Appendix G-4 Part 1 – Consultation Materials: Preliminary Environmental Information Report

Norfolk County Council

GREAT YARMOUTH THIRD RIVER CROSSING

Preliminary Environmental Information Report - Volume I: Written Statement

GYTRC-WSP-EGN-XX-RP-EN-0001
August 2018

Public

Norfolk County **Council**

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Preliminary Environmental Information Report - Volume I: Written Statement

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70046035
OUR REF. NO. GYTRC-WSP-EGN-XX-RP-EN-0001

DATE: AUGUST 2018

WSP
The Forum
Barnfield Road
Exeter, Devon
EX1 1QR
Phone: +44 1392 229 700
Fax: +44 1392 229 701
WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision A	Revision A.1	Revision A.2
Remarks	Draft for client review	Revision A for Issue	Update following final review by nplaw	Update to Appendix Reference
Date	28 June 2018	02 August 2018	10 August 2018	13 August 2018
Prepared by	Jonathan Davey	Jonathan Davey	Jonathan Davey	Jonathan Davey
Signature				
Checked by	Matt Whalley	Marcus Wood	Marcus Wood	Marcus Wood
Signature				
Authorised by	Matt Whalley	Marcus Wood	Marcus Wood	Marcus Wood
Signature				
Project number	70046035	70046035	70046035	70046035
Report number	GYTRC-WSP-EGN-XX-RP-EN-0001/P01	GYTRC-WSP-EGN-XX-RP-EN-0001/A	GYTRC-WSP-EGN-XX-RP-EN-0001/A.1	GYTRC-WSP-EGN-XX-RP-EN-0001/A.2
File reference	Table text\\uk.wspgroup.com\central data\Projects\62240xxx\62240375 - GYTRC\02 WIP\EI EIA and flood risk\03 Document\00 PEIR			

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GLOSSARY

Term	Definition
The Applicant	Norfolk County Council (in its capacity as Highway Authority as promoter of the Proposed Scheme)
Application Site	The proposed development site that falls within the red line boundary, figure 2.3.
The APFP Regulations	The Infrastructure Planning (Applications - Prescribed Forms and Procedure) Regulations (2009)
Bridge lowered	Position of the bascule bridge where it is closed to vessels and open to motor vehicles.
Bridge raised	Position of the bascule bridge where it is closed to motor vehicles and open to vessels.
Crossing	The combined double leaf bascule bridge and the Southtown Road Bridge bridge structure (i.e. from roundabout to junction)
Double leaf bascule bridge	Opening span and mechanism needed to operate the bridge
The EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
The Highways and Railways NSIP Order	The Highway and Railway (Nationally Significant Infrastructure Project) Order 2013
Large vessel waiting facility	Provision of a large vessel waiting facility, if deemed necessary following risk assessment, at a remote location south of the crossing, including any dredging, quay strengthening, fendering and mooring alterations required
NCC	Norfolk County Council (other than in its Highway Authority role as promoter of the Proposed Scheme)
New dual carriageway road	Description of road type on the crossing
NPS	National Policy Statement
NPS for Ports	National Policy Statement for Ports
NPS NN	National Policy Statement for National Networks
Opening span	Length of bridge structure that opens
The Planning Act	The Planning Act 2008, as amended
Proposed Scheme	Great Yarmouth Third River Crossing project
Proposed Scheme Boundary	The boundary of the proposed development site delineated by the red line boundary, as presented in Figure 2.3
Small vessel waiting facilities	Provision of small vessel waiting facilities to the north and south of the crossing, either as floating pontoons or additional fendering to the existing berths, including any dredging and quay strengthening works that may be required.
SoS	Secretary of State
Southtown Road Bridge	Bridge structure over Southtown Road
Study Area	The boundary/extents of a specific assessment

ACRONYMS

Acronym	Definition
AADT	Average Annual Daily Traffic
ADMS	Atmospheric Dispersion Model System
AEP	Annual Exceedance Probability
ANPR	Automatic Number Plate Recognition
AQMA	Air Quality Management Areas
ATC	Automatic Traffic Counts
BCR	Benefit to Cost Ratio
BGL	Below Ground Level
BGS	British Geological Survey
BOD	Biological Oxygen Demand
BS	British Standard
CCME	Canadian Sediment Quality Guidelines for the Protection of Aquatic Life
CDE	Construction, Demolition and Excavation
CEFAS	Centre for Environment Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute for Ecological and Environmental Management
CIRIA	Construction Industry Research and Information Association
CoPA	Control of Pollution Act 1974
CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model
dB	Decibel
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DO	Dissolved Oxygen
DoS	Degree of Saturation
EA	Environment Agency
EAST	Early Assessment Sifting Tool
EFT	Emission Factor Toolkit
EHOs	Environmental Health Officers
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standards
ES	Environmental Statement

Acronym	Definition
EU	European Union
FRA	Flood Risk Assessment
GHG	Greenhouse Gas
GIS	Geographic Information System
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GP	General Practitioners
GQA	General Quality Assessment
GQA	General Quality Assessment
GWDTE	Groundwater Dependent Terrestrial Ecosystem
GYBC	Great Yarmouth Borough Council
GYTRC	Great Yarmouth Third River Crossing
HAWRAT	Highways Agency Water Risk Assessment Tool
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicles
HLC	Historic Landscape Characterisation
HUDU	Healthy Urban Development Unit
IAN	Interim Advice Note
IAQM	Institute of Air Quality Management
ICD	Inscribed Circle Diameter
IEMA	Institute of Environmental Management and Assessment
IMD	Indices of Multiple Deprivation
IROPI	Imperative reasons of over-riding public interest
JNCC	Joint Nature Conservation Committee
LAQM	Local Air Quality Management
LOAEL	Lowest-observed-adverse-effect level
LSOAs	Lower Layer Super Output Areas
MCC	Manual Classified Count
MMP	Materials Management Plan
NAEI	National Atmospheric Emissions Inventory
NCC	Norfolk County Council
NERC	Natural Environment and Rural Communities
NHER	Norfolk Historic Environment Record
NIA	Noise Important Areas
NIR	Noise Insulation Regulations 1975
NPS	Norfolk Property Services
NPSNN	National Policy Statement for National Networks

Acronym	Definition
NPPF	National Planning Policy Framework (2018)
NOEL	No Observed Effect Level
NOx	Nitrogen Oxides
NPSE	Noise Policy Statement for England
NSIP	Nationally Significant Infrastructure Project
O3	Ozone
OAR	Option Assessment Report
OBC	Outline Business Case
ONS	Office of National Statistics
OS	Ordnance Survey
PAH	Polyaromatic Hydrocarbons
PCM	Pollution Climate Mapping
PEA	Preliminary Ecological Appraisal
PEIR	Preliminary Environmental Information Report
PEL	Probable Effect Levels
PHE	Public Health England
PM10	Particulate Matter to 10 microns
PM2.5	Particulate Matter to 2.5 microns
PNPS	National Policy Statement for Ports
PPG	National Planning Practice Guidance
PRA	Preliminary Risk Assessment
PRC	Practical Reserve Capacity
ProPG	Professional Planning Guidance
PRoW	Public Rights of Way
RFC	Ratio of Flow to Capacity
RSI	Road Side Interview
SAC	Special Areas of Conservation
SOAEL	Significant Observed Adverse Effect Level
SPA	Special Protection Area
SPZ	Source Protection Zones
SRN	Strategic Road Network
SSSI	Site of Special Scientific Interest
SWMP	Site Waste Management Plan
tCO2e	Tonnes of Carbon Dioxide Equivalents
TEL	Threshold Effect Levels
THI	Townscape Heritage Initiative

Acronym	Definition
UK	United Kingdom
UKCP09	UK Climate Change Projections
UNFCCC	United Nations Framework Convention on Climate Change
UXO	Unexploded Ordnance
VMS	Variable Message Sign
WFD	Water Framework Directive
ZTV	Zone of Theoretical Visibility

1 INTRODUCTION

1.1 PURPOSE OF THE PRELIMINARY ENVIRONMENTAL INFORMATION REPORT

1.1.1. WSP has been appointed by the Applicant to prepare preliminary environmental information to facilitate the Environmental Impact Assessment (EIA) of the proposed Great Yarmouth Third River Crossing project (the Proposed Scheme). This preliminary environmental information is presented within this Preliminary Environmental Information Report (PEIR).

1.1.2. This PEIR is formed of the following three volumes:

- Volume I: Written Statement (provided within this report)
- Volume II: Figures and Plans
- Volume III: Technical Appendices

1.1.3. This structure is described in further detail in Section 1.4.

1.1.4. The role of this PEIR is to provide consultees with preliminary information, sufficient to enable them to develop an informed view of the likely significant environmental effects of the Proposed Scheme in the context of the current emerging design.

1.1.5. This PEIR accompanies the Applicant's pre-application consultation and publicity under sections 42, 47 and 48 of the Planning Act 2008 ('the Planning Act')[1] which present the current design of the Proposed Scheme.

1.1.6. It is emphasised that the information presented within this PEIR is 'preliminary' and that the preferred design is evolving: it will be reviewed having regard to consultation responses, further technical analysis and other material considerations.

1.1.7. The Applicant is therefore actively seeking the comments of consultees and stakeholders, in relation to this information, through pre-application consultation. There are opportunities to provide feedback either through the website at the consultation events, via the dedicated mailbox, or by post. Further information is provided by the consultation materials and on the project website[2]. The Applicant will take all comments into consideration both in refining the design of the Proposed Scheme and the EIA.

1.1.8. The information presented within this PEIR presents the emerging preliminary assessment and conclusions on the likely significant environmental effects of the Proposed Scheme. Where there is uncertainty about the degree or nature of the impact that is anticipated, any relevant assumptions made are identified. In addition, if the uncertainty is likely to be reduced in the period between consultation and publication of the ES, relevant processes and studies that are to be undertaken have been identified.

[1] All references to legislation in this PEIR are to be taken to be references to that legislation as amended at the date of this PEIR

[2] https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/great-yarmouth/third-river-crossing

1.2 OVERVIEW OF THE PROPOSED SCHEME

1.2.1. The Proposed Scheme will provide a third crossing over the River Yare, creating a new, more direct link between the western and eastern parts of Great Yarmouth. Specifically, it will provide a connection between the Strategic Road Network (A47) and the South Denes Business Park, Enterprise Zone, Great Yarmouth Energy Park and the Outer Harbour, all of which are located on the South Denes Peninsula.

1.2.2. The Proposed Scheme involves the construction, operation and maintenance of a new bascule bridge highway crossing of the River Yare in Great Yarmouth. The Proposed Scheme would include the following:

- A double leaf bascule bridge providing an opening span for vessel movement. This includes structures to support and accommodate operational requirements of the opening mechanism, including counterweights either at, above or below the bridge deck;
- New substructures to support the double leaf bascule bridge within the existing quays either side of the river and within the river itself, potentially requiring new temporary or permanent “knuckle” walls or cofferdams in the waterway to accommodate their construction;
- A new five-arm roundabout connecting the new crossing with Suffolk Road, William Adams Way and the western end of Queen Anne’s Road;
- A single span bridge over Southtown Road, with either reinforced earth embankments or embankments retained by reinforced earth walls, or a combination of these, joining that bridge to the new roundabout at William Adams Way3;
- Reinforced earth walls joining the new single span bridge over Southtown Road to the double leaf bascule bridge; and
- Either reinforced earth embankments or embankments retained by reinforced earth walls, or a combination of these, joining the new double leaf bascule bridge to South Denes Road.
- The closure of Queen Anne’s Road at its junction with Suffolk Road, and the opening of a new priority junction onto Southtown Road providing access to the Queen Anne’s Road residential area;
- Revised access arrangements for existing businesses onto the local highway network including, potentially, a new structure to allow vehicular access under the proposed crossing on the eastern bank subject to agreement with affected businesses and landowner;
- Dedicated provision for cyclists and pedestrians which ties into existing networks.
- A control tower structure located in proximity to the crossing on the western side of the river. The control tower will facilitate the 24/7 operation of the opening span of the new double leaf bascule bridge;
- The demolition of an existing pedestrian bridge on William Adams Way;
- Associated changes, modifications and/or improvements to the existing local highway network as informed by traffic modelling. This could include improvements within the existing highway boundary to some existing junctions within the red line boundary, in addition to amended parking arrangements.

[3] If a bridge with counterweights above the deck is constructed, the double-leaf bascule bridge and the single-span bridge over Southtown Road could be combined into a single, longer, structure, without separation between these two parts.

- Additional signage to assist the movement of traffic in response to network conditions and the openings / closings of the double leaf bascule bridge;
- The relocation of existing allotments to compensate for an area to be lost as a result of the Proposed Scheme; and
- New public realm, landscape, ecology and sustainable drainage improvements;

1.2.3. A detailed description of the Proposed Scheme is presented within Chapter 2 of this report.

1.3 LEGISLATIVE AND POLICY CONTEXT FOR THE SCHEME

1.3.1. In a Direction made under section 35 of the Planning Act dated 26th February 2018, the Secretary of State (SoS) confirmed that he was satisfied that the Proposed Scheme was nationally significant and directed that the Proposed Scheme, together with any matters associated with it, was to be treated as development for which development consent is required. The SoS was of the opinion that the Proposed Scheme was nationally significant for the following reasons:

- "*The Port has a nationally significant role in the renewable energy sector and the offshore gas and oil industry and the scheme will substantially improve connectivity and resilience for port activities;*
- *The scheme will support the delivery of existing and potential renewable energy [Nationally Significant Infrastructure Projects] NSIPs; and the*
- *Supports the Port's role as an International Gateway*".

1.3.2. It was also noted that, in addition, "*the scheme will improve the offer of the Port through better connectivity to the Enterprise Zone*".

1.3.3. The consequence of the Direction is that the Proposed Scheme is now subject to the consenting regime comprised in the Planning Act and associated subordinate legislation (including the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ('the EIA Regulations'). The Proposed Scheme therefore cannot proceed unless the SoS decides to grant development consent by making a Development Consent Order (DCO) under section 114 of the Planning Act. The Applicant thus intends to submit an application for a DCO in Spring 2019.

PRE-APPLICATION STATUTORY CONSULTATION AND PUBLICITY

1.3.4. The Planning Act requires that applicants for NSIPs undertake consultation and publicity before making an application for a DCO. The measures required are, in summary, as follows:

- Section 42 requires consultation with prescribed consultees (e.g. Natural England, Environment Agency, Historic England), specified local authorities, and persons with specified interests in the land to which the Applicants' application for a DCO will relate;
- Section 47 requires consultation with the local community in accordance with a Statement of Community Consultation; and
- Section 48 requires publicity of the proposed application.

ENVIRONMENTAL IMPACT ASSESSMENT

1.3.5. The process and content of EIA is summarised in Regulations 5(1) and (2) of the EIA Regulations. In essence, EIA is a process through which the environmental effects of development are identified, assessed and taken into account in deciding whether the development should be consented. Central to the process is the preparation of an "environmental statement" and the carrying out of associated procedural steps including consultation,

publicity and notification.

1.3.6. Only limited categories of development require EIA. Schedules 1 and 2 of the EIA Regulations, define specified categories of development which will automatically require EIA (Schedule 1 development) and also developments (Schedule 2 development) which will require EIA if they are "*likely to have significant effects on the environment by virtue of factors such as its nature, size or location*". The Proposed Scheme does not fall within any category of Schedule 1 development, but it does constitute Schedule 2 development as it comprises the "*construction of roads (unless included in Schedule 1)*".

1.3.7. The need for an EIA is therefore dependent on whether the Proposed Scheme would be likely to have significant effects on the environment, taking into account specified matters including the selection criteria at Schedule 3 of the EIA Regulations.

1.3.8. The Applicant concluded that the Proposed Scheme had the potential for significant effects upon the environment. The Applicant therefore notified the SoS on 3rd April 2018 that it proposed to provide an Environmental Statement (ES) in relation to the Proposed Scheme. The effect of this notification is to determine for the purposes of the EIA Regulations that the Proposed Scheme is EIA Development[4] and therefore requires EIA.

