The Sizewell C Project

6.7 Volume 6 Sizewell Link Road

Chapter 12 Groundwater and Surface Water

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Contents

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Plates

None provided.

Figures

Appendices

None provided.

12 Groundwater and Surface Water

12.1 Introduction

12.1.1 This chapter of **Volume 6** of the **Environmental Statement** (**ES**) (Doc Ref. 6.7) presents an assessment of the potential effects on groundwater and surface water arising from the construction and operation of the Sizewell link road (referred to throughout this volume as the 'proposed development'). This includes an assessment of potential impacts, the significance of effects, the requirements for mitigation and the residual effects.

12.1.2 Detailed descriptions of the Sizewell link road site (referred to throughout this volume as the 'site'), the proposed development and the different phases of development are provided in **Chapters 1** and **2** of this volume of the **ES**. A glossary of terms and list of abbreviations used in this chapter is provided in **Volume 1, Appendix 1A** of the **ES**.

12.1.3 The Government's Good Practice Guide for Environmental Impact Assessment (EIA)[1] (Ref.12.1) outlines the potential environmental effects that should be considered for groundwater and surface water, for example physical effects of the development and effects on groundwater. Further information on these topics and those which have been scoped into the assessment can be found in **section 12.3** of this chapter.

12.1.4 This assessment has been informed by data from the following assessments:

- **Appendix 11A** of this volume: Sizewell Link Road and Theberton Bypass Phase 1 Desk Study Report 2020.
- **Appendix 11B** of this volume: conceptual site models.
- **Appendix 11C** of this volume: impact assessment tables.
- **Sizewell Link Road Flood Risk Assessment (FRA)** (Doc Ref. 5.6).
- **Water Framework Directive (WFD) Compliance Assessment Report** (Doc Ref. 8.14).

[1] This document has been withdrawn but still constitutes good advice and should be referred to in the absence of alternative guidance.

12.2 Legislation, policy and guidance

12.2.1 **Volume 1, Appendix 6O** of the **ES** identifies and describes legislation, policy and guidance of relevance to the assessment of the potential groundwater and surface water impacts associated with the Sizewell C Project across all **ES** volumes.

12.2.2 This section provides an overview of the specific legislation, policy, and guidance specific to the assessment of the proposed development.

a) International

12.2.3 International legislation relevant to the groundwater and surface water assessment includes:

- WFD 2000/60/EC (Ref.12.2).
- Groundwater Daughter Directive 2006/118/EC (Ref.12.3).
- The Discharge of Dangerous Substances into the Aquatic Environmental Directive 2006/11/EC (Ref.12.4).

12.2.4 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Volume 1**, **Appendix 6O** of the **ES**.

b) National

i. Legislation

12.2.5 National legislation relevant to the groundwater and surface water assessment includes:

- Water Environment (WFD) (England and Wales) Regulations 2017 (Ref.12.5).
- WFD (Standards and Classification) Directions (England and Wales) 2015 (Ref.12.6).
- Environmental Permitting Regulations (England and Wales) 2016 (Ref.12.7).
- Water Resources Act 1991 (Ref.12.8).
- Water Act 2003 (Ref.12.9).
- Flood and Water Management Act 2010 (Ref.12.10).

12.2.6 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Volume 1, Appendix 6O** of the **ES.**

ii. Planning policies

12.2.7 The National Policy Statements (NPS) set out national policy for energy infrastructure. The overarching NPS for Energy (EN-1) (Ref. 12.11) and NPS for Nuclear Power Generation (EN-6) (Ref. 12.12) provide the primary policy framework within which the development will be considered. A summary of the relevant planning policy, together with consideration of how these have been taken into account, is provided in **Volume 1, Appendix 6O** of the **ES**.

12.2.8 Other national policies relevant to the groundwater and surface water assessment include the National Planning Policy Framework (NPPF) (Ref. 12.13).

12.2.9 The requirements of this policy, as relevant to the groundwater and surface water assessment, are described in **Volume 1, Appendix 6O** of the **ES**.

c) Regional

12.2.10 Regional policies relevant to the groundwater and surface water assessment includes:

- Environment Agency Anglian River Basin Management Plan (RBMP) (Ref. 12.14).
- The East Suffolk Abstraction Licensing Strategy 2017 (Ref. 12.15).
- Environment Agency East Suffolk Catchment Flood Management Plan 2009 (Ref. 12.16).

12.2.11 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Volume 1, Appendix 6O** of the **ES**.

d) Local

12.2.12 Local policies relevant to the groundwater and surface water assessment includes:

- Suffolk Flood Risk Management Strategy (Ref. 12.17).
- Strategic Flood Risk Assessment (Ref. 12.18).

- Strategic Coastal District Council (SCDC) Local Plan Core Strategy and Development Management Policies (Ref. 12.19).
- SCDC Final Draft Local Plan (Ref. 12.20).

12.2.13 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Volume 1, Appendix 6O** of the **ES**.

e) Guidance

12.2.14 Guidance relevant to the groundwater and surface water assessment includes:

- Planning Practice Guidance (Ref. 12.21).
- Government's 25 Year Environment Plan (Ref. 12.22).
- The Government's Good Practice Guide (Ref. 12.23) for EIAs.
- The Groundwater protection position statements guidance (Ref. 12.24).
- Control of water pollution from construction sites: A guide to good practice, Construction Industry Research and Information Association (CIRIA) (2001) (Ref. 12.25).
- Environment Agency's Pollution Prevention Guidelines: Working on construction sites (Ref. 12.26).
- The Design Manual for Roads and Bridges (DMRB) (2008) Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects (Ref. 12.27).
- DMRB (2009) Volume 11, Section 3, Environmental Assessment Techniques (Ref. 12.28).

12.2.15 The requirements of these, as relevant to the groundwater and surface water assessment, are described in **Volume 1, Appendix 6O** of the **ES**.

12.3 Methodology

a) Scope of the assessment

12.3.1 The generic EIA methodology is detailed in **Volume 1**, **Chapter 6** of the **ES.**

12.3.2 The full method of assessment for groundwater and surface water that has been applied for the Sizewell C Project is included in **Volume 1**, **Appendix 6O** of the **ES**.

12.3.3 This section provides specific details of the groundwater and surface water methodology applied to the assessment of the proposed development, and a summary of the general approach to provide appropriate context for the assessment that follows. The scope of this assessment considers the impacts of the construction and operational phases of the proposed development.

12.3.4 The scope of this assessment has been established through a formal EIA scoping process undertaken with the Planning Inspectorate (PINS). A request for an EIA Scoping Opinion was initially issued to the PINS in 2014, with an updated request issued in 2019, **Volume 1**, **Appendix 6A** of the **ES**.

12.3.5 Comments raised in the EIA Scoping Opinion received in 2014 and 2019 have been taken into account in the development of the assessment methodology. These are detailed in **Volume 1**, **Appendices 6A** to **6C** of the **ES**.

12.3.6 The Government's Good Practice Guide for EIA states that the following potential environmental effects should be considered for the water environment:

- levels and effects of emissions to water from the development;
- abstractions of/effects on surface or groundwater resources;
- effects of development on drainage or run-off pattern in the area;
- changes to groundwater level, watercourses and flow of underground water;
- crossings of watercourses; and
- effects of pollutants on water quality.

12.3.7 Additionally, consideration should be given to flood risk as well as WFD compliance, and their interactions with other assessments such as geology and land quality, and terrestrial ecology and ornithology assessments.

12.3.8 Potential impacts from existing and new contamination sources on controlled waters have been considered as part of the geology and land quality assessment in **Chapter 11** of this volume, to determine and classify

potential effects associated with ground contamination. Further assessment of identified effects from contamination to groundwater and surface waters is reported in this chapter.

b) Consultation

12.3.9 The scope of the assessment has also been informed by ongoing consultation and engagement with statutory consultees throughout the design and assessment process as outlined in **Volume 1, Appendix 6O** of the **ES**.

Table 12.1 details a summary of consultation responses that have informed the scope and methodology of the groundwater and surface water assessment.

Table 12.1 Summary of consultation responses that have informed the scope and methodology of the assessment and design, relevant to groundwater and surface water.

Date	Consultees	Summary Of Discussion/Comments
9 July 2019	Environment Agency; Natural England	Telephone call held to talk through the design principles and potential ecological impacts. Discussion on the development of the design to limit constraint to flood flows and be recognisant of habitat connectivity.
10 September 2019	Environment Agency; Suffolk County Council	Meeting held to share further information on design principles and option selection including routes, alignment and levels. Confirmed that design would consider the 1-in-100 year event plus 35% climate change, and maximise space and light in balance with highways design limits.
25 November 2019	Environment Agency; Suffolk County Council; East Suffolk Council	Telephone call held to share back details on how consultation feedback has been adopted in the design with respect to mammal migration and afflux. Modifications described following discussion with Suffolk County Council who are expected to adopt the bypass. Information presented on hydraulic performance of culvert crossings. Details provided of iterated design for crossings at Fordley Road and Hawthorn Road.

c) Study area

12.3.10 The study area for the consideration of effects from contaminative sources on controlled waters is discussed in **Chapter 11** of this volume and includes the site and land immediately beyond it to a distance of 500 metres (m) from the site boundary. This is hereafter referred to as the inner study area.

12.3.11 The size of the inner study area takes into account the transport of potential contaminants of concern in the environment, and the connectivity of these contaminants via pathways of migration or exposure to the receptors and resources identified.

12.3.12 The general methodology adopted for the consideration of effects on groundwater and surface water levels and flows, and water dependent receptors and resources extends beyond this inner study area to a distance of 1 kilometre (km) from the site boundary. This is termed the outer study area.

12.3.13 The size of the outer study area allows for any potential physical changes resulting from the proposed development that may propagate through the water environment, and beyond the inner study area to be assessed.

12.3.14 The site boundary and study areas are presented in **Figure 12.1** of this volume.

d) Assessment scenarios

12.3.15 The assessment of effects on the water environment includes the assessment of both the construction phase and operational phase of the proposed development, rather than the assessment of any specific years.

e) Assessment criteria

12.3.16 As described in **Volume 1**, **Chapter 6** of the **ES**, the EIA methodology considers whether impacts of the proposed development would have an effect on any receptors or resources. Assessments broadly consider the magnitude of impacts, and value/sensitivity of receptors/resources that could be affected in order to classify effects.

f) Assessment of physical impacts

12.3.17 Physical impacts include:

- changes or alterations to water levels and flow regimes of groundwater and surface water receptors and resources; and

- changes to water dependent groundwater and surface water receptors and resources.

