of river type, with abundant bank side vegetation. Deviates from natural conditions due to direct and/or indirect channel, floodplain, and/or catchment development pressures | More vulnerable development | Corridor is a navigation route of high importance (e.g. used frequently by a large number of vessels) |

| Importance[1] ^ | Type of Receptor | | | | |
|---|---|---|---|---|---|
| | Groundwater | Surface Water | Morphology[2] | Flood Risk[3] | Navigation |
| Medium | Aquifer providing water for agricultural or industrial use with limited connection to surface water.<br>SPZ 3 | WFD not having a WFD classification shown in a RBMP and Q95 >0.001 $m^3/s$. | Shows signs of previous alteration and/or minor flow regulation but still retains some natural features or may be recovering towards conditions indicative of the higher category | Less vulnerable development | Corridor is a navigation route of medium importance (e.g. intermittently used by a small number of craft) |
| Low | Unproductive strata | Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001 $m^3/s$. | Substantially modified by past land use, previous engineering works or flow regulation and likely to possess an artificial cross-section (for example trapezoidal) and would probably be deficient in bedforms and bankside vegetation. Could be realigned or channelised with hard bank protection, or culverted and enclosed. May be significantly impounded or abstracted for water resources use. Could be impacted by navigation, with associated high degree of flow regulation and bank protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches would fall into this category. | Water compatible development | Corridor is rarely used for navigation or is non-navigable |

1 Professional judgement is applied when assigning an importance category to all water features. All controlled waters are protected from pollution under the *Environmental Permitting (England and Wales) Regulations 2016* (Ref 13-9) and the *Water Resources Act 1991* (as amended) (Ref 13-5), and future WFD targets also need to be considered.

2 Based on the water body 'Reach Conservation Status' presently being adopted for HS2 (and developed originally by Atkins) and developed from the EA conservation status guidance (Ref 13-56; Ref 13-57). *LA 113* (Ref 13-43) provides advice on hydromorphological assessment but does not provide criteria for determining hydromorphological receptor importance.

3 Vulnerable development, less vulnerable development and water compatible development are defined in the *NPPF* (Ref 13-21).

* GWDTE: Groundwater Dependent Terrestrial Ecosystems.

^A negligible level of environmental importance is included in **Table 13-4** as this is as shown in *LA 104* (Ref 13-42). However, in accordance with *LA 113* (Ref 13-43) there is no category for a 'negligible' importance water body. The lowest importance grade for a water body is low.

### Magnitude of impact

13.3.41 The magnitude of impact on the water environment has been established using the criteria outlined in Table 3.71 of *LA 113* (Ref 13-43). These impacts take into consideration the extent that the Scheme would directly or indirectly affect the identified water receptors. The identification of impacts takes account of all embedded and essential mitigation measures described in Section 13.8 of this chapter and **Chapter 2, The Scheme** of the Environmental Statement **[TR010044/APP/6.1]**.

**Table 13-2: Criteria to determine magnitude of impact**

| Magnitude of Impact | Criteria | Description |
|---|---|---|
| Major Adverse | Results in a loss of attribute and/or quality and integrity of the attribute. | Surface water:<br>• Failure of both acute-soluble and chronic sediment related pollutants in HEWRAT and compliance failure with Environment Quality Standard (EQS) values.<br>• Calculated risk of pollution from a spillage >2% annually (spillage assessment).<br>• Loss or extensive change to a fishery.<br>• Loss of regionally important public water supply.<br>• Loss or extensive change to a designated nature conservation site.<br>• Reduction in water body WFD classification. |
| | | Groundwater:<br>• Loss of, or extensive change to, an aquifer.<br>• Loss of regionally important water supply.<br>• Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Groundwater quality and runoff assessment).<br>• Calculated risk of pollution from spillages >2% annually (Spillage assessment).<br>• Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies.<br>• Reduction in water body WFD classification.<br>• Loss or significant damage to major structures through subsidence or similar effects. |
| | | Flood Risk:<br>• Increase in peak flood level >100 mm. |
| Moderate Adverse | Results in effect on integrity of attribute, or loss of part of attribute | Surface Water:<br>• Failure of both acute-soluble and chronic sediment-bound pollutants in HEWRAT but compliance with EQS values.<br>• Calculated risk of pollution from spillages >1% annually and <2% annually.<br>• Partial loss in productivity of a fishery.<br>• Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. |

| Magnitude of Impact | Criteria | Description |
|---|---|---|
| | | • Contribution to reduction in water body WFD classification. |
| | | Groundwater:<br>• Partial loss or change to an aquifer.<br>• Degradation or regionally important public water supply or loss of significant commercial/industrial/agricultural supplies.<br>• Potential medium risk of pollution to groundwater from routine runoff – risk score 150-250.<br>• Calculated risk of pollution from spillages >1% annually and <2% annually.<br>• Partial loss of the integrity of GWDTE.<br>• Contribution to reduction in water body WFD classification.<br>• Damage to major structures through subsidence or similar effects or loss of minor structures. |
| | | Flood Risk:<br>• Increase in peak flood level > 50mm. |
| Minor Adverse | Results in some measurable change in attribute's quality or vulnerability. | Surface Water:<br>• Failure of either acute soluble or chronic sediment related pollutants in HEWRAT.<br>• Calculated risk of pollution from spillages >0.5% annually and <1% annually.<br>• Minor effects on water supplies. |
| | | Groundwater:<br>• Potential low risk of pollution to groundwater from routine runoff – risk score <150.<br>• Calculated risk of pollution from spillages >0.5% annually and <1% annually.<br>• Minor effects on an aquifer, GWDTEs, abstractions and structures. |
| | | Flood Risk:<br>• Increase in peak flood level >10mm. |
| Negligible | Results in effect on attribute, but of insufficient magnitude to affect the use or integrity. | Surface Water:<br>• No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants).<br>• Risk of pollution from spillages <0.5%. |
| | | Groundwater:<br>• No measurable impact upon an aquifer and/or groundwater receptors and risk of pollution from spillages <0.5%. |
| | | Flood Risk: |

| Magnitude of Impact | Criteria | Description |
|---|---|---|
| | | • Negligible change in peak flood level <+/- 10mm. |
| Minor beneficial | Results in some beneficial effect on attribute or a reduced risk of negative impact occurring. | Surface Water:<br>• HEWRAT assessment of either acute soluble or chronic-sediment related pollutants becomes pass from an existing site where the baseline was a Fail condition.<br>• Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is <1% annually). |
| | | Groundwater:<br>• Calculated reduction in existing spillage risk by 50% or more to an aquifer (when existing spillage risk <1% annually).<br>• Reduction or groundwater hazards to existing structures.<br>• Reductions in waterlogging and groundwater flooding. |
| | | Flood Risk:<br>• Creation of flood storage and decrease in peak flood level (>10mm). |
| Moderate beneficial | Results in moderate improvement of attribute quality | Surface Water:<br>• HEWRAT assessment of both acute-soluble and chronic-sediment related pollutants becomes pass from an existing site where the baseline was a fail condition.<br>• Calculated reduction in existing spillage by 50% or more (when existing spillage risk >1% annually).<br>• Contribution to improvement in water body WFD classification. |
| | | Groundwater:<br>• Calculated reduction in existing spillage risk by 50% or more (when existing spillage risk is >1% annually).<br>• Contribution in improvement in water body WFD classification.<br>• Improvement in water body catchment abstraction management strategy (CAMS) (or equivalent) classification.<br>• Support to significant improvements in damaged GWDTE. |
| | | Flood Risk:<br>• Creation of flood storage and decrease in peak flood level (>50mm). |
| Major beneficial | Results in major improvement of attribute quality | Surface Water:<br>• Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse.<br>• Improvement in water body WFD classification. |
| | | Groundwater:<br>• Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. |

| Magnitude of Impact | Criteria | Description |
|---|---|---|
| | | • Increased recharge to an aquifer.<br>• Improvement in water body WFD classification. |
| | | Flood Risk:<br>• Creation of flood storage and decrease in peak flood level (>100mm). |
| No Change | | No loss or alteration of characteristics, features, or elements; no observable impact in either direction. |

### Significance of effect

13.3.42 The identification of the likely significant effects on water resources has relied upon the professional judgement of competent experts. It has also been informed by knowledge and experience gained from assessments of similar highway schemes.

13.3.43 The assignment of effects has involved combining the value of an asset with the predicted magnitude of impact, guided by the significance matrix set out in *LA 104* (Ref 13-42) (reproduced in **Table 13.3**).

13.3.44 The matrix has been used to guide the identification and assessment of effects on water resources; however, where professional judgement has resulted in a deviation from the thresholds contained in the matrix, these are explained within the relevant sections of the chapter and are supported by appropriate evidence and explanation.

**Table 13-3: Significance of effect matrix**

| | | Magnitude of impact (change) | | | | |
|---|---|---|---|---|---|---|
| | | No change | Negligible | Minor | Moderate | Major |
| Environmental importance (i.e. value/sensitivity) | Very High | Neutral | Slight | Moderate or Large | Large or Very Large | Very Large |
| | High | Neutral | Slight | Slight or Moderate | Moderate or Large | Large or Very Large |
| | Medium | Neutral | Neutral or Slight | Slight | Moderate | Moderate or Large |
| | Low | Neutral | Neutral or Slight | Neutral or Slight | Slight | Slight or Moderate |
| | Negligible* | Neutral | Neutral | Neutral or Slight | Neutral or Slight | Slight |

*A negligible level of environmental importance is included as this is as shown in *LA 104* (Ref 13-42). However, in accordance with *LA 113* (Ref 13-43) there is no category for a 'negligible' importance water body. The lowest importance grade for a water body is low (see **Table 13-1**).

13.3.45 Significant effects comprise those effects that are within the moderate, large or very large categories, in accordance with *LA 104* (Ref 13-42).

**Flood Risk Assessment**

13.3.46 A flood risk assessment (FRA) has been prepared for the Scheme in accordance with *NPSNN* (Ref 13-17) and *NPPF* (Ref 13-21) requirements. The assessment related to the flood risk draws upon the studies and conclusions made within the FRA, which is presented in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**.

13.3.47 Any effects identified through the FRA, during either construction or operation phases, have been evaluated and a significance value attributed to each effect in accordance with the methodology outline in this chapter. This impact assessment only considers the potential impact of the Scheme on flood risk, not the suitability of the Scheme in the context of flood risk acting on the site. For an assessment of the suitability of the Scheme in this location refer to **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**.

13.3.48 The magnitude of impact was determined based on the criteria in **Table 13-2** taking into account the likelihood of the effect occurring. The likelihood of an effect occurring is based on a scale of certain, likely or unlikely. Likelihood has been considered in the case of water resources only, as likelihood is inherently included within the FRA.

**WFD assessment**

13.3.49 A WFD assessment has been produced based on a combination of desk study, hydromorphological walkover, aquatic ecology and water quality surveys. This assessment considers whether the Scheme has the potential to:

a. Cause deterioration in ecological status and potential of water bodies.

b. Prevent water bodies from meeting their objective of ‘Good’ ecological status/ potential.

c. Prevent or compromise WFD objectives being met in other water bodies or water dependent protected areas downstream of the Scheme.

13.3.50 In undertaking the assessment, consideration has been given to the conservation objectives for any ecologically sensitive sites, where these might be more stringent. The WFD assessment is presented in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]**.

## 13.4 Assessment assumptions and limitations

**Scheme design and limits of deviation**

13.4.1 The assessment has been based on the Scheme description presented in **Chapter 2, The Scheme** of the Environmental Statement **[TR010044/APP/6.1]** and has taken into account the lateral limits of deviation on the Works Plans **[TR010044/APP/2.3]**, and the vertical limits of deviation, in order to establish a realistic worst case assessment scenario.

13.4.2 This scenario identifies and reports the effect that any lateral (horizontal) and/or vertical deviation would realistically give rise to. This has, for example, taken into account the potential for components of the Scheme to be positioned at a slightly higher elevation, or brought into closer proximity to water features, and thereby potentially result in different effects.

13.4.3 In particular, should the position of new culverts change it is possible that the length of the culvert required could increase or decrease. There is unlikely to be a discernible variance in the length of culverts between preliminary design stage to detailed design stage because the length of the culvert is driven by several things (for example the depth of cover to the finished road level below, the horizontal highway alignment etc.); however, although minor changes in the total length of each culvert is unlikely to alter the magnitude of impact significantly, to ensure that a conservative approach has been taken that accounts for future changes (that could be both longer or shorter), the total length of culverts have been assessed with a 10% increase.

13.4.4 The FRA in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]** has considered lateral and vertical deviation during the modelling of the Scheme design, but not modelled such potential changes.

13.4.5 It has been assumed that any new surface water outfalls required for the Scheme may be located within 20 metres of location shown in the Drainage Strategy (**Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**).

13.4.6 The size of any engineered outfall would be no greater than for a pipe of 300mm diameter or less.

13.4.7 Notwithstanding any potential deviation, all embedded and essential mitigation measures would remain deliverable within the extents of the limits of deviation.

**Baseline data and non-intrusive surveys**

13.4.8 The assessment has been undertaken with reference to the baseline data, information and records pertaining to the water quality derived from desk study sources. These were subsequently validated and enhanced through field surveys where land access was obtained from landowners.

13.4.9 Walkover surveys undertaken focussed on the key watercourses affected by the Scheme (i.e. all possible channels/minor watercourses have not been surveyed). Although desk study and surveys have attempted identify all watercourses, in a rural location such as this here may be additional, unknown minor drains and ditches (for example along hedgerows). These are likely to be very small and have an intermittent or ephemeral flow regime. As the assessment adopts a catchment approach to the assessment of effects where minor tributaries are assessed under the importance of the main channel, any impacts to minor channels (should any remain unknown) would be considered as part of the assessment. The significance of effects reported in this chapter would not materially change.

13.4.10 The assessment is based on the best available water quality data provided by the EA, supplemented by monitoring undertaken between September 2017 to August 2018, covering each season. A selection of watercourses in the study area were monitored with four samples collected from six watercourses quarterly over a calendar year. The baseline data and records obtained are considered to be a snapshot of conditions present at the time of sampling, but it is considered that these would represent an approximation of the conditions that would exist at the point of commencing Scheme construction. In addition, for those not monitored for water quality directly, it is assumed that they exhibit similar water quality to those monitored due to the proximity and similarities of their catchments (see **Appendix 13.5** of the Environmental Statement of the Environmental Statement **[TR010044/APP/6.3]** for details of the results).

13.4.11 Determination of Q95 low flows (i.e. the flow predicted to be exceeded 95% of the time) has been calculated by a desk-based exercise using catchment data and Wallingford Hydrosolutions Ltd LowFlows software. These are estimates of the Q95 flow and do not take account of the increasing proportional variability between the natural flow and the artificial influences, such as abstractions, discharges and storage changes as the river flow diminishes. However, this is the most robust data available to inform the assessment.

13.4.12 Estimates of channel width used in the assessments have been based on estimations obtained during a combination of site visits undertaken on the monitoring visits and site walkovers, and from online aerial imagery, rather than from formal topographical surveys.

13.4.13 Fish and macroinvertebrate surveys were completed for Hen Brook and significant ponds only (see **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**). Other aquatic ecological data have been taken from existing EA monitoring.

13.4.14 No hydromorphological assessment of impacts to Bourn Brook have been undertaken because the main channel of Bourn Brook would not be directly impacted by the Scheme. The road catchment draining to Bourn Brook would also only increase by a very small amount (i.e. 0.07 ha) and discharges would be attenuated.

13.4.15 The FRA presented in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]** reports the flood risk baseline.

13.4.16 A Groundwater Risk Assessment report is presented as **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**. The report contains qualitative and quantitative assessment of the potential impacts of the Scheme on groundwater. It includes analytical assessments of the impacts of groundwater dewatering abstractions at the location of some key elements of the Scheme with the potential deep excavation activities (such as cuttings and borrow pits) and with associated dewatering activities on the water environment. This appendix also includes relevant assumptions and limitations of that assessment.

13.4.17 The groundwater simple assessment has used best estimates of unsaturated zone depth, flow type and effective grain size and lithology using geology and borehole information available on the BGSs Geoindex website, soil information from the Soilscapes website and the Scheme's ground investigation (Ref 13-69).

13.4.18 As detailed in **Chapter 2, The Scheme** of the Environmental Statement **[TR010044/APP/6.1]**, Compañía Logística de Hidrocarburos (CLH) Pipeline System Ltd has an oil pipeline that runs north-south, located between the A1 and the River Great Ouse. There is also a CLH pipeline passing northwest-south east under the Scheme, the latter is disused and has been grouted up. There are no known leaks/pollution incidents in relation to both CLH pipelines. Baseline groundwater quality analytical results within Appendix 13.7 of the Environmental Statement **[TR010044/APP/6.3]** indicate no significant groundwater contamination in the area. Accordingly, there are no major concerns on groundwater quality from historical landfill sites.

**Mitigation**

13.4.19 The expected treatment performance of different SuDS options is based on advice reported in *CG 501* (Ref 13-45) and *CD 532* (Ref 13-44). These are estimates and professional judgement has been used when deciding what percentage treatment a particular option may provide, taking into account the design of the SuDS feature and whether it is considered to be 'optimum' or 'sub-optimum' due to other constraints.

13.4.20 It is assumed in the assessment that all SuDS and drainage networks would be fully maintained and managed as per standard guidance and practice. Requirements for maintenance and management of vegetated drainage systems are described in the drainage strategy in **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]** in accordance with *The SuDS Manual* (Ref 13-46). Where new ditches are proposed instead of engineered outfalls, maintenance of the ditches has also taken into account the biodiversity objectives of the new ditch.

13.4.21 The routine runoff and spillage risk water quality risk assessment is based on traffic data modelled for the Scheme. This is presented as **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]**. Assumptions used in the traffic modelling are not reported in this chapter; however further details regarding the data are presented in the Transport Assessment **[TR010044/APP/7.1]** and in **Chapter 2, The Scheme** of the Environmental Statement **[TR010044/APP/6.1]**.

13.4.22 Roads that pose a low risk from water pollution to local watercourses have only been assessed qualitatively (see **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]** for further details of how this has been determined).

13.4.23 No drainage surveys have taken place for the existing outfalls, existing outfalls used within the assessment have been assumed based on local topography and the presence of watercourses (see **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**). CCTV surveys of the existing assets would be required at detailed design stage to determine the condition and connectivity of any existing drainage assets which would be retained as part of the Scheme.

13.4.24 For any planning applications which are granted and begin construction/are completed, it is assumed they would follow all best practice and legislation and would not cause any significant changes to the baseline conditions of the water resources in the area.

13.4.25 The majority of watercourse crossings would be designed at the detailed design stage. A typical arrangement for a box and a pipe culvert with minimum dimensions has been used for assessment purposes.

13.4.26 The lengths of proposed culverts are generally given to the nearest half metre. Similarly, the lengths of proposed watercourse diversions, realignments, and new ditches is approximate as the final length would not be known until detailed design has been undertaken.

## 13.5 Study area

13.5.1 For the purposes of the water resource (flow and quality) assessment, a study area of approximately 1 kilometre (0.62 miles) around the Order Limits has been defined to identify surface and groundwater bodies that could reasonably be affected by direct impacts associated with the Scheme (i.e. there is a pathway between the Scheme and the water body).

13.5.2 Consideration has also been given to any attributes of surface water bodies, groundwater bodies or water dependent ecological sites outside this study area but downstream along water bodies. This is because pollutants and impacts can propagate downstream. The downstream extent of this review is based on professional judgement and includes an area proportionate to the risk of significant adverse effects from the Scheme (which in this case is of the order of a few kilometres due to the size and dilution of the River Great Ouse). As all but the Eastern Brook / Bourn Brook drain to the River Great Ouse, which then flows for many more kilometres before becoming tidal, the River Great Ouse can be considered the ultimate receiving watercourse, and this watercourse is included in the assessment as a water body receptor.

13.5.3 The flood risk study area comprises the EA flood zones along the watercourses that may be affected by the Scheme. The EA designates flood risk zones on the basis of the annual probability of a flood event to occur as follows:

a. Zone 1 is less than 0.1% annual probability of flood risk (i.e. a very low risk of flooding).

b. Zone 2 between 0.1 - 1% annual probability of flood risk (i.e. a low risk of flooding).

c. Zone 3 is more than 1% annual probability of flood risk (i.e. a medium risk of flooding).

13.5.4 The flood risk study area generally includes the extents of the watercourses 1 kilometre (0.62 miles) upstream and 1kilometre (0.62 miles) downstream of the crossing locations.

13.5.5 For the hydraulic modelling of the River Great Ouse the hydraulic watercourse study area is limited by the upstream catchment of the watercourse crossed by the Scheme, that is required to undertake a hydraulic assessment of any

watercourse crossing, and is not limited to the 1 kilometre (0.62 mile) study area. The modelling extents for the River Great Ouse are at least 3 kilometres upstream and downstream of the Scheme. The modelling extents for the River Great Ouse are at least 3 kilometres (1.86 miles) upstream and downstream of the Scheme. The hydraulic modelling reports for the River Great Ouse are included in the FRA in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**.

## 13.6 Baseline conditions

**Topography, rainfall and land use**

13.6.1 Topographic data for the study area has been obtained from OS mapping. Elevations within the study area are generally between 20 metres and 60 metres Above Ordnance Datum (AOD). The land is generally between 40 metres and 60 metres AOD at the eastern extents of the study area, falling to around 20 metres to 30 metres AOD in the central and western parts of the study area, which correspond with the wide, flat valley of the River Great Ouse.

13.6.2 Land use within the study area is generally agricultural land. There are some small areas of improved grassland and pockets of broadleaved woodland, and urban land use around St Neots, with numerous villages and farms, such as Eltisley and Roxton.

13.6.3 Rainfall data from the period 1981-2010 has been obtained from an automatic weather station at Bedford, available on the Met Office website (Ref 13-49) which is the nearest available station to the study area. The area receives an average of just below 600mm rainfall per year, with it raining more than 1mm on an average of 111 days per year. The wettest period of the year is generally August to November, with February and March being the driest months on average. Rainfall is expected to be a maximum of generally between 60mm and 70mm in October, while the minimum is in February with typically less than 40mm.

13.6.4 The same weather station reports that the area generally gets around 50 days of frost (air) each year, distributed evenly across December, January and February, with occasional days of frost in March, April, May, October and November. Using minimum air temperature as a general indicator of air temperatures, it is clear that the potential for de-icant use on roads would be most likely between November and March, but that the frequency of application can be very variable depending on how cold or wet the winter is.

### Geology, hydrogeology and soils

13.6.5 Full details of the geology and soils baseline is presented in **Chapter 9, Geology and soils** of the Environmental Statement **[TR010044/APP/6.1]**. This section presents a summary of this information. A summary of the geology, hydrogeology and soils is also included within **Appendix 13.6** of the Environmental Statement**[TR010044/APP/6.3].** Further detailed information on hydrogeology is included within **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**.

### Surface water bodies

13.6.6 Inland surface water bodies within the study area include watercourses (e.g. rivers, streams, drains, ditches and canals) and still waters such as ponds and lakes. Key watercourses within the 1 kilometre (0.62 mile) study area and thus with the potential to be impacted by the Scheme are listed in **Table 13-3**.

13.6.7 There are numerous minor and unnamed drains and ditches across the study area, often associated with field boundaries. These have not been itemised in **Table 13-3** but have been considered as extensions of the named watercourses for which they are associated.

13.6.8 **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]** shows the location of key watercourses and their tributaries, taken from digital OS maps (Ref 13-47). Tributaries of named watercourses have been given a unique reference for use within this assessment. These references are used on **Figure 13.1** of the Environmental statement **[TR010044/APP/6.1]** and throughout the remainder of this chapter.

13.6.9 Ponds within the study area are listed in **Table 13-4**.

**Table 13-3: Key surface watercourses within study area**

| Main watercourses (location on Figure 13.1) [approx. Chainage] | Tributaries | Type | Designated body for flood risk management |
|---|---|---|---|
| Begwary Brook<br>(Page 5 of 17)<br>[Ch50 A1] | n/a | Ordinary watercourse, and WFD designated as 'Begwary Brook' (GB105033043230) | Bedford Borough Council |
| Rockham Ditch<br>(Page 5 of 17)<br>[Ch950] | n/a | Ordinary watercourse but not designated under the WFD as a specific water body. Tributary of the 'Ouse (Roxton to Earith)' (GB105033047921) | Bedford Group of Internal Drainage Boards (IDBs), Bedfordshire and River Ivel area |
| River Great Ouse<br>(Page 5 of 17)<br>[Ch2450] | RGO1<br>RGO2 | Main River and WFD designated as 'Ouse (Roxton to Earith)' (GB105033047921) | EA |

| Main watercourses (location on Figure 13.1) [approx. Chainage] | Tributaries | Type | Designated body for flood risk management |
|---|---|---|---|
| Stone Brook<br>(Page 6 of 17)<br>[Ch3000] | StB1 - 6 | Ordinary watercourse, and WFD designated as 'Stone Brook' (GB105033038190) | StB1 Central Bedfordshire<br>StB3 and StB2 within the Bedford Group of IDBs, Bedfordshire and River Ivel area |
| South Brook<br>(Page 5 of 17)<br>[crossed by the A1 near Chawston] | n/a | Ordinary watercourse but not designated under the WFD as a specific water body. Tributary of the 'Ouse (Roxton to Earith)' (GB105033047921) | Bedford Group of IDBs, Bedfordshire and River Ivel area |
| Hen Brook<br>(Page 8 of 17)<br>[Ch7775] | HB1 - 4 | Ordinary watercourse, downstream Main River. Hen Brook/ Abbotsley Brook, WFD designated as 'Abbotsley and Hen Brooks' (GB105033043240) | Cambridgeshire County Council |
| Wintringham Brook<br>(Page 8 of 17)<br>[Ch8450] | Wintringham Brook tributary, WB1, WB2 | Ordinary watercourse but not designated under the WFD as a specific water body. Tributary of the Abbotsley and Hen Brooks' (GB105033043240) | Cambridgeshire County Council |
| Fox Brook<br>(Page 12 of 17)<br>[Ch11400] | FxB1 - 3 | Ordinary watercourse, with Main River downstream. Not designated under the WFD as a specific water body. Tributary of the Abbotsley and Hen Brooks' (GB105033043240) | Cambridgeshire County Council |
| Gallow Brook<br>(Page 12 and 13 of 17)<br>[Ch12250] | GB1 - 3 | Ordinary watercourse but not designated under the WFD as a specific water body. Tributary of the 'Ouse (Roxton to Earith)' (GB105033047921) | Cambridgeshire County Council |
| West Brook Tributaries<br>(Page 13 to 17 of 17)<br>[Ch15300] | WstB1 – 5, and Nill Well Brook | Ordinary watercourse, downstream Main River. WFD designated as 'West Brook' (GB105033042730) | Cambridgeshire County Council |

13.6.10 The following watercourses (and their tributaries) are located within the study area but would not be crossed by the Scheme, and are upstream of the works and other water bodies that may be affected. It has therefore been considered that there is no hydraulic connectivity meaning they would not be affected and t are not considered further:

a. River Kym.

b. River Ivel.

c. Duloe Brook.

d. Colmworth Brook.

13.6.11 As noted in the Aquatic Ecology section of this chapter, there are a total of 85 ponds (mostly field ponds) within 500 metres of the Order Limits. Ponds identified beyond the Order Limits (i.e. for a search area between 500m and 1 kilometre (0.62 mile) from the Order Limits) have no hydrological pathways with the Scheme; therefore they have not been considered further.

13.6.12 Those ponds which are hydrologically connected and/or within the Order Limits, or have the potential to be impacted by construction or operation of the Scheme are listed in **Table 13-4**. These include a pond located within the Begwary Brook Nature Reserve and County Wildlife Site (CWS). **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]** shows the location of these ponds.

13.6.13 Ponds that would either be physically impacted by the Scheme or where the water quality or hydrology could be impacted through hydrological connectivity are listed in **Table 13-4**, supported with a commentary on the hydrological connectivity and the results of surveys carried out.

**Table 13-4: Ponds considered by the assessment**

| Pond reference | National Grid Reference | Description and hydrological connectivity |
|---|---|---|
| Pond 2* | TL 16037 55697 | An isolated pond located within the footprint of the Scheme north of the existing Black Cat roundabout. No hydrological connectivity with future Scheme. The Habitat Suitability Index (HSI) is excellent but no Great Crested Newt (GCN) were found using traditional surveys (presence/absence surveys), and thus GCN are likely to be absent. |
| Pond 3 | TL 16859 56132 | One of the ponds in Begwary Nature Reserve. This is hydrologically connected to Begwary Brook and is located a short distance upstream of the River Great Ouse. The HSI is below average and no GCN were found using traditional surveys, thus it is concluded that GCN are not likely to be present. |
| Pond 9 | TL 15377 55163 | This is the attenuation pond for the existing A421 road catchment. This pond outfalls into Rockham Ditch. The HSI is excellent and the GCN eDNA was positive but no traditional surveys were undertaken in this pond due a lack of access, so on a precautionary basis, the pond should be assumed to contain GCN. |

| Pond reference | National Grid Reference | Description and hydrological connectivity |
|---|---|---|
| Pond 11^ | TL 16646 55316 | This is an existing siltation pond within the Black Cat Quarry and is likely to be hydrologically connected to groundwater and the River Great Ouse through the gravel deposits. Once the quarry ceases activity this pond would be restored and would become a permanent feature. The HSI is below average and the GCN eDNA negative, thus GCN not likely to be present. |
| Pond 19 | TL 19023 56400 | Hydrologically connected to a tributary of the River Great Ouse (RGO2), downstream of the mainline crossing of New Alington Top Farm Bridge. The HSI is Good but the GCN eDNA was negative, thus GCN not likely to be present. |
| Pond 20^ | TL 19216 56344 | Hydrologically connected to a tributary of the River Great Ouse (RGO2), downstream of the mainline crossing of New Alington Top Farm Bridge. Appears to be the start of this tributary. The HSI is poor, and the GCN eDNA is negative, and so GCN likely to be absent. |
| Pond 21 | TL 18861 56299 | Hydrologically connected to a tributary of the River Great Ouse (RGO2), downstream of the mainline crossing of New Alington Top Farm Bridge. This pond was dry at survey so no eDNA/HSI available, thus it is assumed that GCN not likely to be present. |
| Pond 22* | TL 18376 55534 | Appears to have hydrological connectivity to StB6; located in ditch location to west of mainline, and east of the railway. The HSI is average, with the GCN eDNA negative, and thus GCN likely to be absent. |
| Pond 23 | TL 18921 55407 | Hydrological connectivity to ditch downstream of Railway Pond catchment and StB6. The HSI is average, but the GCN eDNA was negative, and so GCN unlikely to be present. |
| Pond 37* | TL 21859 59933 | No hydrological connectivity to watercourses. No access for survey allowed and thus it is assumed on a precautionary basis that GCN may be present. |
| Pond 71 | TL 28023 60913 | Linear pond to west of North East Farm. Hydrological connection to Nill Well Brook tributary. The HSI is good but the GCN eDNA was negative, and this GCN unlikely to be present. |
| Pond 79 | TL 29707 60592 | This is located south-east of the existing Caxton Gibbet roundabout and appears to be associated with a small service area (and could form part of the drainage system). The HSI is average, and the GCN eDNA was negative, thus GCN unlikely to be present. |
| Pond 83 | TL 30033 60698 | This is an existing road drainage attenuation pond located south-east of the existing Caxton Gibbet. The HSI score is excellent. This pond has been surveyed to confirm GCN are present, and is a GCN breeding pond. |
| Pond 84* | TL 29660 60700 | This pond does not have hydrological connectivity. Not surveyed so assumed that GCN may be present. |

| Pond reference | National Grid Reference | Description and hydrological connectivity |
|---|---|---|
| Pond 85* | TL 16255 55437 | This pond does not have hydrological connectivity. The HSI is poor, and although the GCN eDNA was positive, the pond was surveyed and no GCN were present – considered a false positive. |
| Pond 88 | TL16750 56800 | This pond is not part of the Wyboston CWS and is contained within the catchment area of the River Great Ouse, downstream of the Scheme. This is known as North House Lake and is fished by Luton Angling Club. This pond would most likely have social and economic value to the local community. This pond was not surveyed for GCN and therefore it is assumed that GCN is present. Abstraction A23 for spray irrigation abstracts from this pond.<br><br>The presence of fish is a factor in calculating HSI for GCN, as fish would predate the newt larvae, therefore, making it less likely to be a good GCN habitat. |
| * Within the Order Limits and likely to be lost.<br><br>^ Affected by the Scheme but only partial loss predicted. | | |

13.6.14 No further water bodies with hydraulic connectivity were identified from a review of OS mapping or site surveys, although there may be very minor drainage ditches that remain unknown, which have been assessed generically.