1.3.9. In addition, the Applicant submitted an EIA Scoping Report[5] on 3rd April 2018, requesting a Scoping Opinion[6] for the Proposed Scheme from the SoS pursuant to EIA Regulation 10(1) as to what should be included in an ES for the Proposed Scheme. The Scoping Opinion[6] was issued on the 17th of May 2018. Both the EIA Scoping Report[5] and Scoping Opinion[6] are published on the Planning Inspectorate's website and can be accessed online at https://infrastructure.planninginspectorate.gov.uk/projects/eastern/great-yarmouth-third-river-crossing/.

1.3.10. This PEIR has been informed by the Scoping Opinion[6].

1.3.11. PEI is defined in the Regulation 12 (2) of the EIA Regulations as:

"information referred to in regulation 14(2) [which specifies the content of an ES] *which (a) has been compiled by the applicant; and (b) is reasonably required for the consultation bodies to develop an informed view of the likely significant environmental effects of the development (and of any associated development)*".

1.3.12. Regulation 12 (1) requires that the Statement of Community Consultation prepared pursuant to section 47 of the Planning Act must set out how the applicant intends to publicise and consult on the PEI.

NATIONAL POLICY STATEMENTS

1.3.13. National Policy Statements (NPS) are produced by the UK Government. They set out the Government's policies and objectives for the development of Nationally Strategic Infrastructure Projects (NSIPs) and are produced for different types of infrastructure development. The NPS for National Networks (NPS NN)[7] and the NPS for Ports[8] are pertinent to the Proposed Scheme. The Planning Act gives great weight to NPS: section 104 provides that where an NPS has effect in relation to development for which an DCO application has been made, the SoS must decide the application in accordance with the NPS unless specified matters apply.

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[4] See EIA Regulations 6(1),6(2)(a) and 8(1)(b)
[5] WSP (2018) Great Yarmouth Third River Crossing Environmental Impact Assessment Scoping Report. 70041951-ENV-EIA-Scoping/A. Available at https://infrastructure.planninginspectorate.gov.uk/projects/eastern/great-yarmouth-third-river-crossing/ [Verified July 2018]
[6] Planning Inspectorate (May 2018) Scoping Opinion: Great Yarmouth Third River Crossing, Case Reference TR010043. Available at https://infrastructure.planninginspectorate.gov.uk/projects/eastern/great-yarmouth-third-river-crossing/ [Verified July 2018]
[7] Department for Transport 2015. National Policy Statement for National Networks
[8] Department for Transport 2012. National Policy Statement for Ports

National Policy Statements for National Networks

1.3.14. The NPS NN was designated by the SoS for Transport in January 2015 and sets out the Government's policy for nationally significant road and rail networks, together with the information that should be provided alongside any application for Development Consent in order to satisfy their requirements.

1.3.15. The NPS NN has therefore informed the assessments provided within this PEIR and where relevant the NPS NN is referenced and appraised within the relevant chapters.

National Policy Statements for Ports

1.3.16. The NPS for Ports was designated by the SoS for Transport in January 2012 and it sets out the Government's policy for ports and associated development such as road and rail links which are included within new Port proposals.

1.3.17. The Scheme does not provide for port development however, due to its proximity, it is possible that aspects of the scheme could affect the existing port operations/facilities at Great Yarmouth i.e. vessel movements. Where aspects of the NPS for Ports for Ports are pertinent to aspects of the Proposed Scheme, assessments will be appropriately referenced.

COMMUNITIES AND LOCAL GOVERNMENT; PRE-APPLICATION GUIDANCE

1.3.18. In March 2015 the Department for Communities and Local Government (DCLG) published a statutory guidance document on the pre-application process for NSIPs[9]. Section 50(3) of the Planning Act requires the Applicant to have regard to this guidance in complying with the consultation, publicity and other pre-application requirements of the Act. The purposes of the guidance are to:

- "*advise users of the* (Planning Act) *regime on the processes involved in the pre-application stage*;
- *guide applicants as to how the pre-application requirements of the Planning Act should be fulfilled and provide some advice on best practice*;
- *inform other users of the regime, including consultees, of their roles in the pre-application process and to let them know what is expected of applicants at this stage*; *and*
- *help ensure that the regime is transparent and accessible to all".*

PLANNING INSPECTORATE ADVICE NOTES

1.3.19. The Planning Inspectorate has published a series of non-statutory Advice Notes to inform developers, consultees, the public and other interested parties about a range of procedural matters in relation to the Planning Act process. Not all of these Advice Notes are pertinent to the PEIR, although those that are relevant, and have informed the environmental assessment process for the Proposed Scheme, are discussed further below.

Advice Note Seven[10]

1.3.20. This Advice Note details the procedural requirements that apply to NSIPs which are EIA development and provides clarity on the role and purpose of PEIR.

[9] Ministry of Housing, Communities and Local Government March 2015. Planning Act 2008: guidance on the pre application process for minor infrastructure projects. Available here. Last Accessed June 2018.
[10] The Planning Inspectorate, Advice Note 7: Preliminary Environmental Information, Screening and Scoping V6. December 2017.

1.3.21. Advice Note Seven recognises that the degree of information that is available within a PEIR is dependent upon the stage in the design process at which consultation takes place. Within this PEIR, the Applicant has therefore presented information on the likely significant effects associated with the development of the Proposed Scheme, and where further studies and assessments remain, these have been clearly indicated.

Advice Note Nine[11]

1.3.22. This Advice Note provides guidance on the use of the 'Rochdale Envelope'; a term used to describe those elements of a scheme that have not yet been finalised but yet can be constrained within certain limits and parameters hence allowing a determination of likely significant effects to be presented in the ES.

1.3.23. When using the Rochdale Envelope to apply for flexibility within a DCO application, the Advice Note advises that the developer should use a worst case approach to identifying likely significant effects and should incorporate mitigation accordingly within the parameters of their scheme. Greater information is included within Chapter 6 of this PEIR on how the Applicant intends to make use of the Rochdale Envelope in the consenting process for the Proposed Scheme

Advice Note Seventeen[12]

1.3.24. This Advice Note sets out the recommended approach to Cumulative Effects Assessment (CEA) for NSIP projects, including guidance on the relative weight to be applied to other developments depending upon how progressed they are through the consenting process.

1.3.25. Greater information on the CEA is included within Chapter 20.

Advice Note Eighteen[13]

1.3.26. Advice Note Eighteen is a recently published guidance document on the approach to coordinating the requirements of the Water Framework Directive (WFD) with the EIA process.

1.4 SCOPE OF ASSESSMENT

1.4.1. As stated above, PEI is defined by Regulation 12 (2) of the EIA Regulations as: such information "referred to in regulation 14(2)" as is reasonably required for the consultation bodies to develop an informed view of the likely significant environmental effects of the Proposed Project. Regulation 14(2), together with Schedule 4, defines and specifies, in detail, the required content of an ES. It follows that although PEI is not required to be a draft or preliminary ES, it is appropriate for it to have an equivalent scope to the extent necessary and appropriate in the context of the current state of resolution of the Proposed Scheme and the required objective of enabling the consultation bodies to develop an informed view.

1.4.2. Table 1.1 provides a breakdown of the information specified in Schedule 4 and where this information will be located in this PEIR.

Table 1.1 – Location of Required Information within the PEIR

	Required Information	Location within this PEIR
1	Description of the development, including in particular:	

[11] The Planning Inspectorate. Advice Note 9. Rochdale Envelope. July 2018
[12] The Planning Inspectorate. Advice Note 17. Cumulative Effects Assessment. December 2015
[13] The Planning Inspectorate. Advice Note 18. The Water Framework Directive. June 2017

	Required Information	Location within this PEIR
	(a) a description of the location of the development	Chapter 2: Description of the Site and the Surrounding Area
	(b) a description of the physical characteristics of the whole development, including, where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases	Chapter 2: Description of the Proposed Scheme.
	(c) a description of the main characteristics of the operational phase of the development (in particular any production process), for instance, energy demand and energy used, nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) used	Chapter 2: Description of the Proposed Scheme
	(d) an estimate, by type and quantity, of expected residues and emissions (such as water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation and quantities and types of waste produced during the construction and operation phases.	Chapter 5: Approach to EIA and Technical Chapters 6 – 17
2	A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.	Chapter 3: Consideration of Alternatives.
3	A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge	Chapter 5: Approach to EIA and Technical Chapters 6 – 17
4	A description of the factors specified in regulation 4(2) likely to be significantly affected by the development: population, human health, biodiversity (for example fauna and flora), land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quantity and quality), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape.	Technical Chapters 6 – 17
5	A description of the likely significant effects of the development on the environment resulting from, inter alia	
	the construction and existence of the development, including, where relevant, demolition works;	Technical Chapters 6 – 17
	the use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources;	Technical Chapters 8, 11, 15, 16
	the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste;	Technical Chapters 6, 7, 10, 11, 13, 16
	the risks to human health, cultural heritage or the environment (for example due to accidents or disasters);	Technical Chapters 6 - 17
	the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;	Chapter 16: Cumulative Effects

	Required Information	Location within this PEIR
	the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change;	Chapter 15: Climate Change
	the technologies and the substances used.	Technical Chapters 6 – 17
6	A description of the forecasting methods or evidence, used to identify and assess the significant effects on the environment, including details of difficulties (for example technical deficiencies or lack of knowledge) encountered compiling the required information and the main uncertainties involved.	Technical Chapters 6 – 17
7	A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-project analysis). That description should explain the extent, to which significant adverse effects on the environment are avoided, prevented, reduced or offset, and should cover both the construction and operational phases.	Technical Chapters 6 – 17
8	A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to EU legislation such as Directive 2012/18/EU(3) of the European Parliament and of the Council or Council Directive 2009/71/Euratom(4) or UK environmental assessments may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.	Chapter 2: Description of the Proposed Scheme. Technical Chapters 6 – 17
9	A non-technical summary of the information provided under paragraphs 1 to 8	Non-Technical Summary
10	A reference list detailing the sources used for the descriptions and assessments included in the environmental statement.	All chapters

1.4.3. The scope of the ES will be informed by the Scoping Opinion and supporting Scoping responses[6]. Technical chapters within this PEIR incorporate the comments of the Planning Inspectorate on behalf of the SoS in the Scoping Opinion[6]. These chapters should be read together with the introductory chapters of this PEIR (Chapters 1-5, as well as Chapter 18, Assessment of Cumulative Effects).

1.4.4. In order to satisfy the requirements of the EIA Regulations, the emerging EIA will assess (i) Risks of Major Accidents and/or Disasters; (ii) Transboundary Effects; (iii) Residues and Emissions. With the exception of transboundary effects, these assessments have not been progressed as part of the PEIR, due to the availability of design information at this preliminary stage of the Proposed Scheme. These assessments will be progressed as design information becomes available and will be presented within the ES.

Risks of Major Accidents and/or Disasters

1.4.5. The ES will include a description and assessment (where relevant) of the likely significant effects resulting from accidents and disasters applicable to the Proposed Scheme. The assessment will aim to:

(i) evaluate the likelihood of an occurrence and the Proposed Scheme's susceptibility to potential major accidents and hazards;

(ii) consider the vulnerability of the Proposed Scheme to a potential accident or disaster; and

(iii) consider Proposed Scheme's potential to cause an accident or disaster.

1.4.6. The assessment will specifically assess significant effects resulting from the risks to human health, cultural heritage or the environment. Any measures that will be employed to prevent and control significant effects will be presented in the ES.

1.4.7. Where appropriate, the assessment will identify measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.

Transboundary Effects

1.4.8. On the 28 June 2018, transboundary screening was undertaken by the Planning Inspectorate on behalf of the SoS for the purposes of Regulation 32 of EIA Regulations. This is presented in Appendix 1A.

1.4.9. This screening exercise considered the information presented within the EIA Scoping Report[5] and gave regard to the location of the Proposed Scheme, its characteristics, and the environmental importance of the receiving environment.

1.4.10. As part of the screening exercise the Planning Inspectorate identified and considered the Proposed Scheme's likely impact of the proposed scheme, including consideration of potential pathways and the extent, magnitude, probability, duration, frequency and reversibility of the effects. Their screening concluded that the Proposed Scheme is unlikely to have a significant effect either alone or cumulatively on the environment in another European Economic Area State.

1.4.11. The Inspectorate considers that the likelihood of transboundary effects resulting from the Proposed Schemes so low that it does not warrant completion of a formal transboundary screening matrix. It is noted that this position will remain under review and will have regard to any new or materially different information coming to light which may alter that decision.

Residues and Emissions

1.4.12. In accordance with the requirements of the EIA Regulations, the ES will specify the residues and emissions that arise as a result of the Proposed Scheme. This will include an estimate, by type and quantity, of expected residues and emissions. In providing this information, ES will specifically reference aspect chapters relating to water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation and quantities, and types of waste produced during the construction and operation phases, where relevant. These assessments have yet to be progressed, due to the availability of design information at this preliminary stage of the Proposed Scheme . Information about residues and emissions will become available as the above aspect chapters are progress. This information will be presented in within the ES.

Effects upon Maritime Activities

1.4.13. The scope of the EIA includes assessments of the potential impact of the Proposed Scheme upon maritime activities. Table 1.2 provides a list of the assessments to be undertaken where this information will be presented within ES.

Table 1.2 – Assessments of Maritime Effects

Assessment	Location within the ES
Impacts of lighting: A stand-alone lighting assessment will be produced to support the DCO application. This report will be used to assess the impacts of the proposed artificial lighting, including light spill onto the navigation channel.	Chapter 10: Townscape and Visual impacts
Hydromorphological assessment: A hydromorphological assessment will be undertaken which will include sediment transport modelling of the Proposed Scheme to understand the impact of the presence of the bridge infrastructure on the hydromorphology of the River Yare. It will discuss the potential effects on river bed scour/erosion and sediment deposition patterns.	Chapter 11: Water Environment.
Generation of employment opportunities: Once operational, it is anticipated the Proposed Scheme is anticipated to lead to an increase in economic activity due to the greater connectivity afforded. An assessment of employment opportunities will be undertaken and will consider the potential effects on enhanced access for local businesses, the port and industrial estates.	Chapter 14: People and Communities
Land-take, severance and disruption to marine businesses and associated activities: For the assessment of effects on marine commercial businesses and activities, this will focus on land-take, severance and disruption to operations within the River Yare and Port operations. Vessel Simulation Modelling will be undertaken that allows a virtual navigation of a vessel through the River Yare to test how the Proposed Scheme interacts with Port operations, albeit this has not been progressed at this stage of the Proposed Scheme. In addition, a Navigational Risk Assessment will also be prepared and used to inform the ES	Chapter 14: People and Communities

Other Supporting DCO Deliverables

1.4.14. In addition to the above, the ES and DCO application will also be supported by the following documents, which will be presented either as standalone reports, or as an appendix to the final ES:

- Environmental Statement (Non-Technical Summary);
- Natural Environmental Constraints Plan;
- Water Bodies in a 'River Basin Management Plan' Plan;
- Assessment of Nature Conservation;
- Arboricultural Assessment;
- Habitats Regulations Assessment;
- Heritage Environmental Constraints Plan;
- Assessment of Historic Environment;
- Archaeological Written Scheme of Investigation;
- Statutory Nuisance Statement;
- Flood Risk Assessment;
- Navigational Risk Assessment;
- Lighting Assessment;
- Equalities Impact Assessment;

- Mitigation Schedule / Mitigation Commitments Register;
- Outline Code of Construction Practice;
- Framework Construction Environmental Management Plan (CEMP);

1.5 THE STRUCTURE OF THE PEIR

1.5.1. As previously stated, this PEIR is formed of three volumes. This report presents Volume I the Written Statement, the contents of which is presented at the start of the report.

1.5.2. The Written Statement is supported by Volume II: Plans and Figures. The majority of Figures are presented within Volume II, although there are some which have been included within the written text where appropriate. Table 1.3 - Summary of Figures presented a summary of the figures provided in support of the PEIR, the chapter that they relate to and their location.