12.3.18 The assessment criteria of physical impacts on groundwater and surface water receptors and resources are based on the methodology provided in **Volume 1, Appendix 6O** of the **ES** and summarised in the following sub-sections.

i. Sensitivity

12.3.19 The assessment of assigning the levels of sensitivity to receptors and resources is set out in **Table 12.2**.

Table 12.2: Assessment of the value or sensitivity of receptors and resources for groundwater and surface water.

Value Or Sensitivity	Description
High	An attribute with a high quality/rarity, international or national significance that has a low capacity to accommodate disturbance or change.
Medium	An attribute with high quality/rarity, national scale and has some resilience to disturbance or change. An attribute with high quality/rarity, at a regional scale that has at a regional scale a low capacity to accommodate disturbance or change. An attribute with medium quality/rarity, national scale that has a low capacity to accommodate disturbance or change.
Low	An attribute with medium quality/rarity, national or regional scale and some resilience to disturbance or change. An attribute with low quality/rarity, national or regional scale and some resilience to disturbance or change.
Very Low.	An attribute with low quality/rarity, regional and local scale and resilience to disturbance or change.

ii. Magnitude

12.3.20 The magnitude of a potential impact is estimated based on the likely level of change and is independent of the importance of the feature. The definitions of magnitude classifications are provided in **Table 12.3**.

Table 12.3: Assessment of magnitude of impact on groundwater and surface water.

Magnitude	Criteria
High	Large-scale permanent/irreversible, or long-term temporary, changes over the whole development area and potentially beyond (i.e. off-site), to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Medium	Medium-scale permanent/irreversible, or medium-term temporary, changes over the majority of the development area and potentially beyond, to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Low	Noticeable but small-scale change, permanent or temporary changes over a partial area, to key characteristics or features of the particular environmental aspect's character or distinctiveness.
Very Low.	Noticeable, but very small-scale change, or barely discernible changes for any length of time, over a small area, to key characteristics or features of the particular environmental aspect's character or distinctiveness.

12.3.21 Where the assessment of potential impact concludes that, through careful design, and the application of appropriate mitigation, there will be no discernible change (no impact) to a receptor or resource, then a conclusion of no effect will be drawn.

12.3.22 Given the timescales of the Sizewell C Project, the nature of potential changes to the water environment from the proposed development and their reversibility, the definitions of temporary impacts are categorised as follows:

- short-term = less than six months;
- medium-term = between six months and six years; and
- long-term = more than six years.

iii. Effect definition

12.3.23 The classification of the likely effect for groundwater and surface water are determined using the matrix presented in **Table 12.4**.

Table 12.4: Classification of effects.

		Value/Sensitivity of Receptor			
		Very Low.	Low	Medium	High
Magnitude	Very Low.	Negligible	Negligible	Minor	Minor
	Low	Negligible	Minor	Minor	Moderate
	Medium	Minor	Minor	Moderate	Major
	High	Minor	Moderate	Major	Major

12.3.24 An effect can be 'adverse' or 'beneficial' depending on the nature of impact on the quality and integrity on the receptor or resource. For example, an adverse effect would be where there would be a loss or damage to the quality or integrity of an attribute, whereas a beneficial effect would arise from the creation of a new or an improvement to an attribute.

12.3.25 Following the classification of an effect as presented in **Table 12.4**, a clear statement is made as to whether the effect is significant or not significant. As a general rule, major and moderate effects are considered to be significant, and minor and negligible effects are considered to be not significant. However, professional judgement is also applied where appropriate.

g) Assessment of contamination to controlled waters

12.3.26 The assessment of potential impacts from existing and new contamination sources on controlled waters has been considered as part of the geology and land quality assessment in the production of the preliminary conceptual site model (PCSM) to determine and classify potential effects.

12.3.27 Further details on the methodology applied is provided in **Volume 1, Appendix 6N** of the **ES**, and summarised in **Chapter 11** of this volume.

h) Water Framework Directive compliance

12.3.28 WFD impacts are assessed differently to the approach conventionally used within the EIA process and require an assessment of whether a project (or an element of a project) is compliant, or non-compliant with the environmental objectives outlined in Article 4 of the WFD.

12.3.29 The significance of effects on WFD status relates only to compliance or non-compliance. Non-compliance will only occur because of permanent impacts that cannot be mitigated, irrespective of the degree of vulnerability

to change of the receptor. The assessment in this context will be restricted to either compliance or non-compliance.

12.3.30 The **WFD Compliance Assessment Report** (Doc Ref. 8.14) has been provided as a separate document as part of this application for development consent. The main conclusions with relevance to the activities considered as part of the EIA are summarised in this chapter.

i) Flood risk assessment

12.3.31 The **Sizewell Link Road FRA)** (Doc Ref. 5.6) has been provided as a separate document as part of this application for development consent. The main conclusions from the **Sizewell Link Road FRA** with relevance to the potential flood sources affecting the site, and the impacts that the proposed development would have on altering the flood risk levels relating to the surrounding surface water receptors are summarised in this chapter.

j) Assessment methodology

12.3.32 **Volume 1**, **Chapter 6** of the **ES** sets out the broad approach to impact assessment employed within the overall **ES**. This section details the approach to the assessment of impacts specifically relating to groundwater and surface water.

i. General approach

12.3.33 The approach to the groundwater and surface water assessment comprises:

- establishing the baseline conditions for the study area with respect to geology, hydrology, hydrogeology, and water dependent resources and receptors;
- identification of potential impacts on identified water dependent resources and receptors from the construction and operational phases of the proposed development;
- assessment of the significance of likely effects from the proposed development including the consideration of primary and tertiary mitigation measures; and
- identification of any residual effects and secondary mitigation where required.

12.3.34 The assessment also considers the findings of the **WFD Compliance Assessment Report** (Doc Ref. 8.14), and **Sizewell Link Road FRA** (Doc Ref. 5.6).

ii. Existing baseline

12.3.35 Existing baseline conditions are defined based on available published and, where available, site-specific information.

12.3.36 The baseline assessment has relied on existing data, previous desk study and ground investigation reports, groundwater monitoring data and historical records. The following sources have been reviewed:

- Publicly available information from the British Geological Survey (BGS) online mapping resource (Ref.12.29).
- Publicly available information from the Environment Agency (Ref.12.30 and Ref.12.31).
- Publicly available information from the Defra's Multi-Agency Geographic Information for the Countryside (MAGIC) website (Ref.12.32).
- **Appendix 11A** of this volume: Sizewell Link Road Desk Study Report, which includes the Landmark Envirocheck Report for the site and study area, and details of the site walkover.

iii. Future baseline

12.3.37 The future baseline is typically established upon extrapolating the current baseline using technical knowledge of changes (for example changes in rainfall), and future climate forecasts to predict the environmental conditions at a future point in time. This assessment considers future baseline conditions solely in the context of known future developments, and predictable changes in the quality of receptors (for example forecast improvements in the status of WFD water bodies).

iv. Assessment

12.3.38 Potential changes to the water environment in terms of water levels, flow and quality are considered qualitatively against baseline conditions. Should a significant effect be identified at the end of the qualitative assessment, a more detailed quantitative appraisal of potential impacts on water levels, and flow has been undertaken to determine the magnitude and extent of potential changes.

k) Assumptions and limitations

12.3.39 The following assumptions have been made in this assessment:

- All assessment considers development within the site parameters as set out in the description of development at **section 2.3** of **Chapter 2** of this volume of the **ES** and as illustrated on the work plans reproduced in **Appendix 2A** of this volume.
- Surface water discharge will be managed so it does not exceed the predetermined Greenfield run-off rates in accordance with the **Outline Drainage Strategy**, **Volume 2, Appendix 2A** of the **ES**.
- Environmental Quality Standards prescribed for downstream designated WFD water bodies have been adopted for upstream, non-designated watercourses for the purposes of this assessment, in order to consider the worst case scenario.

12.3.40 The following limitations have been identified:

- Ground investigation has not been carried out at the site at the time of writing but will be undertaken prior to the commencement of construction. Therefore, no observed information about the ground conditions at the site, or encountered groundwater was available for the production of this assessment. Publicly available information from the BGS such as historical borehole logs has been used to inform the assessment.
- No groundwater quality data is available for the site, however given the site setting and historical land use there is a low risk of poor quality groundwater. Potential sources of contamination have been considered in **Chapter 11** of this volume and this has informed the assessment.

12.4 Baseline environment

12.4.1 This section presents a description of the baseline environmental characteristics within the site and study area.

a) Current baseline

i. Site walkover

12.4.2 A site visit from public roads and footpaths was undertaken during March 2019 to gain further information on the site setting, to consider the context

of the proposed development, and to confirm the current desk study mapping and aerial photographs. Additionally, it was an opportunity to identify potential visual or olfactory contamination present at the site at the time of the walkover.

12.4.3 The site predominantly comprises agricultural land. The site includes several local roads, existing watercourses and woods, and is also in close proximity to farms and residential properties. The East Suffolk line crosses the site in the west. The areas surrounding the site are predominantly agricultural land with isolated farms and residential properties nearby. Further details on observations made during the site visit including photographs can be found in the Phase 1 Desk Study Report in **Appendix 11A** of this volume.

ii. Topography

12.4.4 The site is located within the Minsmere Old River watershed. Light Detection and Ranging data (LiDAR) show that the highest ground levels are located in the north-west area of the site at approximately 40m Above Ordnance Datum (AOD). The topography across the site varies between approximately 10m AOD and 35m AOD. The topography is gently rolling.

iii. Geology

12.4.5 There is the potential for Made Ground to be encountered in the areas adjacent to the railway line and the existing roads. In addition, due to the nature of the site and surrounding area, there is the potential for fly tipping as well as the potential for farmers tips, the contents of which will be unknown.

12.4.6 BGS records indicate that the site is largely underlain by superficial Diamicton deposits of the Lowestoft Formation, and sand and gravel deposits of the Lowestoft Formation, which comprise an extensive sheet of chalky till as well as outwash sands and gravels, silts and clays.

12.4.7 Head (windblown) deposits are shown on the map where the site crosses Fordley Road and Hawthorne Road. These deposits comprise clay, silt, sand and gravel. Head deposits, comprising gravel, sand and clay deposits are also present in two small areas in the north-east of the site.