13.6.15 During a review of the baseline information, the only known socio-economic uses of the watercourses would be the navigational use of the River Great Ouse. There is a marina adjacent to the A1 with riverside moorings where the A1 crosses the River Great Ouse. The known fishing uses are located on specialist ponds/fisheries and not on the watercourses themselves.

13.6.16 The following sections provide further details of the key watercourses within the study area from west to east, starting with the River Great Ouse and moving downstream. Further details of the hydromorphological character of these watercourses and WFD classification is provided within:

a. The WFD assessment in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]**.

b. Water resources data in **Appendix 13.6** of the Environmental Statement **[TR010044/APP/6.3]**.

13.6.17 Key watercourses are illustrated on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**.

**Water quality data**

*Water quality monitoring*

13.6.18 Surface water quality monitoring has been undertaken in September 2017, January 2018, April 2018 and August 2018 on South Brook, Rockham Ditch, River Great Ouse, Hen Brook, Gallow Brook and Fox Brook. The results of which are presented in **Appendix 13.5** of the Environmental Statement **[TR010044/APP/6.3]**.

13.6.19 The water quality sampling was undertaken to support the interpretation of water bodies with regards to pressures acting on them and overall importance, in the context of existing background water quality data and baseline information. It also provided site specific information on certain parameters needed for the HEWRAT assessment and application of the Metal Bioavailability Assessment Tool (M-BAT). This also provided initial baseline data against which construction phase monitoring could be compared.

13.6.20 All monitored watercourses were generally neutral to slightly alkaline, with pH values in the range of 8.06 – 7.41. Results suggested the water within the watercourses sampled is hard with total water hardness (as calcium carbonate (CaCO3)) values ranging from 222-532 mg/l $CaCO_3$.

13.6.21 Dissolved oxygen values ranged from 62% - 132% suggesting the level of dissolved oxygen range from medium to high across the watercourses sampled. The highest, and healthiest, levels of dissolved oxygen on average were recorded in Gallow Brook (refer to **Appendix 13.5** of the Environmental Statement **[TR010044/APP/6.3]**, where an average saturation of 109% was recorded, whilst the lowest average saturation levels were recorded at Rockham Ditch (see **Appendix 13.5** of the Environmental Statement **[TR010044/APP/6.3]**) with an average of 60%. The healthiest dissolved oxygen levels were recorded in spring in five of the six watercourses sampled, the exception being Rockham Ditch where the healthiest, and highest, dissolved oxygen levels were recorded in the summer 2018.

13.6.22 Common indicators of sanitary pollutants include ammonia, nitrate, biochemical oxygen demand (BOD) and chemical oxygen demand (COD). Ammonia was generally low for each watercourse, with all samples recording ammoniacal nitrogen levels between <0.03 mg/l (Rockham Ditch, January 2018 – and Gallow Brook January and April 2018) to 0.17 mg/l (South Brook, August 2018) all of which is below the value used to indicate good WFD class or better (<0.3 mg/l).

13.6.23 The River Great Ouse recorded the lowest levels of nitrate (27.3 mg/l August 2018 to 47.7 mg/l January 2018) across the sampling programme, although these were still elevated and relatively high. All monitoring sites revealed elevated levels of nitrate, indicative of agricultural catchments with runoff containing fertilizer.

13.6.24 There was one recorded sample across the sampling programme, where total zinc levels exceeded the maximum allowable EQS values, which is 14 µg/l bioavailable. This was recorded at Rockham Ditch in the summer (2018), where total zinc levels were recorded at 33 µg/l during August 2018 monitoring.

13.6.25 Chromium levels were elevated for three out of the four samples taken on Rockham Ditch (5, 3.9, 4.2 µg/l), whilst other exceedance incidents were recorded at South Brook (4 µg/l, January 2018) and the River Great Ouse (3.8 µg/l and 7.1 µg/l during the spring and summer, respectively). No elevated levels were noted in Fox Brook, Gallow Brook or Hen Brook. Across all watercourses, levels ranged from 0.2 – 7.1 µg/l with the highest levels recorded in the River Great Ouse.

13.6.26 The levels of numerous metals recorded in the sample from in Rockham Ditch during the summer were reported as exceeding the maximum allowable EQS values. Total lead, dissolved chromium, total chromium, total zinc, total iron and mercury all surpassed the EQS values in this sample.

**Water resources**

*Water Activity Permits*

13.6.27 Water Activity Permit (formerly discharge consents) information has been obtained from the EA, correct as of June 2020. The data indicates there are 45 active water activity permits in the study area, which is presented in **Appendix 13.6** of the Environmental Statement **[TR010044/APP/6.3]** and includes discharge type and receiving waters. The discharge locations are also shown on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]** and are labelled as D1 – D45.

13.6.28 The majority of these consented discharges are to ditches (i.e. tributaries) of large water bodies such as the Great River Ouse and River Ivel, rather than direct to the main channel. The majority are for pumping stations, public sewage treatment works, and some non-mains domestic sewerage treatment systems. The permitted rates of discharge for these consents has not been provided.

13.6.29 There are several consented discharges to the River Great Ouse or its tributaries in the study area. This includes discharges of final treated effluent and/or sewage from waste water treatment works including from the Little Barford Power Station, Roxton Sewage Treatment Works (STW), Roxton Pumping Station, Little Barford STW, Barford Road Pumping Station, St Neots Market Square Combined Sewer Overflow (CSO), Huntington Street Pumping Station and Chawston STW.

13.6.30 There are several consented discharges to Hen Brook and its tributaries. This includes discharges from the Abbotsley Road Pumping Station, Duck Lane Pumping Station, Brook End Farm and Brampton Pumping Station.

13.6.31 The main channel of West Brook falls outside of the study area, although is connected to the study area by its upstream tributaries. There is a discharge from the Yelling High Street Pumping Station to a tributary of West Brook. There also are consented discharges to a ditch upstream of Stone Brook from the Tempsford Water Recycling Centre and another from Station Farm.

13.6.32 There are no known consented discharges to Begwary Brook.

*Water abstractions*

13.6.33 Information on licensed water abstractions within 2 kilometres (1.24 miles) of the Scheme has been obtained from the EA (correct as of June 2020). The data indicates that there are 34 abstractions in this area, 27 of which are from surface water and eight from groundwater. Full details are given in **Appendix 13.6** of the Environmental Statement **[TR010044/APP/6.3]** and each licensed water abstraction is shown on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]** labelled as A1 – A34 and differentiated as either groundwater or surface water abstractions.

13.6.34 Information on PWS was obtained from South Cambridgeshire District Council, Cambridge City Council, Huntingdonshire District Council, Bedford Borough Council and Central Bedfordshire Council. There are no PWS abstractions within 1 kilometre of the Scheme.

13.6.35 The majority of the licensed water abstractions relate to agriculture, such as direct spray irrigation, with some abstractions for 'general farming and domestic' which have lower abstraction volumes. Other abstraction uses include hydroelectric power generation, and use in unspecified industrial, commercial and public services. Annual consented abstractions in the study area range from 45$m^3$ to 76,032,000 $m^3$.

13.6.36 The largest licensed abstractor in the study area is Breedon Aggregates, as part of their operations at Black Cat Quarry. However, the permitted end date for mineral extraction at Black Cat Quarry has passed and it is expected that the approved restoration landform for the Quarry would be in place before construction works on the Scheme are due to commence.

13.6.37 Based on the information available, no surface water abstractions are located within the study area downstream of watercourses where flows may need to be temporarily over-pumped or flumed through the works when new culverts are being constructed. There are multiple abstractions from the River Great Ouse but flows along this watercourse would be unaffected by the construction works.

*Other designations*

13.6.38 The area of the River Great Ouse valley is contained within a Drinking Water Protected Area (Surface Water) (Water body ID GB105033047921) for the Ouse (Roxton to Erith) which is 'at risk' due to certain pesticides. Drinking Water Protected Areas (Surface Water) are, within the WFD, where raw water is abstracted from rivers and reservoirs and needs to be protected to ensure that it is not polluted which could lead to additional purification treatment.

13.6.39 The majority of the study area (with the exception of the eastern end of the Scheme from Eltisley area to the existing Caxton Gibbet roundabout) is contained within a Drinking Water Safeguard Zone (Surface Water) (Safeguard Zone IH SWSGZ1012) which is related to limiting the accumulation of certain pesticides. Drinking Water Safeguard Zones are designated areas in which the use of certain substances must be carefully managed to prevent the pollution of raw water sources that are used to provide drinking water.

13.6.40 The whole study area is part of a surface water Nitrate Vulnerable Zone (NVZ) for water supply to the River Great Ouse (NVZ ID 391). NVZs are areas designated as being at risk from agricultural nitrate pollution and where action is being directed to manage the risk.

13.6.41 The whole area is part of a groundwater NVZ for groundwater within the Huntingdon River Gravels (NVZ ID 144). The area does not contain a groundwater drinking water safeguard zone.

*Navigation and recreation*

13.6.42 During a review of baseline information, the only known socio-economic uses of the watercourses would be the navigational use of the River Great Ouse. The known fishing uses are located on specialist ponds/fisheries plus recreational fishing rights on the River Great Ouse.

13.6.43 The River Great Ouse is navigable from Bedford to the Wash at King's Lynn with connections to the River Nene via the Middle Level, the Cam, the Lark, the Wissey and Little Ouse. The total navigable length is approximately 120 kilometres (75 miles) and is used for recreation.

13.6.44 There are also connections to the navigable drains of the New Bedford River, Old Bedford River and a flood relief channel from Denver Sluice to near King's Lynn. The location of the Scheme is towards the most inland extent of the navigable River Great Ouse, with Bedford being approximately 18 kilometres (11 miles) upstream of the existing Black Cat roundabout (Ref 13-66). The River Great Ouse falls in elevation approximately 20 metre through 15 lock structures between Bedford and Brownshill Staunch – a 61 kilometre (37 miles) stretch) – where it becomes tidal.

13.6.45 The EA are the navigation authority for the River Great Ouse. The legal framework through which these powers are exercised is the *Anglian Water Authority Act 1977* (Ref 13-65). Recreational byelaws are made under this *Act* (Ref 13-65) to regulate matters including boat registration, boat safety and speed limits.

13.6.46 The EA provided information in response to a data request regarding navigational use of the River Great Ouse. They noted that this is not the most heavily used section of the navigation; however, during busy summer weekends approximately 50 craft would pass through the Scheme area (upstream or downstream) per day. This would be a mix of narrow boats, wide beam boats and cruisers. Detailed vessel movement numbers and craft type data are not available.

13.6.47 There is a marina (Kelpie Marine Boat Yard) adjacent to the A1 southbound bridge (NGR TL 16190 54619) with riverside moorings extending approximately 500 metres downstream of the A1. There is another smaller marina approximately 100 metres upstream of this location.

13.6.48 The Bedford River Festival is a multi-event festival that takes place in July and includes numerous river-based activities. It is expected that higher than usual boat traffic would be expected during this period along the River Great Ouse (Ref 13-68). The next event is to be held in July 2021.

*Fisheries*

13.6.49 Information on fisheries in the area was obtained from the Environment Agency response received in June 2020. The St Neots & District Fish Preservation and Angling Society and the Biggleswade & Hitchen Angling Association both have fishing rights on the River Great Ouse, and still waters in and around St Neots.

13.6.50 The St Neots & District Fish Preservation and Angling Society website shows the location of their fishing sites being downstream of the existing A428 crossing of the River Great Ouse, over 3.5 kilometres (2.2 miles)5 kilometre north and downstream from the Scheme.

13.6.51 The Biggleswade & Hitchen Angling Association has fishing rights at an area known collectively as Tempsford Estate Waters. This includes Campers, School and Anchor Meadow (all upstream) and Pylon Meadow and The Jungle located north of the A1 crossing of the River Great Ouse, on the right hand bank of the River Great Ouse. Pylon Meadow is located adjacent to the works area on the A1 south. The Jungle is approximately 800 metres in length and is located along the right hand bank of the River Great Ouse in the area of the Ouse viaduct.

13.6.52 Luton Angling Club includes fishing within the Wyboston Lakes area.

**Groundwater**

13.6.53 The *EA Catchment Data Explorer website* (Ref 13-51) indicates that the study area is not underlain by a WFD designated Groundwater body. The nearest WFD Groundwater body is the 'Ouse Upper Bedford Woburn Sands' (GB40501G402200) which is located over 2 kilometres (1.24 miles) away to the south-east of the Scheme. Under the 2016 Cycle 2 classification this groundwater body is at poor overall status, poor quantitative status, and poor chemical status. Refer to the WFD Assessment in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]** for more details.

13.6.54 According to *Defra's Magic Map website* (Ref 13-58) the bedrock (i.e. comprising undifferentiated mudstone of the Oxford Clay over the Kellaways Formation in the western/ central area of the Scheme, and undifferentiated mudstone of the West Walton and Ampthill Clay Formations over the Kellaways Formation in the east) beneath the Scheme is unproductive strata. These low permeability geological strata have a negligible significance for water supply or river baseflow. The majority of the deposits are designated as a Secondary (undifferentiated) aquifer, which is assigned where it is not possible to attribute either category A or B to a rock type. The aquifer within the superficial deposits (i.e. comprising river terrace and alluvium deposits) is designated as a Secondary A aquifer. Secondary A aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers.

13.6.55 There are no groundwater SPZs in the study area, and the Scheme does not lie within a Drinking Water Safeguard Zone for groundwater.

**Aquatic ecology**

13.6.56 Details on the aquatic biodiversity baseline and potential impacts are presented in **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]** and in **Appendix 13.6** of the Environmental Statement **[TR010044/APP/6.3]**.

13.6.57 This section provides a summary of information related to the baseline surveys which have been undertaken. Aquatic habitats were identified using the *OS mapping* (Ref 13-47), *Defra's online Magic Map* (Ref 13-58), as well as information obtained in the Phase 1 Habitat Survey for the Scheme (refer to **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**). Eighty-five ponds, mostly field ponds, were identified within 500 metres of the Order Limits, 59 of which were surveyed to better understand their ecology. The other 26 were not surveyed due to access constraints and / or the ponds being dry. This is discussed in further detail under 'Ponds' below.

13.6.58 The River Great Ouse and Hen Brook have been surveyed in detail (aquatic habitats, riparian mammals, fish, aquatic macroinvertebrates and invasive non-native plants) to inform the biodiversity assessment. This is summarised in **Appendix 13.6** of the Environmental Statement **[TR010044/APP/6.3].**

*Ponds*

13.6.59 Of the 85 ponds identified within 500 metres of the Scheme in 2018 and 2019, 59 were accessed and surveyed to determine their habitat suitability for GCN by collecting data from which to calculate a HSI. Further surveys were undertaken either through the eDNA sampling technique or through traditional survey to identify the presence or likely absence of GCN in 2018 and 2019. The study boundary took into consideration higher suitability ponds located within woodland, and farmland, and also lower suitability water bodies and such as garden ponds, fishing ponds and lakes. Please refer to **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]** for full details.

13.6.60 Of the ponds shown in, pond 83 has been confirmed to have GCN present in it. It was not possible to survey ponds 9 (only eDNA positive), 37 and 84, and so on a precautionary basis it has been assumed that GCN could be present. All other ponds are not thought to support GCN and do not contain any notable or protected species. Please refer to **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]** for further details.

13.6.61 The majority of aquatic macroinvertebrate species recorded in the ponds were common, although 'Local' (Conservation value 5) species were recorded in each of the ponds surveyed using the Predictive SYstem for Multimetrics (PSYM) method, indicating that most of the ponds are of Site or Local importance only.

13.6.62 Several species of higher conservation value ('Regionally Notable' (Conservation Score 6) and 'Notable' (Conservation Score 7)) were also identified (refer to **Table 13-5**).

**Table 13-5: Summary of aquatic macroinvertebrate species of higher conservation value ('regionally notable' (conservation score 6) and 'notable' (conservation score 7)) found in ponds**

| Macroinvertebrate species | Conservation status | Number of ponds |
|---|---|---|
| *Sigara limitata* (a corixid waterboatmen) | Conservation Score 6, 'Regionally Notable' | 2 |

| Macroinvertebrate species | Conservation status | Number of ponds |
|---|---|---|
| *Cymatia rogenhoferi* and *Sigara iactans* (two species of corixid waterboatmen) | Conservation Score 6, 'Regionally Notable' | 1 |
| *Enochrus melanocephalus* (water scavenger beetle) | Conservation Score 6, 'Regionally Notable' | 1 |
| *Berosus affinis* (water scavenger beetle) | Conservation Score 7, 'Notable' | 2 |
| *Berosus signaticollis* (water scavenger beetle) | Conservation Score 7, 'Notable' | 1 |
| *Ilybius fenestratus* (diving beetle) | Conservation Score 7, 'Notable' | 2 |
| *Rhantus suturalis* (diving beetle) | Conservation Score 7, 'Notable' | 1 |

13.6.63 None of the species described in **Table 13-6** are defined as nationally scarce, near threatened or of any higher category of nature conservation importance, and none have any specific legislative protection.

13.6.64 As well as individual species, the aquatic invertebrate communities of the different sites have been assessed based on the combination of the biotic indices (diversity, Biological Monitoring Working Party (BMWP), Average Score Per Taxon (ASPT), conservation value and Community Conservation Index (CCI)) and professional judgement. Refer to **Appendix 8.17** of the Environmental Statement **[TR010044/APP/6.3]** for further details.

**Water dependent ecological sites**

13.6.65 Using *Defra's online Magic Map* (Ref 13-58), and with reference to **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**, one ecologically sensitive site (for example SSSI, Special Areas of Conservation (SAC), Special Protection Areas, Ramsar sites, local or National Nature Reserves) is present within the study area (refer to **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**). This is the Elsworth Wood SSSI which is located approximately 0.85 kilometres (0.5 miles) to the north-east of the Order Limits in the area of the existing Caxton Gibbet roundabout. St Neots Common SSSI is approximately 2.3 kilometres (1.4 miles) from the Order Limits, but further still from any significant works. Although the St Neots Common SSSI this site may have some connectivity to groundwater in superficial deposits (sands and gravel) given the distance from any works that would require dewatering (for example any borrow pits and cuttings in sands and gravels are >5 kilometres (>3.1 miles) away) there would be no impacts. The proximity to the River Great Ouse would provide a constant head to maintain water levels at the site.

13.6.66 The description and reasons for notification in Natural England's citation for Elsworth Wood SSSI do not contain any features that are of a wetland nature or sensitive to minor change to the groundwater catchment.

13.6.67 The SSSI is the surviving fragment of a curious ring-shaped wood unusually situated on a ridge between two valleys on calcareous boulder clay. Three types of woodland are represented, none of which is recognised as being sensitive to minor changes in groundwater catchment. The SSSI includes part of a pond (about 30% of the pond area is within the SSSI) and a stream flows through the pond and hence through the wood in a northerly direction. A second drain/ stream flows along the eastern side of the wood, again in a northerly direction, joining the former stream as it exits the wood. The combined stream continues to drain north joining the Great Ouse near Swavesey. The area of the Elsworth Wood SSSI is located within Fen Drayton Drain waterbody catchment, and not within a waterbody catchment where the Scheme would be located. Based on the above, and being located on a ridge, there are no surface watercourses that connect the Scheme to the SSSI and there is a lack of groundwater and surface water connectivity.

13.6.68 There are two SACs within the catchment area of the River Great Ouse. These are Portholme SAC and Ouse Washes SAC. Portholme SAC is located approximately 8.9 kilometres (5.5 miles) from the Scheme (which is approximately 20 kilometres (12 miles) downstream from the Scheme). Ouse Washes SAC is located approximately 16.1 kilometres (10 miles) from the Scheme, and approximately 23 kilometres (14 miles) downstream from the Scheme via West Brook and the River Great Ouse. Given the distance from the Scheme, and the dilution available over this distance in the River Great Ouse, these sites are not considered any further by this water environment impact assessment.

13.6.69 The following CWSs located within 1 kilometre (0.62 miles) of the Scheme are, or contain, aquatic habitats, the locations of which are illustrated on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**:

a. Begwary Brook Pits CWS – this was once a large marsh fed by the River Great Ouse, but in the 1960s gravel extraction created a small lake and a series of pools in the small area of marsh which survives today. Begwary Brook Pits is a Nature Reserve of the Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire.

b. Wyboston Pits CWS – this is another former gravel extraction area within the floodplain of the River Great Ouse and is a wetland site with wouldow trees, common fleabane, marsh woundwort and a number of dragonfly and damselfly species and warblers.

c. The River Great Ouse CWS – this extends from upstream of the study area to downstream of St Neots. The River Great Ouse is a major river not grossly modified by canalisation or poor water quality. This supports various water dependent habitats.

13.6.70 No GWDTE sites have been identified that require assessment. Watercourses are a UK Biodiversity Action Plan priority habitat and as baseflow could be

affected where there are deep excavations close to watercourses this has been assessed as part of the assessment of impacts to groundwater flow and levels.

**Flood risk**

13.6.71 The FRA presented in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]** assesses the present risk of flooding from all sources including fluvial, surface water, groundwater, artificial sources and sewer and water supply infrastructure.

*Fluvial flood risk*

13.6.72 The EA Flood Map for Planning (Ref 13-52) presents a set of flood zones for guidance by developers, councils and communities to explain the probability of fluvial and tidal flooding (ignoring the presence of flood defences) for a Main River. These are shown in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**.

13.6.73 The tributaries of the River Great Ouse which traverse the alignment of the Scheme (as illustrated on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**) are considered ordinary watercourses, with permissive powers to improve and maintain owned by the LLFA or IDB. Detailed flood extents associated with these ordinary watercourses may therefore not be shown on the EA's Flood Map for Planning (Ref 13-52), unless specific modelling has been undertaken. There are a number of these watercourses (Hen Brook, South Brook and Rectory Farm) where flood extents are shown on the EA's Flood Map which suggests some modelling has been undertaken for these watercourses, however the level of detail associated with this modelling is unknown.

13.6.74 The majority of the Scheme is located within Flood Zone 1 (low probability), except where it traverses each of the watercourses. In these locations, the Scheme is shown to coincide with Flood Zone 3 (high probability).

**Baseline Hydraulic Modelling**

13.6.75 Full details of the modelling are included within the FRA (see **Appendix 13.4** of the Environmental Statement **[TR01044/APP/6.3]**). This section includes a summary of the information within the appendix.

*River Great Ouse*

13.6.76 The original EA model (1D-2D FMP-TUFLOW hydraulic model) has been modified to provide more information in the area of the Scheme. Modifications include: changing a 20 metre resolution grid to a 10 metre resolution grid, updated LiDAR Digital Terrain Model (DTM) model being used, proposed Caxton Quarry Restoration ground elevations and water levels added to the model, three additional river cross sections have been surveyed at the Scheme crossing location and built into the 1D network.

13.6.77 The output from the baseline hydraulic modelling for the River Great Ouse is for the 1% Annual Exceedance Probability (AEP) +35% climate change and is shown in **Figure 6.3** of the FRA (**Appendix 13.4** of the Environmental Statement **[TR001044/APP/6.3]**). Floodplain depths are generally observed to be between 1 – 2 metres with the largest depths of flooding intuitively being observed within the restored quarry ponds where maximum flood depths are over 3 metres. There is

also significant floodplain attenuation upstream of the A1 River Great Ouse crossing where maximum flood depths are consistently between 1 – 2 metres during this event.

13.6.78 A comparison of the baseline modelling flood extents and the corresponding EA Flood Zones has been undertaken with figures presented within Section 3 in Annex A of the Flood Risk Assessment in **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]**. To summarise, the modelled 1% AEP and 0.1% AEP flood extents show a good level of agreement to the published Flood Zone 3 and Flood Zone 2 respectively, with slight differences associated with the inclusion of the proposed quarry restoration which do not form part of the EA mapping (Ref 13-52) presently.

*Hen Brook*

13.6.79 Hen Brook is south-east of St Neots and flows through agricultural fields to the north of the B1046 near Abbotsley receiving flow from other minor watercourses and land drains. A new 1D-2D FMP TUFLOW model was developed in the area of the Scheme representing the ordinary watercourse reach only. The only structure along the reach which has been modelled is the culvert beneath the existing A428. For more information on how this model was created, refer to Annex B of the FRA presented in **Appendix 13.4** of the Environmental Statement **[TR001044/APP/6.3]**.

13.6.80 The culvert structure beneath the existing A428 has been modelled. For the 1% AEP event +65% climate change this shows there is out of bank flooding contained within surrounding agricultural fields in low lying land, with greater depths within the field ditches.

13.6.81 The existing A428 presents a barrier to flow, and floodwater backs up against the existing A428 at this location.

*Rectory Farm tributary of Stone Brook tributary (StB3)*

13.6.82 The Rectory Farm tributary of Stone Brook is labelled as StB3 on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**). It originates as two tributaries (Barford and Spinney branches) located in agricultural fields south of Little Barford. These tributaries confluence at a farm access track where the watercourse flows through a culvert. The Rectory Farm tributary continues to flow in a southerly direction until its confluence with the Stone Brook.

13.6.83 There was no available model of this watercourse and therefore a new 1D-2D FMP TULOW model was developed in the area of the Scheme. The output of the baseline hydraulic modelling for Rectory Farm for the 1% AEP +65% climate change event is presented on **Figure 6.5** within the FRA in **Appendix 13.4** of the Environmental Statement **[TR001044/APP/6.3]**. Out of bank flooding is largely contained upstream of the farm access track crossing with a maximum depth of approximately 0.68m in low lying area. Flow is constricted by the culvert and therefore water backs up on the floodplain. This is exacerbated by the raised farm track road which presents a barrier to flow.

13.6.84 Floodwater overtops the farm track road where levels are naturally lower, propagating downstream. Generally, flood depths downstream of the farm track road reach up to 0.20 metres.

*South Brook*

13.6.85 South Brook is located south of St Neots in the area of Chawston. A new 1D-2D FMP TULOW model was developed in the area of the Scheme.

13.6.86 The output of the baseline hydraulic modelling for South Brook for the 1% AEP +65% climate change event shows that out of bank flooding occurs on the floodplain to the north and south of South Brook upstream of the A1 Great North Road. Maximum depths typically reach up to 0.75 metre in this event. The A1 Great North Road acts as a barrier to flow, with floodwater pooling on the floodplain upstream of the road embankment. Some floodwater overtops the road on the southern side, with depths up to 0.15 metres. There is no property flooding present as properties are located approximately 40 metres from the maximum modelled flood extent and 0.40 metres above the maximum flood level.

13.6.87 Out of bank flooding is also present downstream of the A1 Great North Road where floodwater depths typically reach up to 0.10 metre. There is a small area of floodwater adjacent to the channel where depths reach up to 0.50 metre where the land elevation is lower than the surrounding floodplain. The model demonstrates that floodwater flows out of bank and spreads across the floodplain on both the north and south side of the watercourse as the area is generally flat.

*Other ordinary watercourses*

13.6.88 The remaining ordinary watercourses have been modelled using a 1D FMP only approach. As these are ordinary watercourses, flood extents have not been created for these watercourses. The produced data such as levels, flows, flow volumes and velocities are used to compare with the Scheme scenario and are presented in Section 13.9 of this chapter.

*Historical flooding*

13.6.89 Information on historical flooding events have been collected from the EA and LLFA. These are shown in Table 6.1 within the FRA (**Appendix 13.4** of the Environmental Statement **[TR001044/APP/6.3]**. Six flood events are listed from March 1947 to January 2003. Three of the six events are attributed to the Main River, assumed to be the River Great Ouse, and are listed as being caused by the channel capacity being exceeded. These events occurred in the period October to May.

*Surface water flood risk*

13.6.90 It can be identified from the EA Flood Risk for Surface Water (FRfSW) mapping (included as Figure 7 within **Appendix 13.4** of the Environmental Statement **[TR001044/PP/6.3]**) that areas at risk from surface water flooding are present within the study area.

13.6.91 The majority of the surface water flood risk in the study area is categorised as ‘Very low’ (less than 0.1% AEP). However, where the Scheme traverses an ordinary watercourse, the surface water flood risk increases and becomes ‘Low’ (between 0.1% and 1% AEP), ‘Medium’ (between 1% and 3.33% AEP) and

'High' (greater than 3.33% AEP). Naturally risk is higher in areas closest to the watercourses, as shown in Figure 6.7 in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**).