1.5.3. The Written Statement is also supported by Technical Appendices, which are presents as Volume III. Table 1.4 - Volume III: Technical Appendices presents a summary of the Technical Appendices provided.

Table 1.3 - Summary of Figures

Figure	Figure Title	Location
Chapter 1: Introduction		
No figures included		
Chapter 2: Proposed Scheme		
Figure 2.1	Location of the Proposed Scheme	Volume II
Figure 2.2	Strategic Location for the Proposed Scheme	Volume I (embedded in text)
Figure 2.3	Red Line boundary for the Proposed Scheme	Volume II
Figure 2.4	Proposed Scheme draft highway arrangement	Volume II
Figure 2.5	Proposed Scheme draft land use arrangement	Volume II
Figure 2.6	Bascule Bridge Option 1 - Simple Trunnion Conceptual General Arrangement	Volume II
Figure 2.7	Bascule Bridge Option 2 - Balance Beam Trunnion Conceptual General Arrangement	Volume II
Figure 2.8	Southtown Road Bridge Conceptual General Arrangement	Volume II
Figure 2.9	Proposed Drainage Strategy	Volume II
Chapter 3: Assessment of Alternatives		
Figure 3.1	Extract from 2007 Scheme Assessment Report showing the broad study area and proposed bridge and tunnel corridors	Volume I (embedded in text)
Chapter 4: Consultation		
No figures included		
Chapter 5: Assessment Approach		
No Figures included		
Chapter 6: Air Quality		

Figure	Figure Title	Location
Figure 6.1	Construction Phase Assessment Study Area	Volume II
Figure 6.2	Operational Phase Assessment Study Area	Volume II
Figure 6.3	Passive NO2 Monitoring Sites	Volume II
Chapter 7: Acoustic		
Figure 7.1	Provisional Operational Noise Study Area	Volume II
Figure 7.2	Baseline Noise Survey Monitoring Locations	Volume II
Chapter 8: Nature Conservation		
Figure 8.1	Main Study Area	Volume II
Figure 8.2	Extended Study Area	Volume II
Figure 8.3	Bat Survey Area	Volume II
Figure 8.4	Water Vole Survey Area	Volume II
Figure 8.5	Bird Survey Area	Volume II
Figure 8.6	Statutory Designated Sites	Volume II
Chapter 9: Cultural Heritage		
Figure 9.1	Designated Heritage Assets	Volume II
Figure 9.2	Non Designated Heritage Assets	Volume II
Figure 9.3	Heritage Assets at VMS Locations	Volume II
Chapter 10: Townscape and Visual Impacts		
Figure 10.1	Photographic Viewpoints	Volume II
Figure 10.2	Photographic viewpoints	Volume II
Figure 10.3	Study Area	Volume II
Chapter 11: Road Drainage and the Water Environment		
Figure 11.1	Study Area for the Water Environment	Volume II
Chapter 12: Flood Risk		
Figure 12.1	Flood Risk Study Area	Volume II
Figure 12.1	EA Flood Map for Planning	Volume II
Chapter 13: Climate Change		
No figures included		
Chapter 14: People and Communities		
No figures included		
Chapter 15: Materials		
Figure 15.1	Waste Hierarchy	Volume I (embedded in text)

Figure	Figure Title	Location
Figure 15.2	Transfer, material recovery and metal recycling in the East of England	Volume I (embedded in text)
Figure 15.3	East of England Remaining Landfill Capacity (2000/1-2016)	Volume I (embedded in text)
Chapter 16: Geology and Soils		
No figures included		
Chapter 17: Traffic and Transport		
Figure 17.1	Study Area	Volume II
Figure 17.2	Community facilities and cycle routes plan	Volume II
Chapter 18: Cumulative Effects		
No figures included		
Chapter 19: Schedule of Environmental Commitments		
No figures included		
Chapter 20: References and Glossary		
No figures included		

Table 1.4 - Volume III: Technical Appendices

Appendix	Appendix Title
Chapter 1: Introduction	
Appendix 1A	Regulation 32 Transboundary Screening
Chapter 2: Proposed Scheme	
No Appendix included	
Chapter 3: Assessment of Alternatives	
No Appendix included	
Chapter 4: Consultation	
Appendix 4A	Informal Consultation Responses
Chapter 5: Assessment Approach	
No Appendix included	
Chapter 6: Air Quality	
Appendix 6A	Construction Phase Assessment Methodology
Appendix 6B	Wind Rose
Chapter 7: Acoustic	
Appendix 7A	Acoustic Terminology
Chapter 8: Nature Conservation	
Appendix 8A	Preliminary Ecological Appraisal
Appendix 8B	Protected Species Survey Report

Appendix	Appendix Title
Chapter 9: Cultural Heritage	
Appendix 9A	Cultural Heritage Asset Gazetteer
Appendix 9B	Cultural Heritage Desk Study
Appendix 9C	Geo-Archaeological Feasibility Study
Chapter 10: Townscape and Visual Impacts	
No Appendix included	
Chapter 11: Road Drainage and the Water Environment	
Appendix 11A	Impact Assessment Criteria for Surface Water & Groundwater
Appendix 11B	Impact Assessment for Surface Water
Chapter 12: Flood Risk	
Appendix 12A	Hydraulic Assessment Technical Note
Chapter 13: Climate Change	
No Appendix Included	
Chapter 14: People and Communities	
Appendix 14A	Community facilities within 2km of the Application Site
Appendix 14B	Open / recreational spaces within 2km of the Application Site
Chapter 15: Materials	
No Appendix included	
Chapter 16: Geology and Soils	
Appendix 16A	Contaminated Land Desk Study Report
Chapter 17: Traffic and Transport	
Appendix 17A	Preliminary Transport Assessment
Chapter 18: Cumulative Effects	
No Appendix included	
Chapter 20: References and Glossary	
No Appendix included	

2

PROPOSED SCHEME

2 PROPOSED SCHEME

2.1 INTRODUCTION

2.1.1. This Chapter presents the current description of the Great Yarmouth Third River Crossing (hereafter referred to as "the Proposed Scheme") at the consultation stage. Any other descriptions presented within this PEIR document represent a summary of, or are subsidiary to, this chapter. This Chapter is supported by Figures 2.1 – 2.7.

a. Figure 2.1 shows the location of the Proposed Scheme

b. Figure 2.2 shows the strategic location of the Proposed Scheme;

c. Figure 2.3 shows the red line boundary for the Proposed Scheme (including land required permanently, temporarily for construction, and over which rights are sought for maintenance);

d. Figure 2.4 presents the Proposed Scheme draft highway arrangement, as currently envisaged;

e. Figure 2.5 presents the Proposed Scheme draft land use arrangement, as currently envisaged;

f. Draft cross sections of the carriageway, and plan and elevation of the proposed illustrative double-leaf bascule bridge concepts, as currently envisaged (see paragraphs 2.3.10 – 2.3.13), are presented in Figures 2.6 – 2.7 respectively;

g. Figure 2.8 presents the Concept General Arrangement for the Southtown Road Bridge;

h. The proposed draft drainage strategy, as currently envisaged, is presented in Figure 2.9;

2.2 PROPOSED SCHEME LOCATION AND NEED FOR THE PROPOSED SCHEME

2.2.1. Figure 2.1, shows the location of the Proposed Scheme. Great Yarmouth is located at the mouth of the River Yare, one of the main waterways providing access to the Norfolk Broads. The river bisects Great Yarmouth, with the town centre, seafront, industrial areas and outer harbour located on the narrow 4km long, South Denes peninsula between the river and the sea, isolated from the rest of the town. To the south of the River Yare, Gorleston-on-Sea is just a few hundred metres away as the crow flies, but over 7km distance by road.

2.2.2. Figure 2.2 shows the strategic location of the Proposed Scheme. The approximate position of the Proposed Scheme is marked in blue.

2.2.3. The Proposed Scheme will provide a third crossing of the River Yare, creating a direct link into the southern part of the peninsula. It will greatly improve access to the port, outer harbour, employment areas (including the Enterprise Zone), the seafront and residential areas. It will connect the peninsula to the strategic road network via the A47 at Harfrey's Roundabout.

2.2.4. The national significance and need for the Proposed Scheme derives from the considerable improvement in connectivity and resilience it will deliver to the Great Yarmouth Port ("the Port"), which itself has a nationally significant role in the renewable energy sector and the offshore gas and oil industry. The Proposed Scheme objectives are as follows:

- To support Great Yarmouth as a centre for both offshore renewable energy and the offshore oil and gas industry, enabling the delivery of renewable energy NSIPs and enhancing the port's role as an international gateway;

- To improve access and strategic connectivity between Great Yarmouth port and the national road network thereby supporting and promoting economic and employment growth (particularly in the Enterprise Zone);
- To support the regeneration of Great Yarmouth, including the town centre and seafront, helping the visitor and retail economy;
- To improve regional and local access by enhancing the resilience of the local road network, reducing congestion and improving journey time reliability;
- To improve safety and to reduce road casualties and accidents, in part by reducing heavy traffic from unsuitable routes within the town centre;
- To improve access to and from the Great Yarmouth peninsula for pedestrians, cyclists and buses, encouraging more sustainable modes of transport and also reducing community severance; and
- To protect and enhance the environment by reducing emissions of greenhouse gases and minimising the environmental impact of the Proposed Scheme.

2.2.5. The Department for Transport's (DfT) recently published study Transport Infrastructure for our Global Future: A Study of England's Ports Connectivity[14] ("the DfT Study") states that "at present around 95% of all goods entering and leaving the UK are moved by sea and the UK port sector directly contributes £1.7billion to the UK economy". The DfT Study also notes that "if our ports are to continue to thrive then the national, regional and local infrastructure supporting them has to be effective and efficient". The DfT Study further recognises that renewable energy sectors are closely linked to the port industry and that "port access will be an issue for their supply chains and their employees".

2.2.6. Great Yarmouth's proximity to the Strategic Road Network (SRN) plays an important role in relation to the Port, and the Proposed Scheme is identified in the DfT Study as a Port Connectivity Project. The Autumn Budget 2017[15] pledged a contribution of £98 million towards the Proposed Scheme's £120 million programme budget.

2.2.7. The Port, South Denes Business Park, Enterprise Zone and Great Yarmouth Energy Park are located towards the southern end of the peninsula. Supporting this area is a key objective of both the New Anglia Strategic Economic Plan (SEP) (2014)[16] and Great Yarmouth Local Plan Adopted Core Strategy 2013-2030[17] . Furthermore, the relationship between the provision of essential infrastructure and economic growth is well documented; most notably in the NPS NN[18] , the Department for Business, Energy & Industrial Strategy's White Paper Industrial Strategy: Building a Britain fit for the Future (2017)[19] and in the DfT Study.

[14] Department for Transport (April 2018), Transport Infrastructure for our Global Future, A Study of England's Port Connectivity https://www.gov.uk/government/publications/transport-connectivity-to-ports-review-of-the-current-status-and-future-infrastructure-recommendations

[15] https://www.gov.uk/government/publications/autumn-budget-2017-documents

[16] New Anglia new Enterprise Partnership for Norfolk and Suffolk (2014) New-Anglia-Strategic-Economic-Plan. https://newanglia.co.uk/wp-content/uploads/2017/10/New-Anglia-Strategic-Economic-Plan.pdf

[17] Great Yarmouth Borough Council (2015) Great Yarmouth Local Plan: Adopted Core Strategy 2013-2030 https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1884&p=0

[18] Department for Transport (2104) National Policy Statement for National Networks https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

[19] Department for Business, Energy & Industrial Strategy (2017) Industrial Strategy: Building a Britain Fit for the Future https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf

2.2.8. The Department of Transport's publication Action for Roads[20] (2013) identifies capacity issues on the A47 past Great Yarmouth to Lowestoft and predicts that congestion will be severe on that entire section of the road by 2040 (also pointed in Appendix A of the NPS NN).

2.2.9. This evidence further confirms the need for a third crossing, as under the current situation the only access from the SRN to the Port and employment areas is via the Haven Bridge or Breydon Bridge located at the northern end of the peninsula. Neither bridges are considered suitable to accommodate the Port's on-going use and projected growth.

2.2.10. The mix of Port-related and local traffic congestion, particularly on the Haven Bridge, is attributed to delays and unreliable end to end journey times; ultimately Great Yarmouth has become to be perceived as remote, potentially discouraging inward investment. Alternative transport modes such as bus users, cyclists and pedestrians often have long, indirect journeys, discouraging sustainable commuting.

2.2.11. In the Outline Business Case[21] , the Proposed Scheme was demonstrated by an adjusted Benefit Cost Ratio (BCR) of 3.5 , meaning the proposal shows high value for money.

2.2.12. By creating a more efficient connection, the Proposed Scheme will address the congestion and severance within Great Yarmouth, accommodate future growth and improve strategic connectivity between the town, the Port and the Strategic Road Network, which in turn will facilitate the establishment of the Port as a centre for offshore oil and gas industries and its role as an International gateway. Without a new crossing the full potential for growth in the Enterprise Zone and Port may not be fully realised.

[20] Department for Transport (July 2013), Action for Roads, A Network for the 21st Century https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/212590/action-for-roads.pdf

[21] Mouchel (2017) Great Yarmouth Third River Crossing: Outline Business Case

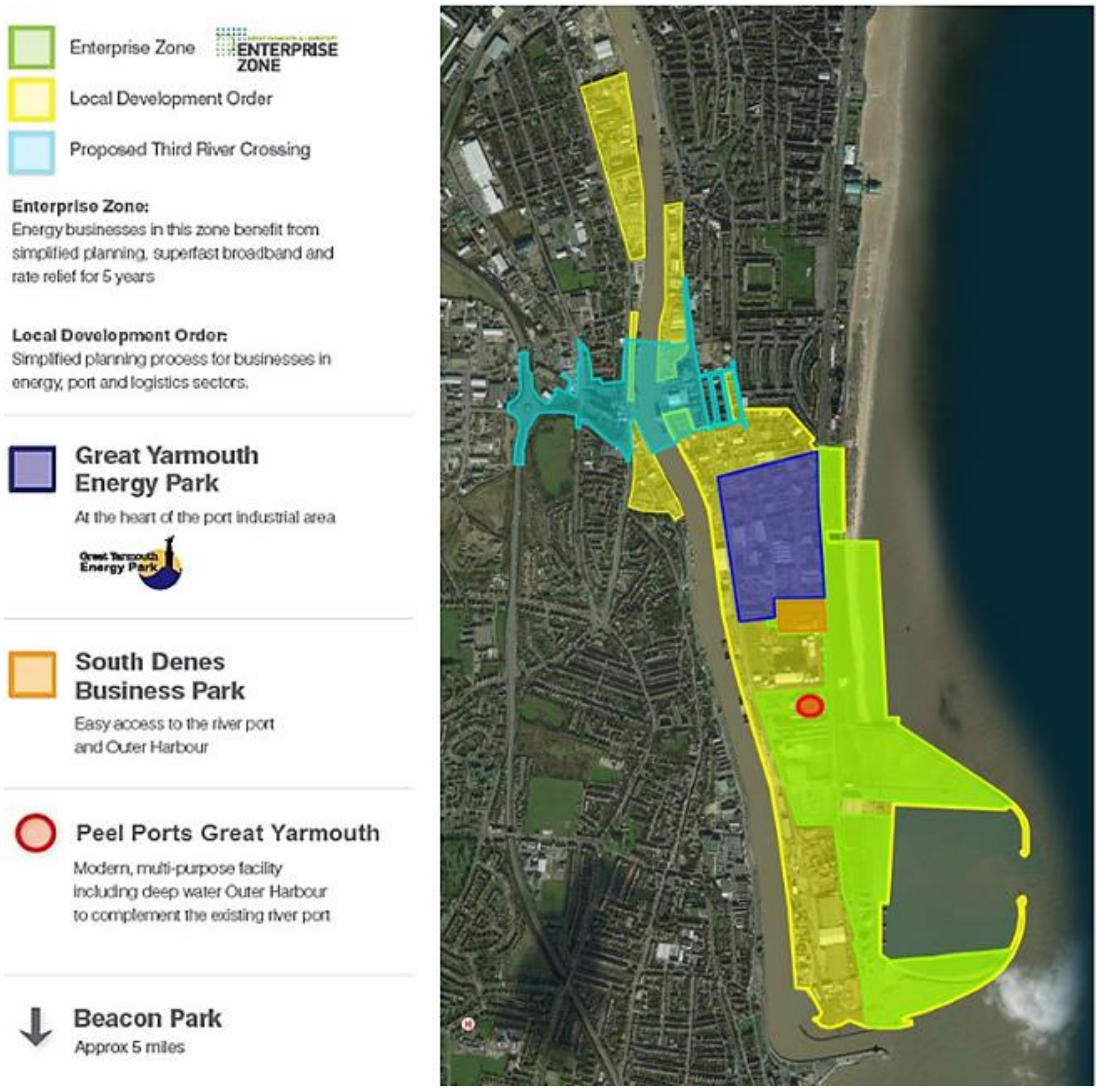


Figure 2.2: Strategic Location of the Proposed Scheme

2.3 MAIN DESIGN CONSIDERATIONS

THE PROPOSED SCHEME

2.3.1. The Proposed Scheme involves the construction, operation and maintenance of the new crossing of the River Yare in Great Yarmouth. The Proposed Scheme consists of a new dual carriageway road across the river, linking the A47 at Harfrey's Roundabout on the western side to the A1243 South Denes Road on the eastern side. The Proposed Scheme will feature an opening span double leaf bascule bridge across the river, which may involve the construction of two new 'knuckles' that extend the quay wall into the river. The Proposed Scheme will also have a clear span over Southtown Road on the western side of the river as it rises to the crest of the new crossing."