12.4.8 The bedrock geology beneath the site comprises sand of the Crag Group. Crag is made up of shallow-water marine and estuarine sands, gravels, silts and clays.

12.4.9 A review of online BGS mapping indicates that there are several borehole or trial pit scans within the inner study area. A summary of the logs is provided, with the full details presented in **Appendix 11A** of this volume.

Red House Farm / Lodge Farm borehole logs (completed 1937 to 1941)

12.4.10 Three borehole logs were identified to the south-west of the site in the vicinity of Red House Farm (TM36NE8) and Lodge Farm (TM36NE9 and TM36NE10), approximately 300m south of the where the site joins with the A12. These logs show the underlying geology in this area to be:

- boulder clay from ground level to a maximum of 19.81m below ground level (m bgl) in borehole TM36NE9;
- glacial sand, gravels and clays and Crag ranging from 54.86m to 54.86m bgl in borehole TM36NE8;
- Crag Group with shell ranging from 37.19m in borehole BH TM36NE9 to 54.86m bgl in borehole TM36NE8; and
- chalk ranging from 49.07m in borehole TM36NE9 to 85.34m bgl in borehole TM36NE8.

Middleton Moor borehole logs (completed 1907 to 1936)

12.4.11 Two borehole logs (TM46NW3 and TM46NW7) were identified approximately 500m to the north of the site in the vicinity of Theberton Cottages. These logs show the underlying geology in this area to be:

- boulder clay: ground level to a maximum of 9.45m bgl in borehole TM46NW7;
- glacial drift: ranging from 6.10m bgl in borehole TM46NW3 to 15.24m bgl in borehole TM46NW3; and
- Crag Group: ranging from 9.45m bgl in borehole TM46NW7 to 34.44m bgl in borehole TM46NW3.

12.4.12 Groundwater was recorded at 17.37m bgl in borehole TM46NW3 and 13.84m bgl in borehole TM46NW7.

Theberton Grange and Theberton Cottages borehole logs (completed 1964)

12.4.13 Seven borehole logs were identified 280m south-west of the site in the vicinity of Theberton Grange and Cottages. However, only borehole TM46NW6 recorded the underlying geology in the area which is as follows:

- topsoil: 0.45m bgl;
- clay: 9.14m bgl;
- ballast: 9.45m bgl;
- sand on Crag: 18.29m bgl;
- Crag Group: 34.14m bgl; and
- loamy sand: 35.97m bgl.

12.4.14 The borehole logs generally correspond with the BGS mapped geology. However, borehole TM46NW6 (completed in 1964) identified 'ballast' from 9.14m to 9.45m bgl. Historically, ballast was used as a term for natural coarse gravels, and it is possible that these materials and the shallower materials were all natural.

iv. Hydrogeology

12.4.15 The Environment Agency classifies the Head deposits and the diamicton of the Lowestoft Formation as secondary aquifers (undifferentiated)[2].

12.4.16 The Environment Agency classifies the Lowestoft Formation – sand and gravels as a secondary A aquifer[3].

12.4.17 The Environment Agency classifies the Crag Group bedrock underlying the site as a principal aquifer[4].

[2] A secondary (undifferentiated) aquifer is designated in cases where it has not been possible to attribute either category secondary A or secondary B to a rock type.

[3] 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 base flow to rivers.

[4] Principal aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

12.4.18 The site does not lie within a groundwater Source Protection Zone[5] (SPZ). A SPZ3 is approximately 400m south of the site at its closest point and is shown on **Figure 12.1**.

12.4.19 Current groundwater levels at the site are not known. Contours shown on BGS hydrogeological mapping (12.33) suggest that groundwater levels within the Crag Group may be around 5m AOD (approximately 15m bgl) at the site. These contours are based on data from 1976, and are only indicative of current levels, however the hydrogeological regime is not considered likely to have changed significantly in the intervening years. Further ground investigation would be needed to establish current groundwater levels at the site.

12.4.20 Groundwater was recorded in the historical BGS logs:

- Red House Farm/Lodge Farm boreholes (completed 1937 to 1941): Response zone of the wells is not provided in the logs. Rest water level is recorded at 30.48m bgl in all three boreholes.
- Middleton Moor boreholes (completed 1907 to 1936): Response zone of the wells is not provided in the logs. Rest water level is recorded between 13.84 and 17.37m bgl.
- Theberton Grange and Theberton Cottages borehole (completed 1964): Response zone of the well is not provided in the log. Rest water level is recorded at 9.45m bgl.

12.4.21 The site is located on the Waveney and East Suffolk Chalk and Crag WFD groundwater body (groundwater body ID GB40501G400600). The Environment Agency catchment data explorer 2016 classification shows that this groundwater body has been classified by the Environment Agency as being of poor quantitative and poor chemical status, with an objective to being of good quantitative and good chemical status by 2027. The poor chemical status is attributed to impacts from agriculture. The site falls within a groundwater Nitrate Vulnerable Zone.

v. Surface water features

12.4.22 The majority of the site is located within the Minsmere Old River WFD water body (ID GB105035046270) (Ref 12.34) catchment. The existing B1122

[5] Groundwater SPZ are areas defined around groundwater sources used for public drinking water supply. The SPZ shows the risk of contamination from activities that might cause pollution in the area. The closer the activity, the greater the risk.

road separates the proposed development from this watercourse. A small section of the western end of the site falls within the River Fromus WFD water body (ID GB105035045980) (Ref 12.35) catchment. The Minsmere Old River water body has an overall 2016 classification of moderate ecological potential, and the River Fromus has received an overall classification of poor ecological potential. The water bodies are presented on **Figure 12.1** of this volume.

12.4.23 The catchment of the Minsmere Old River water body is drained by four principal rivers, namely the River Yox, Minsmere River, Minsmere New Cut River and the Minsmere Old River. None of these rivers fall with the inner study area and only the River Yox and Minsmere River fall within the outer study area.

12.4.24 The Middleton Watercourse, a designated Main River flows parallel to Fordley Road where it passes through the site, underneath the B1122 and then through Middleton to where it joins the Minsmere River.

12.4.25 The Theberton Watercourse, a designated Main River flows in a north-easterly direction through the eastern section of the site towards its confluence with Minsmere Old River.

12.4.26 Additionally, there are three unnamed watercourses within the site that have the potential to be impacted upon and include:

- An unnamed watercourse located to the north of the proposed development that currently flows underneath the B1122 between the villages of Yoxford and Middleton Moor. The watercourse flows in the northerly direction to its confluence with the River Yox.
- An unnamed watercourse that passes through the site to the east of Fordley Road and flows north to its confluence with the Middleton Watercourse, immediately downstream of the B1122.
- An unnamed watercourse that flows through the site on two occasions between Hawthorn Road and Pretty Road. This watercourse flows in a north-easterly direction through an arm of the Walberswick Heaths and Marshes Site of Special Scientific Importance (SSSI) to its confluence with the Minsmere Old River.

12.4.27 There is a surface drain located to the south of the western end of the site. This drain flows south, parallel to the A12 to its confluence with the River Fromus.

12.4.28 There are also 107 ponds present within the inner study area.

vi. Water quality

12.4.29 The 2016 physico-chemical and chemical data presented on Catchment Data Explorer have been reviewed for the Minsmere Old River and River Fromus to characterise the catchments. The chemical status for both rivers is good.

12.4.30 Physico-chemical data indicate that the Minsmere Old River near the site boundary is at good or high status for ammonia, biochemical oxygen demand, dissolved oxygen, pH, phosphate and temperature, and is not adversely affected by pollutants such as copper, triclosan and zinc. The water body is at good physico-chemical status. This suggests that water quality in the catchment is generally good.

12.4.31 Physico-chemical data for the River Fromus indicate that it is at high status for all quality elements, with the exception of phosphate, which is at poor status, and dissolved oxygen, which is at bad status. The latter is likely to be due to high nutrient loadings from agricultural run-off, and/or treated sewage effluent and eutrophication processes. The poor overall ecological status is likely to be the result of the bad status of dissolved oxygen.

12.4.32 No groundwater quality data is available for the site.

vii. Groundwater and surface water interaction

12.4.33 Given the local geology and assumed depth to groundwater it is considered that there is no substantial connection between groundwater and the surface water features identified. There may be local interaction between discrete water bodies in the Lowestoft Formation (diamicton) aquifer and surface water.

viii. Water abstractions

Groundwater

12.4.34 Nine licensed groundwater abstractions have been identified within the outer study area. These are detailed in **Table 12.5** and shown on **Figure 12.1**.

Table 12.5: Licensed groundwater abstraction within the outer study area.

Licence Number	Location Including National Grid Reference	Source	Purpose	Maximum Annual Abstraction (m^3)
7/35/03/*G/0073.	643870, 265270 (40m south-west of the site. Bore at Therberton Grange).	Groundwater	Spray irrigation – Direct.	Unknown
7/35/03/*G/0073.	644100, 265100 (50m south-west of the site. Eighteen Wellpoints Therberton).	Groundwater	Spray irrigation – Direct.	Unknown
7/35/03/*G/0009.	642300, 267500 (400m north of the site. 25 Wellpoints at Moor Farm).	Groundwater	Spray irrigation – Direct.	Unknown
7/35/03/*G/0051.	644500 265700 (480m north-east of site. 20 Wellpoints at Holly Tree Farm).	Glacial Sand and Gravel	Spray irrigation – Direct.	Unknown
7/35/03/*G/0035.	640100 268310 (630m north of site, Well at Rookery Park, Yoxford).	Groundwater	General farming and domestic.	Unknown
7/35/03/*G/0052.	644100, 266500 (800m east of the site. 20 Wellpoints at Therberton Hall Farm).	Groundwater	Spray irrigation – Direct.	Unknown
7/35/03/*G/0061.	642700, 267900 (830m north-east of the site. 15 Wellpoints at Causeway Farm).	Groundwater	Spray irrigation – Direct.	Unknown

Licence Number	Location Including National Grid Reference	Source	Purpose	Maximum Annual Abstraction (m^3)
7/35/03/*G/0051.	645950 265900 (850m south-east of site. Bore near Leiston Old Abbey).	Glacial Sand and Gravel	General Farming and Domestic.	Unknown
AN/035/0004/013.	643100, 267700 (880m north-east of the site. Bridge Farm Woodbridge).	Groundwater	Spray irrigation – Direct.	Unknown

12.4.35 There is the potential for unknown Private Water Supplies (PWS) to be in use within the outer study area. Should any PWS exist, they would likely be associated with the isolated farm buildings and residential properties in the outer study area. It is likely that the properties within the villages of Theberton and Middleton obtain their water from a mains source of supply.