13.6.92 The surface water flood risk flow paths closely match those of the local watercourse network. Therefore, the locations of surface water flooding have been considered as part of the fluvial assessment. This approach was agreed during consultation with the statutory consultees.

*Flooding from artificial water bodies*

13.6.93 The risk of flooding from reservoirs due to dam failure is very low throughout the UK. Based on data received from EA, the following registered large raised reservoirs (i.e. capacity of 25,000 cubic metres or more of water above ground level) could present a flood risk to part of the study area in the unlikely event of a dam failure:

a. Grafham Water.

b. Tythe Farm Reservoir.

c. Southill Park Lake.

d. Lower East End Farm.

e. Great Barford Flood Alleviation – west.

13.6.94 An extract of the published flood risk map from reservoirs obtained from the *EA website* (Ref 13-52) is included in **Figure 6.8** within **Appendix 13.4** of the Environmental Statement **[TR00044/APP/6.3]**.

13.6.95 The flood risk map indicates that, for the majority of the reservoirs in the vicinity of the Scheme, floodwater would follow the route of the Great River Ouse in the case of a dam failure, flowing northwards towards St. Neots. Based on the information presented within the FRA in **Appendix 13.4** of the Environmental Statement **[TR00044/APP/6.3]**, the risk of flooding from artificial sources within the study area is considered to be very low and is therefore not considered further within this assessment

*Flooding from groundwater*

13.6.96 Groundwater flood risk is presented within the FRA, **Appendix 13.4** of the Environmental Statement **[TR00044/APP/6.3]**, and also within **Appendix 13.7** of the Environmental Statement **[TR001044/APP/6.3]**.

13.6.97 The AStGWF map such as Huntingdonshire District Council's *SFRA* (Ref 13-34), shows the study area is susceptible to groundwater flooding from superficial deposits. The area around the existing Black Cat roundabout and the section from Cambridge junction to the existing Caxton Gibbet roundabout is indicated with a 75% (i.e. >75%) susceptibility to groundwater flooding from within the superficial deposits. The area between the existing Black Cat roundabout and Cambridge Road Junction is indicated predominantly with under 25% (<25%) susceptibility to groundwater flooding from the superficial deposits. However, this published map was produced from a regional-scale model, showing groundwater flood areas on a 1 kilometre (0.62 miles) square grid, and therefore may vary in principle from actual site-specific groundwater conditions. The AStGWF data

should be used only in combination with other information, for example local data or historical data.

13.6.98 A conceptual hydrogeological model has been developed in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**, to define the baseline groundwater flood risk condition. The model is based on the geological and hydrogeological conditions beneath the Scheme.

13.6.99 Based on the ground investigation (Ref 13-69) data, the conceptual model assessment and the groundwater susceptibility flood risk map, the risk of groundwater flooding is considered to be low in the vast majority of the study area with the only exception of the western part of the Scheme where the potential for groundwater flooding risk is considered to be high due to the shallow groundwater conditions and the potential for groundwater-surface water interaction in the floodplain of the River Great Ouse.

*Tidal flooding*

13.6.100 Due to the distance from the coast and the ground levels above predicted future tide levels and distance from coastal regions, the area is not considered to be at risk of tidal flooding. As such it is not considered further.

*Flooding from drains and sewers*

13.6.101 The Anglian Water records mentioned in the *SFRA* for Bedford Borough Council (Ref 13-36) show the locations with greatest numbers of flooding records in the period up to 2020 are localised in the centre of the borough, outside of the study area of this FRA.

13.6.102 The Cambridge and South Cambridgeshire *SFRA* (Ref 13-37), indicates some localised sewer and pluvial flood events in the period up to 2010, in Croxton and Eltisley, within the study area of this FRA.

13.6.103 However, given the rural nature of the area surrounding the Scheme and known records of previous incidents, the flood risk from sewers is considered to be low.

**Future baseline conditions**

13.6.104 As detailed in **Chapter 4, Environmental assessment methodology** of the Environmental Statement **[TR010044/APP/6.1]**, a review has been undertaken to determine whether the existing baseline conditions might change between the time of undertaking the assessment and the future years in which the Scheme is planned to be constructed and become operational, as a result of future planned development.

13.6.105 Consideration was given to the following development-related changes that potentially alter or influence the identified water environment resources:

*Construction year baseline (2022)*

13.6.106 The future baseline has been determined qualitatively by considering the possibility of changes in the attributes that are considered when deciding the importance of water bodies in the study area.

13.6.107 It is considered that the baseline conditions at the start of construction would not be significantly different to the baseline reported in this chapter for much of the Scheme. There are, however, known planning applications that have been considered by the impact assessment and presented in **Chapter 15 Assessment of cumulative effects** of the Environmental Statement **[TR00044/APP/6.1]**. To the east of St Neots, west of the Scheme, several approved planning applications are known within the study area for residential and mixed-use development. These are:

a. Potton Road Housing (79 dwellings: approved).

b. Wintringham (2,800 dwellings and other uses: approved).

c. Loves Farm (1,020 dwellings and other uses: approved).

13.6.108 Wintringham is currently under construction, with future housing parcels not yet developed. It is not certain how much of the Wintringham development would be remaining by 2022. The remaining Wintringham development, and the Potton Road and Loves Farm developments are likely to be overlapping in terms of construction period. These are all located to the west of the Scheme, and would be therefore, downstream of the surface watercourse flow.

13.6.109 East of the existing Black Cat roundabout is an area of gravel extraction (Black Cat Quarry). The quarry would have stopped extraction by the time of construction, and that some of the area would be restored before construction of the Scheme commences. The Breedon Group restoration plan (dated January 2017) (Ref 13-70) shows the silt pond (Pond 11) located east of the existing Black Cat roundabout within the line of the new dual carriageway. The surrounding restoration plan shows restored ponds, and reedbed habitat areas. Ground levels are lower than the original floodplain in the area.

13.6.110 To the east of the study area, and south-east of the existing Caxton Gibbet roundabout, the Cambourne development of 2,350 dwellings and other land uses has been granted permission. Another development, awaiting a planning decision, in the east of the study area is Bourne airfield, with 3,500 dwellings and mixed use planned.

13.6.111 Any planning applications that are granted and begin construction/are completed, it is assumed would follow best practice and legislation and would not cause any significant changes the baseline conditions of the water resources in the study area.

13.6.112 Given the timescale between the publication of the DCO application and the year of construction, it is considered the baseline conditions for flood risk would not change significantly. Climate change guidance which was updated in 2019 has been used in the assessment (Ref 13-59).

13.6.113 Environmental baseline conditions are not anticipated to change significantly by 2022 from the conditions as detailed above. As detailed in **Chapter 15, Assessment of cumulative effects** of the Environmental Statement **[TR010044/APP/6.1]** and **Appendix 15.1** of the Environmental Statement **[TR010044/APP/6.3]** of the Environmental Statement, a number of development projects are ongoing, or are planned, that have the potential to change baseline conditions. However, there are no developments within the study area which are anticipated to be operational by 2021.

*Opening year baseline (2026)*

13.6.114 Generally, there is an improving trend in surface water quality and the environmental health of waterways in the UK since the commencement of significant investment in sewage treatment in the 1990's, the adoption of the WFD from 2003, and the application of ever more stringent planning policies. In terms of water quality impacts, the future baseline assumes that all WFD water bodies achieve their final target status.

13.6.115 It is likely that through the action of new legislative requirements and ever more stringent planning policy and regulation, that the health of the water environment would continue to improve post-2027, and therefore towards 2025, although there are significant challenges such as adapting to a changing climate and pressures of population growth that could have a retarding impact. However, it is difficult to forecast these changes with any certainty, and in any case the way the importance of the water environment is determined considers a wide range of attributes, some of which are unlikely to change.

13.6.116 It is considered that the baseline conditions would be similar to that of the date of writing. Any planning applications that are granted and begin construction/are completed are assumed to follow best practice and legislation and would not cause any significant changes the baseline conditions of the water resources in the study area.

13.6.117 It is not anticipated that baseline conditions for flood risk of all types would change significantly between the year of construction and the opening baseline.

*Design year baseline (2041)*

13.6.118 It is not possible to accurately predict baseline environmental conditions for the design year (2041) of the Scheme; however, it is anticipated that baseline conditions in the vicinity of the Scheme and within the associated water environment study area in this year would largely be the same as at 2022.

13.6.119 Using the traffic conditions predicted for the design year, any future increases in traffic have already been accounted for within the HEWRAT assessment (see **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]**) in relation to the design of mitigation for routine runoff.

13.6.120 Due to the changing nature of the climate, there is the potential for more intense rainfall events. This possibility has been included within the design of the mitigation measures for flow attenuation of road runoff to the receiving watercourses.

### Importance of Receptors

13.6.121 The key local water resources receptors within the study area are summarised in **Table 13-6**.

## Table 13-6: Summary of the importance of receptors

| Water body | Main River/ Ordinary Watercourse | WFD Body Catchment | Importance Descriptions |
|---|---|---|---|
| Ouse (Roxton to Earith) and tributaries | Main River | Ouse (Roxton to Earith) – GB105033047921 | Very High Importance for water quality on the basis of being a WFD designated waterbody that is at Moderate Ecological Potential (with an objective of Moderate by 2015). Q95 for River Great Ouse at Roxton 1.99m$^3$/s. Fish surveys indicate the presence of Bullhead and evidence of Otter, which are both protected species under Annex II of the *Habitats Directive* (Ref 13-64). The River Great Ouse is designated as a CWS. The Biggleswade and Hitchen Angling Society, as part of the Tempsford Estate Waters Fishery, have fishing rights on a section of the right bank of the River Great Ouse, approximately 800m long, east of Black Cat junction.<br><br>Finally, there are several surface water abstractions from the River Great Ouse downstream of the Scheme. These are shown on Figure 13-1 and include A17 (spray irrigation abstraction from River Great Ouse next to A1 works area, east of Roxton), A18 (spray irrigation 250m downstream of South Brook confluence with River Great Ouse), and A26 (evaporative cooling, located 2.7km downstream of works on Alington Road Bridge). Other abstractions have been scoped out based on being upstream or greater than 5km downstream on the River Great Ouse.<br><br>High Importance for navigation on the basis of being used by up to 50 vessels per day in summer.<br><br>Low Importance for morphology on the basis that it is a heavily modified waterbody that has been substantially affected by past land use, previous engineering works and impacted by navigation. |
| Rockham Ditch | Ordinary Watercourse | Not designated – tributary of River Great Ouse | Medium Importance as a tributary of the medium importance WFD designated River Great Ouse. Q95 of 0.002m$^3$/s.<br><br>Low Importance for morphology as a heavily modified ditchcourse, with incised banks, numerous structures impeding flow and deficiency of bedforms. |

| Water body | Main River/ Ordinary Watercourse | WFD Body Catchment | Importance Descriptions |
|---|---|---|---|
| Begwary Brook | Ordinary Watercourse | Begwary Brook – GB105033043230 High Importance for water quality on the basis of being a WFD designated waterbody that is at Good Ecological Potential (with an objective of Good by 2015). | High Importance as surveys have shown evidence of Otter, which is a protected species under Annex II of the *Habitats Directive* (Ref 13-64). It is a WFD designated waterbody that is at Good Ecological Potential (with an objective of Good by 2015). Q95 of 0.002 $m^3$/s.<br>Low Importance for morphology on the basis that it is a heavily modified waterbody. |
| Stone Brook Tributary | Ordinary Watercourse | Stone Brook – GB105033038190 | High Importance for water quality on the basis of being a WFD designated waterbody that is at Moderate Ecological Potential (with an objective of Moderate by 2015). Q95 of 0.001$m^3$/s.<br>Low Importance for morphology on the basis that it is a heavily modified waterbody that show numerous signs of intervention (for example straightened channels, heavily incised, ponding around structures and poor flow regime). |
| South Brook | Ordinary Watercourse | Not designated – tributary of River Great Ouse | High Importance due to evidence of otter, which is a protected species under Annex II of the *Habitats Directive* (Ref 13-64). Q95 0.014$m^3$/s.<br>Low Importance for morphology as a heavily modified watercourse, with an artificial concrete bed in places, numerous structures impeding flow and deficiency of bedforms. |
| Wintringham Brook and tributaries | Ordinary Watercourse | Not designated – tributary of Fox Brook | Medium Importance as an upstream tributary of Fox Brook. Q95 of 0.002$m^3$/s.<br>Low Importance for morphology as an ephemeral ditchcourse modified for agricultural drainage. |

| Water body | Main River/ Ordinary Watercourse | WFD Body Catchment | Importance Descriptions |
|---|---|---|---|
| Hen Brook and tributaries | Main River downstream from crossing point – ordinary watercourse at crossing location | Abbotsley and Hen Brooks – GB105033043240 | High Importance due to evidence of Otter, which is a protected species under Annex II of the *Habitats Directive* (Ref 13-64). It is a WFD designated waterbody that is at Moderate Ecological Potential (with an objective of Moderate by 2015). Q95 of 0.002m$^3$/s.<br>Low Importance for morphology on the basis that it is a heavily modified waterbody that show numerous signs of intervention (for example straightened channels, heavily incised, ponding around structures and poor flow regime). |
| Fox Brook | Main River downstream from crossing point – ordinary watercourse at crossing location | Not designated – tributary of Hen Brook | Medium Importance as a tributary of the WFD designated River Great Ouse and based on an estimation of Q95 from visual observations of the channel.<br>Low Importance for morphology as ephemeral ditchcourses modified for agricultural drainage. |
| Gallow Brook and tributaries | Ordinary Watercourse | Not designated – tributary of River Great Ouse | Medium Importance with Q95 of 0.002m$^3$/s.<br>Low Importance for morphology as an ephemeral ditchcourse modified for agricultural drainage. |
| West Brook and tributaries | Main River | West Brook – GB105033042730 | High Importance for water quality on the basis of being a WFD designated waterbody. Q95 of 0.004m$^3$/s. Fish surveys indicate the presence of European Eel, which is a protected species under *The Eels (England and Wales) Regulations 2009* (Ref 13-13).<br>Low Importance for morphology on the basis that it is a heavily modified waterbody that show numerous signs of intervention (for example straightened channels, heavily incised, ponding around structures and poor flow regime). |

| Water body | Main River/ Ordinary Watercourse | WFD Body Catchment | Importance Descriptions |
|---|---|---|---|
| Bourn Brook and tributaries | Ordinary Watercourse | Bourn Brook – GB105033042690 | High Importance for water quality as fish surveys indicate the presence of bullhead, which is a protected species under Annex II of the *Habitats Directive* (Ref 13-64). It is a WFD designated waterbody with Q95 of 0.001$m^3$/s.<br>Low Importance for morphology on the basis that it is a heavily modified waterbody that show numerous signs of intervention (for example straightened channels, heavily incised, ponding around structures and poor flow regime); |
| Pond 9 and 83 (refer to **Table 13-4**) | N/A | N/A | High Importance on the basis of supporting known populations of GCN, that are a protected species. |
| Lakes in Begwary Nature Reserve/CWS, includes Pond 3 | N/A | N/A | Medium Importance as they are part of a Local Nature Reserve and designated as a CWS, and are likely to provide a social and economic resource to the local community. Negative for eDNA so GCN unlikely to be present. |
| Ponds 21, 37, and 84 | N/A | N/A | High importance on the basis that they may support GCN (these ponds were not surveyed or were dry at the time of survey). If these do not support GCN, or any GCN were moved under Natural England license, or within the District Licensing Scheme, the future baseline importance of these ponds would be Low. |
| Non-GCN Ponds (ponds 2, 11, 19, 20, 22, 23, 38, 71, 79 and 85) | N/A | N/A | Low Importance as they do not support any known protected species, are not designated as part of any nature conservation site, and have no known or only minimal, local social and economic uses. |

| Water body | Main River/ Ordinary Watercourse | WFD Body Catchment | Importance Descriptions |
|---|---|---|---|
| Pond 88 | N/A | N/A | Medium Importance on the basis of the fishing by local angling groups (e.g. Luton Angling Club). This is contained within the catchment area of the River Great Ouse, downstream of the Scheme. These would also most likely have social and economic value to the local community. Whilst this pond was not surveyed, and the conservative approach would be that GCN may be present, as this is a fishing club lake the presence of fish species would predate on the GCN larvae, so is it considered unlikely that GCN are present. |
| Groundwater - Superficial Secondary A Aquifer in the River Terrace Deposits (RTD) and Alluvium | N/A | N/A | Medium Importance as this is a superficial Secondary A aquifer that may support water supply at a local scale - Aquifer providing water for agricultural or industrial use with limited connection to surface water. |
| Groundwater – Superficial Secondary Undifferentiated Aquifer in the Oadby Formation (Glacial Till) | N/A | N/A | Low importance as this is a secondary undifferentiated aquifer that is unproductive and is unable to sustain abstraction. |
| Groundwater - Bedrock | N/A | N/A | Low importance as the Oxford Clay is not water bearing (Unproductive strata). |

*Flood Risk and floodplain importance*

13.6.122 For the construction assessment there can be a flood risk (i.e. fluvial / groundwater) to the construction site and compounds including where workers would be present as well as potentially polluting materials that could be washed away during a flood event. As a result, the vulnerability and therefore importance of this temporary land use is considered to be Very High.

13.6.123 For the operation assessment, the importance is based on an understanding of the receptors present within areas at risk of flooding and the existing risk of flooding from all sources.

13.6.124 The floodplain adjacent to the River Great Ouse within the study area includes areas of Flood Zone 2 and 3, and these overlap with, and are adjacent to, residential and commercial properties. Residential properties are classified as 'More vulnerable development' and thus the importance of the floodplain adjacent to the River Great Ouse for impact assessment purposes is considered High.

13.6.125 Similarly, the floodplains of Stone Brook, South Brook, Begwary Brook, Hen Brook, West Brook, Fox Brook and Gallow Brook also feature areas of Flood Zone 2 and 3 which overlap with, or are adjacent to, some residential properties (especially downstream along Hen Brook and Fox Brook in St Neots) that are classified as 'More vulnerable development'. As such, the importance of these floodplains is considered High.

13.6.126 Rockham Ditch and the various agricultural ditches are not associated with Flood Zone 2 or 3 and do not affect residential property. As there is no existing development, or only water compatible development is present, they are considered to be floodplains of Low Importance.

## 13.7 Potential impacts

13.7.1 The scoping exercise identified that the introduction and/or modification of road infrastructure associated with the Scheme would potentially result in different types and durations of impact on water resources, during both the construction and operational phases.

**Construction**

13.7.2 Temporary construction impacts on the water environment that would last for all, or part of, the construction phase is likely to include the following:

a. Reduction in water quality, both surface and groundwater, due to deposition or spillage of soils, sediments, oils, fuels, or other construction chemicals, or through mobilisation of contamination following disturbance of contaminated ground or groundwater, or through uncontrolled site runoff.

b. Alteration in fluvial, overland and groundwater flow paths, and potential increase in flood risk, as a result of localised dewatering and temporary storage of construction materials in the floodplain.

c. Increased risk of blockage of drains as a result of increased material (sands, gravels etc.) transported in runoff from the Scheme into watercourses, land drains and sewers.

d. Increased discharge to local watercourses leading to an increase in flood risk due to a temporary increase in impermeable area and removal of vegetation during construction.

e. Construction works above the River Great Ouse can lead to temporary disruption of navigation rights.

13.7.3 Construction activities such as earthworks, excavations, site preparation, levelling and grading operations result in the disturbance of soils. Exposed soil is more vulnerable to erosion during rainfall events due to loosening and removal of vegetation to bind it, compaction and increased runoff rates.

13.7.4 Surface runoff from such areas can contain excessive quantities of fine sediment, which may eventually be transported to watercourses where it can result in adverse impacts on various water attributes including water quality, flora and fauna.

13.7.5 Construction works within, along the banks and across watercourses and ponds can also be a direct source of fine sediment mobilisation.

13.7.6 Contamination of surface waters and groundwater could result from leakage and spills of fuels, oils, chemicals and concrete during construction affecting watercourses indirectly via site runoff or directly where works are close to and within a water body. Contamination may reduce water quality and impact aquatic fauna and flora.

13.7.7 Any construction works on the floodplain or drainage to watercourses or to ground have the potential to increase the rate and volume of runoff and increase the risk of blockages in watercourses that could lead to flow being impeded, and a potential rise in flood risk. Changes to ground levels and vegetation clearance works may also increase the risk of surface water flooding or via temporary drainage discharges. Finally, excavations can potentially damage existing sewers leading to flooding.

13.7.8 During construction, temporary dewatering or abstraction of groundwater or creation of flow barriers, leading to reduced groundwater level and flow alteration may be required to maintain dry working ground condition, particularly in areas of deep excavation such as cuttings and borrow pit excavations. This may also result in potential groundwater flood risks.

13.7.9 Impacts on groundwater quality from construction activities are similar to those identified above for surface water.

**Operation**

13.7.10 Operational and permanent construction impacts of the Scheme on the water environment are likely to include the following without appropriate mitigation:

a. Impacts on the surface water and groundwater quality from routine highway runoff (including the use of de-icant) or as a result of accidental spillages.

b. Changes in the natural form of the landscape, which may have a subsequent effect on surface water and groundwater drainage patterns, including adverse impacts on local nature conservation sites.

c. Increased risk of fluvial flooding to the Scheme and surrounding area due to loss of floodplain storage.

d. Increase in flood risk (fluvial, surface water, sewer and drainage infrastructure) due to an increase in surface water runoff from the Scheme, and increased risk of fluvial flooding over the lifetime of the Scheme from climate change effects (increased peak river flows).

e. Modification to groundwater flow as a result of permanent dewatering or groundwater drainage.

f. Loss of or changes to the morphology of water bodies that could have both temporary and long-term impacts on the hydromorphological character and conditions of the water bodies (i.e. hydraulic processes and sediment dynamics) and their floodplains. This includes those watercourses which would be traversed by the Scheme.

## 13.8 Design, mitigation and enhancement measures

**Embedded mitigation**

13.8.1 Through the design development process, the Scheme has been designed, as far as practicable, to avoid effects on the water environment drainage design as described in **Chapter 3, Assessment of alternatives** of the Environmental Statement **[TR010044/APP/6.1]**.

*Drainage design and treatment trains*

13.8.2 The Drainage Strategy Report presented in **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]** sets out the treatment train specifications for each strategic road drainage network (i.e. the A428) plus those local roads where traffic flows were more significant and a quantitative assessment was required (see **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]** for details) are summarised in **Table 13-7**. Road drainage outfalls are also presented on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**.The Highway catchment names from **Table 13-7** are shown on drawings within the Drainage Engineering Plans **[TR010044/APP/2.10]**.

13.8.3 The strategic road network along the new dual carriageway would consist of 21 separate road catchments. There are also a further 22 outfalls serving local roads that do not form part of the strategic road network (and are the responsibility of the local highway authorities) which may be affected by the Scheme. Of these, four have been identified as potentially significant, based on contributing area and predicted traffic flows, in this water quality risk assessment and have been quantitatively assessed along with the 21 A428 drainage networks (with remaining outfalls assessed qualitatively, as agreed with the EA) (refer to **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]** for further details). The approximate location of these outfalls is shown on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]** and the water quality risk assessment is reported in **Appendix 13.2** of the Environmental Statement **[TR010044/APP.6.3]**.

13.8.4 Table 3 of **Appendix 13.2** of the Environmental Statement **[TR010044/APP.6.3]** describes the proposed highway runoff treatment train for each road catchment. With the exception of the Roxton Road link (north), Link North Catchment 2, all the local road catchments have ditches within the treatment train. A drainage ditch should provide approximately 25% removal of suspended solids and 15% treatment of dissolved metals. Some catchments also include a pond for flow attenuation (such as Roxton Road link (north) and Eltisley Junction South). A wet pond may provide approximately 60% reduction in suspended solids, and 40% removal of dissolved copper (Ref 13-45). No treatment measures are proposed for Roxton Road Link North catchment 2. However, the road drainage catchment is only 0.1 ha in impermeable area, and the flow rate would be further restricted when compared to existing which would reduce the rate at which routine road runoff can enter Begwary Brook and thus increase the effect of dilution.

13.8.5 The overall drainage strategy for the Scheme is to attenuate and treat highway runoff using wet ponds, filter drains, swales, new highway ditches and hydrodynamic vortex flow separators (VFS) depending on the need to attenuate flows and the water quality risk assessment presented in **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]**. Sustainable drainage features have been designed to mimic natural drainage as far as practicable, and to provide a number of other benefits to ecological habitat creation (refer to **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**).

13.8.6 The water quality risk assessment presented in **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]** includes an assessment of spillage risk. This assessment has concluded that the risk of a serious chemical spillage from all road catchments is low and within the standards set out in the *LA 113* (Ref 13-43). Should a spillage occur this would be contained where possible on the highway by sealing nearby drains, or otherwise within the highway drainage system, where it could be pumped out, rather than contaminating any treatment ponds that are included. Penstocks have not been proposed on outfalls in the current design. However, space for penstocks is available at the majority of mainline road catchments in case future re-assessments say they are needed. Attenuation has been incorporated to control the rate of surface water flow towards the receiving watercourses resulting from increased impermeable road areas for events up to 1 in 100 years including 40% climate change allowance. The sizing of attenuation is to be designed with a discharge of routine runoff from additional impermeable areas at annual flood flow, also known as QBAR, restriction to mimic the existing flow and volume conditions as requested by the EA and LLFAs. Without attenuation increased flows may result in bank erosion, increased sediment loading, greater flooding and increased pollution to the impacted watercourses. The specific treatment train for each road catchment has been designed to reflect the need for flow attenuation and the pollution risk, as well as to reflect stakeholder concerns.

13.8.7 The existing outfalls at Black Cat junction and Caxton Gibbet junction are unlikely to be affected by the Scheme; however, the existing highway drainage ponds at Black Cat roundabout would be decommissioned and infilled by the Scheme as the footprint of the enlarged junction is constructed in their location. Highway drainage from the new road layout has considered the water quality risks from discharges of highway runoff and spillages and includes appropriate treatment measures.

13.8.8 The drainage strategy in **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]** has been designed in accordance with *CG 501* (Ref 13-45), ensuring no surcharge for a 1 in 1 year return period and no flooding in a 1 in 5 year return period. The network has been designed including a 40% increase in rainfall intensity to consider the effects of climate change, as requested by the LLFAs.