2.3.2. If constructed, the Proposed Scheme is currently envisaged to include a new dual carriageway road, crossing the River Yare in an east-west orientation, comprising of:

- A double leaf bascule bridge providing an opening span for vessel movement. This includes structures to support and accommodate operational requirements of the opening mechanism, including counterweights either at, above or below the bridge deck;
- New substructures to support the double leaf bascule bridge within the existing quays either side of the river and within the river itself, potentially requiring new temporary or permanent "knuckle" walls or cofferdams in the waterway to accommodate their construction;
- A new five-arm roundabout connecting the new crossing with Suffolk Road, William Adams Way and the western end of Queen Anne's Road;
- A single span bridge over Southtown Road, with either reinforced earth embankments or embankments retained by reinforced earth walls, or a combination of these, joining that bridge to the new roundabout at William Adams Way22;
- Reinforced earth walls joining the new single span bridge over Southtown Road to the double leaf bascule bridge; and
- Either reinforced earth embankments or embankments retained by reinforced earth walls, or a combination of these, joining the new double leaf bascule bridge to South Denes Road.
- The closure of Queen Anne's Road at its junction with Suffolk Road, and the opening of a new priority junction onto Southtown Road providing access to the Queen Anne's Road residential area;
- Revised access arrangements for existing businesses onto the local highway network including, potentially, a new structure to allow vehicular access under the proposed crossing on the eastern bank subject to agreement with affected businesses and landowner;
- Dedicated provision for cyclists and pedestrians which ties into existing networks;
- A control tower structure located in proximity to the crossing on the western side of the river. The control tower will facilitate the 24/7 operation of the opening span of the new double leaf bascule bridge;
- The demolition of an existing pedestrian bridge on William Adams Way;

[22] If a bridge with counterweights above the deck is constructed, the double-leaf bascule bridge and the single-span bridge over Southtown Road could be combined into a single, longer, structure, without separation between these two parts.

- Associated changes, modifications and/or improvements to the existing local highway network as informed by traffic modelling. This could include improvements within the existing highway boundary to some existing junctions within the red line boundary, in addition to amended parking arrangements.
- Additional signage to assist the movement of traffic in response to network conditions and the openings / closings of the double leaf bascule bridge;
- The relocation of existing allotments to compensate for an area to be lost as a result of the Proposed Scheme; and
- New public realm, landscape, ecology and sustainable drainage improvements;

2.3.3. Works to facilitate the construction, operation and maintenance of the above elements including:

- Creation of temporary construction sites and accesses from the public highway;
- Provision of new utilities and services and the diversion of existing utilities;
- Provision of drainage infrastructure, lighting and landscaping;
- Demolition of a number of existing residential and commercial / business properties;
- Provision of small vessel waiting facilities to the north and south of the crossing, either as floating pontoons or additional fendering to the existing berths, including any dredging and quay strengthening works that may be required;
- Provision of a large vessel waiting facility, if deemed necessary following risk assessment, at a remote location south of the crossing, including any dredging, quay strengthening, fendering and mooring alterations required; and
- Such ancillary, incidental and consequential changes and/or improvements as are required and permitted.

LIMITS OF DEVIATION

2.3.4. As discussed in Chapter 1, the 'Rochdale Envelope' provides for robust environmental assessment of Nationally Significant Infrastructure projects (NSIPs) with 'limits of deviation' for the design parameters of the Proposed Scheme.

2.3.5. The preliminary limits of deviation assessed in this PEIR are set out in Table 2.1. The identification and extent of the preliminary limits of deviation are subject to ongoing design and review, and will be confirmed in the Environmental Statement submission.

Table 2.1: Preliminary Limits of Deviation

Item	Parameters
Cofferdams (steel piled)	Two steel piled cofferdams, one along each quay, may be required and have been assessed. This will enable construction of bascule chambers (in the case of a structure with counterweights at or below deck level) or of piers within the river (in the case of a structure with counterweights above deck level) and will form the protective knuckles (if required) in the permanent condition.
Control tower	A maximum height of 20 metres (m) Above Ordnance Datum (AOD).
Western roundabout Diameter (ICD)	The western roundabout has an ICD of 70m and a tolerance of +5m and -5m

Item	Parameters
Road gradient	A maximum of 5%.
Finished road level tolerance	The finished road level has a tolerance of +500 millimetres (mm) and -500 mm from that presented on Figures 2.6 and 2.7.
Finished Proposed Scheme tolerance	Within the Red Line Boundary.
Double leaf bascule bridge clearance over water	A minimum of 4.5m clearance above Mean High Water Spring Level (MHWSL) to the underside of the double leaf bascule bridge when lowered. Unlimited headroom (air draught) to be provided when the bascule bridge is raised.
Navigable channel width	A minimum navigable channel width of 50m.
Double leaf bascule bridge deck	A maximum height of 9.24m above MHWSL (including +500 and -500mm tolerance on road level).
Double leaf bascule bridge road lighting columns	A maximum setback of 7.70m from the edge of carriageway when located within the defined working design envelope of the bridge structure.
Southtown Road bridge	Minimum clearance of **5.3m** above existing road level for traffic in accordance with the Design Manual for Roads and Bridges (DMRB)

DESIGN STANDARDS AND CROSS SECTIONS

2.3.6. The new crossing will be designed using the Design Manual for Roads and Bridges (DMRB) which has informed the proposed limits of deviation in Table 2.1, and is currently being designed to have a:

- Design speed of 30mph (50kph);
- Carriageway width of 15.4m (2 x 3.65m wide traffic lanes in each direction, with a 0.8m hatched median); and
- A provisional 4.5m width segregated footway and cycleway to the north, and a minimum 2.0m footway to the south.

2.3.7. The minimum carriageway cross-sections to be provided are further detailed in Table 2.2: Minimum Carriageway Widths below:

Table 2.2: Minimum Carriageway Widths

Road Name	Carriageway Width	Central Reserve Width	Footway Width	Segregated Footway Cycle Way Width
Proposed Link over River Yare	15.4m minimum inclusive of central reserve	0.8m minimum width. A minimum width of 3.0m to be provided at crossing points	2.0m minimum on the southern side of road	4.5m minimum comprising a 3m cycleway and a 1.5m footway on the northern side of the road
Proposed Link between Harfrey's Roundabout and Proposed Roundabout	16.4m minimum inclusive of central reserve	1.8m minimum and widened as necessary for splitter islands	N/A	3.0m minimum shared footway / cycleway from the tie-in of Adam's Way at Harfrey's Roundabout to the proposed toucan crossing on the realigned William Adam's Way
Link from proposed roundabout onto William Adams Way	17.6m minimum inclusive of central reserve	3.0m minimum width	2.5m minimum footway on the northern side of the road	4.5m minimum comprising of a 3.0m cycleway and a 1.5m footway on the southern side of the road

2.3.8. These elements are shown in Figure 2.4.

STRUCTURES AND EARTHWORKS

2.3.9. The exact type and form of the double leaf bascule bridge is subject to further design development, in particular with regards to the position of the counterweights required to balance the weight of the bridge deck and reduce energetic requirements during operation.

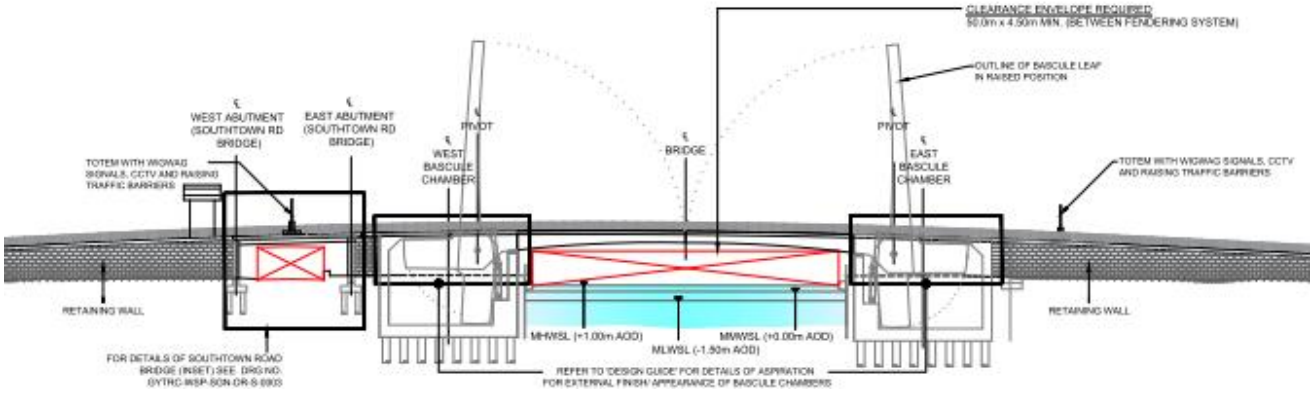
2.3.10. If counterweights are installed at or below deck level, the proposed double leaf bascule bridge may require two bascule chambers in order to accommodate their movement. If required, these will be accommodated within steel sheet-piled knuckle walls, extending into the River Yare from the quays along both banks. The requirement for, and exact shape, form and design of these knuckle walls will be subject to further confirmation and design and will be presented in the Environmental Statement.

2.3.11. If counterweights are installed above the deck level, chambers and permanent 'knuckles' may not be required as there would be sufficient space to accommodate their movement above ground. However, temporary sheet piled cofferdams may still be required to enable the construction of the piers within the River Yare.

2.3.12. Two illustrative opening mechanism designs have been prepared to reflect the arrangements outlined above in paragraph 2.3.11 and 2.3.12 (and shown in Figures 2.4 and 2.5 and Plates 3.1 and 3.2). It is important to note that these possible designs do not reflect an 'either / or' scenario, rather they reflect the ends of a range from which a working design envelope has been defined. The final design of the opening mechanism will be made by the Applicant within that working envelope, taking into account a number of issues, including contractor innovation and construction cost. To ensure that the opening mechanism is adequately assessed in this PEIR, the assessments contained herein consider the 'worst case' of both illustrative designs when combined. As an example, Chapter 10, Townscape and Visual Impacts, assesses a maximum structure height of the open bridge position of 44.5m Above Ordnance Datum (AOD), rather than assessing both the maximum height dimensions of the above deck counterweights (44.5m AOD) and the at, or below, deck counterweights (40.9m AOD).

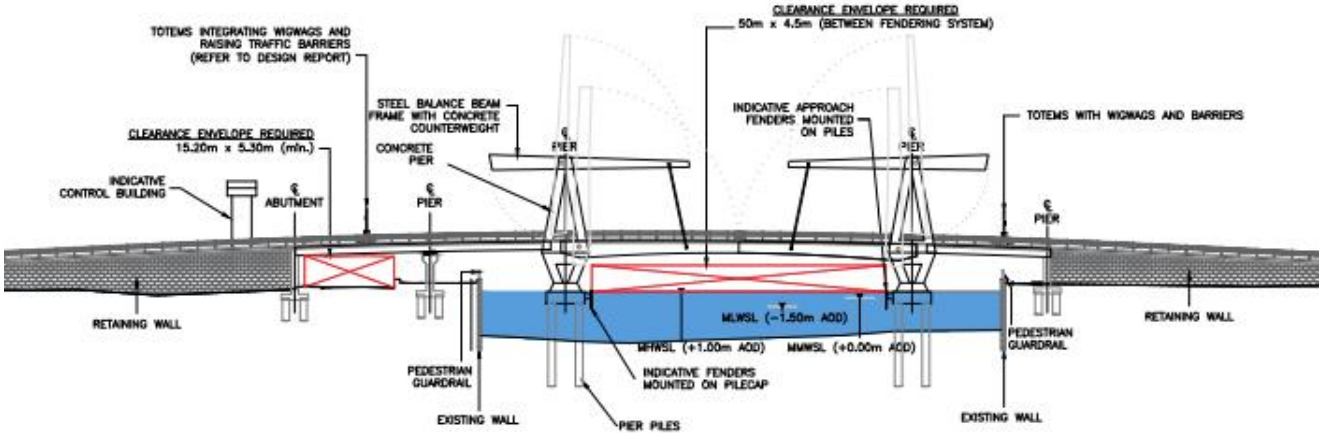
2.3.13. When lowered, the bridge will have a clearance of no less than 4.5m above the Mean High Water Spring level (MHWSL), which will enable smaller boats to pass under the bridge (as shown in Plate 3.1 and Plate 3.2 below). The bridge profile provides a higher actual clearance in the middle of the river that will be confirmed with the development of the design. Higher clearance values would have to be prohibitively high to significantly reduce the frequency of opening of the double leaf bascule bridge. This would have required excessively steep approach road gradients or, alternatively in order to avoid such steep gradients, significant additional work would have been required to raise the level of adjacent roads tying into the new road over the crossing, with an associated increase in land take.

Plate 2.1: Indicative profile of the proposed bascule bridge in the lowered position (counterweights at or below bridge deck level)



Note the profile of the bridge when it is raised is shown in dashed grey outline.

Plate 2.2: Indicative profile of the proposed bascule bridge in the lowered position (counterweights above bridge deck level)



Note the profile of the bridge when it is raised is shown in dashed grey outline.

2.3.14. The new crossing design currently includes a footway provision on either side of the carriageway with one side being wider to accommodate a segregated cycleway as well. The consideration of the provision of a footway and cycleway on both sides of the new crossing, as an alternative, is subject to further investigation and engagement with the stakeholders.

2.3.15. The proposed clear navigation width is of at least 50m between fenders. This is shown on Plate 2.1 and Plate 2.2 and discussed in greater detail in Chapter 15. Plate 2.1 and Plate 2.2 also shows infinite air draught will be provided for the full distance between fenders when the bridge is raised and open to marine vessels.

2.3.16. In consultation with Great Yarmouth Port Company (GYPC), vessel simulation modelling has been undertaken to confirm the effects of setting the navigation channel width at a minimum of 50m between fenders.

2.3.17. It is proposed that the new double leaf bascule bridge will require a control tower with a maximum height of 20m AOD. The location and detail of this structure will be determined in consultation with GYPC in the ongoing design process, although three provisional locations for the tower have been identified, all of which are in proximity to the crossing on the western side of the river, as shown on Figure 2.4.