Surface water

12.4.36 One licensed surface water abstraction has been identified within the outer study area. This is detailed in **Table 12.6** and shown on **Figure 12.1**.

Table 12.6: Licensed surface water abstraction within the outer study area.

Licence number	Location including National Grid Reference	Source	Purpose	Maximum Annual Abstraction (m^3)
7/35/03/*S/0050.	640340, 268760 (935m north of site). River Yox at Trustans Farm, Darsham.	Surface water (River Yox).	General Agriculture: Spray irrigation-Direct. Seasonal-abstraction only 01 May to 30 Sept.	Unknown

ix. Fluvial geomorphology

12.4.37 The surface watercourses in the area are typical of lowland, low energy drainage systems. Many of the channels are entirely artificial, and the natural channels have been extensively modified (probably to facilitate drainage and use of the surrounding marshland as grazing marsh).

12.4.38 Geomorphology and hydromorphology are key factors contributing to whether a water body can achieve, or maintain, 'Good Ecological Status'.

12.4.39 Sediment deposition and, when flows have sufficient energy, transport, are likely to be the dominant fluvial processes which operate in the Minsmere Old River. The behaviour of the fluvial system is largely dominated by artificial modifications, principally the operation of the Minsmere Sluice, which is operated by the Environment Agency. Minsmere Sluice prevents free drainage during high tide or increased water levels.

12.4.40 The tributaries of the Minsmere Old River channel within the site have been modified for land drainage purposes. The Minsmere Old River is designated as a Heavily Modified Water Body (HMWB). The hydrological regime is of sufficient quality to support good status.

12.4.41 The River Fromus is not designated as artificial or as a HMWB. The morphology and hydrological regime of the River Fromus is sufficient to support good status.

x. Flood risk

12.4.42 The East Suffolk Council Strategic FRA maps identify one case of historic flooding from an unknown source to have occurred immediately adjacent to the site in the vicinity of Fordley Road and the Middleton watercourse. Environment Agency surface water flood risk mapping identifies this area as being at risk from surface water flooding. It also identifies further areas at risk within the study area. These are typically associated with the watercourses.

12.4.43 The Environment Agency's Flood Map for Planning indicates that the majority of the site is located in Flood Zone 1 and has a low risk of flooding from rivers or the sea without defences, as shown on **Figure 12.1** of this volume. The Environment Agency's long-term flood risk mapping shows that the majority of the site is also at very low risk of flooding. However, where the Middleton watercourse runs across the site at Fordley Road there is a section of the site that falls within Flood Zone 3. The site boundary extends north from the proposed link road and again falls within Flood Zone 3 where Fordley Road intersects with the B1122.

12.4.44 Further information on flood risk at the site is provided in the **Sizewell Link Road FRA** (Doc Ref. 5.6) which has been submitted as part of this application for development consent.

xi. Historic and environmentally sensitive sites

12.4.45 Further consideration of historic and ecological designated sites, both statutory and non-statutory is given in **Chapters 7** and **9** of this volume. A review of the Multi-Agency Geographic Information for the Countryside website has confirmed that sections of the Minsmere to Walberswick Heaths and Marshes SSSI are located within the outer study area. Refer to **Figure 7.1** of this volume.

12.4.46 The lower reaches of the Minsmere Old River system has been designated for its nature conservation value. The eastern parts of the surface water drainage network comprise the nationally and internationally designated Minsmere to Walberswick Heaths and Marshes SSSI, Special Area of Conservation (SAC), Special Protected Area and Ramsar site. These nationally and internationally designated sites are directly downstream of the site. The proposed development has the potential to be a source of pollution with a direct pathway to this sensitive receptor.

xii. Existing buildings

12.4.47 Changes in groundwater level have the potential to affect building foundations. There are no existing buildings present on-site as provided in **Figure 9.1** of this volume, however, there are several residential properties, farms and associated buildings within the outer study area, including Leiston Abbey.

12.4.48 Further consideration of existing buildings within the study area is given in **Chapter 9** of this volume.

xiii. Potential for existing contamination

12.4.49 The following potential existing contamination sources are discussed in **Chapter 11** of this volume:

- historical site usage;
- waste management sites;
- service stations;
- industrial and other potentially contaminative land uses; and

- potential for unexploded ordnance.

12.4.50 The potential sources of contamination at the site are presented in the PCSM in **Chapter 11** of this volume.

xiv. Summary of key receptors

12.4.51 The key receptors for potential effects are summarised in **Table 12.7.**

Table 12.7: Key receptors within the study area.

Receptor	Receptor Sensitivity To Physical Effects	Receptor Sensitivity To Contaminative Effects
Crag groundwater (principal aquifer).	Medium	Medium
Head Deposits groundwater (secondary aquifer (undifferentiated)).	Very low	Medium
Lowestoft Formation - Diamicton groundwater (secondary aquifer (undifferentiated)).	Very low	Medium
Lowestoft Formation – Sand and Gravel groundwater (secondary A aquifer).	Low	Medium
Groundwater abstractions.	Medium	Medium
Potential PWS.	Medium	Medium
Existing buildings.	Medium	Low
Minsmere River (Main River).	Medium	Medium
Theberton Watercourse (Main River).	Very low	Medium
Middleton Watercourse (Main River).	Very low	Medium
Unnamed watercourses.	Very low	Medium
Surface drain.	Very low	Medium
Existing ponds.	Very low	Medium
Walberswick Heaths and Marshes SSSI and SAC.	High	Medium

b) Future baseline

12.4.52 Committed developments have been considered as future receptors in the assessment of ground and surface water impacts during the construction and operation phases of the proposed development. The four committed developments which have been identified within the study area are summarised in **Table 12.8.**

Table 12.8: Committed developments.

Planning Application Ref	Site Address	Description Of Development	Date Of Approval	Status	Distance (m)
DC/19/4813/FUL	Pretty Road Theberton Suffolk	Conversion of an old council depot/ storage building into a one bedroomed holiday let/ living accommodation. With two extra holiday lodges and a new driveway access into the site from Pretty Road.	Awaiting decision	Awaiting decision	161
DC/16/3947/OUT	Norwood House Littlemoor Road Middleton Suffolk IP17 3JZ.	Erection of 14 sheltered/extra care dwellings, together with residents lounge/meeting room and parking area.	06/09/2017	Construction not commenced.	221
DC/16/0444/COU	Middleton Village Hall Mill Street Middleton Suffolk.	Change of use of part of agricultural field to provide overflow car parking.	30/03/2016	Construction not commenced.	453
DC/14/0329/OUT	Land Adjoining Green Garth Mill Street Middleton Suffolk.	Use of land for the erection of six dwellings (of which two are to be affordable houses) together with car parking and construction of service approach drive utilising existing access point.	05/08/2014	Construction not commenced.	477

12.4.53 The construction timeline for these committed developments is unconfirmed. However, planning permissions generally require construction to commence within three years of the grant of planning permission or reserved matters approval before the planning permission lapses. As such, and for the purposes of this assessment, it has been assumed that the developments will have been constructed prior to 2022. These committed developments have therefore been considered as future receptors as part of the baseline for the groundwater and surface water assessments.

12.4.54 Climate change will be taken into account in the detailed drainage design through the application of the appropriate rainfall intensity allowances.

12.4.55 There is not anticipated to be any change to aquifer classification as a result of any stage of the development.

12.4.56 As the length of the construction and operational phases of the proposed development will cover a 9-12 year period, changes to the WFD status of the Minsmere Old River and River Fromus water bodies could be realised, relating to the default 'good status' been achieved by 2027 and beyond. Although WFD status is only relevant to the WFD Compliance Assessment. By-products, such as improved water quality, geomorphology, or biology as a result of WFD implementation should be considered within the evolution of the future baseline.

12.4.57 The future baseline of the Minsmere Old River water body is not predicted to change, and it is assumed that this will equally apply to the River Yox and Minsmere River in the vicinity of the site. This judgement is based on the following factors:

- physico-chemical quality is already meeting required standards (good or high), so will not be improved through the implementation of the Anglian RBMP;
- the hydrological regime for the Minsmere Old River already supports good status, so will not be improved through the implementation of the Anglian RBMP;
- the HMWB designation recognises that morphological changes are fixed and there is no prospect for change through the implementation of the Anglian RBMP;

- biological quality elements will remain poor due to the unfavourable balance of costs and benefits to improve the status of fish within the system. This is due to physical modifications such as hard barriers and land drainage for agriculture and rural land management; and
- poor biological status is not anticipated to improve so the ecological status will remain as moderate throughout the construction and operational phases of the proposed development.

12.4.58 The future baseline of the River Fromus water body is not predicted to change. This judgement is based on the following factors:

- physico-chemical quality status will remain as moderate, as there are no technical solutions to improve the dissolved oxygen and phosphate elements. This is due to poor soil management, and the consented discharge from the Benhall Sewage Treatment Works;
- the hydrological regime for the River Fromus already supports good status, so will not be improved through the implementation of the Anglian RBMP;
- biological quality elements will remain poor due to the disproportionate burdens to improve the status of fish within the system. This is due to physical modifications such as hard barriers, land drainage for agriculture and rural land management, and the consented discharge from the Benhall Sewage Treatment Works; and
- moderate physico-chemical status and poor biological status is not anticipated to improve so the ecological status will remain as poor throughout the construction and operational phases of the proposed development, due to the consented discharge from the Benhall Sewage Treatment Works.

12.5 Environmental design and mitigation

12.5.1 As detailed in **Volume 1**, **Chapter 6** of the **ES**, a number of primary mitigation measures have been identified through the iterative EIA process, and have been incorporated into the design and construction planning of the proposed development. Tertiary mitigation measures are legal requirements or are standard practices that will be implemented as part of the proposed development.