## Table 13-7: Treatment train contained within drainage strategy

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| 1 | New Ditch BC-D1 | Ditch BC-D1 Outfall | Rockham Ditch, tributary of the River Great Ouse | The surface water runoff from the proposed collector system is conveyed via carrier pipes located in the A421 eastbound verge to a new grassed channel BC-D1 prior to discharging to Rockham Ditch. | ● | | | | |
| 2 | Existing A421 Pond | Existing A421 Pond Outfall | Rockham Ditch, tributary of the River Great Ouse | The existing drainage system connects to proposed carrier pipes in the westbound verge, which would convey the flow to the existing A421 Pond prior to discharging to Rockham Ditch. In addition to a reduction in impermeable area , a VFS is to be added upstream of the pond and the existing wet treatment zone to be cleared and made functional. | | ● | | ● | |

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| 3 | Pond BC1 | Pond BC1 Outfall | Rockham Ditch, tributary of the River Great Ouse | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Pond BC1 and then into the new ditch BC-D5 (a grassed channel/swale) prior to discharging to Rockham Ditch. A penstock chamber and a vortex grit separator are to be added upstream of the pond with a wet treatment zone at the pond inlet, and outfall via a ditch. | | ● | | ● | ● |
| 4 | Pond BC2 | Pond BC2 Outfall | South Brook, tributary of the River Great Ouse; | The surface water runoff from the proposed collector system is conveyed via carrier system, which connects to the pump station. The pump station pumps the surface water runoff into Pond BC2 and then into a carrier pipe system prior to discharging to South Brook. A penstock chamber and a VFS are to be added upstream of a dry pond. | | | ● | ● | ● |

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| 5 | Pond BC3 | Pond BC3 Outfall | An existing ditch, which drains into the River Great Ouse (RGO1) | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Pond BC3 and then into a new ditch (a grassed channel/swale) which ties into an existing ditch before discharging to the River Great Ouse. A penstock chamber is to be added upstream of the pond with a wet treatment zone at the pond inlet, and outfalling via a ditch. | ● | ● | | | ● |
| 6 | A1 South Brook | A1 South Brook Outfall | South Brook, tributary of the River Great Ouse | The surface water runoff from the proposed collector system is conveyed via carrier pipes to a new wide ditch before discharging to South Brook. | ● | | | | |
| 7 | A1 Begwary Brook West | A1 Begwary Brook West Outfall | Begwary Brook; tributary of the River Great Ouse | The surface water runoff is collected in gullies and then conveyed via carrier pipes before discharging to Begwary Brook. | | | | | |
| 8 | A1 Begwary Brook East | A1 Begwary Brook East Outfall | Begwary Brook; tributary of the River Great Ouse | The surface water runoff is collected in gullies and then conveyed via carrier pipes before discharging to Begwary Brook. | | | | | |

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| 9 | A1 South Rockham Ditch | A1 South Rockham Ditch Outfall | Rockham Ditch, tributary of the River Great Ouse | The surface water runoff is collected in gullies and then conveyed via carrier pipes to a proposed ditch before discharging to Rockham Ditch. | ● | | | | |
| 10 | Rectory Farm Pond | Rectory Farm Outfall | Stone Brook tributary; tributary of the River Great Ouse (StB3) | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Rectory Farm Pond prior to discharging to realigned Stone Brook tributary. A penstock chamber and a VFS are to be added upstream of the pond with a wet treatment zone at the pond inlet, and a grassed channel. | ● | ● | | ● | ● |
| 11 | Railway Pond | Railway Pond Outfall | An existing watercourse, flows south into Stone Brook (StB6) | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Railway Pond and then into the new ditch system prior to discharging to an existing watercourse. A penstock chamber is to be added upstream of the wet treatment zone and dry pond, outfalling via a ditch. | ● | ● | | | ● |

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| 12 | Hen Brook South Pond | Hen Brook South Outfall | Hen Brook, a tributary of the River Great Ouse that flows through the town of St Neots | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Hen Brook South Pond and then into proposed ditches prior to discharging to Hen Brook. A penstock chamber is to be added upstream of the dry pond, outfalling via a ditch. | ● | | ● | | ● |
| 13 | Hen Brook North Pond | Hen Brook North Outfall | Hen Brook North – as above | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Hen Brook North Pond and then into new ditches prior to discharging to Hen Brook. A penstock chamber is to be added upstream of the pond. | ● | | ● | | ● |
| 14 | Wintringham Brook Pond | Wintringham Brook Outfall | Wintringham Brook – a tributary of Hen Brook | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Wintringham Brook Pond and then into new ditches prior to discharging to Wintringham Brook. A penstock chamber is to be added upstream of the pond. | ● | | ● | | ● |
| 14A | Cambridge Road junction North | Wintringham Brook Tributary | Wintringham Brook Tributary | The surface water runoff from the northern side of the realigned de-trunked A428 and the junction is collected in gullies carrier pipes to an existing highway ditch located along the north of the realigned de-trunked A428. | ● | | | | |
| 15 | Wintringham Brook | Wintringham Brook | Wintringham Brook Tributary | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Wintringham Brook Tributary | ● | ● | | ● | ● |

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| | Tributary West Pond | Tributary West Outfall | | West Pond and then into a proposed ditch prior to discharging to realigned Wintringham Brook tributary. A penstock chamber and a VFS are to be added upstream of the pond with a wet treatment zone at the pond inlet, and ditch outlet. | | | | | |
| 16 | Wintringham Brook Tributary East Pond | Wintringham Brook Tributary East Outfall | Wintringham Brook Tributary | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Wintringham Brook Tributary East Pond prior to a new ditch system which would finally outfall into realigned Wintringham Brook tributary. A penstock chamber and a VFS are to be added upstream of the pond with a wet treatment zone at the pond inlet, and ditch outlet. | ● | ● | | ● | ● |
| 17 | Gallow Brook Pond | Gallow Brook Outfall | Gallow Brook | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Gallow Brook Pond and then into a new ditch (a grass channel or a swale) prior to discharging to Gallow Brook. A penstock chamber and a VFS are to be added upstream of the pond with a wet treatment zone at the pond inlet, and outfall via a ditch. | ● | ● | | ● | ● |

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| 18 | West Brook Tributary Pond | West Brook Tributary Outfall | West Brook Tributary (WstB2) | The surface water runoff from the proposed collector system is conveyed via carrier pipes to West Brook Tributary Pond and then into a new ditch (a grass channel or a swale) prior to discharging to West Brook Tributary. A penstock chamber is to be added upstream of the pond with a wet treatment zone at the pond inlet, and outfall via a ditch. | ● | ● | | | ● |
| 19 | Northeast Pond | North East Farm Pond Outfall | Nill Well Brook | The surface water runoff from the proposed collector system is conveyed via carrier pipes to a system of two ponds (Northeast Farm East Pond and Northeast Farm West pond). The surface water runoff from the Northeast Farm West pond outfalls into new ditches prior to discharging to Nill Well Brook. A penstock chamber is to be added upstream of the first pond. The first pond outfalls to a linked second pond via hydrobrakes and they act as two ponds in series. | ● | | ● | | ● |
| 20 | Caxton Gibbet Existing Pond | Caxton Gibbet Existing Outfall | An existing watercourse draining northwards alongside the A1198 (Ermine St South) (WstB5) | The surface water runoff from the proposed collector system is conveyed via carrier pipes to Caxton Gibbet Existing Pond prior to discharging to a realigned existing watercourse. | | ● | | | ● |

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| 21 | Caxton Gibbet Southern roundabout | Caxton Gibbet Southern Outfall | An existing watercourse draining northwards alongside the A1198 (Ermine St South) (WstB5) | The surface water runoff from the proposed collector system is conveyed via carrier pipes to a new ditch system and then through a proposed culvert underneath the link road before discharging to the realigned watercourse. | ● | | | | |
| 22 | Caxton Gibbet North Pond | Caxton Gibbet North Pond | An existing watercourse draining northwards alongside the A1198 (Ermine St South) (WstB5) | The surface water runoff from the proposed collector system is conveyed via carrier pipes to two separate new ditch systems to Caxton Gibbet North Pond prior to discharging to a realigned existing watercourse. | ● | ● | | | ● |
| 23 | Caxton Gibbet north roundabout + realigned de-trunked A428 catchment | Caxton Gibbet north roundabout + realigned de-trunked A428 catchment | Existing watercourse, Tributary to West Brook (WstB5) | The surface water runoff is collected via combined kerb drainage units conveyed to new ditches along the northern boundary of the embankment. These flow north to discharge into an existing watercourse. | ● | | | | ● |

| Network number | Highway catchment name | Outfall name | Receiving watercourse | Treatment train | Grass channel/Swale | Dry pond + wet treatment zone | Dry Pond | VFS | Space for Penstock included |
|---|---|---|---|---|---|---|---|---|---|
| 24 | Realigned A1198 south catchment | Tributary to Bourn Brook | Tributary to Bourn Brook | The surface water runoff from this catchment is conveyed via carrier pipes into an existing ditch, which is located along the western boundary of the A1198. This existing ditch ultimately outfalls to an existing watercourse to the west. This existing watercourse outfalls to Bourn Brook (Eastern Brook headwaters) | ● | | | | |

13.8.9 The number of new surface water outfalls has been minimised where possible and the drainage strategy makes use of existing outfalls from the Black Cat junction and Caxton Gibbet junction, in order to prevent construction of unnecessary structures.

13.8.10 Pre-earthworks drainage would be installed to convey land runoff/ intercepted existing land drainage. This would take the form of filter drains or ditches at the top of cuttings and the toe of embankments, and would capture surface flows from natural catchments. This runoff would be unlikely to have a high pollutant load when compared to road runoff and does not require further treatment.

13.8.11 Land drainage ditches would connect to existing watercourses, with the 'natural' connection taking into account the morphology of the existing watercourse. This would require further geomorphological and ecological survey and assessment at a later design stage, which is secured through the First Iteration EMP **[TR010044/APP/6.8]**. During detailed design each land drainage ditch would be designed to avoid being overly uniform and to incorporate suitable features and planting to maximise biodiversity benefits. In particular, in locations where the land drainage ditches are to be over-wide for runoff storage, there may be opportunities to create pocket wetlands or other similar habitat types.

*Engineered and ditchcourse outfalls*

13.8.12 There would be 39 new engineered outfalls for highway runoff from the Scheme and local roads affected by the Scheme. It is not possible to combine runoff from the strategic road network and local roads as the authority responsible for the quality of the discharge and the management and maintenance of the outfalls is different (i.e. either Highways England or local highway authorities).

13.8.13 The final location, position and orientation of any new outfall would be carefully determined and informed by a hydromorphological survey to minimise any adverse but local impact on river processes. It has been assumed that any outfall (and ditchcourse where they apply) may be located within 20 metres upstream or downstream of the positions shown on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]** and the Drainage Strategy (refer to **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**) to allow flexibility in their position, although it is most likely that they would be positioned closer to current proposals. Appropriate micro-siting of the outfall can also minimise loss of bank habitat, the need for bed scour or hard bank protection, and localised flow disturbance or disruption to sediment transport processes. It can also avoid the creation of 'dead' spaces with sedimentation and vegetation blockage risks and to that effect it is not proposed that outfalls are recessed into the bank.

13.8.14 All highway outfalls would be less than or equal to 300mm in diameter with headwalls of a proportional size and as required for the specific setting each outfall would be in. Pre-fabricated concrete headwalls would be used where possible to avoid the need to pour wet concrete into formwork close to a watercourse to minimise the risk of a spillage and pollution occurring has been considered as a possibility in the construction phase impact assessment.

13.8.15 There are three areas where overland flow is directed into the surface water system, within the same catchment area, from catchments interrupted by the Scheme. This includes east of Cambridge Road junction where flows would be directed to Fox Brook, a section of embankment from Toseland Road north directed to Gallow Brook, and an area to the west of Roxton Link Road directed to Begwary Brook.

13.8.16 For new highway outfalls, the drainage design has sought to minimise the number of new engineered outfalls by providing new ditchcourses where possible to convey treated runoff to the receiving watercourses avoiding the need for pipe outfalls supported by concrete headwalls. There are five locations on drainage networks 3 (to Rockham Ditch), 5 (to a ditch to the River Great Ouse), 6 (to South Brook), 11 (to a tributary of South Brook), and 17 (to Gallow Brook).

13.8.17 Where proposed, it is generally not intended that these ditchcourses would be required to provide treatment of highway runoff, but the HEWRAT assessment (refer to **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3])** is not undertaken until the point of discharge. The flow through these new ditchcourses would be strongly influenced by treated highway runoff, but they would nonetheless provide some biodiversity enhancement, linking new SuDS to the local waterways, and ultimate help to avoid unnecessary engineered outfalls.

13.8.18 The design of new ditches would be informed by a geomorphologist and would include where practicable 'natural' features such as a sinuous low flow channel (albeit along a straight corridor) incorporating shallow berms and occasional sections where the channel is narrowed to improve flow (or other similar and appropriate channel features). The hydromorphology of the receiving watercourse would also be taken into account during the detailed design, but given the ditchcourse is a more natural feature, no significant issues are anticipated. Finally, these ditches would be planted with suitable species for appropriate habitat creation.

*Floodplain compensation*

13.8.19 The following floodplain compensation areas illustrated on the Environmental Masterplan on **Figure 2.4** of the Environmental Statement **[TR010044/APP/6.2]** would be constructed:

a. River Great Ouse: Two floodplain compensation areas to be constructed using topographic amendments to the current floodplain area as a result of the proposed embankment to mitigate volume loss. These are located to the south-east of Black Cat junction and the west of the River Great Ouse.

b. Rockham Ditch: Two floodplain compensation areas adjacent to Rockham Ditch upstream of the A1 crossing.

c. Begwary Brook: Two floodplain compensation areas.

d. South Brook: Two online floodplain compensation areas were represented using topographic amendments to the DTM, to compensate for the floodplain storage volume lost as a result of the proposed embankment. These are located west of the A1 prior to the culverted South Brook and are to the east and west of the Roxton Road link.

e. Rectory Farm: One floodplain compensation area to be constructed using topographic amendments to compensate for the floodplain storage volume lost as a result of the Scheme. This floodplain compensation area would have a triangular type form mainly to the north of the Scheme.

f. Hen Brook: An online floodplain compensation area to be constructed using topographic amendments to compensate for the floodplain storage volume lost as a result of proposed embankments.

g. Top Farm Watercourse: A rectangular shaped floodplain compensation area to the east of the Scheme.

13.8.20 Six high flow culverts each 3 metres by 1.5 metres (approximately 75 metres in length) are included through the embankment of the new dual carriageway to provide additional conveyance in the area of the Hen Brook crossing.

*Watercourse crossings, realignments and diversions*

River Great Ouse Viaduct (S9)

13.8.21 The River Great Ouse and its floodplain would be crossed by a new viaduct, located east of Black Cat junction. The structure would be a six-span twin ladder girder, steel-concrete composite viaduct comprising of two decks each carrying the new eastbound and westbound carriageways. Each deck would be supported by in-situ reinforced concrete abutments and intermediate piers comprising four circular reinforced concrete columns with monopile foundations pre-cast concrete deck slabs installed as a number of discrete panels. The piers and adjoining embankments have been designed and located to avoid the river channel (minimum offset of 2 metres) and provide minimal obstruction of floodplain flows during both construction and operation. Construction would require a temporary crane platform on the floodplain.

13.8.22 From west to east, the first viaduct spans would be approximately 35 metres wide, followed by four spans that are 42.3 metres wide, and then a final span of 55.6 metres wide. In total, the viaduct would be 260 metres long. The River Great Ouse would flow beneath easternmost and widest span. The soffit for the viaduct where it spans the River Great Ouse has been determined by ensuring sufficient clearance for navigation (i.e. a minimum headroom clearance of 3.0 metres for navigation above the normal retention level (stated as 15.05 metres AOD at this location) across the navigable width of the river (taken to be wherever there is at least a 0.5 metres draft for boats) and flood risk (a minimum clearance of 0.6 metres freeboard above the 1:100 year flood event level with 35% allowance for climate change). Flood levels have been calculated based on hydraulic modelling undertaken for the Scheme (refer to the FRA in **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**) and gave a minimum soffit level of approximately 17.9 metres AOD, thus the higher, normal flow navigation headroom level (which is 18.05 metres AOD) dictates the minimum soffit level for the viaduct river span.

13.8.23 The minimum set back of the piers is 2 metres from the bank edge, this would allow safe access for construction and to minimise the span length required to cross the River Great Ouse.

13.8.24 A temporary platform would encroach on the northern part of Pond 11 as part of the construction of the River Great Ouse viaduct. Prior to construction of this platform being constructed in this area, the owners of Black Cat Quarry would be consulted on the reinstatement that would take place in this area.

Culverts

13.8.25 In addition to the viaduct and bridge proposed across the River Great Ouse, there would be a further 55 structures (culverts) across watercourses. Of these, five structures are existing, of which only two would be extended (E72-RD and E74-SB).

13.8.26 Overall, the vast majority of the watercourses crossed by the Scheme and which would be culverted are minor in their nature. **Table 13-8** provides a summary of these culverts, including details of the watercourses crossed, whether the culvert is existing (i.e. structures with a number beginning 'E') or newly proposed (i.e. structures with a number beginning 'S'), is a box or pipe culvert, and the proposed minimum dimensions of the culvert. A national grid reference is provided for the location of these culverts, which are also shown on **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**.

**Table 13-8: Proposed culverts**

| WFD water body | Structure number | Structure name | Approx. length (m) | Width (m)/ Height (m) | Location |
|---|---|---|---|---|---|
| Begwary Brook | E15 | Begwary Brook A1 Culvert | 38.00 (same as current) | 1.5 dia. pipe | TL163564 |
| Begwary Brook | S16 | Begwary Brook/ Roxton Road Link Culvert | 25.30 | 2.1/2.1 | TL162565 |
| Abbotsley and Hen Brooks | S53 | Cambridge Road Accommodation Track Culvert | 45.00 | 2.7/3.0 | TL226601 |
| Abbotsley and Hen Brook | S64 | Cambridge Road Bridleway North Culvert | 8.70 | 2.1/1.8 | TL228602 |
| Abbotsley and Hen Brooks | S86 | Fox Brook Track South Culvert | 4.00 | 2.4/2.7 | TL228601 |
| Abbotsley and Hen Brooks | S87 | Fox Brook Track North Culvert | 3.00 | 1.8/1.5 | TL228602 |
| Abbotsley and Hen brooks | S19 | New Hen Brook Culvert and Underpass | 33.20 | 6.85/5.9 (incl. footpath) | TL202584 |
| Abbotsley and Hen brooks | S20 | Hen Brook Pond Access Track Culvert | 8.00 | 5.0/3.15 | TL202583 |

| WFD water body | Structure number | Structure name | Approx. length (m) | Width (m)/ Height (m) | Location |
|---|---|---|---|---|---|
| Abbotsley and Hen brooks | S23 | Hen Brook South Field Access Culvert | 4.50 | 1.5/1.5 | TL201582 |
| Abbotsley and Hen brooks | S26 | Hen Brook North Field Access Culvert | 5.20 | 1.5/1.5 | TL202584 |
| Abbotsley and Hen Brooks | S41 | B1046 West Culvert | 14.00 | 1.2/1.0 | TL201578 |
| Abbotsley and Hen Brooks | S42 | B1046 West Emergency Access Culvert | 13.90 | 1.2/1.0 | TL196579 |
| Abbotsley and Hen brooks | S21 | Wintringham Brook Culvert | 39.50 | 2.4/2.65 | TL205590 |
| Abbotsley and Hen brooks | S22 | Wintringham Brook Pond Access Track Culvert | 6.50 | 2.1/2.4 | TL205590 |
| Abbotsley and Hen brooks | S24 | New Cambridge Road Culvert | 37.30 | 2.6/1.8 (incl. mammal ledge) | TL210597 |
| Abbotsley and Hen brooks | S29 | Fox Brook Culvert | 40.10 | 2.5/2.7 | TL210597 |
| Abbotsley and Hen Brooks | S55 | Cambridge Road East Culvert | 30.00 | 2.1/1.8 | TL217599 |
| Ouse (Roxton to Erith) | S30 | Gallow Brook Culvert | 42.80 | 3.5/2.1 (incl. mammal ledge) | TL238605 |
| Ouse (Roxton to Erith) | S56 | Toseland Road North Culvert | 11.70 | 1.8/1.8 | TL245607 |
| Ouse (Roxton to Erith) | S85 | Industrial Unit Access Culvert | 8.20 | 1.2/ 1.2 | TL244603 |
| Ouse (Roxton to Erith) | S43 | Top Farm Culvert | 90.80 | 2.3/ 1.65 (incl. mammal ledge) | TL195572 |
| Ouse (Roxton to Erith) | E72 | Black Cat Culvert – Proposed | 72.10 (current 38.5) | 1.5/1.8 | TL159549 |
| Ouse (Roxton to Erith) | E76 | Culvert 8 | 113.30 (same as current) | 1.25/1.5 | TL153552 |
| Ouse (Roxton to Erith) | E77 | Roxton Culvert | 20.70 (current 25) | 1.2/1.5 | TL154551 |

| WFD water body | Structure number | Structure name | Approx. length (m) | Width (m)/ Height (m) | Location |
|---|---|---|---|---|---|
| Ouse (Roxton to Erith) | S73 | Kelpie Marina Access Road West Culvert | 13.60 | 1.8/1.5 | TL160547 |
| Ouse (Roxton to Erith) | S75 | Roxton Road Culvert | 14.50 | 1.2/1.5 | TL155551 |
| Ouse (Roxton to Erith) | S79 | Black Cat Ditch North Culvert | 29.00 | 1.2 dia. pipe | TL153553 |
| Ouse (Roxton to Erith) | S80 | Black Cat Ditch South Culvert | 17.00 | 1.2 dia. pipe | TL152552 |
| Ouse (Roxton to Erith) | S89 | Kelpie Marina Access Road Culvert | 15.30 | 1.5/ 1.8 | TL155551 |
| Ouse (Roxton to Erith) | E74 | Brookhouse Chawston | 60.80 (current 28.4) | 3.6/3.0 (incl. mammal ledge) | TL161558 |
| Ouse (Roxton to Erith) | S4 | South Brook/Roxton Road Link Culvert | 17.00 | 4.5/2.7 (incl. mammal ledge) | TL161558 |
| Ouse (Roxton to Erith) | S90 | Roxton Link West Culvert | 5.40 | 1.8/1.5 | TL156555 |
| Ouse (Roxton to Erith) | S91 | Roxton Link East Culvert | 15.40 | 1.8/1.5 | TL159556 |
| Stone Brook | S49 | Top Farm track Culvert | 53.00 | 1.2/1.5 | TL193563 |
| Stone Brook | S11 | Rectory Farm Access Culvert | 5.50 | 2.4/2.0 | TL173554 |
| Stone Brook | S12 | Rectory Farm Culvert | 32.00 | 2.4/1.8 | TL174554 |
| Stone Brook | S44 | Station Farm West Culvert | 58.50 | 1.5/1.5 | TL183554 |
| Stone Brook | S46 | Station Farm East Culvert | 53.90 | 2.1/1.65 | TL186555 |
| Stone Brook | S48 | Railway Access Track Culvert | 14.00 | 2.1/1.65 | TL188554 |
| Stone Brook | S82 | Barford Road South Culvert 1 | 29.60 | 1.8/1.8 | TL168550 |
| Stone Brook | S83 | Barford Road South Culvert 2 | 14.50 | 1.2/1.2 | TL168549 |
| Stone Brook | S84 | Field Access Culvert | 6.80 | 1.2/1.2 | TL168549 |
| West Brook | S35 | Fairview Farm Culvert | 43.20 | 2.1/2.1 | TL264604 |

| WFD water body | Structure number | Structure name | Approx. length (m) | Width (m)/ Height (m) | Location |
|---|---|---|---|---|---|
| West Brook | S36 | North East Farm Track Culvert | 13.40 | 1.8/1.5 | TL288605 |
| West Brook | S37 | Pillar Plantation Culvert and Underpass | 39.50 | 5.6/4.7 | TL267603 |
| West Brook | S39 | North East Farm Culvert | 31.20 | 2.1/1.8 | TL281604 |
| West Brook | S59 | Caxton E/B Off-Slip Culvert | 15.40 | 1.2 dia. | TL295608 |
| West Brook | S63 | Caxton Link Culvert | 19.00 | 1.2 dia. | TL295608 |
| West Brook | S65 | Caxton Track East Culvert | 26.00 | 1.2/0.8 | TL297609 |
| West Brook | S66 | Caxton E/B On-Slip Culvert | 14.50 | 2.0/1.8 (incl. mammal ledge) | TL296609 |
| West Brook | S67 | Eltisley Road Culvert | 16.50 | 2.7/1.5 | TL278604 |
| West Brook | S68 | Caxton Track North Culvert | 14.50 | 2.6/1.5 (incl. mammal ledge) | TL295607 |
| West Brook | S69 | Caxton W/B Off-Slip Culvert | 15.00 | 2.3/2.1 (incl. mammal ledge) | TL297606 |
| West Brook | S70 | Caxton Underbridge Culvert | 78.00 | 2.3/2.1 (incl. mammal ledge) | TL296607 |
| West Brook | S71 | Caxton West Culvert | 63.20 | 1.5 dia. pipe | TL290604 |

13.8.27 Other than structures S9 (River Great Ouse), S19 (Hen Brook), and S37 (WstB2), for which a preliminary design has been undertaken, no design for the majority of culverts has yet been undertaken. The detailed design of all structures would be undertaken post-DCO consent during the detailed design stage. The minimum dimensions of these culverts, which are shown in **Table 13-9** have been sized to be adequate for flood risk management and are in keeping with the size of the channels being crossed. They would all be provided with sunken inverts (minimum 150mm depth, but where possible options to make this 300mm would be considered at the detailed design stage) in order that a natural bed can be provided that minimises interruption to hydromorphological processes. However, the construction of culverts would result in the loss of riparian habitat and mitigation for this is discussed in the next section.

13.8.28 The First Iteration EMP **[TR010044/APP/6.8]** includes a commitment to ensure that the culverts used would be sized to be as a minimum, those specified within the FRA (see **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**) and associated hydraulic modelling. These minimum sizes are reported in **Table 13-8**.

13.8.29 The First Iteration EMP **[TR010044/APP/6.8]** also includes a commitment that the design of new culverts would be informed by a geomorphologist to ensure that flow is adequately conveyed without interruption of any sediment transport processes or the risk of formation of channel interruption due to excessive erosion or deposition, and that opportunities to enhance channel form and biodiversity are maximised.

Watercourse diversions and realignments

13.8.30 Associated with some of the above structures is the need to divert some sections of watercourses to maintain a more perpendicular crossing and the shortest possible crossing through the new dual carriageway. These are summarised in **Table 13-9** showing the change in channel between the existing to the proposed, also taking into account the partial loss of channel from the new structure.

13.8.31 Where the channel is realigned it may be that there remains a length of the old channel but which has now been cut off from the upper catchment. Overtime, these features would likely convert from open (in some cases already ephemeral/intermittently flowing small channels) to a non-flowing ditch. Although no longer carrying a flow, they would nonetheless provide local biodiversity diversity. These residual lengths of old channel have not been included in the retained length of channel reported in **Table 13-9**.

## Table 13-9: Proposed watercourse diversions

| WFD water body | Water body (see Figure 13.1) | Relevant structure | Approx. existing channel length (m) | | | | Change existing to proposed *^ |
|---|---|---|---|---|---|---|---|
| | | | Through Scheme* | Lost to Scheme* | Cut off from flow only* | New channel length minus new structure(s) length | |
| Ouse (Roxton to Earith) | Trib of Ouse - Top Farm Brook (RG02) | S49 | 439 | 221 | 218 | 394 | -45 |
| | Gallow Brook Trib (GB3) | S56 | 141 | 141 | 596 | 648 | +507 |
| | Gallow Brook | S30 | 151 | 151 | 0 | 125.2 | -25.8 |
| Abbotsley and Hen Brooks | Hen Brook | S19, S20 | 157 | 157 | 0 | 121.8 | -35.2 |
| | Wintringham Brook (WB1) | N/A | 74 | 74 | 54 | 1125 | +1051 |
| | Wintringham Brook Tributary | S24 | 205 | 205 | 0 | 207.7 | +2.7 |
| | Fox Brook | S29 | 209 | 209 | 0 | 208.9 | +0.1 |
| Stone Brook | Rectory Farm Tributary of Stone Brook (StB2) | S11, S12 | 248 | 130 | 118 | 619.5 | +371.5 |
| West Brook | West Brook Tributary WstB2) | S37 | 156 | 156 | 0 | 132.5 | -23.5 |
| | West Brook Tributary (Nill Well Brook) | S39, S67 | 288 | 288 | 0 | 694.3 | +406.3 |
| | West Brook Tributary (WstB5) | S59, S63 | 509 | 509 | 0 | 335.6 | -173.4 |
| | West Brook Tributary (WstB5) | S66, S68, S69, S70 | 367 | 367 | 0 | 292 | -75 |

* Measurement of through the Scheme, lost to the Scheme, and cut off taken from point at which diversion starts and ends.
^ Does not include retained length of channel with depleted flow due to being cut off from upper catchment.

13.8.32 The design of watercourse diversions and realignments would be informed by a geomorphologist and would include where possible enhancement on the current channel. Due to the existing modifications to most channels there are opportunities to provide more natural channels creating bedforms and improving connectivity to the floodplain and riparian corridor. However, the detail of what would be delivered in each location would be subject to further surveys, assessment, and landowner consultation. Removal of any invasive plant species and the creation of wider buffer zones to support future management of diffuse agricultural pollution would also be considered where applicable.

13.8.33 In seven locations the route of an existing minor watercourse would be altered so that it discharges into the same receiving channel but at a slightly different location. The result of re-routing a minor watercourse is a change in total channel length along the 'flowing' course, although where there remains redundant channel this would succeed to become more of a ditch type habitat. **Table 13-10** summarises where re-routed channels would be required within the Ouse (Roxton to Earith), Abbotsley and Hen Brooks, and West Brook WFD water body catchments.

**Table 13-10: Re-routed minor watercourses**

| Re-routed watercourses | Start of diversion | Original confluence NGR | New confluence NGR | Current channel length (approx. m) | Proposed channel length (approx. m) | Approx. change (m) |
|---|---|---|---|---|---|---|
| Gallows Brook Tributary (GB3) – Ouse WFD | TL 24835 60801 | TL 24809 60667 | TL 23744 60656 | 125 | 1152 | +1027 |
| Minor watercourse Hen Brook Tributary - Abbotsley and Hen Brooks WFD | TL 20076 58045 | TL 19850 58794 | TL 20261 58387 | 1,108 | 389 | -720 |
| Minor watercourse Fox Brook Tributary (FxB2) - Abbotsley and Hen Brooks WFD | TL 22454 60144 | TL 22519 60426 | TL 22985 60186 | 289 | 548 | +258 |
| Minor watercourse Fox Brook Tributary (FxB3) - Abbotsley and Hen Brooks WFD | TL 22742 60132 | TL 22806 60285 | TL 22985 60186 | 166 | 249 | +83 |
| Wintringham Brook Tributary (WB1) - Abbotsley and Hen Brooks WFD | TL 20735 59188 | TL 20172 59222 | TL 21064 59684 | 737 | 648 | -89 |
| Minor watercourse West Brook Tributary (WstB1) – West Brook WFD | TL 25906 60720 | TL 25924 60659 | TL 26010 60699 | 64 | 106 | +42 |

| Re-routed watercourses | Start of diversion | Original confluence NGR | New confluence NGR | Current channel length (approx. m) | Proposed channel length (approx. m) | Approx. change (m) |
|---|---|---|---|---|---|---|
| Minor watercourse West Brook Tributary – West Brook WFD | TL 25922 20664 | TL 26371 60981 | TL 26726 60325 | 560 | 873 | +313 |

13.8.34 With the exception of Hen Brook and South Brook, watercourses affected by diversions and realignments are generally small, grassed, ephemeral and generally overgrown channels that are not considered fully ecologically functioning watercourses as they are often dry with a low biodiversity value having been modified by past land uses (e.g. historically straightened). Therefore, new diversions present opportunities for channel enhancement over existing form and function.

13.8.35 Regardless of the size and status of the majority of watercourses affected by culverts or diversions, at the detailed design stage, the design of any re-routed watercourses and channel realignments would ensure flood risk is not increased, that flow is adequately conveyed without interruption of any sediment transport processes or the risk of formation of channel interruption due to excessive erosion or deposition, and that opportunities to enhance channel form and biodiversity are maximised. This would be secured through the First Iteration EMP **[TR010044/APP/6.8]**.

Pond Loss

13.8.36 From the ponds within **Table 13-4**, there is the potential loss of five ponds located within the Order Limits (ponds 2, 22, 37, 84, and 85), and the partial loss of two ponds (ponds 11 and 20). Ponds 37 and 84 are assumed to be a potential location of GCN. The loss of terrestrial habitat would be mitigated through the use of District Licensing or the application for a licence from Natural England, or a combination of the two (see **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**). Additionally, the Environmental Masterplan illustrated on **Figure 2.4** of the Environmental Statement **[TR010044/APP/6.2]** includes measures to provide habitat for Great Crested Newt through the creation of new ponds with associated hedgerow and scrub to strengthen connectivity.

**Essential mitigation**

13.8.37 A number of essential mitigation measures have been identified to reduce, remediate or compensate likely significant adverse environmental effects.

*Construction*

13.8.38 Measures that would be undertaken during construction to mitigate potential temporary adverse impacts on the water environment are described in an Outline Water Management Plan (OWMP), which forms part of the First Iteration EMP **[TR010044/APP/6.8]**.

13.8.39 Pollution prevention mitigation measures that accord with legal compliance and good practice guidance to be implemented when working with or around water bodies or resources would broadly focus on:

a. Controlling and minimising the risk of pollution to surface waters and groundwater by managing construction site runoff and the risk of chemical spillages.

b. Measures to control the storage, handling and disposal of potentially polluting substances during construction.

c. The management of activities within floodplains in the area of River Great Ouse, and Hen Brook (i.e. kept to a minimum) with temporary land take required for construction to be located out of the floodplain as far as reasonably practicable or allowances made for floodplain control measures and contingency actions.

d. Management of water removed from cuttings and the borrow pit for construction dewatering activities. Managing the risk from groundwater flooding, for example in the area of the A1 underpass, through appropriate working practices (during excavations) and with adequate plans and equipment in place for de-watering to ensure safe dry working environments.

e. Appropriate methods and mitigation measures when undertaking works within, over, under and adjacent to water bodies.