2.3.18. A series of fenders will be provided within the river to provide protection to the double leaf bascule bridge structure against impact from ships. The fenders will be designed for the range of vessels expected to transit the bridge – they will likely comprise either unit element or cone fenders with low friction (Ultra-High Molecular Weight Polyethylene) facing panels.

2.3.19. It is anticipated that all the material for the new earthworks/embankments will need to be imported.

MAIN JUNCTION ARRANGEMENTS

2.3.20. Presented in Figure 2.4 are roundabout arrangements at the west of the Proposed Scheme and a signalised junction at the east of the Proposed Scheme. Whilst the design of junctions is well advanced, the final designs to be assessed in the Environmental Statement may differ in detail from those presented here following completion of the final Transport Assessment.

THE WESTERN JUNCTION

2.3.21. Paragraph 2.3.3 above provides an overview of the Proposed Scheme. In relation to the highway works to the western and eastern junctions, the existing junction of William Adams Way with Suffolk Road proposes a new 5-arm roundabout that will link to the existing A47 Harfrey's Roundabout through a realigned dualled section of William Adams Way. One of the arms of the new roundabout will link into a new dual carriageway road across the River Yare, and will oversail Southtown Road.

2.3.22. The other arms on the new roundabout provide accesses to The Kings Centre on Queen Anne's Road, Suffolk Road and the south eastern realigned dual section of William Adam's Way. Controlled pedestrian and cycle crossing facilities will be incorporated.

THE EASTERN JUNCTION

2.3.23. On the eastern section of the road crossing, the proposed link over the River Yare links into a new signalised junction with South Denes Road. The direction of operation of Sutton Road and Swanston's Road will be reversed to ensure efficient operation. Controlled crossing facilities will be incorporated, the final design of which will be presented in the Environmental Statement.

ACCESS TO PROPERTIES

2.3.24. One of the five arms of the proposed western roundabout will connect to the west side of Queen Anne's Road, providing all movements with access to the Kings Centre and the veterinary clinic.

2.3.25. A new priority junction on Southtown Road will provide access to the residential area at the eastern side of Queen Anne's Road.

2.3.26. The existing Perenco access onto South Denes Road will be permanently stopped up to enable construction of the Proposed Scheme, and access to their site via the northern-most Fish Wharf junction will also be severed by the new crossing. The permanent and temporary footprint of the Proposed Scheme will reduce the land they have available to operate their business. Alternative access arrangements and operational layouts within their site are being discussed with both Perenco and ASCO including potentially, a new structure to allow vehicular access under the proposed crossing on the eastern bank subject to agreement with the affected businesses and landowner.

DRAINAGE

2.3.27. An indicative drainage design is shown on Figure 2.9 that shows how drainage could be managed within the Proposed Scheme, and is described further below.

2.3.28. Outline approval is currently being sought from the relevant Risk Management Authorities with regards to the high level Drainage Strategy, however this is yet to be obtained. What has currently been proposed may therefore be susceptible to alterations based on liaison outcomes. However, the 'key principles' (paragraph 2.3.28 and 'general drainage design' (paragraph 2.3.29) points are expected to remain the same.

2.3.29. Key principles include:

- Discharge rates and volumes into receiving waterbodies/systems will be limited as close as reasonably practical to the greenfield runoff scenario, for the 1 in 100 year plus climate change event. Where this is not obtainable, it will be ensured that post development runoff rates and volumes will not exceed existing scenario values;
- All runoff will be adequately treated before entering receiving waterbodies/systems;
- Attenuation will be included within all spaces available;
- Sustainable Urban Drainage Systems (SuDS) will be included where possible;
- Drainage and landscape design will be incorporated where possible; and
- All storage sized to store runoff from a 1 in 100 year storm + climate change with a six hour duration storm.

2.3.30. General drainage design principles include:

- It is likely that verges and footways will either drain to the carriageway or drain to a SuDS feature within the verge (e.g. swale) and then discharge into the carriageway drainage system;
- There will be various watercourse realignments, culvert replacements and culvert extensions within the proposed drainage works. These will be agreed with the Internal Drainage Board (IDB) and other stakeholders;
- The proposed drainage network will be constructed in accordance with:
  - NCC's standard drawings;
  - The Manual of Contract Documents for Highway Works (MCHW) Highway Construction details; and
  - Sewers for Adoption (edition to be agreed with Anglian Water); and
- Provision must be made to contain any accidental spillages by providing penstocks upstream of any feature; and
- Future maintenance will be considered as part of the design.

Area 1

2.3.31. For the western side of the Proposed Scheme (if a centreline is taken from the highest level of the proposed River Yare spanning bridge deck) the first instance will be to discharge into the ordinary watercourses. Liaison is currently being undertaken with the Waveney, Lower Yare & Lothingland IDB to obtain ordinary watercourse discharge consent.

2.3.32. Runoff from the carriageway will be collected by the highway drainage (most likely highway gully & manhole system) and discharged into the attenuation feature Pond 1 (see Figure 2.9). The size, type and location of Pond 1 is to be confirmed. Pond 1 will discharge into the existing watercourse via a restriction device to reduce the rate/volume to a value acceptable to the IDB.

2.3.33. Pond 1 will have a permanent depth of water to allow for pollution treatment before discharging into the ordinary watercourse.

2.3.34. Alternative discharge strategies for the western side of the Proposed Scheme are also being explored; these include full discharge into the River Yare main river and a split discharge to the main river and ordinary watercourses, in case agreement cannot be reached with the IDB. These other potential options are being discussed with the relevant authorities.

Area 2

2.3.35. Runoff from the carriageway will be collected by the highway drainage and discharge into the underground attenuation feature Storage 2 which will be located within the roundabout central island. The size, type and location of Storage 2 is to be confirmed. Storage 2 will discharge into the replacement culvert via a restriction device to reduce the rate/volume to a value acceptable to the IDB.

2.3.36. A proprietary device will be installed upstream of Storage 2 so that all runoff can be treated before it enters the attenuation feature.

2.3.37. The highway drainage provision within the roundabout circulatory area will most likely be combined kerb drainage or gully & manhole system.

2.3.38. The River Yare double leaf bascule bridge deck drainage provision will be determined at detailed design stage. The options will include a piped or kerb system incorporated within the bridge deck or a collection system at the outer extents of the bridge deck (an at source collection system is currently preferred).

2.3.39. The Southtown Road single span bridge deck will be drained via a combined kerb system.

2.3.40. The remaining carriageway areas within Area 2 will have a highway gully and manhole system or combined kerb drainage to collect the runoff.

2.3.41. As with Area 1, alternative discharge strategies are being explored for Area 2 in case agreement cannot be reached with the IDB.

Area 3

2.3.42. For the eastern side of the crossing, the expectation is that drainage will discharge into the existing Anglian Water (AW) combined sewer on South Denes Road restricted at an existing rate or a rate specified by AW. Liaison is currently being undertaken with AW to obtain discharge consent.

2.3.43. It is expected that oversized pipes will be required to attenuate the rate & volume before the proposed system discharges into the AW network. This is due to available storage space being limited.

2.3.44. A restriction device will be installed upstream of the AW network connection.

2.4 OTHER DESIGN ELEMENTS

LIGHTING

2.4.1. The full extent of the Proposed Scheme will be lit in accordance with BS5489-1:2013 Code of Practice for the design of road lighting and public amenity areas, and also the relevant NCC road lighting specifications. Provisional lighting classes and luminaire mounting heights have been agreed with NCC.

2.4.2. The lighting design will be developed further during detailed design, to incorporate both the architectural lighting of the crossing and also the public realm areas that have been identified. The lighting scheme will utilise LED luminaires with specialised optics in proximity to the waterways to minimise obtrusive light as well as the installation of cowls to mitigate any light pollution onto the River Yare. Discussions will continue with Peel Ports and The Applicant to ensure their requirements are considered and a suitable design developed that does not affect the safety of their operations.

TECHNOLOGY

2.4.3. Variable Message Signs (VMS) will be provided to assist the movement of traffic in response to the double leaf bascule bridge status. The proposed signage locations, as indicated on Figure 2.3, have been informed by a review of the Great Yarmouth road network to determine locations where signs can reduce congestion on the approach to the crossing and in the town centre.

ROAD RESTRAINT

2.4.4. New road restraints will be provided for the full length of the new crossing using metal barrier systems at the outer edge of the structure. Vehicle parapets 1.4m in height including for fall prevention and to deter climbing over, will be provided along both edges of the bridge and along approach retaining walls. These comply with relevant standards, and DMRB requirements as far as is reasonably practicable, safe, and permitted by the Technical Approval Authority.

2.4.5. Additionally, metal guardrails will be provided along both sides of the carriageway to segregate pedestrians and cyclists from other road users on the approaches to the rising barriers preventing access to the bascule section of the crossing. This enables separate rising barriers to be provided on the carriageway and on the footway/cycleway, and will assist in optimising the lifting sequence to minimise delay.

LANDSCAPING

2.4.6. The Proposed Scheme will include hard and soft landscaping where it is necessary to mitigate any identified environmental effects, and to enhance the setting of the Proposed Scheme so that is fully integrated into the wider townscape. Current proposals are shown on Figure 2.5, however these are subject to ongoing design development to ensure the necessary mitigation identified by the Environmental Statement is provided, before being finalised for the DCO application. The proposals aim to enhance non-motorised users (NMUs) networks and connections to ensure safety, continuity and convenience around the Proposed Scheme.

2.4.7. The Proposed Scheme reduces severance between the communities, employment, and destinations on either side of the River Yare through the addition of the third crossing. Where possible and appropriate, the design enhances the experience of NMUs to encourage sustainable modes of transport to make this lifestyle choice more attractive and convenient.

2.4.8. The area around the bridge support structure at Bollard Quay on the western side of the River Yare provides the opportunity for a new public space, forming an important node for pedestrians and cyclists in this area. The type of mechanism developed for the double leaf bascule bridge, and the impact and footprint upon Bollard Quay, will further inform the design of the public space and connecting NMU routes. The public space will also be designed to allow access for maintenance to the crossing.

2.4.9. The western approach to the crossing features NMU routes north and south of the embankment structures, to enhance connectivity between Southtown Road and destinations west of this area including Suffolk Road, the allotments, and Southtown Common. There is an opportunity for these routes to enhance these areas of the Proposed Scheme, the experience for NMUs, and provide bio-diversity benefits through varied planting and tree species. These routes facilitate access maintenance for the approach embankments when necessary. As these routes will be primarily traffic-free (except maintenance access when required) and there is an opportunity for planting to be considered, they are hereafter referred to as 'green NMU routes' to differentiate from the standard footway routes provided elsewhere on the Proposed Scheme.

2.4.10. The planting strategy for the green NMU routes, to be developed in detailed design, will be diverse with native species to reflect the surrounding Norfolk County area and to benefit bio-diversity. A mix of native and ornamental planting will attract wildlife and visually enhance these areas. The species chosen will consider the need to simplify maintenance and management regimes.

2.4.11. To replace allotments affected by the Proposed Scheme, a plot has been allocated north of Queen Anne's Road, to ensure this amenity remains within the vicinity of its current location. The proposed plot is of a comparable area and will include 4 individual plots with appropriate facilities provided so far as is practicable as part of the Proposed Scheme. The 'Mind' community space will be reinstated within a smaller footprint adjacent to the base of the embankment of the widened and elevated William Adams Way. The relocated allotments, and existing 'Mind' community space will be accessible from the southern green NMU route which frames this area, and also from Queen Anne's Road for vehicles.

NMU CROSSINGS

2.4.12. The eastern junction will provide signalised crossings at every arm of the junction except Sutton Road. The crossings on both approaches from the A1243 South Denes Rd will be a pedestrian only puffin crossing, and a crossing will also be located on the bridge approach. All controlled crossings will be staggered and a waiting area in the central reservation will be provided.

2.4.13. Controlled toucan crossings for pedestrians and cyclists will be provided at the William Adams Way southeast (to replace an existing pedestrian bridge which will be demolished), and the bridge approaches to the western roundabout. Both will be signalised and staggered with a waiting area in the central reservation.

2.4.14. An uncontrolled crossing across Southtown Road for pedestrians and cyclists will also be provided.

2.4.15. A new signalised crossing will also be located on Suffolk Road, north of the new roundabout.

2.4.16. The NMU route on the north-western side of the crossing approach connects Southtown Road users to Suffolk Road and onto the bridge deck to cross to the eastern side. The northern side of the crossing will have a segregated cycleway and footway to tie into these connections.

2.5 CONSTRUCTION

2.5.1. Subject to the Development Consent Order (DCO) being made in line with anticipated timescales, it is envisaged that construction of the Proposed Scheme will commence in Autumn / Winter 2020 and will open in early 2023.

2.5.2. Mobilisation for the Proposed Scheme could commence in Spring 2020, subject to confirmation of the DCO, enabling site office and compound facilities to be established and advanced works such as site clearance activities, ecological mitigation and the diversion of the utilities to be undertaken prior to the main start of works where possible.

2.5.3. Ecological and cultural heritage mitigation works will be carried out in accordance with a Construction Environmental Management Plan (CEMP). Where possible, ecological and cultural heritage works will be completed in advance of construction works under the supervision of suitably qualified specialists. Work that impacts upon protected species will be subject to a mitigation/conservation licence(s) from Natural England. Where required, these licences will be in place prior to the commencement of work, and work will be undertaken in line with the mitigation requirements and conditions of the licence(s).

2.5.4. Land will only be released for construction once the ecological and cultural heritage works have been completed. All areas of the site will be signed off by the relevant environmental or archaeological specialists prior to work commencing.

2.5.5. Visual and noise mitigation, where identified, will be constructed as soon as practicably possible to minimise local disturbance. Further information is provided in Chapters 7 (Acoustics) and Chapter 10 (Townscape and Visual Impacts) of this PEIR.

2.5.6. Temporary drainage arrangements will be constructed ahead of the construction works commencing to ensure that surface run-off will not directly enter existing water courses. All private water supplies will be identified with landowners and clearly marked on the site and contract drawings.

2.5.7. Construction access and haulage roads will be constructed to ensure access is available to meet both the earthworks, structure construction and surfacing programmes.

2.5.8. Landscaping works will be undertaken as soon as practicable upon completion of the earthworks. The optimum amount of planting will be undertaken at the end of the first year of construction. All landscaping works will be subject to an appropriate maintenance period.

2.5.9. The site will be secured progressively, in accordance with the sequence of work as planned, with permanent fencing being erected (including any specified netting) wherever possible. Local roads will be maintained as far as is practicable and diversions will be completed prior to stopping up.

2.5.10. The programme of construction works will have regard to best practice and takes into account the need to avoid, where practicable, disruption to local communities and the environmental effects of construction. Working hours will reflect the need to complete the construction works as quickly and effectively as possible, whilst minimising the disturbance to local communities. Earthworks operations will be programmed between 07:00 and 19:00 Monday to Friday and 07:00 and 13:00 on Saturdays. Extended hours of working (e.g. Sundays and overnight works) may be required, for example, to construct tie-ins to side roads. All working hours will be discussed and agreed with the Environmental Health Officer (EHO) prior to starting the construction works.

2.6 OPERATION AND MAINTENANCE

2.6.1. Operation of the double leaf bascule bridge will be the responsibility of NCC as the Highway Authority. The day to day operator has not yet been agreed however discussions are currently ongoing with the Great Yarmouth Port Company to carry out this role. It is anticipated that the proposed double leaf bascule bridge will be operated on demand for commercial vessels and by agreement for recreational vessels at set times when requested in advance. The double leaf bascule bridge is expected to be operational 24 hours per day and 365 days per year.

2.6.2. Whilst the opening arrangements for the double leaf bascule bridge have yet to be agreed, it is envisaged that the bridge will open on average an estimated 15 times a day. Modelling has assumed that each opening will take approximately 5.5 minutes including vessel passage time, meaning that the crossing will be closed to traffic for approximately 82 minutes on a typical day.