12.5.2 The assessment of likely significant effects of the proposed development assumes that primary and tertiary mitigation measures are in place. For groundwater and surface water, these measures are identified, in the

following section, with a summary provided on how the measures contribute to the mitigation and management of potentially significant environmental effects.

a) Primary mitigation

12.5.3 Primary mitigation is often referred to as 'embedded mitigation' and includes modifications to the location or design to mitigate impacts; these measures become an inherent part of the proposed development.

i. Construction phase

12.5.4 The proposed development would cross two Main Rivers (referred to as the 'Middleton Watercourse' and 'Theberton Watercourse'), as well as three unnamed watercourses; some watercourses are crossed by the route of the Sizewell link road and proposed side roads. Where the proposed development crosses existing watercourses, portal culverts of varying lengths would be installed to maintain hydrological connectivity and would straddle the watercourse to reduce the disturbance of the bank. At Hawthorn Road, the new junction layouts on the south side of the route would require the side road to cross the unnamed tributary. At this location a portal culvert is proposed which would include provision for a mammalian ledge. At Fordley Road the watercourse will be diverted to avoid the new junction so that only one crossing is required, and a flood relief culvert would be provided adjacent to the portal culvert. At the Sizewell link road/B1122/B1125 junction the existing culvert under the B1122 will be retained and extended to maintain flows. A flood relief culvert and a watercourse relief basin are also proposed south of Theberton and Brown's plantation to manage surface water flow.

ii. Operational phase

12.5.5 Water draining from the road infrastructure will pass through appropriate drainage, including the incorporation of SuDS measures as set out in the **Outline Drainage Strategy** in **Appendix 2A** of **Volume 2** of the **ES**, and petrol/oil interceptors as necessary (following a Highways England Water Risk Assessment Tool assessment as part of the detailed design for the drainage elements of the proposed development). This will allow infiltration to the superficial aquifer, whilst also protecting the underlying groundwater from hydrocarbon contamination and the Walberswick Heaths and Marshes SSSI and SAC that lies downstream.

12.5.6 Infiltration basins would be located along the length of the site and would be designed to cater for a 100 years flood event plus allowance for climate change. Swales would be provided along the length of the route of the

Sizewell link road. The swales would attenuate and convey surface water run-off at a rate not exceeding existing Greenfield run-off rates.

b) Tertiary mitigation

12.5.7 Tertiary mitigation will be required regardless of any EIA assessment, as it is imposed, for example, as a result of legislative requirements, and/or standard sectoral practices.

12.5.8 Groundwater management during the construction phase may be required to dewater the area immediately adjacent to the cuttings, should groundwater be locally present. These groundwater control measures for the site will be developed at detailed design stage if required following ground investigation.

12.5.9 Tertiary mitigation measures to be incorporated into the proposed development during enabling works, construction, and operation, as set out in the **Code of Construction Practice** (**CoCP**) (Doc Ref. 8.11) include:

- Foul sewage arising from the construction compound to be tankered off-site.
- Temporary SuDS to be implemented early in the construction phase. Construction phase water management zones to intercept surface run-off, sediment and contaminants from the construction compound and laydown areas, and incorporate sustainable drainage measures such as swales, filter drains, infiltration ponds and soakaways to promote infiltration.
- Construction drainage to be contained within the site, with infiltration to ground. A low bund is proposed to be constructed to achieve this with an external toe drain to intercept off-site run-off that may otherwise be impeded by the presence of the proposed bund. Only if full infiltration is not possible, would these systems discharge into existing surface drainage networks at greenfield run-off rates to minimise the potential for impact.
- Hardstanding to be constructed within the construction compounds where required to mitigate potential spills and leaks. Water falling onto impermeable surfaces to pass through a bypass separator.
- Implementation of appropriate pollution incident control e.g. plant drip trays and spill kits. Spill kits would be available on-site at all times.

Sand bags or stop logs would also be available for deployment on the outlets from the site drainage system in case of emergency spillages.

- Implementation of appropriate and safe storage of fuel, oils and equipment during construction. For example, all fuels, oils, lubricants and other chemicals would be stored in an impermeable bund with at least 110% of the stored capacity. All refuelling would take place in a dedicated impermeable area, using a bunded bowser. Biodegradable oils should be used where possible.

- The wheels of all vehicles would be free of contamination before arriving at site. All vehicles would be inspected prior to leaving site and should contaminative substances be identified suitable measures (e.g. wheel washing) would be implemented.

- Concrete and cement mixing and washing areas would be situated at least 10m away from surface water receptors. These would incorporate settlement and recirculation systems to allow water to be re-used. All washing out of equipment would be undertaken in a contained area, and all water would be collected for off-site disposal.

- Stockpiles would be located a minimum of 10m from the nearest watercourse.

12.5.10 The following measures would be incorporated into the construction works to minimise flood-related health and safety risks:

- Construction works for activities within or adjacent to watercourses should employ weather monitoring to predict potential extreme events and halt construction works, if required.

12.5.11 Additional tertiary mitigation that would be anticipated and referenced in the **CoCP** (Doc Ref. 8.11) includes:

- Excavation and handling of materials and stockpiling, and construction waste, would be managed by good working practice in accordance with the materials management measures, soil management measures and waste management measures set out in the **CoCP** (Doc Ref. 8.11).

- Plan and design piling activities in compliance with Environment Agency guidance. This guidance may highlight the need for a piling risk assessment to ensure that piling techniques deemed appropriate are implemented at the site by identifying and managing potential risks as a result of creating pathways to the aquifer.

12.6 Assessment

a) Introduction

12.6.1 This section presents the findings of the groundwater and surface water assessment for the construction and operation of the proposed development.

12.6.2 This section identifies any likely significant effects that are predicted to occur, and **section 12.7** of this chapter then highlights any secondary mitigation, and monitoring measures that are proposed to minimise any adverse significant effects (if required).

b) Construction

i. Groundwater level and flow regime

12.6.3 The removal of on-site vegetation and the compaction of soils due to construction vehicles and materials storage may locally reduce the rate at which rainfall makes its way into the groundwater for a short duration, however, the overall volume of water discharging to ground is unlikely to change. The impact to groundwater from these activities would be very low, resulting in a negligible effect for the very low and low value superficial deposits, and a minor adverse effect for the medium value Crag deposits. These effects would be **not significant**.

12.6.4 Current groundwater levels at the site have not been established, however, available BGS hydrogeological data suggest that levels will be variable across the site. Based on the data presented in the historical borehole logs, the thickness of the geological deposits also varies across the site. The construction of the proposed development includes a series of cuttings at depths of up to 6m bgl (+1m/-1m as per the site parameters), with a minimum elevation of 8.5m AOD in the east of the site. However, based on the information available at the time of writing, it is anticipated that the cuttings will be wholly within the Lowestoft Formation (diamicton), and so it is considered unlikely that the groundwater of the sands and gravels of the Lowestoft Formation and the Crag Group will be encountered during the proposed works. Due to the anticipated limited lateral extent of groundwater within the Lowestoft Formation (diamicton) and its low permeability, it is likely that any groundwater control measures required to dewater the superficial aquifer during the construction of the cuttings would be localised, and of short duration. The impact to the very low value Lowestoft Formation (diamicton) aquifer would be low, and the effect classified as negligible. The effect would be **not significant**.

12.6.5 It is unlikely that the base of the cutting will extend beyond the base of the Lowestoft Formation (diamicton) aquifer. Therefore, no groundwater control measures are anticipated to be required within the Lowestoft Formation sand and gravels aquifer or the Crag aquifer, and there would be no effect on these aquifers with respect to dewatering activities. Geological horizons and groundwater levels will need to be established during the ground investigation, with the impact of the cuttings on the aquifers to be reassessed once the data is made available.

12.6.6 Whilst two of the licensed groundwater abstractions are located within 100m of the site, however, they are at some distance from the construction activities which may decrease groundwater availability. Groundwater control measures are anticipated to be confined to the Lowestoft Formation (diamicton) aquifer, from which it is unlikely that the groundwater abstractions would take water. With the implementation of the primary and tertiary mitigation measures identified, the groundwater abstractions identified are unlikely to be affected by any local changes to the hydrogeological environment. It is concluded that there would be no effect on all of the licensed groundwater abstractions identified in the outer study area with respect to water level and flow.

12.6.7 There are no known PWS in the outer study area, however, groundwater control measures are anticipated to be confined to the Lowestoft Formation (diamicton), from which it is unlikely that PWS would abstract water. It is concluded that there would be no effect on PWS in the outer study area with respect to groundwater level and flow.

12.6.8 Due to the anticipated localised and short-term groundwater control requirements at the site, it is concluded that there would be no effect on the medium value existing buildings in terms of subsidence risk.

ii. Contamination of groundwater

12.6.9 As presented in **Chapter 11** of this volume, the construction phase would potentially introduce new sources of contamination to the site through spills or leaks of contaminants used during construction. Construction works, such as excavation and stockpiling, can pose a risk to groundwater receptors through leaching and run-off of contaminants. Intrusive activities and removal of low permeability material can pose a risk to groundwater by creating new contaminant pathways, or mobilising existing contamination through exposure of contaminated soil or remobilisation of contaminants through soil disturbance. The potential contaminant linkages assessed in **Chapter 11** of this volume which have been carried forward into this assessment are:

- The potential for mobilising contaminants by excavation and stockpiling of material, increasing the risk to controlled water receptors through leaching and run-off. Earthworks could provide opportunities for run-off to contain suspended solids if not carried out in line with required management procedure.
- The potential for introducing new sources of contamination i.e. from spillages and leaks.
- The potential for creation of new pathways to groundwater during groundworks, through opening up ground temporarily and construction activities, such as earthworks, piling, installation of drainage, and other below-ground services and foundations.

12.6.10 Earthworks activities such as excavation of cuttings during the construction process create a potential pathway for existing on-site contamination to reach groundwater. It is unlikely that the cuttings would extend beyond the base of the low permeability Lowestoft Formation (diamicton) aquifer, and into the underlying sand and gravel Lowestoft Formation and Crag aquifers. Should contamination be introduced it would likely be confined to the Lowestoft Formation (diamicton) aquifer.

12.6.11 Piling activities would be localised and of short-term duration and undertaken in compliance with Environment Agency guidance, potentially needing a piling risk assessment.

12.6.12 As presented in **Chapter 11** of this volume, there is also the potential for existing contamination at the site, as well as the introduction of new contaminants, and preferential pathways through construction activities. The implementation of the primary and tertiary mitigation measures identified in **section 12.5** of this chapter and in **Chapter 11** of this volume, including implementation of pollution incident control and safe storage of fuel, oils and equipment, would reduce this risk.

12.6.13 The Crag groundwater would be protected from any spills or leaks where it is overlain by low permeability superficial deposits. However, in areas where the superficial deposits are absent or more permeable, there is a potential pathway for contamination to reach the Crag groundwater.