13.8.40 The measures detailed within the First Iteration EMP **[TR010044/APP/6.8]** would be developed into the Second Iteration EMP for the Scheme which would be implemented by the Principal Contractor. The following sections highlight some of the more specific activities that would be undertaken as part of the works.

13.8.41 Treatment ponds would be excavated and used as a temporary water storage facility for the duration of the main earthwork's construction. Water would be pumped into these ponds when required and water bowsers would use them as a water source when dust suppression is required.

13.8.42 The following sections highlight some of the more specific activities that would be undertaken as part of the works.

*River Great Ouse viaduct and associated bridge structures including two cutting sections*

13.8.43 The Scheme would cross the River Great Ouse and its floodplain. The methodology for works within the area of the River Great Ouse, and the construction of the viaduct and associated bridge structures and two cuttings sections would be developed during the detailed design stage of the Scheme and would include best practice measures outlined within the First Iteration EMP **[TR010044/APP/6.8]**.

13.8.44 The length of this structure would allow a production line type methodology to be adopted in the build, with various activities following each other across the structure rather than waiting to complete an activity over the full extent of the structure before commencing the next. This would add complexity to the detailed design but would facilitate a more efficient construction phase.

13.8.45 A temporary works crane and piling platform would be constructed over the plan area of the new viaduct on the west side of the river. This platform would be 70 metres in width and would include a haul route and crawler crane track to service both sides of the new structure. The EA would be consulted regarding the detailed design plans.. The design would ensure that it reduces the possible obstruction as far as practicable to river flow should a flood event occur during the construction period.

13.8.46 An early warning procedure would be established such that should a flood alert be received plant and materials can be lifted and moved to a works/storage area outside the floodplain.

13.8.47 Due to the nature of the floodplain land which includes very soft ground and various ponds, the platforms would be constructed by end tipping imported clean stone (or equivalent) and progressively extending the platform toward the river. Geogrids would be incorporated where required to reinforce the upper layers of the platform.

13.8.48 River span pier cofferdams and internal span pier cofferdams would be installed for construction of the pilecaps for the river span piers and internal span piers, respectively. They would be placed centrally around each pier location and would be 34 metres by 10 metres by 1.9 metres deep.

13.8.49 A number of construction activities that would take place over the River Great Ouse would require navigation rights to be suspended. As the works on the structure on the river span are unlikely to be continuous, the Principal Contractor would require daytime closures while a particular activity is completed. There would then be a break while this activity is completed on other spans of the viaduct that do not require river closures. These works would take place over a period of up to eight months during which it is estimated that up to ten weeks of river closures would be required.

13.8.50 These works would generally be undertaken in weekday day shifts and works would be checked and secured at the end of the shift so the river can be reopened outside of working hours. It is anticipated that the river would be closed for no longer than 24 hours for any one activity to be completed and so this would be the maximum period of delay to river traffic passing the worksite. The planned closures/disruption to river access would be communicated in advance to the local area, and to interested parties, for example local marina owners, operators and hire boats.

13.8.51 The outline methodology for the physical closure of the river is as follows:

a. Temporary mooring buoys or points would be installed in the river on the approach to the proposed closure.

b. A dory type safety boat would be deployed in the river.

13.8.52 When the river is to be closed – strings of buoys would be deployed to clearly mark the closed section of the river. The safety boat would pull these buoys across the full width of the navigation and secure these in place – these would be at least 50m upstream and downstream of the extent of the worksite.

13.8.53 The dory crew would man the closure at all times and direct the public to the hold station and temporary mooring points and keep the public informed of when the navigation would reopen.

13.8.54 During the river closure, the adjacent riverbanks would also be closed to public access with physical barriers and signs displayed to confirm the closure and warn of the hazards.

13.8.55 The EA would be consulted during further development of the proposed construction methodology at detailed design stage. The construction methodology for the construction of the River Great Ouse viaduct and associated structures would follow best practice and best practicable methods to minimise the potential for adverse impacts to the River Great Ouse and its nearby minor tributaries, as well as disruption to navigation rights.

*Management of dewatering activities*

13.8.56 There would be dewatering of groundwater and the potential for local depression of the groundwater table where there are deep excavations of the ground such as for cuttings and borrow pits. In particular, dewatering is likely to be required in the area of deep excavations such as the A1 underpass cutting, the two borrow pits located to the northwest and northeast of the existing Black Cat roundabout, and other cuttings (such as those near Barford Road and Alington Hill).

13.8.57 Construction of the Scheme also includes four borrow pits. Two would be located in the west of the Scheme near Black Cat junction while two would be located in the east of the Scheme near Caxton Gibbet junction. Dewatering of perched groundwater would be required in order to facilitate the excavate of construction materials from these pits.

13.8.58 The borrow pit to the west of the existing Black Cat roundabout is located adjacent to Rockham Ditch, with the ditch flowing south-east along the southern boundary of the area for the borrow pit. The second borrow pit is located to the northeast of the existing Black Cat roundabout and is approximately 100 metres south from the South Brook.

13.8.59 In order to minimise the impact of the dewatering on groundwater and surface water resources, a construction dewatering strategy would be prepared by the Principal Contractor in accordance with the Groundwater Risk Assessment presented as **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]** and **Chapter 13, Road Drainage and the Water Environment**, of the Environmental Statement **[TR010044/APP/6.1]**. This strategy is secured through the First Iteration EMP **[TR010044/APP/6.8]**.

13.8.60 The purpose of the strategy is to:

a. Review and update the existing ground investigation (Ref 13-69) data and refine the existing groundwater risk assessment (see **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**) and to confirm the final volume estimates of water that may need to be dewatered and the likely quality of that water.

b. Consider how phasing/sequencing of the excavation of borrow pits and other cuttings would influence the amount of water that may need to be managed at any given time.

c. Undertake a feasibility assessment of options to remove water, including undertaking appropriate ecological and hydromorphological surveys, and hydraulic modelling (if necessary). Disposal options may include, but are not limited to:

   i. Re-use of water on-site (e.g. for dust suppression).

   ii. Discharge to local watercourses.

   iii. Direct discharge to the River Great Ouse via temporary pipelines or by mobile bowser.

   iv. Spraying to nearby fields.

d. Subject to further surveys, hydraulic modelling and assessment, determine the volume, rate and duration of flows that can be discharged to local watercourses without resulting in significant flood risk or environmental effects, or non-compliance with the WFD. Note that some water may need to be discharged to replenish any temporary reduction in baseflow to affected watercourses.

g. Where it is deemed not possible to discharge all of the water removed from deep excavations (e.g. cuttings and borrow pits) to a nearby watercourse, and there are no other alternative options, require the Principal Contractor to consider methods to reduce further the ingress of groundwater (and overland flow) into the excavations (e.g. working smaller area at a time or sealing the borrow pit/excavation by a suitable method).

e. Where water is to be discharged to watercourses:

f. Determine the constraints on the discharge (e.g. no discharge when flows in the receiving watercourse exceed a certain level at a certain location etc.) and what pre-treatment may be required; and

g. Determine the scope of water quality and water level monitoring that is required. It is expected that baseline monitoring will be required for a period in advance of the works - this is to be agreed with all relevant stakeholders but is assumed to be a minimum of 12 months; and

   i. Provide technical information to support applications to the Environment Agency for a Water Abstraction Licence under the *Water Resources Act 1991* (Ref 13-5) and a Water Activity Environmental Permit under the *Environmental Permitting (England and Wales) Regulations 2016* (Ref 13-9), and potentially a Land Drainage Consent from the Bedford Group of Internal Drainage Boards (IDBs), Bedfordshire and River Ivel area in accordance with the *Land Drainage Act 1991* (Ref 13-4) (where it is not agreed to disapply these regulatory processes through the DCO, refer to the Consents and Agreements Positions Statement **[TR010044/APP/3.3]**).

13.8.61 It is proposed that the strategy would also include a programme of water monitoring and controlled discharges of water abstracted during dewatering. The groundwater monitoring process would be facilitated by the site-specific ground investigation (Ref 13-69) (GI) boreholes installed between October 2019 and June 2020, some of which are currently used for groundwater level and quality monitoring. Where necessary, it is proposed that additional monitoring boreholes should be drilled at strategic points (for example at or near areas of potential deep excavation with associated dewatering activities) in order to ensure the monitoring process is effective. Automatic water level data loggers (or other suitable method) to facilitate continuous monitoring would be installed in selected monitoring boreholes at strategic locations.

13.8.62 At this stage the preferred option is to discharge any groundwater abstracted from dewatering activities to a watercourse (where it may compensate for any reduction that might occur from localised lowering of the groundwater table temporarily) or spread across land to infiltrate following appropriate treatment to remove suspended solids. The dewatering operation would be kept under observation and should chemical contamination be suspected any discharge to ground or a nearby watercourse would be halted and the contaminated water isolated for either additional treatment or suitable disposal at an off-site waste water site.

13.8.63 When discharging water to a nearby watercourse the rate of discharge would need to be agreed with the relevant authority (i.e. the IDB in the case of Rockham Ditch and South Brook) to ensure that there is no unacceptable increase in flood risk or risk of scour. To manage scour risk at the point of discharge it is expected that paddleboards or similar measures would be required to dissipate the energy of the discharge. Where the required rate of discharge to keep the excavation dry exceeds what may be allowed to a single watercourse, additional locations for discharging the water would need to be provided or storage provided. Any discharge would need to be undertaken with the agreement of the relevant statutory regulator in accordance with the Consents and Agreements Positions Statement **[TR010044/APP/3.3]**. Discharges would also need to comply with the pollution prevention requirements set out in the First Iteration EMP **[TR010044/APP/6.8]**.

13.8.64 If groundwater contains high concentrations of suspended fine sediment, this would be filtered by using storage basins (for example the proposed long term treatment ponds would be excavated first so they can be used for this purpose), and, in combination with other proprietary measures (for example lamella clarifiers).

*Site offices, welfare compounds and satellite compounds*

13.8.65 As detailed in **Chapter 2, The Scheme** of the Environmental Statement [**TR010044/APP/6.1**], three main offices and a number of satellite compounds are proposed for the Scheme.

13.8.66 Each office and compound would operate on a 24-hour basis in order to facilitate continuous water management across the Scheme. Each compound would have:

a. A water management area to manage site runoff from the impermeable area.

b. Have a positive drainage system with SuDS provision as part of the compound design and construction.

c. Rainwater would drain through this granular type construction of the hardstanding on each compound, with surface water from the cabins routed to suitable soakaways.

d. Foul drainage from the cabin and welfare units at each compound would be collected in storage tanks which would be emptied regularly by a tanker (with appropriate waste carrier licence etc.) for offsite disposal at a suitably licensed waste-water facility.

*Culverts*

13.8.67 Culverts would generally be constructed offline from the existing watercourse. The route would be open cut to formation with benched sides and the base blinded. A system of local sumps and suction pumps would be used to keep the excavation dry with the water discharges via silt sock either back into the ground or into a local pre-earthworks ditch.

13.8.68 Where it is necessary to construct culverts on-line with the original water course a system of over pumps would be set up to bypass the culvert site which would include contingency measures such as a standby pump or flume pipe and a detailed maintenance procedure. Once this pumping system is in place the watercourse would be blocked and the pumps made operational leaving a dry section for the culvert construction.

13.8.69 When the new culvert structure is complete, the approach section of the new drainage route would be excavated and tied back into the watercourse and the water diverted to the new route. This would only be done once proposed vegetation has established or suitable biodegradable matting has been laid in areas of erosion risk. The original route would then be sealed off, and any soft spots dug out before the original route is backfilled and reinstated.

*Diversion of CLH Pipeline*

13.8.70 One operational CLH oil pipeline is currently located on the west side of the River Great Ouse and would need to be diverted to the west of its current alignment so the River Great Ouse viaduct can be constructed. South of the Scheme the CLH passes through an area identified for floodplain compensation for the River Great Ouse. In the locality of the CLH pipeline the floodplain compensation area narrows, in order that the pipeline can be protected in this area.

13.8.71 The diversion would require the ground in the area to be excavated to allow for the new diversion pipeline route to be installed. Access for this would use purpose-built haul routes to the site.

13.8.72 Excavations to allow the pipeline to be relocated would need to be dewatered. The dewatering system would use a series of pumps which would discharge the water into a settlement lagoon or other suitable measure to remove fines.

13.8.73 CLH would install the pipework for the diversion, and be responsible for pressure testing the pipe before adoption and use. Sheeted pits around the connection points to the existing pipeline would be excavated and connections made on a planned pipeline isolation methodology. These activities would take place in consultation with the CLH stakeholder manager. All activities would take place in accordance with environmental health and safety and quality procedures. On their website (Ref 13-72) the CLH group state they undertake all their '*activity based on responsibility towards people, the safety of the same and of the goods, environmental respect.*'. Their Environmental Management System is certificated in accordance with the UNE-EN ISO 14001:2015 standard.

13.8.74 A second disused CLH pipeline that runs northwest to southwest crosses the Scheme in the Rectory Farm area. This disused pipeline has been grouted and is not considered further.

**Operation**

*Maintenance of highway drainage assets*

13.8.75 Maintenance of the drainage network and assets is required as part of the operation of the Scheme. The maintenance requirements for vegetative systems is included within the Drainage Strategy in **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**.

13.8.76 The future maintenance of new drainage ditch courses linking treatment ponds to the existing watercourse network would take into account the biodiversity objectives of these channels.

13.8.77 No further mitigation is considered to be required during operation of the Scheme.

*WFD enhancement opportunities*

13.8.78 The Drainage Strategy (**Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**) proposes to use SuDS to manage and treat surface water runoff from the highway. This includes the creation of new open ditches, swales and ponds across the Scheme, which would provide new aquatic habitats.

13.8.79 A WFD Mitigation and Enhancement Strategy, secured through the First Iteration EMP **[TR010044/APP/6.8]**, would be implemented at the detailed design stage post-DCO consent with the aim of developing a suite of site specific and appropriate environmental enhancements within the Order Limits for various watercourses affected by the Scheme.

13.8.80 In addition to culvert design, the impact of new structures affecting watercourses is mitigated by the creation of new channels where they are to be diverted associated with new structures or in a small number of cases on minor watercourses, re-routed, with additional riparian habitat created along proposed new highway drainage and land drainage ditches. However, in keeping with planning policy and supporting meeting WFD objectives and achieving a net biodiversity gain, the Scheme has also identified opportunities to further enhance the water environment within the Order Limits (see also **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]**).

13.8.81 Further hydromorphological and ecological survey and assessment would be undertaken to inform the detailed design of suitable interventions. Consultation with the EA is required to incorporate RBMP mitigation measures where feasible and to define the scope of the WFD enhancements for each water body. Where options may affect flood risk, the current FRA would need to be reviewed, and hydraulic modelling may be required to determine the change in risk associated with the proposed enhancements so as to ensure they are acceptable. In addition, for reaches close to the Order Limits there may be greater restriction on interventions that significantly alter the planform, cross-section, or roughness of the channel.

13.8.82 The environmental enhancements for the various watercourses affected by the Scheme, from small ditches to brooks, are envisaged to fall into three types and these are described in the WFD Assessment presented in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]**).

13.8.83 The implementation of different enhancement actions would depend on the site-specific constraints, the character of what the unmodified watercourse would be, and the current condition of the watercourse including local modifications and pressures. Flood risk management and landowner consultation would also inform considerations. Types and opportunities would be defined by ecologists, geomorphologists and water quality scientists, and would include integrated assessments of catchment – watercourse connectivity such as fine sediment and agricultural pollutant pathways. Further survey and assessment (for example hydromorphological, ecology, engineering constraints, flood risk and land owner considerations) would be required at the detailed design phase to establish these constraints and to determine what opportunities for enhancement are possible. At this stage channel enhancement options may include:

a. Creation of narrower and/or multi-stage channels to increase base flow depths and velocities, improving flow regimes and reducing fine sediment deposition.

b. Improvement of channel geomorphic diversity through the addition of bedforms (for example alternating shallow berms, riffles and pools in more established channels where gradients are sufficient), and woody material linked with riparian improvements.

c. Improvement of connectivity between the floodplain and habitat diversity within the channel by re-grading the bank (scrapes), creating two stage channels, small bays and marginal wetlands.

d. Management of undesirable plants that have invaded the riparian zone and into the channel.

e. Management of overgrown vegetation to improve light penetration to the channel where appropriate (for example diversification of trees and shrubs).

f. Improvement of the structure of the existing riparian vegetation and vegetation-driven morphological processes.

g. Provision of or increase in the width of existing riparian buffer zones between the channel and surrounding farmland to manage risk from diffuse agricultural pollution.

h. Install new stock proof fences where applicable and with landowner consent.

13.8.84 Particular enhancements for Hen Brook and Wintringham Brook have been linked to integrate with the Wintringham Development green corridors, but equivalent targeted measures have not been identified for other watercourses because there are no other earmarked developments for cumulative environmental benefits.

13.8.85 For all WFD water bodies, except Begwary Brook where there is only a small increase in culverting (i.e. 27.5 metres including a 10% contingency), the Scheme would result in a net increase in channel length over that affected by new culverts. In addition, to this, significant lengths of watercourse have been identified within the Order Limits that could potentially be enhanced, particularly in the River Great Ouse catchment (i.e. Gallow Brook and smaller tributaries as the main stem is crossed using a viaduct), Hen Brook (including Wintringham Brook and Fox Brook), and Stone Brook. This would be set within the overall biodiversity net gain calculated for the Scheme, and with consideration that many of the watercourses are small headwater ditches, heavily modified, ephemeral and dry at the time of baseline surveys. No reaches have been identified within the Begwary Brook catchments for possible enhancement, although the impact would be mitigated through good culvert design and the provision of new riparian habitat along proposed land drainage ditches.

13.8.86 Riparian buffer strips (mainly grasses) would provide water course physico-chemical and morphological benefits due to the filtration effects on fine sediment and associated pollutants from agricultural runoff. Woody riparian planting could add biological complexity to channel corridors, and input woody material into the channel for morphological diversity. Given the existing highly modified and deteriorated nature of the watercourses, riparian measures are considered to provide significant local enhancement opportunities.

13.8.87 Further details would be developed at detailed design stage with relevant statutory stakeholders to be consulted further. In order to fully define the scope of the enhancements, further hydromorphological survey of the channels, together with consultation with the EA would be required. Where options may affect flood risk suitable flood risk assessment would be required.

13.8.88 In total, and as shown in Table 5-5 of **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]**, almost 5,000 metres of watercourse has been identified within the Order Limits that may potentially be improved as part of the delivery of this Scheme. However, as discussed above, there are many factors to consider when determining what interventions if any can be made to enhance the watercourse and the riparian corridor, including issues of land ownership/land owner agreements, and it is not anticipated that all of this would be subject to some form of improvement. However, the lengths identified show that there is sufficient potential to ensure that the Scheme provides net benefit in terms of watercourses, over and above the mitigation proposed for culverts etc.

13.8.89 Of the total length of watercourses identified within the Order Limits that could be improved, approximately 2,250 metres would be within the highway boundary. The remaining circa 2,750 metres would reside on land between the highway boundary and the Order Limits. In this zone, there are greater restrictions on what interventions may be possible without future landowner consent.

**Relevant permits, consents, and licences**

13.8.90 The Scheme crosses a Main River, the River Great Ouse, and numerous ordinary watercourses (see **Table 13-3** and **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**). The proposed works in, around and over the River Great Ouse would require a Flood Risk Activity Permit from the EA under the *Environmental Permitting (England and Wales) Regulations 2016* (Ref 13-9), where exemptions do not apply. Such works are intended to be undertaken with the agreement of the EA but without the need for a formal consent by seeking to disapply their respective empowering legislation in the draft Order insofar as they apply to the Order land. However, if consent to disapply is not granted then an application for this permit would be made to the EA. Refer to the Consents and Agreements Position Statement **[TR010044/APP/3.3]** for further information.

13.8.91 Temporary discharges of 'unclean' runoff may also require a Water Activity Permit under the *Environmental Permitting (England and Wales) Regulations 2016* (Ref 13-9) from the EA, also where exemptions do not apply. In addition, the temporary or permanent diversion of watercourses and the dewatering of ponds and the ground may require water abstraction, impoundment or transfer licences from the EA under the *Water Resources Act 1991* (Ref 13-5). Such works are intended to be undertaken with the agreement of the EA but without the need for a formal consent by seeking to disapply their respective empowering legislation in the draft Order insofar as they apply to the Order land. However, if consent to disapply is not granted then an application for the respective permit or licence would be made to the EA. Refer to the Consents and Agreements Position Statement **[TR010044/APP/3.3]** for further information.

13.8.92 As part of the Scheme, works would be taking place which would normally require the consent of the local Bedfordshire and River Ivel IDB under the *Land Drainage Act 1991* (Ref 13-4) as amended by the *Flood and Water Management Act 2010* (Ref 13-2) and under *the Bedfordshire and River Ivel Internal Drainage Board Byelaws 1985*. Such works are intended to be undertaken with the agreement of the IDB but without the need for a formal consent by seeking to disapply their respective empowering legislation in the draft Order insofar as they apply to the Order land. However, if consent to disapply is not given then an application would be made to the IDB for permission to carry out the works. Refer to the Consents and Agreements Position Statement **[TR010044/APP/3.3]** for further information. This includes works relating to Rockham Ditch, South Brook, and Stone Brook.

13.8.93 As part of the Scheme, works may be taking place which would normally need the approval of the Central Bedfordshire Council Drainage Board under the *Land Drainage Act 1991* (Ref 13-4) as amended by the *Flood and Water Management Act 2010* (Ref 13-2) and under the *Central Bedfordshire Council Land Drainage Byelaws 2016*. Such works are intended to be undertaken without the need for a formal consent by seeking to disapply their respective empowering legislation in the draft Order insofar as they apply to the Order land. However, if consent to disapply is not given then an application would be made to the CBC Drainage Board for permission to carry out the works. Refer to the Consents and Agreements Position Statement **[TR010044/APP/3.3]** for further information. This includes works relating to Stone Brook.

13.8.94 Under the *Flood and Water Management Act 2010* (Ref 13-2) and Section 23 of the *Land Drainage Act 1991* (Ref 13-4), consent may be required for certain works that may affect the flow in Ordinary Watercourses (i.e. all watercourses that are not Main Rivers or maintained by IDBs) from the LLFAs. Such works are intended to be undertaken with the agreement of the LLFAs but without the need for a formal consent by seeking to disapply their respective empowering legislation in the draft Order insofar as they apply to the Order land. However, if consent to disapply is not given then an application would be made to the LLFA for the respective consents. Refer to the Consents and Agreements Position Statement **[TR010044/APP/3.3]** for further information.

13.8.95 Under the *Anglian Water Authority Act 1977* (Ref 13-65) the EA is the navigation authority for the River Great Ouse. The EA currently has the power to temporarily close the waterway, subject to certain conditions being met. The Scheme would cross the River Great Ouse on a viaduct, the construction of which would require the temporary suspension of navigation rights for public safety and the safety of construction workers. The suspension of navigation would be for 24 hour periods only, with the timetable for the required closures being communicated to local interested parties. The process to temporarily suspend navigation rights is included in the DCO.

13.8.96 As part of the Scheme there may be a requirement for a Trade Effluent Consent from the Local Water Undertaker under the *Water Industry Act 1991* (Ref 13-17) for the purposes of discharging trade effluent from welfare facilities. Refer to the Consents and Agreements Position Statement **[TR010044/APP/3.3]** for further information.

## 13.9 Assessment of significant effects

13.9.1 The prediction of impacts and the assessment of effects (and their significance) during construction and operation of the Scheme on road drainage and the water environment has taken account of the embedded and essential mitigation measures presented in Section 13.8.

**Importance of receptor**

13.9.2 Based on the baseline data, and assessed against **Table 13-1**, the local water resources receptors within the study area have been attributed an importance level. These are tabulated in **Table 13-6**, and below that table for flood risk importance.

**Magnitude of impacts and significance of effects:**

**Construction**

13.9.3 The prediction of impacts and the assessment of significance of effects have taken account of the embedded and essential mitigation measures identified within Section 13.8 and **Chapter 2, The Scheme** of the Environmental Statement **[TR010044/APP/6.1]**.

*Surface water quality*

13.9.4 Where construction works are undertaken in close proximity to, within, over or under water bodies, close to existing land drains providing a pathway to surface watercourses or ponds, or on steeper terrain angled towards a waterbody, there is the potential for direct adverse effects on water quality due to deposition or spillage of soils, sediments, oils, fuels, or other construction chemicals spilt on site. There may also be indirect water quality impacts from works further from water bodies via existing land drains/ sewers. The River Great Ouse may also be at risk from cumulative effects as the majority of the watercourses that the Scheme would interact with ultimately drain to this watercourse downstream.

13.9.5 The construction works in general, but particularly earthworks, dewatering of excavations, construction of the CLH oil pipeline, and the construction of watercourse crossing structures, such as the open span viaduct over the River Great Ouse, the culverted crossings of ordinary watercourses (including some diversions and re-alignments), drainage and outfall installations have the potential to cause a reduction in water quality through contaminated construction runoff, and the risk of chemical spillages from plant, equipment and materials. Additionally, the construction of watercourse crossings, diversions and realignments would sometimes take place upstream of a number of online ponds with hydrological connectivity to the Scheme (i.e. ponds 3, 9, 11, 19, 20, 21, 22, 23, 71, 83 and 88 as summarised in **Table 13-4**, and shown in **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**). Therefore, there is the potential to cause a reduction in water quality through contaminated runoff, and the risk of chemical spillages from plant, equipment and materials to all of these ponds.

13.9.6 Construction of road outfalls for the Scheme would require some works close to and within the receiving watercourses. There would be potential for conveyance of spills and fine sediment during any works to these outfalls to result in direct impacts on the receiving watercourses. Outfalls from five new attenuation ponds would be via ditch outfalls. In these locations there would be less risk to the receiving watercourse as there would not be the need for the construction of an engineered outfall. Some existing outfalls and culverts would be utilised by the Scheme without any significant construction works at the outfall. Due to the works across the catchment of the River Great Ouse, there may also be cumulative and indirect effects to this watercourse (refer to **Figure 13.1** of the Environmental Statement **[TR010044/APP/6.2]**).

13.9.7 Some elements of the Scheme are likely to impact on groundwater level, flow and quality. These are mainly associated with potential deep excavations such as cuttings, borrow pits and retaining wall structures, several of which may intercept groundwater and may therefore, require temporary and or permanent groundwater dewatering/drainage management systems to facilitate the Scheme. These activities may temporarily and locally affect the flows and quality in adjacent watercourses.

13.9.8 As described in **Chapter 2, The Scheme** of the Environmental Statement **[TR010044/APP/6.1]**, and Section 13.8, construction of the Scheme would require three main construction compounds. The compounds would have a positive drainage system with rainfall infiltrating through the granular surfaces, runoff from buildings draining to ditches and soakaways, and high-risk locations such as fuel storage or concrete batching/pre-cast concrete forming having dedicated and isolated drainage systems where runoff is captured for appropriate off-site disposal. Foul water from welfare facilities would be stored in tanks and emptied regularly into a tanker for off-site disposal at a suitable wastewater management facility.

13.9.9 During construction, areas of temporary topsoil/earthworks storage would be required in close proximity to the Scheme. Water may also be used during dust suppression giving rise to runoff containing high levels of fine particles.

13.9.10 **Table 13-11** describes the assessment of construction phase surface water quality risks for each water body.