2.6.3. Maintenance of the Proposed Scheme will be the responsibility of NCC as the Highway Authority, and will involve routine, planned maintenance and system checks, as well as reactive maintenance and repairs.

2.7 DECOMMISSIONING

2.7.1. The Proposed Scheme bascule bridge will be designed to have a life of at least 120 years in accordance with the requirements of BS EN 1990:2002 Eurocode – Basis of Structural Design.

2.7.2. Any decommissioning would be likely to be completed in less time than the construction of the Proposed Scheme and, whilst the Applicant has no plans to decommission and remove the Proposed Scheme, were it to be removed, it would be likely to require a similar degree of plant, equipment and disturbance within the navigation channel to that predicted during construction.

2.7.3. Given that the Applicant has no plans to decommission the Proposed Scheme, and as the environmental constraints in the mid-22nd Century cannot be reasonably predicted, further consideration of decommissioning is not considered appropriate (although please refer to Chapter 15 where greater information on the nature of the materials used in construction and how their suitability will be assessed is included).

3

ASSESSMENT OF ALTERNATIVES

3 ASSESSMENT OF ALTERNATIVES

3.1 INTRODUCTION

3.1.1. This section outlines the alternative scheme options that have previously been considered. Section 14(2)(d) of the EIA Regulations states that an ES should include "*a description of the reasonable alternatives studied by the applicant, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment*", In Schedule 4, the EIA Regulations state that an ES must include: "*A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects".*"

3.1.2. The Applicant has opted to provide this information within the PEIR to provide as much information as possible on the rationale behind the design and to present the decision making process that has been followed. Further detail will be provided in the ES.

3.1.3. This section has been informed by OBC Report[23] and the two supporting Option Assessment Reports (OAR) were prepared in 2016[24] and 2017[25]. These detail the option selection process that was applied to the Proposed Scheme. The proposed options for the scheme were subject to a further sifting process to identify the final three preferred options which were then taken forward for consideration in an Environmental Options Assessment Report[26] (EOAR), prepared in 2017 and summarised in Section 3.6.

3.2 DEVELOPING OPTIONS

STAGE 1 (2007)

3.2.1. A Stage 1 Scheme Assessment Report was commissioned in 2007 in order to understand existing constraints and potential engineering solutions available for the provision of a crossing of the River Yare in Great Yarmouth.

3.2.2. Within the 2007 Scheme Assessment Report, a broad area of interest was identified for the proposed scheme. This was determined through consideration of the following:

- The predicted number of bridge openings at various points on the river. The Stage 1 Assessment concluded that an opening structure placed at the southern end of the area of interest would have to open 4000 times a year for the large vessels, with additional openings for pleasure craft. If the bridge was placed at the northern extremity of the area of interest this would reduce to 2000 times a year, with additional openings for pleasure craft.
- The potential impact of a new structure upon the navigation of the river. Any structure on a curve of the river would require a larger clear span, which would incur greater cost.
- The need to minimise any impact on existing built development.

[23] Mouchel (2017). Technical Report. Great Yarmouth Third River Crossing, Outline Business Case. Available here.
[24] Mouchel (2016). Technical Report. Great Yarmouth Third River Crossing, Supporting Document 1 – 2016 Options Assessment Report. Available here.
[25] Mouchel (2017). Technical Report. Great Yarmouth Third River Crossing, Support Document 2 – 2017 Final Options Assessment Report. Available here.
[26] Mouchel (2017). Technical Report. Great Yarmouth Third River Crossing, Supporting Document 12 – Environmental Options Assessment Report. Available here.

3.2.3. On this basis the study area for the scheme was defined. This is shown in Figure 3.1 below, which presents an extract from the 2007 Scheme Assessment Report. Within the area of interest, three proposed corridors were identified for bridge and tunnel options. These are also presented in Figure 3.1. The 2007 Scheme Assessment Report concluded that, due to the existing trunk road layout and physical constraints placed by surrounding development, the only economically viable tie-in with the trunk road network was at the Harfreys Roundabout on the A47.

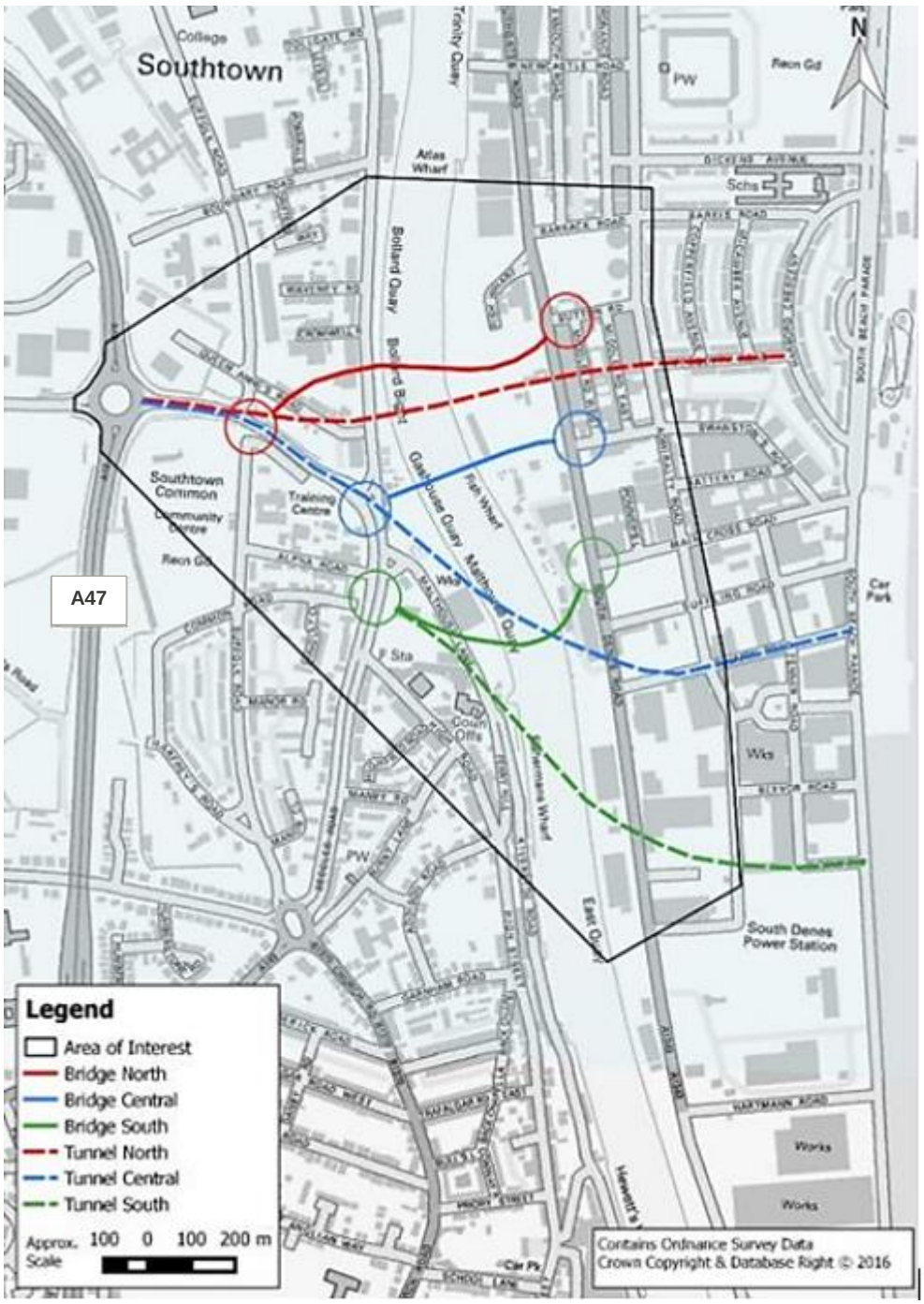


Figure 3.1 – Extract from 2007 Scheme Assessment Report showing the broad study area and proposed bridge and tunnel corridors

3.2.4. For each of the three route alignments, a high and low level bridge option as well as options for a tunnel were developed. This produced nine options in total.

3.2.5. At Stage 1, cost estimates were prepared for options in the northern and southern corridors only, as it this was considered sufficient to obtain an indication of the value for money of a third crossing scheme. This concluded that there was relatively little difference between the costs of high level and low level bridges, but the tunnel options were significantly more expensive than any of the bridge options.

3.2.6. In addition, an Environmental Assessment was undertaken at Stage 1 and considered all nine route options. It reported that the scheme would have numerous impacts on the local environment, some being beneficial and some adverse. For example, each of the routes would lead to a minor adverse impact on air quality. The report found that there were many aspects of construction that would cause disruption to aspects of the natural environment, most notably noise and vibration, water quality and drainage and ecology.

3.2.7. Three of the options identified at Stage 1 were tested using the Great Yarmouth SATURN model (northern alignment opening bridge, central alignment tunnel and southern alignment opening bridge). The key findings showed that either bridge options would carry more traffic (and hence provide more traffic relief) than the tunnel option. An economic assessment was also undertaken using TUBA, with accident benefits calculated using COBA. Of all the options tested show a positive benefit cost ratio:

- Bridge (northern location): 4.3
- Bridge (southern location): 4.9
- Tunnel (central location): 2.2

3.2.8. The Stage 1 Assessment showed that a third river crossing would be feasible, and that either a bridge or a tunnel could produce benefits in excess of its costs. A bridge would be less expensive and therefore produce a significantly better benefit- cost ratio than a tunnel.

3.2.9. The Stage 1 Assessment concluded that the following be included at the start of the Stage 2 scheme assessment process:

- High level opening bridge
- Low level opening bridge
- Immersed tube tunnel

3.2.10. The Stage 1 Assessment determined that the exact route alignment would depend on the cost (environmental, social and economic) of the alignment.

STAGE 2 (2009)

3.2.11. A Stage 2 Scheme Assessment Report was commissioned to develop options further. Different types of crossing were considered, which included a fixed bridge, swing bridge, lifting bridge, bascule bridge and a tunnel. Following a detailed investigation of these options (described in a Structural Options working paper[27]), three options (two bridge options on the shortest alignment and an improved tunnel option) were shortlisted for further assessment work:

- Bridge Option 1 – Bascule bridge with roundabout on Southtown Road;
- Bridge Option 2 – Bascule bridge with t- junction on Southtown Road; and

[27] Great Yarmouth Third River Crossing, Structural Options Working Paper (Mott MacDonald for Norfolk County Council January 2009

- Tunnel option- Tunnel from A47 north east onto Southgates Road

3.2.12. Results from the economic assessment carried out in the OAR stage showed that although the economic benefits of the tunnel option would be nearly as high as those for the bridge options, its cost would be much higher at three times that of the bridge. The resulting Benefit to Cost Ratio (BCR) was less than 2.0, confirming that a tunnel option is unlikely to become a viable solution. Both bridge options have a BCR of greater than 4, offering very high value for money (Table 3.1).

Table 3.1 - Cost and CBR of options

Option	Bridge Option 1	Bridge Option 2	Tunnel
Cost (2015)	£121.676 million	£112.301 million	£375.828 million
Cost benefit Ratio	4.5	4.8	1.5

3.2.13. The Stage 2 Scheme Assessment Report found that a bridge in the southern corridor would offer the greatest monetised benefits and, because it was also likely to be the least expensive option, would generate the highest BCR. Further to this, detailed data on commercial vessel movements within the inner harbour were used to determine the likely number of bridge openings required for different locations. It was concluded that a bridge on the shortest route across the river, would require about six openings each day. Further south, the number of openings would be greater. Further north, the cost of construction would be higher.

3.2.14. The OAR concluded that the crossing should be located between Hatfrey's Roundabout and South Denes Road.

3.2.15. Based on this location, a list of 40 options was subsequently produced based on different criteria including the location, form and geometry of the western and eastern tie-ins to the local road network, bridge height and carriageway standard. These 40 options were predominantly variants at three different tie-in locations.

3.3 OPTION SELECTION PROCESS

SIFTING PROCESS

3.3.1. The 40 identified options were put through an initial sift in order to narrow down to a selection of preferred options. This approach quickly reduced the initial list of options by removing those that did not make significant contributions to meeting the defined objectives; did not resolve the identified problems; or were not deliverable or feasible.

3.3.2. For each objective and identified problem, a score was allocated based on the anticipated impact of the option being assessed. The total score for each option was then calculated by summing the individual scores for each function, thus enabling a comparison between options.

3.3.3. The long list then became nine primary options (listed below) following the initial sift which were variants of three different western tie-in forms and locations outlined in the OAR.

EARLY ASSESSMENT SIFTING TOOL

3.3.4. DfT's Early Assessment Sifting Tool (EAST) is a decision support tool that has been developed to quickly summarise and present evidence on options in a clear and consistent format. It provides decision makers with relevant, high level, information to help them form an early view of how options perform and compare.

3.3.5. EAST has been designed to be consistent with Transport Business Case principles and follows the same five cases as the DfT Business Case model.

3.3.6. The nine options (listed in Table 3.2) which successfully met the evaluation criteria within the initial sifting process were taken forward to the final stage of sifting, using the EAST decision support tool. This assessment identified the high level economic, environmental and social impacts of all nine options based on DfT's five case

model approach. Reviewing the schemes performance across all of the cases is the preferred approach, and therefore a Red/Amber/Green (RAG) score was applies to each of the nine options to provide a visual guide (Table 3.2).

3.3.7. NB: On Wednesday 1st March 2017, the A12 between Great Yarmouth and Lowestoft became part of the A47. The work ensures that the A47 is a continuous trunk road between Peterborough and Lowestoft, while the A12 is a continuous trunk road between Ipswich and London.

Table 3.2 - Preferred Options Table

Option	Width	Tie in location (west)	Tie in form (west)	Tie in location (east)	Tie in form (east)	Cost (£M)
4	single carriageway	A12 Harfrey's Roundabout tie-in	Existing four-arm roundabout	South Denes	T- junction	£65
5	dual carriageway	A12 Harfrey's Roundabout tie-in	Existing four-arm roundabout	South Denes	T- junction	£102
6	three-lane carriageway	A12 Harfrey's Roundabout tie-in	Existing four-arm roundabout	South Denes	T- junction	£87
31	single carriageway	Suffolk Road	New four-arm roundabout	South Denes	T- junction	£62
32	dual carriageway	Suffolk Road	New four-arm roundabout	South Denes	T- junction	£97
33	three-lane carriageway	Suffolk Road	New four-arm roundabout	South Denes	T- junction	£83
37	single carriageway	Southtown Road tie-in	At grade junction	South Denes	T- junction	£62
38	dual carriageway	Southtown Road tie-in	At grade junction	South Denes	T- junction	£95
39	three-lane carriageway	Southtown Road tie-in	At grade junction	South Denes	T- junction	£81

3.4 DISCOUNTING OF INITIAL OPTIONS

3.4.1. Having selected nine options, it was necessary to identify which did not represent realistic solutions. The need for the selected scheme to perform well across economic, environmental and social indicators required a process of sifting and discarding of options to ensure that final options made a significant contribution to achieving scheme objectives.

3.4.2. The DfT Early Assessment Sifting Tool (EAST) was applied to reduce nine options down to the final three. The shortlisted options were subjected to preliminary operational testing using both SATURN and Paramics Discovery model platforms. Of the nine options, the following outlines the preliminary findings from the sifting assessments:

- Following the option assessment and findings from the preliminary operational performance testing, Options 32, 33 and 37 were recommended to be carried forward to next stage for further appraisal.
- Both options 32 and 33 met all specific, intermediate and operational objectives of the scheme and addressed a balance of benefits to both the local and strategic road network. Option 37, which is a two-lane low bridge that ties in at-grade to Southtown Road, was to be carried forward as the low-cost option. Testing showed that all key indicators suggest that option 32 performed better than either option 33 or 37.

- Option 39 would be expected to experience comparable over capacity queuing issued at the AM and PM peak traffic time, and was therefore discarded

- SATURN model outputs for option 38 indicated that whilst the travel time and distance is likely to be reduced in comparison to the 'do nothing' scenario, there may be significant over-capacity queuing issues that arise

- Structurally, low level bridge options (38, 39) involve complicated construction methods that are relatively expensive.