12.6.14 Where a spill or leak does occur, given the relatively low volumes of potentially contaminative material and the primary and tertiary mitigation measures employed, the scale of the spill or leak is likely to be small.

12.6.15 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial, and bedrock aquifers from the leaching/migration of

contaminants through the soil is slightly increased during the construction phase and the effect is classified as minor adverse. The effects would be **not significant**.

12.6.16 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial and bedrock aquifers from the migration of contaminants through preferential pathways created by the construction activities is slightly increased during the construction phase, and the effect is classified as minor adverse. The effects would be **not significant**.

12.6.17 The abstraction boreholes located at Theberton Grange are located within 100m of the site boundary. Due to their proximity to the site, it is considered that there is the potential for contamination from the site activities to migrate to the abstractions, through leaching through the soil or via the creation of preferential pathways. With the implementation of the primary and tertiary mitigation measures, it is anticipated that the risk to the abstractions is the same as for the aquifer from which they abstract groundwater. This is an increase from the existing baseline during the construction activities and the effect is classified as minor adverse. The effect would be **not significant**.

12.6.18 The other licensed groundwater abstractions identified are located over 400m from the site. Due to their distance from the site and with the implementation of the primary and tertiary mitigation measures identified, it is concluded that there would be no effect on the abstractions with respect to water quality.

12.6.19 There are no known PWS in the inner study area, however there is the potential for as yet unidentified PWS to be within the inner study area. With the implementation of the primary and tertiary mitigation measures identified, the impact to potential PWS with respect to water quality beyond the site itself would be the same as for the groundwater from which they would abstract and therefore classified as minor adverse. The effect would be **not significant**.

12.6.20 It is considered that there is no pathway for contaminative sources from the construction activities to impact groundwater receptors beyond the inner study area of 500m. Groundwater receptors identified in the baseline environment **section 12.4** of this chapter which are situated outside of the inner study area are, therefore, not assessed for the effects from contaminative sources during the construction phase.

12.6.21 Further risks from existing on-site contamination are discussed in further detail in **Chapter 11** of this volume.

iii. Alteration of surface water flow regime

12.6.22 Any changes to the flow regime have the potential to increase existing pressures and adversely affect the hydromorphology of the Theberton and Middleton Watercourses, unnamed watercourses, existing ponds, and the surface drain. The sensitivity of these receptors is considered very low.

12.6.23 Where construction increases the extent of bare and compacted ground for a prolonged period, there is the potential for an increase in surface run-off and increase in flood peaks in the nearest receptor. The proposed development would create new areas of bare ground for prolonged periods during the construction phase.

12.6.24 Construction phase water management is embedded in the design, with on-site surface water run-off being infiltrated or discharged at Greenfield run-off rates until the SuDS infrastructure is operational. This will result in a very low magnitude impact. This effect would be negligible, and considered to be **not significant** for these surface water receptors. Once the drainage infrastructure is operational, there will be no effect.

iv. Contamination of surface waters

12.6.25 It is considered that there is a pathway for contaminative sources from the construction activities to impact surface water receptors beyond the inner study area. Surface water receptors identified in the baseline environment described in **section 12.4** of this chapter which are situated in the outer study area (Minsmere River and the Walberswick Heaths and Marshes SSSI) are therefore assessed for the impacts from contaminative sources during the construction phase.

12.6.26 Contamination of surface waters arising from construction activities through the disturbance/mobilisation of existing sources of contamination or the introduction of new sources/contaminants have the potential to adversely affect the water quality of the Minsmere River, Theberton and Middleton Watercourses, the unnamed watercourses, surface drain, existing ponds and the Walberswick Heaths and Marshes SSSI, increasing existing pressures on these receptors.

12.6.27 Where excavations and the introduction of contaminants to a site take place, there is the potential for an increase in the risk of contaminating the nearest receptor. The proposed development would involve excavations and therefore has the potential to introduce contaminants during the construction phase.

12.6.28 Surface water run-off would be contained within the site, with drainage to ground wherever feasible. Implementation of appropriate pollution incident control in accordance with the **CoCP** (Doc Ref. 8.11) would further minimise the impacts of site construction activities on the surface drainage network.

12.6.29 As detailed in **Appendices 11B** and **11C** of this volume**,** the risk on the receptors from both lateral migration of existing contamination, and discharge of contaminants from construction activities are considered slightly increase compared to the baseline risk. The effects from both impacts on these surface water receptors are classified as minor adverse and considered to be **not significant**.

v. Flood risk

12.6.30 The proposed development would include sustainable drainage for the life time of the development to manage any additional surface water run-off from it. A combination of infiltration and controlled discharge methods are proposed for the discharge of surface water run-off. Controlled discharge would be agreed with the Highway Authority. The culverts which would be installed on the watercourses have been sized to accommodate flood flows. As the majority of the site is located in Flood Zone 1, construction activities will not lead to a loss in functional floodplain storage or displacement of sea or river flood water. **No significant** effect is predicted.

12.6.31 Further information on flood risk at the site is provided in the **Sizewell Link Road FRA** (Doc Ref. 5.6) which has been submitted as part of this application for development consent.

vi. WFD compliance

12.6.32 The site is located within the Minsmere Old River and River Fromus WFD water body catchments, and on the Waveney and East Suffolk Chalk and Crag groundwater body. The River Fromus water body was screened out of the WFD compliance assessment because the proposed activities would be confined to a very small proportion of the water body catchment (0.016km^2, 0.04%), and the activities are located on the watershed.

12.6.33 The preliminary (Stage 2) WFD assessment demonstrates that proposed construction activities would not have direct or indirect effects on the Minsmere Old River, and Waveney & East Suffolk Chalk and Crag water bodies, that would be sufficient to cause deterioration in the status of the water body or protected areas located within the water bodies.

12.6.34 However, the construction of the watercourse crossings has the potential to affect the hydromorphology of the Minsmere Old River and counteract or otherwise affect the delivery of four mitigation measures (remove or soften hard bank, preserve or restore habitats in-channel morphological diversity and enhance ecology) identified for the water body. The potential impacts of these activities were therefore considered in a more detail assessment (Stage 3).

12.6.35 The proposed construction activities would not directly interact with the main channel of the Minsmere Old River, with the works confined to watercourses which drain into the main water body. Furthermore, construction phase impacts within these minor watercourses would be restricted to a small proportion of each watercourse during the construction period.

12.6.36 The detailed assessment demonstrates that, although the proposed construction of the watercourse crossings could result in highly localised effects on hydromorphology, the changes are not predicted to be sufficient to result in deterioration of the status of any quality elements in the Minsmere Old River (within or between status classes).

12.6.37 Furthermore, any effects would not prevent the implementation or counteract the effects of the mitigation measures identified in the RBMP.

12.6.38 As the proposed construction stage activities will not lead to a change in the overall status of the water bodies; the proposed construction activities are deemed compliant with the WFD.

12.6.39 Further information on the WFD compliance assessment is provided in the **WFD Compliance Assessment Report** (Doc Ref. 8.14), submitted as part of this application for development consent.

vii. Inter-relationship effects

12.6.40 This section provides a description of the identified inter-relationship effects that are anticipated to occur on groundwater and surface water receptors between the individual environmental effects arising from construction of the proposed development.

12.6.41 There are anticipated to be inter-relationship effects between groundwater and surface water (i.e. groundwater providing baseflow to surface watercourses); geology and land quality (i.e. naturally elevated concentration of contaminants in certain geologies); and terrestrial ecology and ornithology (i.e. groundwater dependent ecosystems). This is in

relation to potential receptors which could be impacted during the construction of the proposed development.

12.6.42 The assessment of groundwater and surface water flows and levels is considered in this chapter, and there are no further combined effects beyond those stated in the preceding section.

12.6.43 The assessment of contamination on groundwater and surface water is considered inherently within the geology and land quality assessment as provided in **Chapter 11** of this volume, and no further combined effects are anticipated.

12.6.44 The assessment of terrestrial ecology is considered in **Chapter 7** of this volume.

c) Operation

12.6.45 This section assesses the potential impacts of the operational phase of the proposed development on groundwater and surface water hydrology, geomorphology, and water quality.

i. Groundwater level and flow regime

12.6.46 Instances where cuttings intercept the water table could have an impact on the groundwater flow and flow direction, although long-term groundwater dewatering is unlikely to be required given the limited lateral extent of groundwater within the Lowestoft Formation (diamicton), and the depth to the sand and gravel Lowestoft Formation and Crag aquifers which are unlikely to be intercepted by the cutting. The potential impact to groundwater levels in the aquifers, and to existing buildings from the proposed development with respect to subsidence risk, therefore, does not require assessment.

12.6.47 The proposed drainage design incorporates the use of SuDS. Water falling onto impermeable surfaces would be channelled into the SuDS infrastructure. This would allow infiltration to the superficial aquifer and would mean that although the spatial distribution of infiltration would be changed locally within the development area, the total volume of infiltration entering the ground would not be significantly changed relative to the groundwater system. The impact to the very low and low value superficial aquifers would therefore be of long-term very low magnitude, and the effect classified as negligible. The effect would be **not significant**.

12.6.48 The Crag is predominantly overlain by the low permeability Lowestoft Formation (diamicton) aquifer, however, changes to the distribution of

recharge over the site area may have an effect on the flow regime of the Crag groundwater under the site. The impact on the medium value Crag aquifer would therefore be very low, and the effect on the flow regime of the Crag aquifer is classified as minor adverse. The effect would be **not significant**.

12.6.49 The abstraction boreholes located at Theberton Grange are located within 100m of the site boundary. Due to the relatively small changes in the groundwater flow and level regime, in combination with the implementation of the primary and tertiary mitigation measures identified, the impact on these groundwater abstractions with respect to groundwater level, and flow would be very low and the effect classified as minor adverse. The effect would be **not significant**.

12.6.50 The other licensed groundwater abstractions identified are located over 400m from the site. Due to their distance from the site, and with the implementation of the primary and tertiary mitigation measures identified, they are unlikely to be affected by any local changes to the hydrogeological environment. It is concluded that there would be no effect on the abstractions with respect to water level and flow.

12.6.51 Whilst there are no known PWS in the outer study area, the superficial and bedrock aquifers are anticipated to experience no discernible change resulting from the proposed development. The impact on any medium value PWS would be very low and the effect would be classified as minor adverse. The effect would be **not significant**.

ii. Contamination of groundwater

12.6.52 As presented in **Chapter 11** of this volume, the operation of the proposed development could introduce new sources of contamination to the site and create additional potential pathways for the migration of potential contamination. The implementation of the primary and tertiary mitigation measures identified in **section 12.5** of this chapter, and in **Chapter 11** of this volume, would reduce this risk.