## Table 13-11: Summary of effects of construction to surface water quality

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| River Great Ouse | Very High | Works close to and over the River Great Ouse include the construction of a multi-span viaduct (requiring the creation of a temporary piling platform and a satellite compound 200m to the east for the eastern abutment works), a main site compound located approximately 300m to the west, and construction of floodplain compensation areas to the west. The CHL oil pipeline to the west of the River Great Ouse, passing through the floodplain compensation area, and to the east of Black Cat would also need to be diverted as part of the works. In addition, as the majority of the Scheme lies within the headwaters of numerous tributaries to the River Great Ouse, there is also the potential for cumulative indirect impacts to the river from works to these smaller water bodies.<br><br>All construction works w be carried out in accordance with best practice and a Water Management Plan (WMP) that would deliver the minimum mitigation requirements set out in this chapter and in the First Iteration EMP **[TR010044/APP/6.8]**. The River Great Ouse is also a large water body that would offer a high level of dilution and dispersion reducing its sensitivity to pollution. However, the River Great Ouse is designated as a CWS and numerous surface water abstractions are licensed along it (e.g. for spray irrigation (A17, A18) and for evaporative cooling (A26)) and deterioration in water quality, even temporary should be avoided by the application of mitigation measures.<br><br>Overall, with the implementation of the mitigation measures set out in Section 13.8 and the First Iteration EMP **[TR010044/APP/6.8]** a direct and indirect, short term and temporary **negligible** impact from the risk of chemical spillages and contaminated site runoff is predicted. On a very high importance watercourse this would result in a **slight adverse effect** (not significant) on the water quality, water supply and conveyance of River Great Ouse. | Negligible Adverse | Slight Adverse (Not significant) |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| Rockham Ditch | Medium | Works potentially affecting Rockham Ditch include the Black Cat junction remodelling and A1 underpass (including the discharge of water from dewatering operations from deep excavations), the operation of a satellite compound for the construction of Rockham Road bridge which is to be located adjacent to the east side of Rockham Ditch, the excavation of a borrow pit to the north of the watercourse and the A421, and the construction of a number of new surface water outfalls (LPA1/5/6, SRN1/3/9). No significant works are proposed to the existing A421 and A1 culverts but there would be the construction of new culverts (E72, E76, E77, S75, S80, S89).<br><br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **minor adverse** impact upon Rockham Ditch (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| South Brook | High | The closest element of the Scheme to the South Brook is the borrow pit to the northeast of Black Cat junction located approximately 100m away and a new culvert for the Roxton Road link. No ground contamination has been reported or observed during the detailed 2019/2020 ground investigation (Ref 13-69) for the Scheme. Water from dewatering operations may be discharged into South Brook, maintaining its flow, but also increasing the risk of introducing fine sediment or pollutants. To the west of the A1 the new Roxton Road link would be constructed. A new culvert (S4) would be constructed across South Brook for the Roxton Road link and this would require a minor realignment of the channel. Finally, new surface water outfalls would also be constructed (LPA2/7/8, SRN4/6). However, with the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **minor adverse** impact upon South Brook (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |
| Begwary Brook | High | Works affecting Begwary Brook are related to those along the A1 near Wyboston. This includes construction of the new Roxton Road link, and the construction of a culvert as this crosses Begwary Brook (S16), and new surface water outfalls (LPA3, SRN7/8). The construction of two floodplain compensation areas would also be created to the west of the A1. The watercourse flows through the Begwary Brook Pits CWS.<br><br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary, short term **minor adverse** impact upon Begwary Brook, and the CWS (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| Stone Brook | High | Works within the catchment include the construction of the Scheme in what is currently greenfield land, the construction of Barford Road crossing, Rectory Farm attenuation pond, new culverts across numerous minor tributaries to Stone Brook (S11, S12, S82, S44, S46, S48, S83, and S84), new surface water outfalls SRN10/11 and LPA9) and the setting up and operation of temporary satellite compounds for the construction of East Coast Mainline underbridge and Barford Road Bridge. There are no works to the main channel of Stone Brook.<br><br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **minor adverse** impact upon Stone Brook (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |
| Abbotsley and Hen Brooks | High | Works within the catchment include construction of the new mainline and associated infrastructure including new attenuation ponds and drainage works, high level flow culverts and floodplain compensation areas, and modifications to the existing culvert and other structures (S19, S20, S23 and S26 in and around the main channel and immediate drains, S41 and S42 on a small tributary to the south close to the B1046, and S43 on another minor tributary further south), new surface water outfalls (SRN12/13 and LPA11/12), and the main construction compound at the Urban and Civic Wintringham Development and the satellite compound at Potton Road overbridge.<br><br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **minor adverse** impact upon Abbotsley and Hen Brooks and tributaries (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| Wintringham Brook and tributaries | Medium | Works include construction of the mainline road and associated infrastructure, attenuation ponds, new culverts for Wintringham Brook and Wintringham Brook tributary (S21, S22 and S24, S29 and S55, respectively), construction of the Cambridge Road junction, new surface water outfalls (SRN14/14a/15 and LPA13), and the setting up and operation of two temporary satellite compounds at Wintringham Footbridge (located west of the Scheme Ch8600) and for the Cambridge Road junction (located north of the Scheme, Ch9500).<br><br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **minor adverse** impact upon Wintringham Brook and tributaries (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |
| Fox Brook and tributaries | Medium | Works include construction of the mainline and associated drainage infrastructure and structures in the headwaters of Fox Brook. This includes the construction of new culverts across minor headwater channels (S53, S64, S86 and S87), a new treatment pond, a new surface water outfall (SRN16) and the setting up and operation of a satellite compound (Fox Brook Bridleway Bridge, located south of the Scheme, Ch11200).<br><br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **minor adverse** impact upon Fox Brook (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| Gallow Brook and tributaries | Medium | Works include construction of the mainline and associated drainage infrastructure and structures in the headwaters of Gallow Brook. This includes the construction of new culverts across minor headwater channels (S30, S56, and S85), a new treatment pond, new surface water outfalls (SRN17 and LPA14/15), and the setting up and operation of a satellite compound (Toseland Road Bridge, located south of the Scheme, Ch12950).<br><br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **minor adverse** impact upon Gallow Brook (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |
| West Brook and tributaries | High | Works include construction of the mainline and associated drainage infrastructure and structures. This includes the construction of new culverts across numerous minor headwater tributaries (S35, S36, S37, S39, S59, S63, S68, S69, S70, and S71), ponds, and new surface water outfalls (SRN18/19/20/21/22/23 and LPA16/17/18). Two borrow pits are also proposed to the north of the Caxton Gibbet junction, although significant dewatering is not considered likely in this area of the site. Eltisley Junction satellite compound (St. Ives Road Bridge, located north of the Scheme, Ch16000), and the construction compound to the east of Caxton Gibbet junction, would also be nearby to headwater watercourses of West Brook. However, all works are taking place on minor headwater tributaries of West Brook, with the named watercourse being approximately 6 km downstream.<br><br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **minor adverse** impact upon West Brook and its tributaries (on the basis that new culverts are constructed offline) (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Minor adverse | Slight adverse (not significant) |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| Bourn Brook (as Eastern Brook) | High | In the catchment area of Bourn Brook, the A1198 south of Caxton Gibbet junction would be realigned. This being carried out at some distance to the watercourse direct physical impacts are unlikely and the main pathway for impacts would be from uncontrolled site runoff via any existing drainage pathways. A new outfall would also be constructed to an unnamed minor tributary of Bourn Brook (SRN24).<br>With the implementation of the mitigation measures outlined in Section 13.8 it is considered that the construction works would have a temporary and short term **negligible** impact upon Bourn Brook (including the water quality, dilution and removal of waste products and conveyance of flow) resulting in a **slight adverse effect** (not significant). | Negligible | Slight adverse (not significant) |
| Pond 2, 22, 37, 84 and 85 | Low: Pond 2, 22 and 85<br>High: Pond 37 and 84 | These ponds are located within the footprint of the Scheme and would be lost during the works. As they would be infilled by the Scheme they would not be a receptor during the construction works and no assessment is required. | Not applicable | Not applicable |
| Pond 3 | Medium | Pond 3 is downstream and online with Begwary Brook and is located with the CWS. Works to Begwary Brook as described earlier could lead to pollutants being conveyed downstream and into this pond. With the implementation of mitigation measures outlined in Section 13.8 it is considered this would have a short term and temporary **minor adverse** impact on Pond 3, this would result in a **slight adverse** effect (not significant). | Minor Adverse | Slight adverse (not significant) |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| Pond 11 | Low | Pond 11 is a siltation pond which is part of the Black Cat Quarry operated by the Breedon Group. This water body is located beneath the line of the viaduct. Construction of a 235m by 70m viaduct construction/piling platform would result in the temporary loss of approximately one third of Pond 11. At this point in time it remains unclear how material would be placed into this water body, but such works would be comparable to its current use as a siltation pond for quarrying activities. While the construction platform is in place, there is a risk of runoff containing fine sediments and chemicals washing off into this pond due to the close proximity to the works and hard standing to the water's edge. Further impacts may occur when the infilling aggregate is removed. Overall, it is considered there would be a temporary and short term **minor adverse** impact given the current use of the pond. This would result in a **neutral effect** (not significant). | Minor adverse | Neutral (not significant) |
| Pond 20 | Low | Pond 20 is a pond located near New Alington Top Farm Bridge which is hydrologically connected to RGO2, a small tributary of the River Great Ouse. The pond is located on the southern side of the minor road, to the south west of the overbridge. The works for construction of the overbridge would result in partial loss of the pond along the northern edge of the pond. There is also a risk of runoff containing fine sediments and chemicals washing into the pond due to the close proximity to the works. Overall, it is considered there would be a temporary and short term **moderate adverse** impact. This would result in a **slight adverse effect** (not significant) | Moderate adverse | Slight adverse (not significant) |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| Ponds 9 and 83 | Ponds 9 and 83 GCN present, High | Ponds 9 and 83 are currently road runoff attenuation ponds. Within pond 9 there would be construction works to add a wet treatment area and works upstream to install a VFS and construction of the Scheme more generally. There would be no works within Pond 83, but there would be works within its catchment area. With the implementation of mitigation measures during construction and following required measures for any relocation and protection of GCN would have a short term and temporary **minor adverse** impact on pond 9 and 83, resulting in **slight adverse** (not significant) impact on these ponds. | Minor adverse | Slight adverse (not significant) Ponds 9 and 83 |
| Ponds 19, 21, 23, 38, 71, and 88. | High for Pond 21, and Low for remaining | Ponds 19, 21, 23 and 38 are online and downstream of the construction works area.<br>Pond 71 is downstream of the works online with a minor tributary of West Brook. Works to this watercourse to construct the mainline could result in pollutants being conveyed downstream and into this pond.<br>Pond 88 is located downstream on the River Great Ouse, with some connectivity to the River Great Ouse. It is located approximately 1.5km downstream from works over the River Great Ouse, and 800m downstream of works on the A1.<br>With the implementation of mitigation measures outlined in Section 13.8 it is considered this would have a short term and temporary **negligible** impact on these ponds of low importance, and the same for Pond 21 (of high importance) this would result in a **neutral effect** (not significant) for the low importance receptors, and **slight effect** (not significant) for Pond 21. | Negligible | Slight (not significant) for Pond 21, and Neutral (not significant) for remaining ponds |
| Pond 79. | Low | Pond 79 is close to the working areas but it should be possible to adequately protect it using mitigation measures so that it remains unaffected. | No change | Neutral (not significant) |

*Ponds: impacts on morphology*

13.9.11 Pond 11 is currently a siltation pond within the Black Cat Quarry. There would be a temporary and short term moderate adverse impact on this water body due to the construction of a piling platform. This would result in the temporary loss of approximately a third of the pond. This is considered to result in moderate adverse impact, which on a low important water body, results in a slight adverse effect (not significant).

***Groundwater flow***

*Groundwater level and flow alteration from construction of deep excavations*

13.9.12 The construction of the Scheme would involve a number of cuttings along the route some of which may require dewatering as a result of interception with the natural groundwater level and flow path. Using baseline geological and hydrogeological data, a conceptual hydrogeological model for the Scheme was developed to assess the potential impact on groundwater from construction of the cuttings as detailed in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**.

13.9.13 The assessment considers the elevation of the deepest point of each cutting against the maximum recorded groundwater level as measured from the site-specific GI monitoring boreholes installed in 2019/2020 and available data from historical borehole records. It also considers the existing ground elevation against the proposed elevation profile of the Scheme, while taking into consideration the geology and hydrogeology beneath the Scheme.

13.9.14 Based on the conceptual model, the preliminary qualitative screening assessment as detailed in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]** showed that the majority of the cuttings are unlikely to intercept with or would only minimally intercept the groundwater table with no significant adverse effects. Depending on local groundwater conditions, there would also be minor dewatering of perched groundwater related to the diversion of utilities (i.e. the CLH pipeline, Cadent and National Grid gas mains lowering). The utility diversions would take place as advance and early works, in 2021, before the main construction of the Scheme. It is anticipated that the maximum excavation depth of the trenches for the utility pipelines would not exceed 3 metres below ground level. Given the shallow depth of installation, its temporary nature, and considering the groundwater condition beneath the area, it is unlikely that there would be any significant change to prevailing groundwater conditions and therefore no further assessment would be undertaken.

13.9.15 Cuttings and borrow pits such as the A1 underpass cutting, Barford Road cutting and Alington Hill cutting and the two borrow pits located near Black Cat junction, are likely to have greater interaction with groundwater and the impact assessment for these locations is summarised below (further detailed analytical impact assessment of these cuttings and borrow pits on groundwater was carried out, as presented in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**).

13.9.16 **Black Cat A1 Underpass Cutting:** The anticipated maximum depth of the cutting is approximately 8m with an approximate length of 750 metres and would

penetrate the underlying permeable River Terrace Deposits with its base terminating in the underlying low permeability Oxford Clay. The ground elevation at the maximum depth of the cutting is at 21.91 metres AOD with the minimum base of the River Terrace Deposit at 15.71 metres AOD (i.e. 6.2 metres BGL). Groundwater monitoring boreholes installed between 2019 and early 2020 and the historical borehole logs show that the groundwater level in the superficial deposits varies between 20.60 metres AOD and 17.82 metres AOD in the vicinity of the A1 underpass. Based on this information, it is considered that the base of the cutting would be approximately 6.7 metres below the groundwater level at an elevation of approximately 13.91 metres AOD. Temporary dewatering of the groundwater would therefore be required to maintain dry ground conditions during construction. Subject to consultation with the Environment Agency and other relevant stakeholders, groundwater abstracted during dewatering would be discharged to nearby watercourses likely to be impacted by the temporary dewatering activities to mitigate and or reduce the effect significance.

13.9.17 Based on the highest groundwater levels recorded in the GI monitoring boreholes in the area of the proposed cutting, preliminary analytical assessment showed that the maximum estimated groundwater inflow to the cutting to be dewatered to maintain dry ground condition during construction would be approximately **1,465m$^3$/day** This is based on an average saturated aquifer thickness of **3.95 metres** along the full length of the cutting and a corresponding maximum dewatering drawdown of approximately **3.95 metres** and a maximum zone of influence of approximately **138m**. The aquifer in the RTD is designated a Secondary A aquifer with a **medium** importance. It is concluded that the magnitude of the impact on groundwater level and flow from dewatering activities would be **minor adverse**. Please refer to **Table 13-12** for details of the significance of effect of the Scheme on each relevant water body.

13.9.18 The South Brook flows 470 metres north of the cutting and is the closest surface water body to the cutting. As the brook is outside the estimated zone of influence, a **no change** impact magnitude on the brook from potential dewatering is anticipated. Additionally, flows in the brook would be monitored before and during construction and if there is a significant lowering of flow when compared to pre-construction monitoring that cannot be otherwise explained with confidence, the Scheme would augment flows by the discharge of water from the excavation (in agreement with regulatory organisations and with appropriate controls on rate, quality etc.).

13.9.19 **Barford Road Cutting:** The anticipated maximum depth of the cutting is approximately 6.8 metres with an approximate length of 380 metres and would penetrate the underlying glacial Till (Till) with its base terminating approximately 0.8m in the underlying low permeability Oxford Clay (OXC). The ground elevation at the maximum depth of the cutting is at approximately 27.4 metres AOD with the base of the Till at 21.4 metres AOD. Groundwater monitoring boreholes installed between 2019 and early 2020 and the historical borehole logs show that the groundwater level in the Till varies significantly between 26.25 metres AOD and 16.95 metres AOD in the vicinity of the cutting. Based on this information, it is considered that the base of the cutting is approximately 5.7 metres below the groundwater level at an elevation of approximately 20.6 metres AOD. Temporary

dewatering of the groundwater would therefore be required to maintain dry ground conditions during construction. During the operational phase of the Scheme, some level of permanent dewatering may be required to prevent groundwater ingress to the road and drainage systems for Scheme. This would incorporate measures such as groundwater flow path barriers, to be defined during the detailed design.

13.9.20 Based on the highest groundwater levels recorded in the GI monitoring boreholes in the area of the proposed cutting, preliminary analytical assessment show that the estimated groundwater inflow to be dewatered to maintain dry ground conditions during construction of the cutting would be approximately **12 $m^3$/day.** This is based on an average saturated aquifer thickness of **3.37 metres** along the full length of the cutting and corresponding maximum dewatering drawdown of approximately **3.37 metres** and a maximum zone of influence of less than **10 metres**. The aquifer in the Till is designated a Secondary undifferentiated aquifer by the Environment Agency and has been assigned a **low** importance in line with the criteria set out in **Table 13-1**. It is concluded that the magnitude of the potential impact on groundwater level and flow as a result of dewatering activities would be **minor adverse**.

13.9.21 The River Great Ouse flows approximately 200 metres west of the cutting and is the closest surface water body to the cutting that is likely to be hydraulically connected to and receiving baseflow from the Till. As the river is outside the estimated zone of influence, a **no change** impact magnitude on the river is anticipated as a result dewatering activities at the cutting. Additionally, it is anticipated that any water abstracted during dewatering would be discharged to the River Great Ouse to further mitigate any impacts on baseflow to the river as a result of dewatering. Please refer to **Table 13-12** for details of the significance of effect of the Scheme on each relevant water body.

13.9.22 **Alington Hill Cutting:** The anticipated maximum depth of the cutting is 7.6 metres with an approximate length of 1,370 metres and would penetrate the underlying glacial Till (Till) with its base terminating approximately 0.6 metres into the underlying low permeability OXC. The maximum depth of the cutting is at approximately 43.74 metres AOD with the minimum base of the Till at 44.34 metres AOD. Groundwater monitoring boreholes installed between 2019 and early 2020 and the historical borehole logs show that the groundwater level in the Till varies significantly between 51 metres AOD and 39 metres AOD in the vicinity of the cutting. Based on this information, it is considered that the base of the cutting would be approximately 6 metres below the groundwater level at an elevation of approximately 44 metres AOD. Temporary dewatering of the groundwater would therefore be required to maintain dry ground conditions during construction. During the operational phase of the Scheme, some level of permanent dewatering may be required to prevent groundwater ingress to the road and drainage systems for Scheme. This would incorporate measures such as groundwater flow path barriers, to be defined during the detailed design.

13.9.23 Based on the highest groundwater levels recorded in the GI monitoring boreholes in the area of the proposed cutting, preliminary analytical assessment show that the calculated maximum groundwater inflow to the cutting to be dewatered to maintain dry ground condition during construction would be approximately

**65m$^3$/day** This is based on an average saturated aquifer thickness of **4.72 metres** along the full length of the cutting and a corresponding maximum dewatering drawdown of approximately **4.72 metres** and a maximum zone of influence of less than **10 metres**. The aquifer in the Till is designated a Secondary undifferentiated aquifer by the Environment Agency and has been assigned a **low** importance in line with the criteria set out in **Table 13-1**. Accordingly, it is concluded that the magnitude of the potential impact on groundwater level and flow as a result of dewatering activities would be **minor adverse**.

13.9.24 The River Great Ouse flows approximately 1.7 kilometres (1 mile) northwest of the cutting and is the closest surface water body to the cutting. A local spring is located approximately 1.8 kilometres (1.1 miles) northwest of the cutting. As the river and the spring are outside the estimated zone of influence, a **no change** impact magnitude of potential dewatering impact on these receptors is predicted. Refer to **Table 13-12** for details of the significance of effect of the Scheme on each relevant water body.

13.9.25 In order to further minimise impacts on any nearby surface water bodies from these cuttings during construction dewatering operations, where possible, abstracted groundwater should be discharged upstream of any nearby watercourses to maintain the flow in the watercourse. It would be necessary to settle the water to reduce the suspended solids concentration prior to discharge to any water bodies. The construction abstraction would require an abstraction licence and the discharge would be the subject of an Environmental Permit both issued by the EA. The draft DCO seeks, subject to consent from the EA, to disapply section 24 of the *Water Resources Act 1991* (Ref 13-5) which would remove the need to obtain an abstraction licence for dewatering activities (see the Consents and Agreements Position Statement **[TR010044/APP/3.3]**). With implementation of the essential mitigation, the significance of the effect of dewatering on groundwater flow and on baseflow discharge to nearby surface water bodies would be further minimised or eliminated.

***Borrow Pit Dewatering Impact Assessment***

13.9.26 A proposed borrow pit (BPA) would be located to the north-west of Black Cat junction, covering approximately 85,000 m$^2$ in area and would be up to 3m deep into the underlying RTD aquifer. It is understood that as part of the borrow pit restoration strategy, the pits would be backfilled with screened inert materials (i.e. materials screened for contamination to ensure compliances to all regulatory requirement) obtained from the construction of the Scheme.

13.9.27 Ground elevation at the location of the BPA is approximately 24 metres AOD. A review of nearby *BGS* (Ref 13-50) boreholes (TL15NE100, TL15NE97 and TL15NE60) and the GI groundwater monitoring boreholes (BH203, BH206, BH207 and BH215) installed in 2019/2020 in the vicinity of the site indicates that the average groundwater elevation at the proposed borrow pit location is approximately 23 metres AOD (i.e. 1 metres BGL) with an easterly flow direction towards the River Great Ouse. Given the proposed depth (3 metres) of the pit and the shallow groundwater level at the location, a dewatering drawdown of up to 3 metres below the rest water level (i.e. 2 metres to the base of the pit, plus 1 metres below the base to maintain dry conditions in the working area of the pit) would be required to maintain a dry operational area irrespective of natural seasonal variations in the groundwater level.

13.9.28 Based on the highest groundwater levels recorded, preliminary calculations as detailed in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]** show that the estimated groundwater inflow to the borrow pit would be approximately **2,775m$^3$/day** for the maximum required drawdown of 3 metres with a maximum zone of influence of approximately **85 metres**. The aquifer in the RTD is designated a Secondary A aquifer with a **medium** importance. Accordingly, it is considered that the magnitude of the potential impact on groundwater level and flow as a result of dewatering activities would be **minor adverse,** resulting in a slight effect (not significant).

13.9.29 The Rockham Ditch flows along the southern boundary of BPA and is within the zone of influence, and thus baseflow could be impacted (if hydrologically linked). However, given that most of the water abstracted during dewatering would be discharged to the ditch downstream to maintain its original flow, it is anticipated that only a small portion of the ditch within the boundary area of the pit would be impacted. Hence the magnitude of impact on the Rockham ditch as a result of dewatering is considered to be **minor adverse.** Please refer to **Table 13-12** for details of the significance of effect of the Scheme on each relevant water body.

13.9.30 The South Brook that flows eastwards, at approximately 290 metres to the north of the pit is outside the calculated zone of influence. It is unlikely that the lowering of groundwater around the borrow pit would pose any significant risks to the brook. Accordingly, a **no change** impact magnitude is anticipated. Refer to **Table 13-12** for details of the significance of effect of the Scheme on each relevant water body.

13.9.31 A proposed borrow pit would be located north-east of Black Cat junction covering a maximum area of 36,000 m$^2$ and would be up to 7 metres deep. The target material extraction from this borrow pit is the Till. The location of the proposed borrow pit is part of the existing Black Cat Quarry site where most of the RTD above the Till has been extracted and the area backfilled with unsuitable aggregate, comprising soft to firm brown slightly sandy gravelly clay and fine sand. A review of historical borehole records from the quarry, indicated that the average base of the RTD at this location is approximately 15 metres AOD, approximately 2 metres BGL. The records show that the initial thickness of the RTD before it was quarried was 2 – 3 metres and is underlain by at least approximately 10 metres of Till. The site-specific 2019/2020 GI records indicated a saturated residual RTD of approximately 0.5 metre to 1 metre thick is present

at the site and groundwater in the RTD is likely to be in hydraulic continuity with the surface water bodies in the area, which are mainly the South Brook and River Great Ouse that flows approximately 100 metres north and 420 metres east of the proposed borrow pit, respectively.

13.9.32 While the Till is a low permeability stratum which restricts groundwater flow, groundwater occurs within the deposits where permeable granular layers are present. GI logs indicate the upper 0.5 metres of the Till is likely to be saturated while the remaining layers beneath it is dry as a result of the low permeability nature of the Till. The EA has designated the aquifer in the Till as a Secondary undifferentiated aquifer with limited groundwater potential.

13.9.33 Ground elevation at the location of the borrow pit to the north-east of Black Cat junction is approximately 17 metres AOD. A review of historical borehole records BH2015/21, BH2015/20, BH2015/19, BH2015/18, BH2015/17, BH2015/16, BH2015/15, BH2015/14 and the 2019/2020 GI logs for TP334 and TP365 indicate that the average groundwater elevation at the proposed borrow pit location is 16.5 metres AOD, less than 1 metre BGL, with an easterly flow direction towards the River Great Ouse. Given the groundwater condition at the site and the proposed anticipated maximum depth (7 metres) of the borrow pit, some level of dewatering would be required to maintain a dry operational area during excavation irrespective of natural seasonal variations in the groundwater level.

13.9.34 Based on the highest groundwater levels recorded, preliminary analytical calculations as detailed in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]** show that the estimated groundwater inflow to the borrow pit would be approximately **770m$^3$/day** for the maximum drawdown of 1.5 metres required for the dewatering operations of the residual 1 metre RTD and the upper 0.5 metres of the Till. A maximum zone of influence of approximately **42 metres** has been calculated. The aquifer in the RTD is designated a Secondary A aquifer with a **medium** importance. It is considered that the magnitude of the impact on groundwater level and flow as a result of dewatering activities would be **minor adverse**. Refer to **Table 13-12** for details of the significance of effect of the Scheme on each relevant water body.

13.9.35 The South Brook and the River Great Ouse are the closest surface water bodies to the proposed borrow pit located to north-east of Black Cat junction, being approximately 100 metres and 420 metres from the northern and eastern boundaries of the borrow pit.

13.9.36 Given the proximity of these surface water bodies to the borrow pit it is likely that there is hydraulic continuity between the groundwater in the RTD and these surface water bodies, with groundwater providing baseflow to the South Brook and the River Great Ouse. However, as these water bodies are outside the calculated zone of influence it is unlikely that the lowering of groundwater around the borrow pit would pose any significant risks to these surface water resource. Accordingly, a **no change** impact magnitude is anticipated. Refer to **Table 13-12** for details of the significance of effect of the Scheme on each relevant water body.

13.9.37 A summary of the significance of effects from dewatering activities at the locations of deep cuttings and borrow pits is provided below in **Table 13-12**.

**Table 13-12 Summary of significance of effects from dewatering of deep excavations on groundwater flow (cuttings and borrow pits)**

| Receptor | Impact | Importance | Magnitude of impact | Significance of effect |
|---|---|---|---|---|
| Secondary A Aquifer | Minor and deep excavations around the existing Black Cat area (western extent of the Scheme) | Medium | Minor adverse | Slight |
| Secondary undifferentiated Aquifer | Minor and deep excavations central and eastern areas of the Scheme up to Caxton Gibbet | Low | Minor adverse | Slight |
| River Great Ouse | Minor and deep excavations around the existing Black cat area (western extent of the Scheme) | Very High | No change | Neutral |
| South Brook | Minor and deep excavations around the existing Black cat area (western extent of the Scheme) | Very High | No change | Neutral |
| Rockham Ditch | Minor and deep excavations around the existing Black cat area (western extent of the Scheme) | Medium | Minor adverse | Slight |

*Groundwater quality*

13.9.38 Overall, no ground contamination has been reported or observed during the detailed 2019/2020 ground investigation for the Scheme (Ref 13-69). As discussed in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**, groundwater quality analytical results for water samples collected from 21 sampling points within the Order Limits indicated no significant groundwater contamination issues, except for one sampling point (WS275) located at a former fuel filling station in the Wyboston area at approximately 1.2 kilometres northeast from the existing Black roundabout that indicated localised hydrocarbon groundwater contamination. This sampling point (WS275) is located down the hydraulic gradient from the cuttings and borrow pits in the area and it is also outside the maximum calculated dewatering zone of influence from any of the cuttings or borrow pits. Provided best practice dewatering measures are followed in accordance with the proposed First Iteration EMP **[TR010044/APP/6.8]** and the proposed construction dewatering strategy, impacts on groundwater quality would be **low**.

13.9.39 Therefore, the risk of potential impacts on groundwater quality in the vicinity of the cuttings and borrow pits boreholes during dewatering or other associated construction activities including incidental spillages and or remobilisation of any unidentified contaminant during excavation would be low provided best practice dewatering and construction methodology, which would include groundwater quality monitoring, is implemented as provided in the First Iteration EMP **[TR010044/APP/6.8]** and the proposed construction dewatering strategy. However, areas of deepest excavation have been considered in more detail below.

13.9.40 In terms of impacts on groundwater quality, where construction works are undertaken in areas of **medium** sensitivity aquifer status (i.e. Secondary A aquifer) like the RTD, especially where these involve breaking into the ground such as excavations and the formation of cuttings, there is the potential for the excavations to act as preferential pathway for new contaminants to be mobilised into the groundwater and for adverse effects on groundwater quality due to the deposition or spillage of oils, fuels or other construction chemicals spilt on-site. Impacts on groundwater quality in areas of **low** sensitivity aquifer status (i.e. Secondary undifferentiated aquifer) such as the Till are likely to be very localised given the low permeability nature of the Till.

13.9.41 For the cuttings, both the Barford Road and the Alington Hill cuttings would involve excavation activities through low permeability Till that restrict groundwater flow with **low** importance. Accordingly, the magnitude of potential impacts on groundwater quality at the location of these cuttings as a result of construction activities is likely to be localised and a **negligible** magnitude impact is predicted. Please refer to **Table 13-13** for details of the significance of effect of the Scheme on each relevant water body.

13.9.42 The A1 underpass cuttings would involve excavation through a potentially permeable RTD with a **medium** importance. Accordingly, with the implementation of the embedded mitigation measures, the magnitude of potential impacts on groundwater quality associated with the excavation and construction of the A1 underpass cutting is likely to be localised and therefore a **minor** magnitude impact is predicted. Refer to **Table 13-13** for details of the significance of effect of the Scheme on each relevant water body.

13.9.43 For the proposed borrow pits in the area of Black Cat junction these would be located in areas underlain by aquifers of **medium** importance. It is likely that the excavation of these borrow pits can act as a preferential pathway for any new contaminants to be mobilised into the groundwater. It is understood that the pits would be backfilled using inert materials obtained from the construction of the Scheme, which are considered unsuitable on engineering parameters. Provided the backfill material is sampled and screened for contamination in line with the Scheme's materials management plan, the magnitude of potential impacts on groundwater quality due to material excavation and extraction activities and backfilling of the borrow pits is likely to be localised and a **minor** magnitude of impact is anticipated. Refer to **Table 13-13** for details of the significance of effect of the Scheme on each relevant water body.

13.9.44 **Table 13-13** provides a summary of the impact assessment for the potential effect of construction on groundwater quality.

**Table 13-13: Summary of effects of construction to groundwater quality**

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of effect |
|---|---|---|---|---|
| Groundwater in areas of secondary A aquifer | Medium | General construction works, cuttings and potentially borrow pits in the vicinity of the existing Black Cat junction towards the western extent of the Scheme | Minor adverse | Slight |
| Groundwater in areas of unproductive superficial and bedrock aquifer | Low | General construction works, minor and deep excavations in the central and eastern areas of the Scheme up to Caxton Gibbet (e.g. the proposed cuttings near Barford Road and Arlington Hill) | Minor adverse | Slight |

*Impact of dewatering large excavations and borrow pits on receiving watercourses*

13.9.45 All excavations but especially the deepest excavations, such as for road cuttings and borrow pits, and particularly those in the Black Cat area where there are RTD (i.e. the A1 Underpass and borrow pits to the northwest and northeast of the junction), have the potential to have ingress of groundwater. **Table 13-14** provides a summary of the estimated volumes of water that may need to be dewatered alongside estimate of normal flows from nearby watercourses:

## Table 13-14: Estimated volumes of water that may need to be dewatered

| Excavation | Estimated daily volume of water to dewater | | Estimated daily volume of water to dewater based on phased excavation (c. 20% of the total area/length for borrow pit/cutting)* | | Potential receiving watercourse (if discharged) | Estimated Normal Discharge^ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $m^3/d$ | | | l/s | | |
| | $m^3/d$ | l/s | $m^3/d$ | l/s | | Q10 | Q50 | Q95 | Q10 | Q50 | Q95 |
| Borrow pit to the northwest of Black Cat | 2775 | 32.12 | 957 | 11.08 | Rockham Ditch. | 1910 | 346 | 173 | 22 | 4 | 2 |
| Borrow pit to the northeast of Black Cat | 770 | 8.91 | 330 | 3.82 | South Brook (or River Great Ouse). | 20218 | 3283 | 1210 | 234 | 38 | 14 |
| A1 Underpass | 1500 | 17.36 | 300 | 3.47 | South Brook. | 20218 | 3283 | 1210 | 234 | 38 | 14 |
| Barford Road Cutting | 12 | 0.14 | <5 | <0.06 | Not defined as volumes are relatively small. | n/a | n/a | n/a | n/a | n/a | n/a |
| Arlington Hill Cutting | 65 | 0.75 | 13 | 0.150 | Not defined as volumes are relatively small. | n/a | n/a | n/a | n/a | n/a | n/a |
| Caxton Gibbet Borrow Pits (BPE&BPF) | 95 | 1.10 | <20 | <0.23 | Not defined as volumes are relatively small. | n/a | n/a | n/a | n/a | n/a | n/a |

*Refer to **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]** for details of how these estimates were made.