- Options 4, 5 and 6 tie-in at Harfrey's roundabout and were ruled out because of significant drawbacks to the wider road network and by not meeting specific operational objectives (to achieve a balance between the needs of road and river traffic and to minimise environmental impact, compulsory purchase and demolition of residential and commercial property).

- Despite performing well during the junction assessment, Option 31 was not taken forward because the four and three lane variants (Options 32 and 33) that tie in to the same location on Suffolk Road are expected to deliver better resilience to the network and to provide more benefits to the local road network as opposed to a two-lane carriageway standard.

3.5 FINAL OPTIONS ASSESSMENT

3.5.1. Following the discounting of options stage, three final design options were identified as:

- Preferred Option 32 - Suffolk Road tie-in to the west (four lane high level bridge, roundabout as west tie in and traffic signals to the east at South Denes Road);

- Alternative Option 33 - Suffolk Road tie-in to the west (three lane high level bridge, roundabout as west tie in and traffic signals to the east at South Denes Road); and

- Alternative Option 37 - Southtown Road tie in to the west (Single Carriageway two lane low level bridge with traffic signal junctions to the west and the east at South Denes Road).

3.5.2. A summary of further appraisal work undertaken for options 32, 33 and 37 are outlined in the following sections. This included an environmental assessment as outlined in the Options Environmental Appraisal Report (EOAR)[28], summarised in Section 3.6.

Saturn Model Updates

3.5.3. Saturn Model outputs relating to overall journey times, distance travelled, queuing and total trips on the network for morning, evening and inter peak periods for 2030 are summarised in Table 3.3.

3.5.4. The results show that Option 32 has a marginal benefit overall in respect of the total distance travelled in the modelled road network.

[28] Mouchel. Great Yarmouth Third River Crossing Environmental Options Appraisal Report, 2017

Table 3.3 - Do min- v Options 32, 33 and 37 (2030) forecast year

Period	Scenario	Total Distance Travelled (pcukm)	Total Travel Time (pcuhr)	Total trips on the network (pcu*)
AM	Do min			
	Option 32	44920.6	1387.6	14809.5
	Option 33	44988.9	1380.9	14809.5
	Option 37	44857.4	1407.7	14809.5
IP	Do min			
	Option 32	49019.8	1676.7	17208.2
	Option 33	48129.3	1746.7	17208.2
	Option 37	48271.5	1869.4	17208.2
PM	Do min			
	Option 32	51424.8	1851.1	17401
	Option 33	51484.5	1853.4	17401
	Option 37	51490.1	2198.2	17401
*pcu: passenger car units				

Queuing Lengths

3.5.5. Table 3.4 shows the predicted maximum queue lengths for the three options. All key indicators suggest that Option 32 performs better than either Option 33 or 37.

Table 3.4 - 2023 Max queue (m) for Average Case Scenario and Worst-Case Scenario

ACS 2023	Option 32	Option 33	Option 37		WCS2023	Option 32	Option 33	Option 37
Western Side	154	341	407		Western Side	296	329	424
Eastern Side	189	182	397		Eastern Side	245	249	445

3.5.6. Table 3.5 shows the forecast journey time and distance savings for 2023.

Table 3.5 - Forecast Journey Time and Distance Savings 2023

2023	Vehicles	Total Distance (m)	Reduction (m)	Total Journey Time (s)	Reduction (s)
Do min	109,170	284,144,403	-	30,656,804	-
Option 32	109,267	277,221,279	6,923,124	29,375,070	1,281,734
Option 33	109,281	277,366,867	6,777,536	29,400,413	1,256,391
Option 37	109,246	276,572,017	7,572,386	30,231,789	425,016

3.5.7. Table 3.6 shows the forecast journey times and distance savings for 2038.

Table 3.6 - Forecast Journey Time and Distance Savings 2038

2038	Vehicles	Total Distance (m)	Reduction (m)	Total Journey Time (s)	Reduction (s)
Do min	121,984	319,680,152	-	40,219,537	-
Option 32	122,756	313,060,558	6,619,593	35,786,851	4,432,686
Option 33	122,738	312,980,112	6,700,039	35,872,101	4,347,436
Option 37	122,424	312,103,104	7,577,048	38,090,568	2,128,968

Cost

3.5.8. Table 3.7 outlines the predicted costs for each option.

Table 3.7 - Estimated Scheme Cost

Option	Estimated Cost
32	£96,538,000
33	£82,604,665.67
37	£61,513,841

3.6 ENVIRONMENTAL OPTIONS ASSESSMENT

3.6.1. The EOAR was prepared in 2017, to support the OBC. The primary objective of the appraisal was to assess the impacts on the environment for options 32, 33 and 37.

3.6.2. The methodology adopted for the environmental impact appraisal was informed by the guidance provided in the relevant chapters of TAG Unit A3 (WebTAG guidance for Environmental Impact Appraisals). Additionally, some assessment of the potential environmental impact and effect of the options used guidance contained within the Design Manual for Roads and Bridges (DMRB) Volume 11.

3.6.3. To inform the Environmental Impact Appraisal, desk based data gathering was undertaken for each of the environmental disciplines, which include noise, air quality, greenhouse gases, landscape, townscape, biodiversity, historic environment and the water environment. It is noted that contaminated land, human health and population were not assessed within this report. A preliminary ecology survey was undertaken to inform the scope of ecology surveys. Due to the absence of appropriate traffic data for the options, a proportionate air quality and noise assessment was undertaken to inform the appraisal. This comprises a qualitative analysis of the likely effects using available information, such as potential number of sensitive receptors (e.g. properties and sensitive areas).

3.6.4. The findings of the assessments are summarised below. The appraisal scoped out the need for assessing impacts on greenhouse gases as it was deemed that this would not present a material change on the optioneering process. Given the urban nature of the Proposed Scheme, it was concluded that the townscape sub discipline adequately considered the potential impacts in relation to the setting and that the landscape sub discipline would not be directly relevant to the decision-making process. Accordingly, the landscape sub discipline was scoped out of the overall appraisal.

Noise:

3.6.5. For all scheme options, there are 663 sensitive receptor buildings and no Noise Important areas within the 300m study area.

3.6.6. The EOAR concluded, overall, receptors close to the all three options would experience an increase in noise as a result of increased traffic flow. Option 37 was located marginally further away from sensitive receptors, and therefore could be expected to result in the lowest impact of the proposed options.

Air Quality:

3.6.7. The appraisal indicated that options 32 and 33 would have a greater number of potentially sensitive receptors situated within 200m of their design footprint than option 37. Due to the predicted reduction in traffic on the existing road links around the existing bridge, along with the absence of an AQMA in the vicinity, an overall neutral local air quality impact was considered most likely for each option.

Townscape:

3.6.8. The majority of townscape impacts were predicted to have a neutral effect for all options. The bridge in its temporary open position, however, would be an evident feature of Great Yarmouth's contextual townscape as a skyline feature. The assessment concluded that this would not fundamentally change the associated character of the river corridor, or how the town is perceived in context with its surrounding landscape.

Biodiversity:

3.6.9. All options passed through several areas of habitat that are suitable for breeding birds, as well as several buildings which may have suitable bat roosts within them that could be affected. The appraisal determined that, once suitable mitigation has been implemented, the effect of all options on biodiversity should not exceed slight adverse.

Historic Environment:

3.6.10. The EOAR deemed that all options would have a moderate adverse effect upon the setting of two listed buildings due to their proximity to the options. Additionally, the construction of all options would have a major adverse effect upon any unknown sub-surface archaeological remains.

Water Environment:

3.6.11. All three of the options were located entirely within floodplain cited as Flood Zone 3, and were deemed to be a significant adverse effect upon the water environment as a result of impacts to the floodplain. However, no effects upon the permeability of surrounding land and aquifer recharge were anticipated. The overall effect of all options on the water environment was deemed to be moderate adverse.

SUMMARY OF ENVIRONMENTAL OPTIONS ASSESSMENT REPORT

3.6.12. Table 3.8 provides a summary of the potential environmental impacts of each option.

Table 3.8 - Summary of Environmental Appraisal

Environmental Discipline	Option 32	Option 33	Option 37
Noise*	N/A	N/A	N/A
Air Quality*	N/A	N/A	N/A
Greenhouse gases	Scoped Out	Scoped Out	Scoped Out
Landscape	Scoped Out	Scoped Out	Scoped Out

Environmental Discipline	Option 32	Option 33	Option 37
Townscape	Neutral	Neutral	Neutral
Historic Environment	Moderate Adverse	Moderate Adverse	Moderate Adverse
Biodiversity	Slight Adverse	Slight Adverse	Slight Adverse
Water Environment	Moderate Adverse	Moderate Adverse	Moderate Adverse
*A WebTAG impact assessment had not been undertaken at this stage of the appraisal process for noise and air quality as the options are at the same crossing point, making the outcome of a distributional impact immaterial to the optioneering process..			

3.7 CONCLUSION OF THE OPTIONS SELECTION PROCESS

3.7.1. Considering the finding of the Option Selection process and the EOAR, Option 32 was chosen as the Preferred Option for the scheme. The results showed that Option 32 was forecast to provide the greatest potential benefit in terms of total travel distance and time saved across the modelled road network. In addition, Option 32 was also forecast to present the best operational performance at the junctions adjacent to the bridge, with the lowest levels of queueing and most efficient dissipation of these queues once the bridge re-opens for vehicular traffic.

4

CONSULTATION

4 CONSULTATION

4.1 CONSULTATION TO DATE

INFORMAL CONSULTATION

4.1.1. The Applicant has been undertaking consultations on The Proposed Scheme since 2009.

4.1.2. The most recent consultations have followed a three-stage process, as discussed in the Applicant's Statement of Community Consultation and summarised below:

Stage 1 (November 2016 – January 2017)

- Initial engagement, non-statutory consultation
  The purpose of this stage was to invite and assess views on congestion within Great Yarmouth and the surrounding area, to share emerging proposals and to understand the level of support for the Proposed Scheme.

- Nearly 500 individuals responded[29], including local residents and business representatives. Responses were as follows:
  - 71% of respondents said traffic congestion in Great Yarmouth was either a serious or very serious issue;
  - 79% either strongly agreed or agreed that the third river crossing would make their journey times shorter;
  - 80% either strongly agreed or agreed that congestion would be greatly reduced by a new river crossing; and
  - 81% said they would be very likely or likely to use a third river crossing.

Stage 2 (September 2017 – October 2017)

- Scheme development, non-statutory consultation
  The purpose of this stage was to invite and assess views on the Proposed Scheme development work so far.

- The consultation responses showed an overall support for the scheme, with the majority of respondents saying that:
  - congestion in Great Yarmouth is either a serious or a very serious issue;
  - the Third River Crossing would make their journey times shorter; or
  - congestion would be greatly reduced by the new crossing.

4.1.3. As part of this process, the Applicant undertook non- statutory consultation in advance of preparation of the EIA Scoping Report[5]. This was based upon information presented in the Outline Business Case and Options Assessment Report. Stage 2 consultation responses were received from Historic England, Natural England, the

[29] https://www.norfolk.gov.uk/roads-and-transport/major-projects-and-improvement-plans/great-yarmouth/third-river-crossing/public-consultation-on-third-river-crossing (accessed 20/07/2018)

Broads Authority and the Environment Agency (EA) in October and November 2017, ahead of undertaking EIA Scoping. These consultation responses are presented in Appendix 4A.

Stage 3 (Planned for August 2018 – October 2018)

- Statutory pre-application consultation
  The purpose of this stage will be to provide updated details on the Proposed Scheme and to invite and assess views on it, before an application for a DCO is submitted.

4.1.4. Stages 1 and 2 allowed the Applicant to take into account the comments from local people and other parties, allowing for development of the proposals. Stage 3 will inform further refinements of these proposals, prior to DCO application submission, and will welcome comments from anyone wishing to express a view. The Applicant, in its Statement of Community Consultation, states that Stage 3 will specifically seek views on:

- the principle of, need for and design of the Proposed Scheme (including alternative ways of meeting the need);
- detailed proposals for the Proposed Scheme including bridge alignment, junction layouts, works on existing roads and side roads, and design details;
- preliminary environmental information relating to the construction, operation and maintenance of the Proposed Scheme (provided by the PEIR and the non-technical summary);
- potential impacts of the Proposed Scheme on traffic (and possible mitigation measures); and
- potential impacts of the Proposed Scheme on port related activities and river vessel movements.

EIA SCOPING

4.1.5. The following organisations were consulted by Applicant when preparing the EIA Scoping Report[5].

- Planning Inspectorate;
- NCC Planning Department;
- NCC Archaeological Officer;
- NCC Landscape Officer;
- NCC County Ecologist;
- Marine Management Organisation (MMO);
- Historic England;
- Environment Agency;
- Peel Ports; and
- Highways England.

4.1.6. The following organisations have provided responses to the EIA Scoping Report[5]:

- Anglian Water Services Limited;
- Environment Agency;
- ESP Gas Group Limited;
- Forestry Commission;
- Fulcrum Pipelines Limited;
- Great Yarmouth Port Authority;

- Harlaxton Energy Networks Limited;
- Health & Safety Executive;
- Marine Management Organisation;
- Maritime and Coastguard Agency;
- National Grid;
- Natural England;
- Norfolk County Council;
- Public Health England;
- Royal Mail;
- South Norfolk Council;
- Trinity House;
- Waveney Lower Yare & Lothing and Internal Drainage Board;
- Historic England; and
- Great Yarmouth Borough Council.

4.1.7. These scoping responses are provided within in Appendix 2 of the Scoping Opinion[6]. Responses from Historic England and Great Yarmouth Borough Council were received after the statutory deadline and were therefore not include within the Scoping Opinion[6]. Nevertheless, the scoping responses have also been published on the Planning Inspectorates website alongside the Scoping Opinion[6].

4.2 STATUTORY PRE-APPLICATION CONSULTATION AND PUBLICITY

4.2.1. Part 5, Chapter 2 of the Planning Act requires an applicant for a DCO to undertake consultation and publicity prior to submitting their application. Accordingly, between August and October 2018, the Applicant will undertake the following in accordance with the requirements of the Planning Act and the EIA regulations.

(i) Section 42 consultation with prescribed consultees, specified local authorities and those with specified interests in the land (the first two categories are also the "consultation bodies" for the purposes of the EIA Regulations);

(ii) Section 47 consultation with the local community in accordance with the Applicant's Statement of Community Consultation. As required by Regulation 12(1) of the EIA Regulations, the statement explains how the Applicant will publicise and consult on the PEIR; and

(iii) Section 48 publicity (by notice) of the proposed application for a DCO. A copy of the notice will be sent to prescribed bodies in accordance with Regulation 13(1) of the EIA Regulations.

4.2.2. Before a DCO application is accepted, the SoS must be satisfied that the applicant has complied with the requirements of Part 5 Chapter 2 of the Planning Act. The pre-application consultation and publicity is thus a key part of the process of seeking a DCO.

4.2.3. The Applicant will take into account representations received in response to the pre-application consultation and publicity in refining and resolving the Proposed Scheme, and in preparing the Environmental Statement required to accompany the application for a DCO.

4.2.4. The PEIR and accompanying non-technical summary will be sent (in electronic form) to all persons consulted under section 42. Paper copies will be provided on request and the documents will also be available to view on the Applicant's website. The PEIR and accompanying non-technical summary will also be available at Public Exhibitions being held. These will provide an opportunity for the public to view and comment on the scheme proposals, including the PEIR.

5

ASSESSMENT APPROACH

5 ASSESSMENT APPROACH

5.1 INTRODUCTION

5.1.1. This chapter presents the overarching approach to be applied to the PEI. EIA is a process that identifies the likely significant environmental effects of a proposed development. It ensures that effects are properly considered as part of the design development process and that adverse effects are adequately mitigated. EIA assists in decision-making so that environmental factors can be given due weight. EIA also helps the Applicant to avoid, minimise and compensate for adverse environmental effects. EIA provides an opportunity for iterative feedback throughout the design process providing a mechanism to take into account environmental effects within the design process. The results of the PEI and responses to it will inform the Environmental Statement (ES) that will be submitted with the DCO application.