12.6.53 During operation the main risks from contamination are fuel spills or leaks along the route. It is not anticipated that significant spills, or leaks, would occur from vehicles using the route. It is understood that contamination from these sources would be of limited magnitude, and longevity, and would be mitigated through tertiary mitigation methods. The presence of silt traps and hydrocarbon separators within the drainage design would prevent the supply of sediment, and other contamination, to the drainage network. The provision of infiltration basins would protect the underlying groundwater from hydrocarbon contamination.

12.6.54 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial and bedrock aquifers from the leaching/migration of contaminants through the soil is slightly decreased during the operation phase and the effect is classified as minor beneficial. The effects would be **not significant**.

12.6.55 Compared to the existing baseline, the level of risk to groundwater in the underlying superficial, and bedrock aquifers from the migration of contaminants through preferential pathways created by the operational activities, is slightly decreased during the operation phase and the effect is classified as minor beneficial. The effects would be **not significant**.

12.6.56 The abstraction boreholes located at Theberton Grange are located within 100m of the site boundary. Due to their proximity to the site, it is considered that there is the potential for contamination from the site activities to migrate to the abstractions, through leaching through the soil or via the creation of preferential pathways. With the implementation of the primary and tertiary mitigation measures, it is anticipated that the risk to the abstractions is the same as for the aquifer from which they abstract groundwater. This is a decrease from the existing baseline during the operational activities and the effect is classified as minor beneficial. The effect would be **not significant**.

12.6.57 The other licensed groundwater abstractions identified are located over 400m from the site. Due to their distance from the site, and with the implementation of the primary and tertiary mitigation measures identified, it is concluded that there would be no effect on the abstractions with respect to water quality.

12.6.58 Whilst there are no known PWS in the inner study area, with the implementation of the primary and tertiary mitigation measures identified, the impact to potential PWS with respect to water quality would be the same as for the groundwater from which they would abstract, and therefore the effect would be classified as minor adverse. The effect would be **not significant**.

12.6.59 It is considered that there is no pathway for contaminative sources from the operational activities to impact groundwater receptors beyond the inner study area of 500m. Groundwater receptors identified in the baseline environment **section 12.4** of this chapter which are situated outside of the inner study area are, therefore, not assessed for the effects from contaminative sources during the operation phase.

iii. Alteration of the flow regime

12.6.60 Any changes to the flow regime during operation have the potential to increase existing pressures, and adversely affect the hydromorphology of the Theberton and Middleton Watercourses, unnamed watercourses, existing ponds and the surface drain.

12.6.61 An increase in the extent of hardened surfaces will lower the infiltration rate and could increase surface run-off in receiving watercourses. Whilst the proposed development will have areas of impermeable surfaces, an operational drainage system is embedded in the design, with on-site surface water run-off being infiltrated, or discharged at Greenfield run-off rates. No effect is therefore predicted for the Theberton and Middleton Watercourses, the unnamed watercourses, and the surface drain.

iv. Contamination of surface waters

12.6.62 It is considered that there is a pathway for contaminative sources from the operational activities to impact surface water receptors beyond the inner study area of 500m. Surface water receptors identified in the baseline environment **section 12.4** of this chapter which are situated in the outer study area (Minsmere River and the Walberswick Heaths and Marshes SSSI) are therefore assessed for the effects from contaminative sources during the operation phase.

12.6.63 Contamination of surface waters may arise from the operation of the proposed development due to the introduction of new sources of contaminants. If this occurs, these have the potential to adversely affect the biology and water quality of the Minsmere River, Theberton and Middleton Watercourses, the unnamed watercourses, surface drain, existing ponds, and the Walberswick Heaths and Marshes SSSI, increasing existing pressures on these receptors.

12.6.64 As presented in the Design Manual for Roads and Bridges (Ref. 12.36) the risk of contaminants reaching a surface water receptor is lower for newly constructed roads as opposed to existing roads due to an improvement in drainage system solutions.

12.6.65 Water draining from the proposed development will pass through bypass separators before discharging to the swales. Implementation of appropriate pollution incident control will further reduce the risks of run-off from chemical spills, or leaks and prevent water contamination.

12.6.66 As detailed in **Appendices 11B** and **11C** of this volume, on the basis of the primary and tertiary mitigation measures, the risk on surface waters would

remain the same as the baseline risk. The effects from lateral migration and discharge of contaminants on these surface water receptors are classified as negligible and considered to be **not significant**.

v. Flood risk

12.6.67 The majority of the site is located in Flood Zone 1, meaning that there will be no loss in functional floodplain storage, or displacement of sea, or river flood water as a result of the proposed development. The proposed development will not, therefore, increase flood risk to surrounding areas.

12.6.68 The existing site is currently 'greenfield' with the only impermeable surfaces being existing roads and tracks that will connect to the proposed link road. Therefore, the proposed highway development would significantly increase the impermeable area on the site. This increase in impermeable area has the potential to increase the surface water run-off and the associated flood risk both on and off site.

12.6.69 The proposed development is classed as being 'essential infrastructure' under the NPPF and is located in Flood Zone 1. As per the Flood Risk Vulnerability and Flood Zone Compatibility table, the development is considered appropriate in terms of flood risk vulnerability.

12.6.70 The increase in impermeable area associated with the proposed development will require sustainable management of surface water run-off through the attenuation and controlled discharge of flows to the surrounding environment, most likely infiltration to ground.

12.6.71 The proposed development will require seven culverts across minor watercourses: two on the Middleton Watercourse, one on Theberton Watercourse, and four on unnamed tributaries. The presence of the culverts could result in reduced flow, creating upstream impoundments, and affect patterns of flood risk. However, the design of the culverts will ensure that their impacts are minimised.

12.6.72 Based on the information presented, the proposed mitigation measures and in line with NPPF guidance, the development site is considered to be appropriate in terms of flood risk. No effect is predicted.

12.6.73 Further information on flood risk at the site is provided in the **Sizewell Link Road FRA** (Doc Ref. 5.6) which has been submitted as part of this application for development consent.

vi. WFD compliance

12.6.74 The site is located within the Minsmere Old River and River Fromus WFD water body catchments, and on the Waveney and East Suffolk Chalk and Crag groundwater body. The River Fromus water body was screened out of the WFD compliance assessment.

12.6.75 The preliminary (Stage 2) WFD assessment demonstrates that proposed operational activities would not have direct or indirect effects on the Minsmere Old River and Waveney & East Suffolk Chalk, and Crag water bodies that would be sufficient to cause deterioration in the status of the water body or protected areas located within the water bodies.

12.6.76 However, the presence of the watercourse crossings has the potential to affect the hydromorphology of the Minsmere Old River and counteract or otherwise affect the delivery of four mitigation measures (remove or soften hard bank, preserve or restore habitats, in-channel morphological diversity and enhance ecology) identified for the water body. The potential impacts of these activities were therefore considered in a more detail assessment (Stage 3).

12.6.77 The operational phase of the proposed development would require the presence of seven culverts across minor watercourses which drain into the Minsmere Old River (two on the Middleton Watercourse, one on Theberton Watercourse, and four on unnamed tributaries). The operational presence of the culverts could result in reduced flow and sediment conveyance (thereby limiting river continuity), create upstream impoundment, and affect patterns of erosion and sedimentation (e.g. by encouraging upstream sedimentation and downstream erosion). However, the design of the culverts will ensure that their impacts on river continuity are minimised.

12.6.78 The detailed assessment demonstrates that, although the proposed operational activities could result in highly localised effects on hydromorphology, any changes are not predicted to be sufficient to result in deterioration in the status of any quality elements in the Minsmere Old River (within or between status classes).

12.6.79 Furthermore, any effects would not prevent the implementation or counteract the effects of the mitigation measures identified in the RBMP or prevent WFD objectives being achieved in this water body in the future.

12.6.80 As the proposed operational phase activities will not lead to a change in the overall status of the water bodies; the proposed operational phase activities are deemed compliant with the WFD.

12.6.81 Further information on WFD compliance assessment is provided in the **WFD Compliance Assessment Report** (Doc Ref. 8.14) as part of the application for development consent.

vii. Inter-relationship effects

12.6.82 This section provides a description of the identified inter-relationship effects that are anticipated to occur on groundwater and surface water, receptors between the individual environmental effects arising from operation of the proposed development.

12.6.83 There are anticipated to be inter-relationship effects between groundwater and surface water (i.e. groundwater providing baseflow to surface watercourses); geology and land quality (i.e. naturally elevated concentration of contaminants in certain geologies); and terrestrial ecology and ornithology (i.e. groundwater dependent ecosystems). This is in relation to potential receptors which could be impacted during the operation of the proposed development.

12.6.84 The assessment of groundwater and surface water flows and levels is considered in this chapter, and there are no further combined effects beyond those stated in the preceding section.

12.6.85 The assessment of contamination on groundwater and surface water is considered inherently within the geology and land quality assessment as provided in **Chapter 11** of this volume, and no further combined effects are anticipated.

12.6.86 The assessment of terrestrial ecology is considered in **Chapter 7** of this volume.

12.7 Mitigation and monitoring

a) Introduction

12.7.1 Primary and tertiary mitigation measures which have already been accounted for as part of the assessment are summarised in **section 12.5** of this chapter. Where other mitigation is required, this is referred to as secondary mitigation, and where reasonably practicable, secondary mitigation measures have been proposed.

12.7.2 This section describes the proposed secondary mitigation measures for groundwater and surface water, as well as describing any monitoring required of specific receptors/resources, or for the effectiveness of a

mitigation measure. The requirements, scope, frequency and duration of a given monitoring regime are set out, as far as possible.

b) Mitigation

12.7.3 A ground investigation would be undertaken to confirm ground conditions, contamination status, and other ground related risks. This would be completed prior to commencement of construction works. Where the ground investigation and subsequent generic risk assessments identifies unacceptable levels of contamination and ground related risks, further detailed quantitative risk assessment followed by, where necessary, and the remediation of soil and groundwater contamination prior to construction may be required.

12.7.4 Active management and maintenance of the drainage infrastructure would be required to ensure the continued efficacy of the surface water drainage system.