^Estimated using LowFlows Software.

13.9.46 Excavations for cuttings and borrow pits further east are unlikely to require significant dewatering given their shallow depth in relation to the water table/limited groundwater potential of the Till and thus can be managed using standard methods and are not considered in detail any further.

13.9.47 **Table 13-14** shows that only Rockham Ditch and South Brook may receive relatively large discharges of water dewatered from excavations and borrow pits, and the impact of this is assessed below.

Rockham Ditch

13.9.48 With reference to the estimated flow data presented in Table A4 in **Appendix 13.6** of the Environmental Statement **[TR010044/APP/6.3]**, the estimated maximum discharge from the borrow pit (BPA) to the northwest of Black Cat (if sequence of excavation is not phased) is equivalent to the annual mean Q6 flow. Looking at it on a seasonal basis, it could be as low as Q11 to Q18 in the winter, and up to between Q1-Q2 during the summer, when this watercourse may be liable to drying up (it was observed as dry in August 2018).

13.9.49 The discharge would be additional to what is existing within the Rockham ditch. For example, the annual mean flow (which is approximately Q23 (c. 0.01$m^3$/s)) would increase to approximately Q4 when considering that the maximum discharge into the ditch is proposed to be 0.032 $m^3$/s (therefore total mean flow would be 0.042 $m^3$/s). This would vary across the year and would be around Q10 in the winter.

13.9.50 If the discharge was phased and only 20% of the borrow pit was worked at any one time, the discharge would be equivalent to approximately Q23 (and Q10 in the summer). Q23 is also approximately the mean annual flow, and with a phased excavation of the borrow pit, the discharge from the borrow pit dewatering would increase this to around Q11 (i.e. approximately 0.021 $m^3$/s).

13.9.51 Dewatering the entire borrow pit would increase flows in Rockham Ditch and if sustained over long periods could have a greater risk of altering hydraulic habitats, causing scour and transporting excess fine sediment observed building up in the channel near to existing channel constrictions (such as culverts). However, this may be considered a benefit from a hydro-ecology perspective. For phased working of the borrow pit, where the rate of discharge would be smaller, the risk to Rockham Ditch would be proportionately lower.

13.9.52 Based on the above analysis, the temporary impact on baseline flows from discharging water from the excavation of the borrow pit to the northwest of Black Cat, could result in the mobilisation of excess fine sediment within the channel, but the risk of scour would be low as the flows would remain within those that typically occur, albeit they may be sustained over longer periods of time. A construction dewatering strategy, secured in the First Iteration EMP **[TR010044/APP/6.8]**, would also be prepared in consultation the Bedford Group of IDBs, Bedfordshire and River Ivel area (and potentially the Environment Agency if the water is considered to be 'unclean'), to determine a suitable method of discharge to Rockham Ditch. This would include agreement of a rate, duration and volume of discharges, and any monitoring and treatment measures that are required.

13.9.53 Rockham Ditch is considered to be of medium importance for water quality (taking into account biodiversity) and low importance for morphology. Overall, a minor adverse impact is predicted, resulting in a slight adverse effect on water quality (not significant) and morphology (not significant).

South Brook

13.9.54 With reference to the estimated flow data presented in Table A5 in **Appendix 13.6** of the Environmental Statement **[TR010044/APP/6.3]**, the combined estimated peak daily discharge from dewatering the A1 underpass and the borrow pit to the northeast of Black Cat is equivalent to the annual mean Q65 flow. On a seasonal basis, it could be equivalent to around Q95 (i.e. exceeded 95% of the time) in the winter (December to February) and around Q25 in August/September.

13.9.55 The discharge would be additional to what is flowing at any given time within South Brook but would still remain below Q10 based on the annual flow of 102 l/s (approximately Q23). The mean flow would therefore be around Q18 inclusive of the discharge. This would vary across the year and would be greater than Q10 May-September if the peak volume is discharged.

13.9.56 Based on the above analysis, the temporary impact on flows from discharging the estimated flows from the excavation of the A1 underpass and borrow pit to the northeast of Black Cat, is unlikely to have any significant impact on channel form, water quality or aquatic ecology. Maintaining higher flows through the summer (with appropriate treatment of water prior to discharge) might even provide beneficial support for river ecology during periods of low flow. A construction dewatering strategy, secured in the First Iteration EMP **[TR010044/APP/6.8]**, would also be prepared in consultation the Bedford Group of IDBs, Bedfordshire and River Ivel area (and potentially the Environment Agency if the water is considered to be 'unclean'), to determine a suitable method of discharge to South Brook. This would include agreement of a rate, duration and volume of discharges, and any monitoring and treatment measures that are required.

13.9.57 South Brook is considered to be of high importance for water quality (taking into account biodiversity) and low importance for morphology. Overall, a negligible impact is predicted resulting in a slight adverse effect on water quality (not significant), and a negligible effect on morphology (not significant).

*Navigation*

13.9.58 The construction of the River Great Ouse viaduct would require the temporary closures of the river for certain activities. The activities requiring this closure include lifting and fixing structural steel into position, construction of the concrete bridge deck and fixing of the parapets and drainage system. The works would not be continuous but would need periods of daytime closures while a particular activity is completed over the river and there would then be a break while this activity is completed on other spans of the viaduct that do not require river closures.

13.9.59 These construction works for the viaduct would take place over a period of up to 8 months during which there would be ten weeks of river closures.

13.9.60 There is potential for up to four weekend closures during the eight month period.

13.9.61 The temporary closures have the potential to result in an adverse impact on navigation during the identified construction period. However, in the context of the wider water body, the EA advise that this section of the river is not as heavily used as further downstream with approximate peak use of 50 vessels per day in summer (Ref 13-74). This stretch of river can also be circumnavigated using alternative navigable waterways between the Wash and Northampton (e.g. River Nene), from where Milton Keynes and Bedford can be accessed. However, given the limited period of time that the river would be shut at any one time (i.e. periods of 24 hours only), this is unlikely to be necessary or efficient.

13.9.62 Advisory notices of the closure would be published in advance on the *Anglian Waterways webpage* (Ref 13-71). This is standard practice in accordance with Section 15 of the *Anglian Water Authority Act 1977* (Ref 13-65) and is provided for in the DCO. This would allow recreational waterway users adequate time to plan for the proposed closure.

13.9.63 The construction of the bridge would not impact on the hydrology of the river or cause long term navigational disruption.

13.9.64 Overall, there would be an intermittent temporary (for approximately 8 months) minor adverse impact on the high importance (for navigation) River Great Ouse. This is considered an appropriate magnitude given the temporary nature of the impact on recreational use, and the safety measures that would be in place. This would result in a temporary slight adverse effect (not significant) during construction.

*Potential risk of flooding from fluvial sources during construction*

13.9.65 The construction phase of the Scheme would involve works in areas close to and within the floodplains of Hen Brook and the River Great Ouse. Should a fluvial flood event occur during construction this could be a significant risk to construction workers in the vicinity of watercourse crossings and on the floodplain, with the greatest risk occurring around River Great Ouse. For the viaduct construction there would be piers and embankment constructed within the floodplain area, this has potential to interrupt flood flows and create a local backwater.

13.9.66 The baseline fluvial flood risk could be exacerbated during construction works by the temporary increase in the rate and volume of surface water runoff from an increase in impermeable areas such as compacted soils, any on-going in channel works that may constrict or alter the flow within it, and the presence of stockpiled materials and equipment temporarily stored on the floodplain. Sediment, construction materials and equipment may also be washed downstream where it may block the channel and lead to or increase the risk of flooding.

13.9.67 However, with the implementation of standard construction methods and mitigation as described in this chapter and the First Iteration EMP **[TR010044/APP/6.8]** and OWMP this risk can be effectively managed (for example by monitoring weather forecasts and EA flood warnings, by undertaking works close to watercourses during periods of dry weather, by ensuring an adequate temporary drainage system was in place and maintained throughout the construction phase, and avoiding stockpiling material on floodplains). As such, the magnitude of flooding from these sources during construction, on site and further downstream, is considered to be negligible resulting in a slight effect (not significant).

*Potential risk of flooding from surface water sources during construction*

13.9.68 The Scheme would in general be at a low risk from surface water flooding, although in some areas associated with watercourses there are areas of medium and high risk (such as those close to the River Great Ouse). However, during the works existing surface flow paths may be disrupted and altered due to site clearance, earthworks, and excavation work. The exposure and compaction of bare earth and the construction of new embankments and impermeable surfaces may increase the rates and volume of runoff and increase the risk from surface water flooding. However, with the implementation of standard construction methods and mitigation measures described in this chapter and in the First Iteration EMP **[TR010044/APP/6.8]**, this risk can be effectively managed. As such, the magnitude of flooding from these sources during construction is considered to be negligible resulting in a slight adverse effect (not significant) in the area of the River Great Ouse, and neutral elsewhere on the Scheme.

*Potential risk of flooding from artificial sources during construction*

13.9.69 From the FRA (refer to **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**) the risk of flooding from artificial sources within the study area is considered to be low. Based on this assessment, the current risk of flooding from artificial sources is considered to be no change, resulting in a neutral effect (not significant).

*Potential risk of flooding from groundwater sources during construction*

13.9.70 Huntingdonshire District Council's published *SFRA* (Ref 13-34) for the area indicates that the risk of groundwater flooding in the study area ranges from low (<25% chances of groundwater flooding risk) to high (>75% chances of groundwater flooding risk). The western (i.e. around the existing Black Cat roundabout area) and eastern part (i.e. the existing Caxton Gibbet roundabout area) of the Scheme lies within the 1 kilometre (0.6 mile) grid squares that indicate a high (i.e. >75%) risk of groundwater flooding while the central area of the Scheme lies within the 1 kilometre grid squares that indicate low risk of groundwater flooding. It is noted however that the published map should be viewed with caution as it was produced from a regional-scale model and as such the risk of groundwater flood may vary in principle from actual site-specific ground conditions.

13.9.71 Groundwater flood risk in the area is primarily due to permeable superficial deposits which tend to have a relatively high-water table and are in hydraulic connection with the main and/ or ordinary water courses in the area.

13.9.72 Groundwater level varies significantly across the Scheme. In the western part of the Scheme, groundwater levels range from 0.5 metres to 5.5 metres BGL, while in the central part of the Scheme, levels range from 0.5 metres to 9 metres BGL. In the east, groundwater levels range between 0.5 metres and 13 metres BGL. The risk of groundwater flooding is likely to arise and impact on elements of the Scheme such as cuttings and borrow pits that are located in areas with shallow groundwater conditions. Accordingly, some cutting excavations may liberate groundwater in some areas in the form of seepages from any water-bearing higher permeability zones within the superficial deposits that are intercepted. Open excavations in some locations may also be more prone to becoming inundated by groundwater.

13.9.73 As discussed in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**, the depth to groundwater level at the location of the majority of the cuttings is greater than >3 metres BGL and the cuttings only minimally (i.e. <1 metre) intercept the water table at most of these locations which are underlain by the low permeability Till, and as such, the potential risk of groundwater flooding on the cuttings would be **low**. The only exceptions are at the locations of the A1 underpass cutting, Barford Road cutting and Alington Hill cutting where the need for dewatering is required to maintain dry ground conditions to facilitate construction as the groundwater level at this location is less than <1.5 metres BGL and as such the risk from groundwater flooding would be **high**. However, it is anticipated that the risk would be mitigated by the proposed temporary dewatering system to be used during construction at the location of each cutting. The maximum potential dewatering inflows estimated at the Barford Road cutting and Alington Hill cutting were no more than **150m$^3$/day** due to the limited groundwater potential and the low permeability nature of the Till. Therefore, provided best practice dewatering measures are followed during construction dewatering, the potential risk of groundwater flooding to the Scheme would be **low**. Accordingly, given the **low** sensitivity/importance of the aquifer in the Till, the magnitude of impact from groundwater flooding risk is considered to be **minor adverse**, resulting in a **slight significance effect**.

13.9.74 The A1 underpass cutting is located in an area underlain by higher permeability Alluvium and River Terrace Deposits with shallow groundwater level of <1.5 metres BGL with the base of the cutting at approximately 5.7 metres below the water table and as such the risk from groundwater flooding during construction excavation is **high.** The maximum potential dewatering inflows at the A1 underpass cutting is estimated to be approximately **2,240 m$^3$/day**. Accordingly, given the medium sensitivity/importance of the aquifer in the Alluvium/River Terrace Deposits, the magnitude of impact from groundwater flooding risk on the Scheme during construction is considered to be **moderate adverse**, resulting in a **moderate significant effect**. However, provided best practice dewatering mitigation measures are undertaking during construction with adequate drainage facilities, this would further reduce the magnitude of impact to **minor adverse**, resulting in a **slight significance effect**.

13.9.75 The impact of dewatering the borrow pits near Black Cat junction are unlikely to have an adverse flood impact on nearby watercourses providing flow rates to the watercourse are controlled over a period of time, ensuring that this discharge does not occur while water levels are elevated in the channel as a result of heavy rain. Controls on dewatering rates (and treatment required) would be in accordance with the dewatering strategy secured by the First Iteration EMP **[TR010044/APP/6.8]**.

*Potential risk of flooding from drainage infrastructure during construction*

13.9.76 The Scheme is at low risk of flooding from sewers and other water supply infrastructure as confirmed in the FRA (refer to **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3]**). Taking into account embedded mitigation, and the diversion of any drainage infrastructure being carried out after liaison with the statutory undertaker, Anglian Water, it is considered the magnitude of impact from these sources during construction is no change, on a receptor of very high value, resulting in a neutral effect (not significant). The summary of the effects of construction to flood risk for all sources of flood risk is given in **Table 13-15.**

**Table 13-15: Summary of effects of construction to flood risk**

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of Effect |
|---|---|---|---|---|
| Flood zone 2/3 associated with River Great Ouse | High | Fluvial flooding | Negligible | Slight adverse (not significant) |
| Flood zone 2/3 associated with Stone Brook, South Brook, Begwary Brook, Hen brook, Fox Brook, Gallow Brook, and West Brook | High | Fluvial flooding | Negligible | Slight adverse (not significant) |
| Areas associated with surface watercourses | High for the Ouse, and High for other flood zones, Low elsewhere | Surface water flooding | Negligible | River Great Ouse and other flood zones: Slight adverse (not significant); elsewhere Neutral (not significant) |
| Scheme area | Low | Flooding from artificial sources | No change | Neutral (not significant) |
| Western area of the Scheme with groundwater levels at depth <3m BGL where dewatering is required in permeable stratum | Medium | Flooding from groundwater sources | Minor | Slight |
| Scheme area with groundwater levels at depth >3 m BGL where dewatering is required in low permeability stratum | Low | Flooding from groundwater sources | Minor adverse | Slight |

| Receptor | Importance | Description of impact, pathways and scale/risk | Magnitude of impact (with mitigation) | Significance of Effect |
|---|---|---|---|---|
| Scheme area | Low | Flooding risk from drainage infrastructure | No change | Neutral (not significant) |

### Operation

*Surface water quality: routine road runoff*

13.9.77 The HEWRAT quantitative assessment for routine road runoff, groundwater and assessment of accidental spillage risk to the water environment potentially impacted by the Scheme has been undertaken in accordance with *LA 113* (Ref 13-43). A number of local road catchments, both existing and new, cover a small area and / or have low traffic flows (<10,000 AADT). These are detailed within **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]** but only a qualitative assessment of these catchments has been undertaken in this section as they are not considered to result in any significant risk to surface water bodies. An assessment of routine runoff from two existing outfalls that would be retained as part of the new dual carriageway has also been undertaken.

13.9.78 The two existing drainage catchments are Networks 2 and 20, see **Table 13-7**). Network 20 drains to the headwaters of West Brook via the existing Caxton Gibbet pond (Network 20, see **Table 13-7**) and passes all the EQS of the HEWRAT and spillage risk assessment (refer to **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]**). Network 2 drains via an existing A421 pond and was found to fail in the existing scenario for soluble metals for acute failures. The current treatment by a dry pond is not effective at treating soluble metals in highway runoff. However, with the Scheme the road catchment area within Network 2 would be reduced, an VFS would be provided, and a wet treatment area incorporated within the pond area. With this mitigation, Network 2 would pass all criteria of the HEWRAT and spillage risk assessment.

13.9.79 For the with Scheme scenario, the HEWRAT assessment identified that in the absence of additional mitigation:

13.9.80 Drainage networks; 6, 7, 8, 9, 13, 14, 14a, 20, 21, 23 and 24 pass the assessment.

a. Drainage networks 4 and 12 fail for sediment-bound pollutants only.

b. Drainage networks: 2, 3, 5, 10, 11, 15, 16, 17, 18, 19, and 22 fail for soluble heavy metals and sediment-bound pollutants.

13.9.81 Analysis of the levels of bioavailable copper through the M-BAT tool show bioavailability levels would be within the EQS limits for copper. The annual average concentrations of zinc pass the EQS without the need to carry out the M-BAT assessment.

13.9.82 In light of these failures, a mix of sustainable drainage measures and proprietary measures have been proposed in the Drainage Strategy (refer to **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**) to treat highway runoff to the required standard based on the HEWRAT risk based assessment. The Scheme design includes: dry attenuation basins, dry attenuation ponds with wet treatment zones, grassed channels, swales and ditches, and VFS where design constraints limited other options, to provide treatment as outlined in **Table 13-7** for each road network and outfall. Once this mitigation is incorporated, all of the twenty-five networks quantitatively assessed meet the required standards.

13.9.83 Cumulative assessments were also carried out for any discharges that were within 1kilometre (0.6 miles) of each other for soluble pollutants, or 100m of each other for sediment-bound pollutants. These included highway outfalls to Rockham Ditch, Begwary Brook, Wintringham Brook tributary, and a ditch watercourse adjacent to the A1198 at Caxton Gibbet which flows towards Eastern Brook and ultimately the Bourn Brook. Begwary Brook passes the cumulative assessment with no sensitivity analysis.

13.9.84 For the single and cumulative outfall assessments, the dissolved zinc passes the Annual Average EQS assessment. For dissolved copper the M-BAT assessment has been carried out and concludes that bioavailable copper is less than the annual average EQS concentration, and therefore passes the assessment.

13.9.85 For watercourses with an estimate low receiving flow (Q95), the cumulative HEWRAT assessment shows some instances of soluble acute copper failures (Rockham Ditch receiving flow of 2 l/s, and 1 l/s for Wintringham Brook tributary and the small watercourse adjacent to the A1198,). For Rockham Ditch the results show that with the Scheme there might be 3.5 exceedances of the 24 hour Runoff Specific Threshold. This is an improvement over the existing situation where 6 exceedances per year of the 24 hour RST are predicted. The sediment bound pollutants pass the assessment.

13.9.86 For the Wintringham Brook tributary and watercourse next to the A1198, the cumulative assessment with a treatment train shows some exceedances of the 24 hour RST. However, the numerical treatment efficiencies within *CG 501* (Ref 13-45) are indicative and a starting point for the calculations. In providing a three step treatment train it is likely that the efficiency of mitigation would be increased over the 'indicative' numbers given within *CG 501* (Ref 13-45). It is considered a three step treatment train would supply the additional 5% required over that provided by the indicative treatment efficiencies. Therefore, with a three step treatment train within the Scheme design, this would result in a pass of the numerical assessment.

13.9.87 In the Caxton Gibbet area, the cumulative impact assessment has been carried out for Networks 20, 21, 22 + 23 which outfalls into an existing ditch watercourse adjacent to A1198 Ermine Street South. As for the discussion for Wintringham Brook, provision of a multistage treatment train is likely to provide increased mitigation over the 'indicative' numbers within *CG 501* (Ref 13-45). It is considered that the mitigation included within the drainage design would provide the additional 12% required for the numerical assessment to pass the acute copper assessment.

13.9.88 HEWRAT was not designed for water quality assessment for the smallest headwater channels and field ditches, with the focus being on protecting the more significant channels further downstream. Therefore, for watercourses with low flow (Rockham Ditch, tributary of Wintringham Brook, and headwaters of West Brook) , a sensitivity analysis was undertaken to determine what increase in flow would result in a pass and the results are provided in **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]**). Watercourses with low receiving flow were also assessed for risk using Annex C of *LA113* (Ref 13-43). This assessment is presented below.

13.9.89 For both existing and new local road catchments that were considered to have only small impermeable areas and/ or predicted low traffic flows (<10,000 AADT) no quantitative HEWRAT assessment has been carried out. The HEWRAT quantitative assessment includes banded traffic flows from 10,000 upwards and thus to apply it to roads where the traffic flows may be substantially lower than this would be overly conservative. Instead, a qualitative assessment has been undertaken for these catchments. All catchments, except one, include SuDS treatment measures (i.e. new ditches and some with treatment ponds) which provide a reduction in sediment-bound pollutants and dissolved metals in highway runoff. The exemption to this is the Roxton Road Link North catchment, where the flow is to be attenuated using oversize pipes and restricted flow rate. However, this road catchment is just 0.1ha in size with a daily traffic flow of less than 2000 vehicles, and thus the water quality risk is considered to be very low.

13.9.90 Overall, using the criteria in Table 13-2a minor beneficial impact is predicted to Rockham Ditch (of medium importance) due to the improvement in the results of the HEWRAT assessment from an existing failure to a pass with the new mitigation measures included. This would improve the quality of runoff from the existing A421, which would result in a slight beneficial effect (not significant).

13.9.91 For Wintringham Brook tributary and watercourse next to the A1198, the cumulative assessment with the treatment trains would pass the numerical assessment. Using the criteria in **Table 13-2**, this is considered to result in a potentially negligible impact. This results in a slight adverse effect (for high and medium importance water body respectively) (not significant).

13.9.92 For all other water bodies, and with reference to the criteria in **Table 13-2**, where no risks (both acute soluble and chronic sediment related pollutants) are identified by HEWRAT a negligible impact is predicted, resulting in a slight adverse (for high and very high important water bodies) to neutral (for medium or lower important water bodies) effect, that is not significant in all cases.

*Routine road runoff assessment: Impacts on groundwater*

13.9.93 Road drainage networks 5, 10, 11, 15, 16, 19, 20, 21 and 22 all discharge to minor drainage ditches, which are estimated to have Q95 low flows below 0.001m$^3$/s. Therefore, these networks were also assessed as soakaways using the groundwater risk assessment method in Annex C of *LA 113* (Ref 13-43).

13.9.94 The results of this assessment are described in full in **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**. All the outfalls have been assessed as representing a medium risk to groundwater in terms of quality. No infiltration features or soakaways are proposed for treatment or disposal within the proposed design due to either low permeability superficial deposits or relatively high groundwater levels (please refer to **Appendix 13.3** of the Environmental Strategy **[TR010044/APP/6.3]** ). The use of attenuation ponds are suitable mitigation measures, which provide protection of both groundwater resources and surface watercourses.

13.9.95 As no routine road runoff is directed to groundwater, it is considered the routine road runoff would result in a negligible impact to groundwater. This would result in a neutral (not significant) effect to groundwater (both the Secondary A aquifer and the Secondary undifferentiated aquifer).

*Surface water quality: accidental spillages*

13.9.96 The probability that an accidental spillage would lead to a serious pollution incident has been calculated for each road catchment and for the cumulative outfalls. All the catchments have returned an acceptable standard of spillage risk. Full results are included within **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**.

13.9.97 It is predicted that the potential impact on the receiving watercourses is permanent, long term but negligible, resulting in a neutral or slight adverse (not significant) effect depending on the importance (very high to medium) of each water body (refer to **Table 13-6**).

*Surface water quality: surface de-icing*

13.9.98 When temperatures are around 4°C or less, de-icing salts would likely be applied (when required) to the Scheme to maintain a safe driving surface and to help clear away any snow fall. The application of de-icing salts tends to be intermittent and can be very variable between years depending on how many cold days there are, and how long the cold period lasts. During this time, highway runoff (that may also include snow melt) may contain sodium chloride (NaCl) and lesser amounts of clay, cyanide, sediment, and a number of metals. De-icing salts can also be corrosive to metals and may potentially increase the mobilisation of heavy metals in sediments (such as in highway treatment ponds). Similarly, NaCl can potentially trigger the release into solution of accumulated nutrients and heavy metals absorbed to suspended solids.

13.9.99 Generally, it is considered that because de-icing salts are used only infrequently and in the colder months, over short periods and with frequent higher flows in between in which to dilute and disperse 'salty' water, and when flora tends to have died back and fauna is less active and dormant, significant long term adverse effects are not likely to occur. SuDS systems may also provide some dilution of salt, although they are not generally considered to reduce salinity and there is a risk that the 'salty' water can re-mobilise metals deposited in the sediments.

13.9.100 While de-icing salts have often been linked to detrimental impacts to aquatic ecosystems, and macroinvertebrates in particular (Ref 13-60), there are also numerous scientific reports indicating that road salts do not induce significant acute negative responses on macroinvertebrate communities, but that responses are variable at the species level, where different tolerances are observed (Ref 13-61; Ref 13-62). These latter studies considered short term/ pulsed exposures of road salt on macroinvertebrate communities where there were short residence times for the de-icing. It was considered that salt could accumulate and have more detrimental impacts in more restricted-flow systems leading to potential chronic effects on fauna.

13.9.101 The de-icing regime would be purely weather dependent, with decisions made regarding when to grit the road based on three weather updates per day. As a broad indication of spreading rates, the *Highways Winter Maintenance: A Practical Guide* (Ref 13-63) suggests 10 to 20g/$m^2$ of salt in a precautionary salting, increasing to 20-40g/$m^2$ prior to snowfall or rain followed by freezing. Whilst the Scheme would result in new impermeable areas and new outfalls to the watercourses crossed by the Scheme, all of these watercourses are currently already crossed by the existing A428 and would thus be affected to an extent already by the application of de-icant salts. It is thus likely that the aquatic communities of these watercourses are already exposed to de-icant salts, and thus may already have adapted to seasonal exposure to them.

13.9.102 *Cambridgeshire County Council's gritting map* (Ref 13-73) shows that the following are currently gritted: existing A428, A1 and some major roads in the area (B1428 to Cambridge junction area, B1046 southwards to Abbotsley, Toseland Road north from Croxton, B1040 north and south from Eltisley). There are no details of the days of de-icant applications. However, from the weather station at Bedford there are on average around 50 days of frost (air) each year and the frequency of applications would be expected to be less than this.

13.9.103 The Q95 flows for the majority of receiving watercourses in the area (estimated from Lowflows software analysis) are in the region of 0.001 – 0.002$m^3$/s, with 0.018$m^3$/s for Hen Brook and 0.014$m^3$/s for South Brook. However, the flow in the River Great Ouse is substantially greater and it is likely to be far less sensitive to de-icant salts. Overall, it is considered that there would be a negligible impact on the River Great Ouse and seasonal but long term and temporary minor adverse impacts on all other receiving watercourses when road salts are washed off the carriageway. This would result in a slight adverse (not significant) effect on the Begwary Brook, Hen Brook, and Bourn Brook (as all are of high importance for water quality), and a slight adverse (not significant) effect for all other highway runoff receiving watercourses.

*River Morphology: watercourse crossing structures/diversions/realignments*

13.9.104 The following presents the impact assessment of new structures, diversions and realignments. It should be read alongside the information presented in the WFD Assessment, **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]**. This provides more information in the impact of culverting not just on physical form and processes, but also on aquatic ecology.

13.9.105 The Scheme design includes the construction of culverts on the watercourses crossed by the Scheme (i.e. Rockham Ditch, South Brook, Begwary Brook, tributaries of Stone Brook, Hen Brook and tributaries HB1/2/3/4, Wintringham Brook and tributaries WB1/2, Gallow Brook and tributary GB2, Fox Brook and tributaries FxB 2/3, headwater tributaries of West Brook Wst1/2/4/5, and minor tributary RGO2 of the River Great Ouse) and one clear-span viaduct over the River Great Ouse. These structures, together with associated watercourse diversions are described in Section 13.8.

13.9.106 The River Great Ouse would be crossed by a clear span viaduct structure with a soffit above the 1:100 year flood event level with 35% allowance for climate change and 600mm freeboard and requirements for navigation. No structures are to be located within the channel of the watercourse. Supporting piers would be set back from the top of the bank by a minimum of 2 metres. Overall, and with reference to the criteria in **Table 13-2**, given the size of the River Great Ouse (and its low importance for morphology), the Scheme is predicted to result in no permanent and long term change in hydromorphology, resulting in a neutral effect (not significant).

13.9.107 The detailed design for the culverts/ watercourse crossings aims to minimise changes in river alignment and length as much as is feasible. As stated in the embedded mitigation described in Section 13.8, the culverts would be designed to be of an appropriate size compared to the existing channel and for flood risk management, with a sunken bed where possible to maintain existing flow conditions, and channel diversions would be designed to minimise changes in river realignment. Following construction, the channel bed of all new culverts would be naturalised to minimise impacts on ecology, hydrology and sediment transport processes.

13.9.108 Embedded design mitigation would help to reduce adverse impacts from new culverts by maintaining fluvial processes and avoiding step changes in the bed and allowing for a naturalised bed to form. However, each culvert would still result in the unavoidable permanent loss of a section of open channel and surrounding riparian habitat depending on the length of the culvert.

13.9.109 To mitigate for this, new lengths of channel are being provided where watercourses need to be diverted and realigned at crossing locations or in a small number of locations, re-routed. Across the Scheme the total length of new channel created would be greater than that lost to culverts. The design of proposed watercourse diversions and re-routed channels would be in keeping with industry best practice and informed by a geomorphologist and ecologist. Given the modified character of watercourses in the study area there is potential to provide betterment on the existing channel form and function along these new channels. In addition, riparian habitat lost through culverting would in part be

compensated for by the creation of new riparian habitat along highway drainage and land drainage ditches, that would connect with the existing watercourse networks helping to extend green corridors. Please refer to **Table 5-4** of the WFD Assessment in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]** for full details of the channel lengths involved.