12.7.5 A flood risk emergency plan would be developed to identify safe access and escape routes, demonstrate free and safe movement of people during a design flood and set out the potential for evacuation before a more extreme event.

c) Monitoring

12.7.6 A programme of gas, groundwater and surface water monitoring would be designed as part of the ground investigation and would be required prior to construction works commencing. The results of this short-term monitoring would determine whether further long-term gas, and groundwater monitoring is required during the construction and operational phases.

12.7.7 Implementation of a contamination watching brief by suitably qualified and experienced personnel would be completed when excavating areas of potential contamination risk.

12.8 Residual effects

12.8.1 The following tables (**Table 12.9** and **Table 12.10**) present a summary of the groundwater and surface water assessment. They identify the receptor/s likely to be impacted, the level of effect and, where the effect is deemed to be significant, the tables include the mitigation proposed and the resulting residual effect.

Table 12.9: Summary of effects for the construction phase.

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Crag groundwater (Principal Aquifer).	Reduction in the rate/volume of water discharging to ground.	Temporary SuDS and water management zones. Ground investigation and risk assessment. Remediation of soil and groundwater if necessary. Ensuring all site activities are carried out in accordance with the **CoCP** (Doc Ref. 8.11).	Minor adverse.	Ground investigation and relevant risk assessments completed prior to commencement of construction works. Remediation of soil and groundwater if necessary. Longer term gas, groundwater and surface water monitoring if necessary.	Minor adverse (**not significant**).
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial (**not significant**).
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial (**not significant**).
Head Deposits groundwater (Secondary Aquifer (Undifferentiated)).	Reduction in the rate/volume of water discharging to ground.		Negligible.		Negligible (**not significant**).
	Lowering of groundwater levels.		Negligible.		Negligible (**not significant**).
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial (**not significant**).
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial (**not significant**).
Lowestoft Formation (diamicton) groundwater. (Secondary Aquifer (Undifferentiated)).	Reduction in the rate/volume of water discharging to ground.		Negligible.		Negligible (**not significant**).
	Lowering of groundwater levels.		Negligible.		Negligible (**not significant**).

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial (**not significant**).
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial (**not significant**).
Lowestoft Formation sands and gravels groundwater (Secondary A Aquifer).	Reduction in the rate/volume of water discharging to ground.		Negligible.		Negligible (**not significant**).
	Lowering of groundwater levels.		Negligible.		Negligible (**not significant**).
	Leaching/migration of contamination in soils to groundwater.		Minor adverse.		Minor beneficial (**not significant**).
	Migration of contamination through preferential pathways to groundwater.		Minor adverse.		Minor beneficial (**not significant**).
Groundwater abstractions <100m from the site.	Reduction in groundwater availability to the abstraction.		No effect.		No effect (**not significant**).
	Contamination mobilised during construction migrating to the abstraction.		Minor adverse.		Minor beneficial (**not significant**).
Groundwater abstractions >100m from the site boundary.	Reduction in groundwater availability to the abstraction.		No effect.		No effect (**not significant**).
	Contamination mobilised during construction migrating to the		No effect.		No effect (**not significant**).

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
	abstraction.				
Potential PWS.	Reduction in groundwater availability to the PWS.		No effect.		No effect (**not significant**).
	Contamination mobilised during construction migrating to the PWS.		Minor adverse.		Minor beneficial (**not significant**).
Existing buildings.	Groundwater control measures attributing to subsidence risk.		No effect.		No effect (**not significant**).
River Yox (Main River).	Contamination of the river.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground. Adoption of pollution prevention measures.	Minor adverse.	Ground investigation and relevant risk assessments completed prior to commencement of construction works. Remediation of soil and groundwater if necessary. Longer term gas, groundwater and surface water monitoring if necessary.	Negligible (**not significant**).
Therberton Watercourse (Main River).	Alteration of surface water flow regime.		No effect.	Not required.	No effect (**not significant**).

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
	Contamination of the river.		Minor adverse.	Ground investigation and risk assessment. Remediation of soil and surface water receptor if necessary.	Negligible (**not significant**).
Middleton Watercourse (Main River).	Alteration of surface water flow regime.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground. Adoption of pollution prevention measures.	No effect.	Not required.	No effect (**not significant**).
	Contamination of the river.		Minor adverse.	Ground investigation and relevant risk assessments completed prior to commencement of construction works. Remediation of soil and groundwater if necessary. Longer term gas, groundwater and surface water monitoring if necessary.	Negligible (**not significant**).
Unnamed tributaries and surface drain.	Alteration of surface water flow regime.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground. Adoption of pollution prevention measures.	No effect.	Not required.	No effect (**not significant**).
	Contamination of the river.		Minor adverse.	Ground investigation and relevant risk assessments completed prior to	Negligible (**not significant**).

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
				commencement of construction works. Remediation of soil and groundwater if necessary. Longer term gas, groundwater and surface water monitoring if necessary.	
Existing ponds.	Alteration of surface water flow regime.	Isolation of the site from the wider environment to prevent off-site effects, with drainage to ground. Adoption of pollution prevention measures.	No effect.	Ground investigation and relevant risk assessments completed prior to commencement of construction works. Remediation of soil and groundwater if necessary. Longer term gas, groundwater and surface water monitoring if necessary.	No effect (**not significant**).
	Contamination of the receptor.		Minor adverse.		Negligible (**not significant**).
Walberswick Heaths and Marshes SSSI and SAC.	Contamination of the receptor.		Minor adverse.		Negligible (**not significant**).
Flood risk to surrounding areas.	Loss of functional floodplain storage or displacement of sea or river water, including from the introduction of new structures.		No effect.	Not required.	No effect (**not significant**).

Table 12.10: Summary of effects for the operational phase

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Crag groundwater (Principal Aquifer).	Reduction in the rate/volume of water discharging to ground.	Water draining from the site will pass through appropriate drainage, including the incorporation of SuDS, and bypass separators where necessary. This will allow infiltration to the superficial aquifer, whilst also protecting the underlying groundwater from hydrocarbon contamination.	Minor adverse.	Longer term gas, groundwater and surface water monitoring if necessary. Management and maintenance of the SuDS.	Minor adverse (**not significant**).
	Leaching/migration of contamination in soils to groundwater.		Minor beneficial.		Minor beneficial (**not significant**).
	Migration of contamination through preferential pathways to groundwater.		Minor beneficial.		Minor beneficial (**not significant**).
Head Deposits groundwater (Secondary Aquifer (undifferentiated)).	Reduction in the rate/volume of water discharging to ground.		Negligible.		Negligible (**not significant**).
	Leaching/migration of contamination in soils to groundwater.		Minor beneficial.		Minor beneficial (**not significant**).
	Migration of contamination through preferential pathways to groundwater.		Minor beneficial.		Minor beneficial (**not significant**).
Lowestoft Formation (diamicton) groundwater (Secondary Aquifer (undifferentiated)).	Reduction in the rate/volume of water discharging to ground.		Negligible.		Negligible (**not significant**).
	Leaching/migration of contamination in soils to groundwater.		Minor beneficial.		Minor beneficial (**not significant**).
	Migration of contamination through preferential pathways to groundwater.		Minor beneficial.		Minor beneficial (**not significant**).

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Lowestoft Formation sands and gravels groundwater (Secondary A Aquifer).	Reduction in the rate/volume of water discharging to ground.		Negligible.		Negligible (**not significant**).
	Lowering of groundwater levels.		Negligible.		Negligible (**not significant**).
	Leaching/migration of contamination in soils to groundwater.		Minor beneficial.		Minor beneficial (**not significant**).
	Migration of contamination through preferential pathways to groundwater.		Minor beneficial.		Minor beneficial (**not significant**).
Groundwater abstractions <100m from the site boundary.	Reduction in groundwater availability to the abstraction.		Minor adverse.		Minor adverse (**not significant**).
	Contamination mobilised during construction migrating to the abstraction.		Minor beneficial.		Minor beneficial (**not significant**).
Groundwater abstractions >100m from the site boundary.	Reduction in groundwater availability to the abstraction.		No effect.		No effect. (**not significant**).
	Contamination mobilised during operation migrating to the abstraction.		No effect.		No effect. (**not significant**).
Potential PWS.	Reduction in groundwater availability to the PWS.		No effect.		No effect. (**not significant**).
	Contamination mobilised during operation migrating to the PWS.		Minor adverse.		Minor beneficial. (**not significant**).

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Existing buildings.	Groundwater control measures attributing to subsidence risk.		No effect.		No effect (**not significant**).
River Yox (Main River).	Contamination of the river.	The operational drainage system is embedded in the design. Adoption of pollution prevention measures.	Negligible.	Management and maintenance of the SuDS.	Negligible (**not significant**).
Therberton Watercourse (Main River).	Alteration of surface water flow regime.	Infiltration basins and swales will be incorporated into the design.	No effect.	Management and maintenance of the SuDS.	No effect (**not significant**).
	Contamination of the river.	The operational drainage system is embedded in the design. Adoption of pollution prevention measures.	Negligible.	Management and maintenance of the SuDS.	Negligible (**not significant**).
Middleton Watercourse (Main River).	Alteration of surface water flow regime.	Infiltration basins and swales will be incorporated into the design.	No effect.	Management and maintenance of the SuDS.	No effect (**not significant**).
	Contamination of the river.	The operational drainage system is embedded in the design. Adoption of pollution prevention measures.	Negligible.	Management and maintenance of the SuDS.	Negligible (**not significant**).
Unnamed tributaries and surface drain.	Alteration of surface water flow regime.	Infiltration basins and swales will be incorporated into the design.	No effect.	Management and maintenance of the SuDS.	No effect (**not significant**).
	Contamination of the river.	The operational drainage system is embedded in the design. Adoption of	Negligible.	Management and maintenance of the	Negligible (**not significant**).

Receptor	Impact	Primary or Tertiary Mitigation	Assessment of Effects	Additional Mitigation	Residual Effects
Walberswick Heaths and Marshes SSSI and SAC.	Contamination of the receptor.	pollution prevention measures.	Negligible.	SuDS.	Negligible (**not significant**).
Existing ponds.	Alteration of surface water flow regime.		No effect.		No effect (**not significant**).
	Contamination of surface waters.		Negligible.		Negligible (**not significant**).
Flood risk to surrounding areas.	Loss of functional floodplain storage or displacement of sea or river water, including from the introduction of new structures		No effect.	Not required.	No effect (**not significant**).

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