13.9.110 The Scheme is also committed to delivering further enhancement of watercourses within the Order Limits, the scope of which would be defined by a WFD Mitigation and Enhancement Strategy, to be prepared during detailed design post-DCO consent (please refer back to Section 13.8 for further details). Please refer to **Table 5-4** of the WFD Assessment in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]** for full details of the channel lengths involved.

13.9.111 The scope of improvement works would be defined by a WFD Mitigation and Enhancement Strategy, which is secured through the First Iteration EMP **[TR010044/APP/6.8]**, and which would be prepared at the detailed design stage post-DCO consent in consultation with relevant regulators (such as the EA). Section 13.8 provides further details on the WFD mitigation and enhancement Strategy.

13.9.112 **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]** provides a more detailed assessment of the hydromorphological impacts to watercourses, the mitigation proposed, and the potential for future watercourse enhancement, but to summarise:

a. **River Great Ouse Catchment** – Within the River Great Ouse catchment it is proposed to construct 16 culverts of which four are existing structures (i.e. S30, S56, S85, S43, E72, E76, E77, S73, S75, S79, S80, S89, E74, S4, S90, and S91). In total, 548 metres of existing channel would be culverted by the Scheme (603m with 10% added should proposed lengths slightly change during detailed design). However, diversions associated with some of these structures would create approximately 436 metres of new channel, with a further approximately 1027 metres created from re-routed minor headwater watercourses. In addition, new land drainage ditches would create new riparian habitat connected to existing watercourses (approximately 9180 metres). The design of culverts, the creation of new lengths of channel and riparian habitat along new highway drainage ditches and land drains would compensate for the loss of channel from proposed culverts. The Scheme is also committed to supporting enhancement of local watercourses and within this catchment approximately 2.65 kilometres (1.65 miles). However, approximately 3 kilometres (1.8 miles) of watercourse within the Order Limits has been identified for possible enhancement (1543 metres of which is within the Highway Boundary). This includes reaches across Rockham Ditch, South Brook and Gallow Brook in addition to some unnamed watercourses.

b. **Begwary Brook** – Two culverts are proposed (E15 and S16), one of which is an existing culvert beneath the A1 that would not be lengthened (E15). In total the combined length of the two culverts is approximately 63 metres, although only 25 metres of new culverting would be required (27.5 metres with 10% added should proposed lengths slightly change during detailed design). Although the new culvert would be designed to ameliorate what impacts can be addressed through design, it would result in the loss of part of the channel where the new structure would be constructed. No significant channel diversion would be required and following a review no opportunities for channel enhancement have been identified. Mitigation for the loss of habitat along Begwary Brook would be by the creation of new riparian habitat along drainage ditches with approximately 85 metres proposed.

c. **Tributaries of Stone Brook** – Nine new culverts are proposed on heavily modified 1st order headwater tributaries of Stone Brook (i.e. S11, S12, S44, S46, S48 S49, S82, S83 and S84). In total, 268 metres of existing channel would be culverted (295 metres with 10% added should proposed lengths slightly change during detailed design). However, diversions associated with these structures would result in more than 372 metres of new channel being created. These channels would be designed in keeping with best practice and aim to be an enhancement on the current modified and impacted channel form (see Section 13.8). In addition, new land drainage ditches would provide opportunities to create new riparian habitat connected to existing watercourses (approximately 4640 metres of ditch is proposed). The Scheme is also committed to supporting enhancement of local watercourses and within this catchment approximately 390 metres of watercourse within the Order Limits has been identified for possible enhancement (all outside of the highway boundary).

d. **Hen Brook Catchment** - Within the Hen Brook catchment it is proposed to construct 15 culverts (i.e. S53, S64, S86, S87, S19, S20, S23, S26, S41, S42, S21, S22, S24, S29, and S55). In total, 293 metres of existing channel would be culverted by the Scheme, although much of this is on minor, modified, 1st order channels (322 metres with 10% added should proposed lengths slightly change during detailed design). However, diversions associated with some of these structures would create approximately 1019 metres of new channel, and although this would be offset against a further 480 metres of headwater small channels that would be lost to re-routing of the watercourse (there is no proposal to infill these depleted reaches but they would be disconnected from the upper catchment and are likely to become non-flowing ditches) this still represents a net gain in channel length when compared to the baseline. In addition, new land drainage ditches would provide opportunities to create new riparian habitat connected to existing watercourses (approximately 6978 metres). The design of culverts, the creation of new lengths of channel and riparian habitat along new highway drainage ditches and land drains would compensate for the loss of channel from proposed culverts. The Scheme is also committed to supporting enhancement of local watercourses and within this catchment approximately 1.9 kilometres (1.2 miles) of watercourse within the Order Limits has been

identified for possible enhancement (698 metres of which is within the Highway Boundary). This includes reaches along the main channel of Hen Brook itself, as well as Wintringham Brook and other unnamed tributaries.

e. **Headwaters of West Brook** - Within the West Brook catchment it is proposed to construct 13 culverts (i.e. S35, S36, S37, S39, S59, S63, S65, S66, S67, S68, S69, S70, and S71). In total, 389 metres of existing channel would be culverted by the Scheme, although all are on minor, modified, 1st order headwater channels (428 metres with 10% added should proposed lengths slightly change during detailed design). However, diversions associated with some of these structures would create approximately 134 metres of new channel, with a further approximately 356 metres created from re-routed minor headwater watercourses. In addition, new land drainage ditches would provide opportunities to create new riparian habitat connected to existing watercourses (approximately 9730 metres). The design of culverts, the creation of new lengths of channel and riparian habitat along new highway drainage ditches and land drains would compensate for the loss of channel from proposed culverts. No opportunities for additional enhancement of watercourses was identified, in part due to the small watercourses affected in this catchment already being improved along proposed diversions or there being very limited space within the Order Limits.

13.9.113 With reference to **Table 13-2**, with the appropriate design of each culvert and the implementation of mitigation to be provided through the design of new lengths of watercourse, improvement works to existing channels within the Order Limits, and the creation of new riparian habitat along land drainage ditches that would be connected to the existing green-blue corridors, a minor adverse impact is predicted on all watercourses. Refer to **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]**, for details of the assessment of potential impacts on specific ecological species and habitats.

13.9.114 As all watercourses crossed by the Scheme are considered to be of low importance in relation to morphology, due to their highly modified nature, the overall impact of culverting, diversions and re-routing coupled with the proposed mitigation, would result in a slight adverse effect (not significant) with regard to river morphology.

*River morphology: outfalls*

13.9.115 The outfalls from five of the new road catchments and attenuation ponds would be by new ditches thus avoiding the need for an engineered outfall in these locations (i.e. to Rockham Ditch, RGO1, South Brook, StB6, and Gallow Brook). However, it has not been possible to avoid engineered outfalls in some situations on every watercourse.

13.9.116 No highway outfall would be greater than 300mm diameter and would be carefully micro-sited to minimise any adverse impact on the receiving watercourse. Regarding land drainage, these would be new ditches (other than small sections where there would be filter drains) and would connect with existing watercourses without the need for engineered outfalls. The design of the connection would be informed by suitable site survey by a geomorphologist and an ecologist, and opportunities for biodiversity enhancement would be considered (please refer to Section 13.8 for details of the proposed WFD mitigation and enhancement strategy).

13.9.117 Overall, the placement of a new engineered outfall would result in the loss of a small amount of bankside habitat, but through appropriate design, no long term impacts on channel morphological processes are expected. Highway outfalls (strategic road network and local roads) are required to: Rockham Ditch, South Brook, Begwary Brook, Stone Brook and tributaries, Hen Brook and tributaries, Wintringham Brook and tributaries, Gallow Brook and tributaries, headwater tributaries of West Brook, and headwater tributaries of Bourn Brook (via Eastern Brook), and other unnamed tributaries of the River Great Ouse. The placement of engineered outfalls on these watercourses would result in a minor adverse impact. As the affected watercourses are all classed as of low importance for morphology, but due to the multiple outfalls that would be required, a slight adverse effect (not significant) is predicted on watercourses where highway outfalls are proposed.

*Groundwater flow*

13.9.118 As shown in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]** the Scheme includes the excavation of several permanent cuttings, the majority of which would not intercept with or would only minimally intercept the groundwater table given the depth to the groundwater table at the locations of the cuttings. Also, the majority of the cuttings are located in the area (i.e. from the East Coast Main Line area through the central and eastern area of the Scheme up to the Caxton Gibbet Junction) directly underlain by the Till, which has limited groundwater potential and low permeability that resists groundwater flow. Consequently, in the finished road condition, the drainage invert of the cuttings would have no contact or only a minimal interception with the groundwater table in the Till.

13.9.119 Accordingly, it is concluded that no groundwater control measures would be required at the locations of these cuttings during the operational phase, and hence there would be a **no change** impact on groundwater flow. The only exceptions to these are the cuttings to the west which intercept the groundwater table at greater depths, and these are discussed further below.

13.9.120 For the cuttings to the west of the Scheme which are also directly underlain by the low permeability Till, it is concluded that the magnitude of impact and significance of effects on groundwater flow would be similar to that of the other cuttings to the east of the Scheme. A **no change** magnitude of impact on groundwater flow and lever is anticipated, resulting to a **neutral significant effect**.

13.9.121 For the remaining proposed cutting (i.e. the A1 underpass cutting) at the existing Black Cat roundabout, to the west of the Scheme that is underlain by the Alluvium and River Terrace Deposits with moderate to high permeability, the impact on groundwater flow and level would be slightly different given the shallow (i.e. <2 metres BGL) groundwater condition in this area and the potential ingress of groundwater into the Scheme. The cutting would be up to 8 metres BGL and would intercept the groundwater table up to 6.7 metres below the water table with a saturated water-bearing zone of up to 5 metres from the base of the cutting. The cutting would fall to the northeast from approximately 19.80 metres AOD to approximately 13.60 metres AOD before rising again northeast to approximately 18.80 metres AOD.

13.9.122 Analytical assessment, as detailed in **Appendix 13.7** of the Environmental Statement **[TR010044/APP/6.3]**, indicated a dewatering drawdown radius of influence of approximately 138 metres with an estimated dewatering inflow volume of about 1,465 m3/day would be required over the full length of the cutting to temporarily dewater and maintain dry ground condition to facilitate the construction of the cutting. During the operational phase of the Scheme, it is anticipated that similar or slightly reduced radius of influence and inflow volumes of groundwater would still need to continuously be permanently dewatered or diverted from the cutting to prevent groundwater ingress to the road and drainage systems and maintain the groundwater level below the base of the completed cutting. Assuming a permanent groundwater dewatering pumping system is used, it is anticipated that the magnitude of impact on groundwater level and flow would be moderate adverse, resulting in a moderate significance effect. However, several dewatering options are being considered to avoid using a continuous permanent dewatering pumping system to prevent or reduce groundwater ingress to the road and drainage systems for the Scheme. These options would incorporate but not be limited to the use of groundwater flow path barriers/creation of a sealed system involving secant piled walls with slurry walls behind, to be defined during the detailed design. Accordingly, provided the final design option is effective and does not include a continuous permanent dewatering pumping system, it is anticipated that the magnitude of impact on groundwater flow and level and other water receptors would be significantly reduced to minor adverse, resulting in a slight effect (not significant).

13.9.123 Additionally, subject to the final detailed dewatering design option, it is assumed that a small proportion of baseflow to nearby watercourses may be lost as a result of the A1 permanent dewatering system design, and it may be that a small proportion of groundwater from the vicinity of the A1 underpass cutting would be drained into the drainage system for the Scheme. However, it is anticipated that any drained groundwater due to flow interception would be appropriately discharged to any affected nearby watercourses to minimise any impacts resulting from loss of baseflow. Therefore, taking into account the proposed drainage strategy for the Scheme, embedded mitigation measures, the lateral extent of the aquifer and the overall baseflow from the aquifer to nearby watercourses such as the River Great Ouse which is of very high importance, it is considered that the magnitude of impact on the flow in the river would be negligible, resulting in a slight adverse effect (not significant). Similarly, the

magnitude of impact on the South Brook and Rockham Ditch that is both within the vicinity of the cutting and also of medium sensitivity/importance would be no more than minor adverse, resulting in a slight adverse effect (not significant). Other than the River Great Ouse, South Brook and Rockham Ditch, there are no other water receptors in the vicinity of the cutting that is likely to be impacted.

*Ponds: impacts on morphology and surface water quality*

13.9.124 Pond 3 is located downstream of the Scheme along Begwary Brook. Pollutants from highway runoff discharged to Begwary Brook may propagate to Pond 3. Road runoff from the A1 already discharges to Begwary Brook. In addition, the HEWRAT assessment presented in **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]** states that the risk to Begwary Brook from routine runoff and spillages is very low and there is no need for any treatment or containment measures. Therefore, it is considered this would result in a negligible change to water quality within Pond 3. On a medium importance receptor this results in a slight adverse effect to the water quality within Pond 3. There would be no changes to the morphology of Pond 3.

13.9.125 The Scheme includes the permanent partial loss of Pond 20. Pond 20 is located southwest of New Alington Top Farm Bridge, the construction of the overbridge and associated drainage would result in a permanent loss of the northern part of the pond. This is considered to result in a moderate adverse impact on the morphology of the pond, and on a low important water body this results in a slight adverse effect (not significant). There would be a no change impact to water quality within Pond 20 during operation, as no mainline Scheme drainage is directed to Pond 20. This results in a neutral effect (not significant).

13.9.126 Ponds 9 and 83 are currently road balancing ponds. The Scheme would continue to use these as balancing ponds. Pond 9 would have a decreased catchment area of approximately 2ha for the Scheme. Pond 83 has a decrease in catchment area of approximately 0.5ha. It is considered there would be a negligible change in the morphology and water quality of these ponds, which on high importance water bodies, result in a slight adverse effect (not significant).

13.9.127 Ponds 2, 22, 37, 84 and 85 are within the footprint of the Scheme and would be lost. Of these ponds 2, 22 and 85 are considered to be low importance receptors, and 37 and 84 considered to be high importance receptors (on the basis of the potential presence of GCN; not confirmed through survey). The loss of each pond is considered to be a major adverse impact. However, as noted within **Chapter 8, Biodiversity** of the Environmental Statement **[TR010044/APP/6.1]** any potential GCN present in the ponds would be moved and mitigated under licence. Removing GCN from the pond would reduce the importance of ponds 37 and 84 to low. The Scheme would also partially compensate for the loss of these ponds through the creation of new ponds associated with the highway drainage system (in total there would be nine wet treatment ponds and nine dry treatment ponds). However, overall a major adverse impact is predicted on these low important water bodies, resulting in a slight adverse effect (not significant).

13.9.128 The operational Scheme would be upstream of the following ponds based on topography and flow direction: 19, 21, 23, 71 and 88. Ponds 19 and 21 are downstream of the Scheme, but there is no operational Scheme drainage directed to the watercourse RGO2, and there would be no morphological changes to these ponds. Therefore, it is considered there would be no change to the water quality within these ponds, which on low important water bodies results in a neutral effect (not significant).

13.9.129 Pond 23 is downstream of road drainage from the Scheme (Railway Pond Catchment), and Pond 71 is downstream of road drainage from the Scheme (north east farm pond catchment). There would be no morphological changes to Ponds 23 and 71. Railway Pond Catchment and Northeast Pond Catchment have been assessed using the HEWRAT assessment, to ensure the inclusion of sufficient mitigation measures for soluble metals and sediment bound pollutants are included within the drainage design. Therefore, it is considered there would be negligible impact to the water quality within Ponds 23 and 71, which in low importance water bodies, results in a neutral effect (not significant)

13.9.130 Pond 88 is North House Lake, which is located downstream of the River Great Ouse from the River Great Ouse viaduct. There would be no changes to the morphology of this lake, and due to its distance downstream, and limited connectivity to the main flow of the River Great Ouse, it is considered there would be no change to the water quality within Pond 88. This would result in a neutral effect (not significant).

13.9.131 Pond 79 is close to the existing Caxton Gibbet roundabout but is not part of the Scheme road drainage. There would be no change to the morphology or water quality within pond 79 as a result of the operation of the Scheme. Therefore, it is considered there would be a no change impact to this pond, resulting in a neutral effect (not significant).

## Flood risk effects

*Potential increased risk of fluvial flooding*

13.9.132 An FRA (refer to **Appendix 13.4** of the Environmental Statement **[TR010044/APP/6.3])** has been undertaken to assess the risk of all types of flooding as a result of and to the operation of the Scheme. For the River Great Ouse, a hydraulic model and capacity assessment has been undertaken to establish flood zone extents and the capacity of the watercourse channel for the Scheme post construction.

*River Great Ouse*

13.9.133 For the River Great Ouse the allowance of +35% climate change has been used and simulated sensitivity runs with +65%, were also modelled as agreed with the Environment Agency at the outset of the project. When considering the 1% AEP +35% climate change event for the River Great Ouse (1D-2D model) maximum water elevations increase (as intended) within the compensatory areas and intuitively, flooding is removed where the mainline embankment crosses the floodplain. There is also a general reduction in maximum water levels outside of the Order Limits, upstream of the Scheme.

13.9.134 It is noted that there is an increase in maximum flood depths on the right bank of the River Great Ouse upstream of the Scheme immediately outside of the Order Limits of +10mm to +50mm. This occurs in agricultural areas which already flood to a depth greater than 1 metre during the 1% AEP +35% climate change event. These would be discussed with risk management authorities and addressed during the detailed design stage.

13.9.135 Any changes to modelled flood depths are limited to areas of agricultural land or undeveloped green space. Where increases and decreases in flood depth occur, the majority of these occur in areas which are already at risk of flooding and the changes are within heavily vegetated sloped agricultural fields within the floodplain that already flood to a depth of over 1m during the 1% AEP + 35% climate change event baseline scenario. It is considered that these increases can easily be eliminated in the detailed design phase by adjusting design parameters such as viaduct or flood compensation earthwork slopes and minor modelling parameters to optimise overall hydraulic results, and such changes can be accommodated within the Order Limits. Based on the detailed design phase being able to eliminate any flood increases to below 10mm increase, from **Table 13-2**, it is considered there would be a negligible impact on the fluvial flooding of the River Great Ouse.. The River Great Ouse floodplain is considered to be a high importance receptor. As a result, the resultant permanent effect is considered to be slight adverse (not significant).

*Hen Brook*

13.9.136 For the ordinary watercourses, the Environment Agency did not provide any specific advice on climate change simulations and as a result the climate change allowances within the Environment Agency's 'Flood Risk Assessments: Climate Change Allowances" were applied and therefore +65% was applied to the 1% AEP event. When considering the 1% AEP +65% climate change event for Hen Brook (1D-2D model), maximum water elevations increase (as intended) within the compensatory areas and intuitively, flooding is removed where the mainline embankment crosses the floodplain. There is a decrease in flood depths immediately upstream and downstream of the Scheme (-600mm) which is attributable to the compensation areas.

13.9.137 Initial modelling showed a few isolated areas where flood depths increase as a result of the Scheme however the majority of these were located within the Order Limits and located away from sensitive receptors. As a result, further modelling was undertaken with additional high level flow culverts at the Hen Brook crossing location. The additional culverts have resulted in a small increase (up to 10mm) immediately upstream of the proposed A428 highway adjacent to the left bank. From **Table 13-2** this is considered to be a minor adverse impact on the fluvial flooding behaviour of Hen Brook, a High importance receptor, and a resulting slight adverse effect (not significant).

*Rectory Farm tributary of Stone Brook (StB2)*

13.9.138 When considering the 1% AEP +65% climate change event for Rectory Farm tributary of Stone Brook (StB2) (1D-2D model), maximum water elevations increase (as intended) within the compensatory areas and intuitively, flooding is removed where the mainline embankment crosses the floodplain. There are a few isolated areas where flood depths increase (+36mm) as a result of the Scheme however these are all located within the footprint of the Scheme. As a result, it is considered the Scheme would have a negligible impact on fluvial flooding on the Stone Brook, resulting in a slight adverse (not significant) effect.

South Brook

13.9.139 When considering the 1% AEP +65% climate change event for South Brook (1D-2D model), maximum water elevations increase (as intended) within the compensatory areas and intuitively, flooding is removed where the mainline embankment crosses the floodplain. These compensation areas also cause a reduction in flood extents upstream of the Scheme while downstream there is a negligible impact on fluvial flooding. As a result, there is considered to be a negligible magnitude of impact, result in a slight adverse effect (not significant).

*Other ordinary watercourses*

13.9.140 For the ordinary watercourses which were modelled in 1D only, results for the 1% AEP +65% climate change event have shown that the Scheme has negligible impact on downstream level and flow. Some watercourses experienced an increase with the in-channel water level; however flow remains in-bank. For the ordinary watercourses modelled in 1D (i.e. West Brook, Wintringham Brook and its tributary, Gallow Brook, Begwary Brook, Rockham Ditch and the Top Farm Brook tributary to Hen Brook), it is considered the Scheme would result in a negligible impact. For low importance receptors for fluvial flood risk, this results in a neutral effect (not significant).

*Potential increased risk of surface water flooding*

13.9.141 The area within the Order Limits is generally at low risk from surface water flooding, although there are some areas of medium and high risks associated with ordinary watercourses.

13.9.142 The Scheme alignment is predominantly on undeveloped (greenfield) land currently used for agricultural purposes. Given that the Scheme would increase the impermeable area along the entirety of its length, there would be the potential for the surface water flood risk, both to the highway alignment and surrounding area to increase.

13.9.143 With the implementation of the Drainage Strategy (refer to **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3]**) there would be no increase in surface water flood risk from the Scheme. Overall, a no change magnitude of impact is predicted, resulting in a neutral effect (not significant).

*Potential increased risk of flooding from groundwater*

13.9.144 The risk of groundwater flooding in the study area ranges from low (<25% chances of groundwater flooding risk) to high (>75% chances of groundwater flooding risk) according to the published *groundwater flood risk map* (Ref 13-53).

13.9.145 The ground investigation (Ref 13-69) indicates that groundwater levels are variable across the Scheme, with recorded depths ranging from 0.5 to 13 metres BGL. The lowering of land to facilitate the construction and operation of the Scheme may pose an increased risk of groundwater flooding. However, groundwater level monitoring data collected between November 2019 and December 2020 shows that the groundwater level is generally below the vertical impact and base levels of the Scheme. Hence there is a negligible risk that the groundwater level would rise to intercept the Scheme to cause any groundwater flooding. The only exception to this is at the location of the A1 Underpass cutting, Barford Road cutting and Alington Hill cutting where shallow groundwater conditions have been observed with the base of the cuttings at depth > 1.5 metres below the natural groundwater table. However, for the Barford Road and the Alington Hill cuttings, the risk of groundwater flooding would be negligible given that both cuttings are located in the summit of ridges where the groundwater table is convex and would naturally shed water away from the cuttings and coupled with the low permeability Till directly beneath the cuttings.

13.9.146 For the A1 underpass cutting, during the operation of the Scheme, the risk of groundwater flooding of the Scheme is considered to be **high,** as some level of groundwater control would be required to maintain the groundwater level below the completed road level, as the level would be below the groundwater table in areas of moderate to highly permeable deposits. However, as discussed previously, coupled with proposed drainage strategy for the Scheme, a number of design options and mitigation measures including the use of groundwater flow path barriers are being considered as part of the detailed design for the Scheme to mitigate the risk of groundwater ingress and flooding of the Scheme in this area. Additionally, general drainage from the cutting would be discharged to surrounding surface watercourses. Thus, taking into account the proposed design option and the drainage strategy for the Scheme (refer to **Appendix 13.2** of the Environmental Statement **[TR010044/APP/6.3])**, the impact from groundwater flooding mechanisms due to the Scheme is considered to be minor in the operational phase. Overall, provided these mitigation measures properly implemented, a negligible adverse magnitude of impact is predicted, resulting in a slight significance effect (not significant).

*Potential increased risk of surface water flooding and artificial sources*

13.9.147 The area within the Order Limits is at low risk of flooding from artificial sources, sewers and other water supply infrastructure. As the proposed drainage strategy is to discharge directly into watercourses at an attenuated rate via a dedicated highway drainage network (i.e. no runoff would be discharged to nearby sewers during operation of the Scheme), there should be no change to the flood risk from existing sewers and drainage infrastructure, resulting in a neutral effect (not significant).

### WFD Assessment

13.9.148 A WFD Assessment has been completed and is included in **Appendix 13.1** of the Environmental Statement **[TR010044/APP/6.3]** which provides a description of the relevant water bodies with the study area and how they could be impacted by the Scheme. The assessment is based on a combination of existing data and site survey.

13.9.149 The WFD assessment indicates that, based on the current understanding of the Scheme, no significant adverse effects to WFD relevant water bodies would occur. Therefore, it is concluded that the Scheme is compliant with the WFD objectives for the River Great Ouse (Roxton to Earith), Abbotsley and Hen Brooks, West Brook, Stone Brook, Begwary Brook and Bourn Brook water bodies, taking into account the mitigation measures identified.

13.9.150 These mitigation measures include the best practice measures to be adopted during construction to manage all pollution risks, which would be implemented by the Principal Contractor using a OWMP prepared as part of a First Iteration EMP **[TR010044/APP/6.8]**, and measures to treat surface water runoff and manage the risk of future routine road runoff and risk of accidental spillages as described in the Drainage Strategy (refer to **Appendix 13.3** of the Environmental Statement **[TR010044/APP/6.3]**) for the Scheme.

13.9.151 Riparian and channel improvements adjacent to culverts and within the Order Limits would provide a means of offsetting culvert impacts, and watercourse enhancements are to be developed in the detailed design stage as part of a WFD Mitigation and Enhancement Strategy (secured through the REAC within the First Iteration EMP **[TR010044/APP/6.8]**. Riparian buffer strips would provide water course physico-chemical and morphological benefits due to the filtration effects on fine sediment and associated pollutants from agricultural runoff. Woody riparian planting could add biological complexity to channel corridors and input woody material into the channel for morphological diversity. Given the existing highly modified and deteriorated nature of the watercourses, riparian measures are considered to provide significant local enhancement opportunities.

#### Summary of significant effects

13.9.152 The assessment process initially identified potential water resource receptors in terms of surface watercourses, hydromorphology, groundwater, flood risk and drainage and classified their importance or sensitivity. For each of the receptors identified the likely impacts of the Scheme in relation to construction and operation phases have been determine and the significance of effect presented.

13.9.153 The assessment of significant effects has been undertaken taking into account mitigation measures as set out in Section Design, mitigation and enhancement measures. A summary of the significance of effects is presented below:

a. For surface water receptors (including ponds and surface watercourses, and their morphology) during construction, it is considered there would be no significant effects with the implementation of proposed mitigation measures.

b. For groundwater during construction, with the implementation of proposed mitigation measures, it is considered there would be no significant effects on groundwater as a result of temporary groundwater dewatering activities and/or interruption of groundwater level and flow regime by the Scheme.

c. It is considered that there would be a temporary slight adverse effect (not significant) during construction on navigation of the River Great Ouse during construction.

d. It is considered there would be no significant flooding related effects during construction.

e. During the operational phase it is considered that there would be no significant effects on the surface water bodies receiving routine drainage from the Scheme, from spillage risk or runoff containing de-icant salts. with the mitigation proposed.

f. During operation, adverse impacts are predicted on morphology of watercourses, from the installation of new culverts and outfalls, but with mitigation the effect is not considered to be significant.

g. The Scheme would result in the loss of, or partial loss of a small number of ponds. However, through compensatory mitigation no significant effect is predicted.

h. During operation, considering the proposed drainage strategy and embedded mitigation/design mitigation measures for the Scheme, the potential for effect on groundwater flow and quality is considered to be not significant.

i. During operation, there are no significant effects identified related to flood risk.

j. The risks of groundwater flooding during the operation of the Scheme is not significant given the general groundwater conditions beneath the Scheme. In areas of deep excavation such as the A1 underpass cutting where the groundwater table would be above the completed road level, taking into account the proposed embedded design mitigation measures and the drainage strategy for the Scheme the risk of groundwater flooding is considered to be not significant.

13.9.154 The WFD assessment concludes that the WFD objectives would be met with the mitigation included within the Scheme. In addition, the Scheme has identified reaches along watercourses within the Order Limits where there is potential for enhancement. The scope of this would be determined through a WFD mitigation and enhancement strategy to be prepared in consultation with the EA during the detailed design stage.

## 13.10 Monitoring

13.10.1 *LA 104* (Ref 13-42) sets out the requirements of monitoring. Proportionate monitoring should be carried out where there are significant adverse impacts. These are discussed below under construction and operation.

### Construction

13.10.2 The OWMP presented in the First Iteration EMP **[TR010044/APP/6.8]** sets out broad principles of monitoring to be undertaken during the Scheme construction phase to ensure that the mitigation measures embedded in the Scheme design are appropriately implemented and to ensure compliance with the WFD.

13.10.3 A programme of water quality monitoring would be undertaken prior to and during construction to ensure that no detrimental effect on the water environment occurs, and to allow any pollution incidents to be identified and remedied. This would also build data on the effectiveness of design and mitigation measures within the drainage strategy to drive improvement in environmental performance for future projects.

13.10.4 A Water Quality Monitoring Plan would be prepared covering the pre-construction phase, during construction, and post-construction where considered necessary. It would cover the water bodies that may be impacted as a result of construction works (including Rockham Ditch and South Brook that may be affected by dewatering operation of excavations around Black Cat). The water quality monitoring would consist of regular site visits to make visual and olfactory observations, the use of in-situ water quality monitoring and regular sampling for laboratory analysis. It is not anticipated that water samples are collected from every watercourse due to the large number of them, but rather a representative sample across each sub-catchment. During site visits any evidence of unnatural sediment accumulation that may be attributed to the construction works would also be recorded and action taken if required.

### Operation

13.10.5 No significant operation effects are predicted. However, post-construction appropriate surveys would be undertaken of all new culverts and bridges to review the effectiveness of embedded mitigation and the function along any new diverted channel reaches, as well as to check the establishment and functioning of any channel enhancements delivered under the WFD mitigation and enhancement strategy. If there is any evidence of excessive erosion or sedimentation associated with new structures further actions would be considered to remedy that impact in as sustainable a way as possible. This would be detailed in subsequent iterations of the First Iteration EMP **[TR010044/APP/6.8]**.

13.10.6 No likely significant adverse effects are identified for flood risk; therefore no monitoring is required.

## 13.11 References

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