5.2 LEGISLATION AND GUIDANCE

5.2.1. Regulation 14 (2) of the EIA Regulations sets out the content which the ES must, as a minimum, include. The overarching purpose of the EIA process is to identify, describe and assess the direct and indirect significant effects of the proposed development (including operational effects) on the aspects of the environment specified in Regulation 5(2)(a) to (e).

5.2.2. In this context PEI has a distinct limited role, being designed to facilitate later stages of the EIA process. Regulation 12(2) defines the PEI as being such information as is referred to in Regulation 14(2) as is reasonably required for the consultation bodies to develop an informed view of the likely significant effects of the Proposed Scheme (which in turn will facilitate the preparation of the ES). It is also relevant to note that PEI is required to be prepared at the pre-application stage alongside statutory consultation and publicity: a stage when, as is necessary for the consultation to have substantive value, the design and other details of the Proposed Scheme have not been fully resolved. This in turn limits the finality and detail which can be achieved in identification and assessment of effects in the PEI. It follows that whilst the present PEIR generally follows the anticipated format and structure of the ES, it is not (and is not required to function as) a draft ES.

5.2.3. In addition, the Design Manual for Roads and Bridges (DMRB)[30] provides guidance for all aspects of the planning, design and assessment of major road schemes. The guidance in Volume 11 specifically addresses environmental assessment and identifies impacts and effects, which can be anticipated where a major road scheme is being introduced into the environment, although it is acknowledged that the DMRB predates the current EIA Regulations. The guidance has been used, where relevant to assist the assessment team in establishing which impacts and effects could potentially occur, and the specific nature of them for the Proposed Scheme. Where it is concluded that assessment is required, there is a description of the assessment considered appropriate and methods of assessment which are to be adopted.

5.3 ASSESSING THE EXISTING BASELINE

5.3.1. Environmental effects are described in the PEIR in terms of the extent of predicted change to the baseline condition. The baseline is generally taken to be the environmental conditions that are prevalent at the time that the assessment and supporting survey works are undertaken. Baseline environmental conditions, have been identified through:

- desk-based review of existing and available data; or
- on site surveys, intrusive investigations and modelling where considered necessary.

[30] Highways England. Design Manual for Roads and Bridges. Volume 11. Available here.

5.3.2. For each environmental aspect topic, the EIA will clearly define (i) sources of information; (ii) limitations pertaining to the baseline information or to the collation process

5.3.3. For some aspect topics it is appropriate to consider the future baseline associated with the Proposed Scheme, such as Traffic and Transport, Air Quality and Acoustics. This is determined by modelling the predicted future conditions, with and without the Proposed Scheme. These methods are described further within the individual aspect chapters.

5.3.4. During the EIA process, each environmental aspect topic has prepared a baseline section for the PEIR. Each aspect topic will determine relevant resources and sensitive receptors. These can include (but are not limited to) (i) sensitive ecological receptors; (ii) conservation and landscape designations (iii) structures or artefacts of heritage/archaeological value; (iv) watercourses; (v) people (vi) residential dwellings, (vii) places of employment; and (viii) other community facilities, such as education facilities, care homes, hospitals, places of worship.

5.3.5. The baseline sections will be updated throughout the EIA process, as new information emerges in line with the emerging design, emerging survey results, and through the consultation processes.

5.3.6. The ES will therefore have the objective of identifying and assessing which potential effects of the Proposed Scheme on the environment are likely to be significant, both positive and negative and, irrespective of duration. Direct effects will be assessed, together with (where relevant) indirect, secondary, cumulative and transboundary effects. Where possible, effects will be assessed quantitatively and mitigating measures and features will be considered.

5.4 DETERMINING STUDY AREA

5.4.1. Each environmental aspect topic will be responsible for defining the study area for their impact assessments. The study area will vary for each discipline and is driven by the nature of the existing environmental baseline. It is recognised that some effects only impact on a defined area whereas other effects are more widespread.

5.4.2. The spatial scope for the EIA includes (but is not limited to):

- the footprint of the proposed works including areas required for construction, enabling works and mitigation;
- the footprint of the traffic model where traffic flows are used for the transport assessment, air quality air quality assessment and noise assessments;
- the presence of European conservation designations; a wider study area of 3km has been applied to fully assess the effects upon these designations;
- the manner in which effects are likely to be propagated (effects of flooding and sediment transport could extend far beyond the Proposed Scheme Boundary);

5.5 TIMING AND DURATION OF WORKS

5.5.1. The EIA will consider the timing of the effects as well as the duration over which likely significant effects may occur. It will address effects arising from the construction, temporary and permanent land take and operation of the scheme as follows:

- Construction effects that may arise directly from construction activities (e.g. piling) and from the temporary use of land (e.g. construction sites), or from associated changes in traffic movements (e.g. diversions); and
- operational effects that may arise from the new infrastructure and traffic flows.

5.5.2. For the purposes of the EIA, the base year for assessments is given as 2018, with an opening year of 2023. The temporal scope may vary for specific disciplines but will generally extend from commencement of construction works to 15 years after the opening of the Proposed Scheme.

5.6 DETERMINING EFFECT SIGNIFICANCE

5.6.1. The ES will have the objective of identifying and assessing which potential effects of the Proposed Scheme on the environment are likely to be significant, both beneficial and adverse and irrespective of duration. Direct effects will be assessed, together with (where relevant) indirect, secondary, cumulative and transboundary effects (as states in Section 1.4, screening has been undertaken by the Planning Inspectorate on behalf of the SoS and concluded that the proposed scheme was unlikely to have a significant effect either alone or cumulatively on the environment in another EEA state). Where possible, effects will be assessed quantitatively and mitigating measures and features will be considered.

5.6.2. The significance of effects will be assessed within the ES using the following criteria as appropriate to the effect concerned:

- international, national and local standards;
- sensitivity of receiving environment;
- reversibility and duration of effect;
- inter-relationship between effects and cumulative effects; and
- the results of the consultations.

5.6.3. The significance of effects reflects the professional judgement of the technical specialist as to (i) the value or sensitivity of the affected receptor(s); and (ii) the nature and magnitude of the predicted changes.

5.6.4. It is proposed that the methodology and criteria used for the EIA be based upon the approach published in Volume 11, Section 2, Part 5 of the DMRB (HA 205/08)[31], updated as necessary to take account of the 2017 EIA Regulations. Where individual topics depart from this approach, the alternative methodologies and terminology will be provided within the relevant chapter.

5.6.5. Environmental value/sensitivity and impact magnitude detailed within HA 205/08[31] are reproduced in Table 5.1 - Environmental Value (or Sensitivity) and Typical Descriptors and Table 5.2 - Magnitude of Impact and Typical Descriptors respectively.

Table 5.1 - Environmental Value (or Sensitivity) and Typical Descriptors

Value (sensitivity)	Typical Description
Very High	Very high importance and rarity, international scale and very limited potential for substitution.
High	High importance and rarity, national scale, and limited potential for substitution.
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.
Low (or lower)	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

[31] Highways England. Design Manual for Roads and Bridges. Volume 11. Available here

Table 5.2 - Magnitude of Impact and Typical Descriptors

Magnitude of impact	Typical criteria descriptors
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse).
	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Moderate	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse).
	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse).
	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse).
	Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).
No Change	No change as a result of the proposed scheme

5.6.6. Using the level of sensitivity (value) and the magnitude of an impact, the significance of an effect can be determined using the Significance Matrix presented in Table 5.3. Using this approach, it is possible that a major adverse impact on a feature or site of low sensitivity will be of lesser significance than the same magnitude of impact on a feature or site of high sensitivity. Unless otherwise stated in the individual assessment, effects deemed to be of moderate, large or very large significance are deemed to be significant effects.

5.6.7. Table 5.3 presents the matrix, upon which the significance of effects will be determined. A description of the significance levels is presented in Table 5.4. Both tables are based upon the significance matrix and significance descriptions published by the DMRB in HA 205/08[31].

Table 5.3 - Significance of Effect Matrix

Importance / Sensitivity / Value						
	Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large
	High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
	Medium	Neutral	Neutral or Slight	Slight	Moderate	Moderate or Large
	Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
	Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
		Magnitude of impact				

Table 5.4 - Descriptors of the Significance of Effect Categories

Significance Category	Typical descriptors of effect
Very Large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the Proposed Schemet.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

5.7 MITIGATION AND RESIDUAL EFFECTS

5.7.1. The ES will evaluate the measures required to avoid, minimise or offset the significant adverse effects of the Proposed Scheme. As previously stated, this will include engagement with the designers throughout the design process. This process of iterative feedback will promote effective mitigation design and will help reduce significant environmental effects to a practicable minimum.

5.7.2. Where significant effects are identified as part of the EIA, mitigation measures will be proposed to avoid or reduce these effects. Where measures are integral to the design and the applicant has committed to their implementation, mitigation will be termed “embedded mitigation”.

5.7.3. Where significant effects remain after application of mitigation, they are termed residual effects. The significance of residual effects will be assessed within the ES.

6

AIR QUALITY

6 AIR QUALITY

6.1 INTRODUCTION

6.1.1. This chapter of the PEIR provides preliminary information as it relates to the Proposed Scheme to date and to data currently available and gathered at this point of the assessment process.

6.1.2. The level of air pollution adjacent to roads and within urbanised areas is typically a function of vehicle emissions. Emissions of nitrogen oxides (NO_x, including nitrogen dioxide, NO_2) and particulate matter (PM_{10} and $PM_{2.5}$)[32] from vehicles are of greatest concern with respect to human health. Concentrations of these pollutants are subject to air quality standards, established by UK legislation[33] for the protection of human health.

6.1.3. There is the potential for impacts to regional emissions, including those of NO_x, PM_{10} and carbon dioxide (CO_2), as a result of changes to vehicle flow characteristics across the roads affected by the Proposed Scheme.

6.1.4. The air quality impact assessment will also consider potential air quality impacts associated with emissions relating to the construction phase of the Proposed Scheme, with a focus on construction dust emissions. Where applicable, this chapter outlines the appropriate mitigation measures that are required to negate and/or minimise potentially significant air quality effects.

6.1.5. It is supported by Figure 6.1 to 6.3 and Appendices 6A to 6B.

STUDY AREAS

6.1.6. The study area for the assessment of construction phase dust emissions and associated potential local air quality impacts (the Construction Study Area) is defined by the location of sensitive receptors identified within 350m of the Proposed Scheme Boundary as specified in step one of the guidance on the assessment of dust from demolition and construction from the Institute of Air Quality Management (IAQM)[34], as shown in Figure 6.1. Included in the redline boundary is large vessel waiting facility has been designated for vessels to wait in should the bridge be closed in an emergency or inoperable, when further information on the design is available the waiting facility will be considered in an updated construction assessment to be presented within the ES.

6.1.7. The local air quality assessment study area is dependent on traffic data and is yet to be defined. The study area will encompass sensitive receptors identified within 200m of roads that will be affected by the implementation of the Proposed Scheme (the Operational Study Area), with reference to the criteria given by the Design Manual for Roads and Bridges (DMRB, HA207/07)[35]. The assessment will focus on predicted changes in concentrations of NO_2, PM_{10} and $PM_{2.5}$ at those receptor locations that are immediately adjacent to the affected road network and junctions included in the study area, where the effects of changes in vehicle emissions associated with the Proposed Scheme would likely be highest.

6.1.8. The final selection of sensitive receptors to be included in the Operational Study Area will be determined once the affected road network is known. This will be confirmed within the ES. However, based on the traffic model network identified by the Proposed Scheme Transport Planner, Figure 6.2 presents the property locations that are considered to represent receptors most susceptible to changes in vehicle emissions. Further information on the definition of an affected road is given in Paragraph 6.3.18.

[32] PM_{10} assessed as the fraction of airborne particles of mean aerodynamic diameter less than 10 micrometres. $PM_{2.5}$ assessed as the fraction of airborne particles with an aerodynamic diameter less than 2.5 micrometres.
[33] HMSO, 2010, Air Quality Standards Regulations 2016.
[34] Institute of Air Quality Management (IAQM) (2014) Assessment of Dust from Construction and Demolition, IAQM
[35] Highways Agency (2007) Design Manual for Roads and Bridges HA 207/07, Volume 11, Section 3, Part 1 Air Quality

6.1.9. The regional emissions assessment study area will include affected roads as defined by the criteria given in the Design Manual for Roads and Bridges (DMRB, HA207/07)[35]. The assessment will consider the changes in emissions of NO_x, PM_{10}, $PM_{2.5}$ and CO_2 as a result of operation of the Proposed Scheme. Further information on the criteria defining affected roads for regional assessment is given in Paragraph 6.3.30.

LIMITATIONS

6.1.10. The information contained herein is intended to inform consultation responses at this stage. A more detailed assessment of likely significant impacts as a result of the Proposed Scheme on identified sensitive receptors will be undertaken at subsequent stages to inform the ES.

6.1.11. Any gaps in information identified at this PEIR stage will be considered and addressed along with specific mitigation measures as part of the assessments for production of the ES.

6.2 DIRECTIVES, STATUTES AND RELEVANT POLICIES

6.2.1. The following Directives and Regulations have informed the conduct of the assessments.

DIRECTIVES

European Ambient Air Quality Directive 2008

6.2.2. The 2008 Ambient Air Quality Directive (2008/50/EC as amended by Directive 2015/1480/EC))[36] is the primary driver for managing and improving air quality for each member state of the EU. The Directive sets legally binding limit values for concentrations in ambient (outdoor) air of pollutants that can impact public health, including NO_2 and particulates (PM_{10} & $PM_{2.5}$).

6.2.3. EU limit values are set for individual pollutants and comprise a concentration value, an averaging time over which it is to be measured, the number of allowed exceedances per year (if any), and a date by which it must be achieved. Some pollutants (e.g. PM_{10}) have more than one limit value covering different averaging times.

LEGISLATION

Air Quality Standards Regulations (England)

6.2.4. In relation to England the 2008 Directive was transposed into domestic law by the Air Quality Standards Regulations 2010, as amended in 2016.

6.2.5. The responsibility for meeting the prescribed air quality limit values is devolved to the national administrations. In England, the SoS for Environment, Food, and Rural Affairs has responsibility for adhering to the limit values, whilst the Department for Environment, Food and Rural Affairs (Defra) co-ordinate the assessment of compliance with limit values and development of Air Quality Plans for the UK (last updated in 2017).

6.2.6. Under the 2017 Air Quality Plan[37], certain local authorities are required under the Environment Act to undertake feasibility studies to identify options to deliver compliance with EU limit values. Great Yarmouth Borough Council was not included in the list of authorities required to do this.

The Environmental Protection Act 1990

[36] The European Parliament and the Council of the European Union (2008). Ambient Air Quality Directive (2008/50/EEC)
[37] Air Quality Plan for Nitrogen Dioxide (NO^2) in the UK 2017. Policy Paper

6.2.7. The Environmental Protection Act (EPA) (Section 79, Chapter 43, Part III - Statutory Nuisance and Inspections), contains a definition of what constitutes a 'statutory nuisance' and places a duty on Local Authorities to detect any such nuisances within their area. Dust, steam, odour, or other effluvia arising from construction works, together with smoke, fumes, and gasses emitted from premises could amount to a statutory nuisance if 'prejudicial to health or a nuisance'.

POLICY AND GUIDANCE

National Policy Statement for National Networks

6.2.8. NPS NN provides planning guidance for promotors of nationally significant infrastructure projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the SoS.

6.2.9. The NPS NN Chapter 5, Generic Impacts, Air Quality states the requirement for an Environmental Statement (ES) where "*the impacts of the project (both on and off-scheme) are likely to have significant air quality effects in relation to meeting EIA requirements and / or affect the UKs ability to comply with the Air Quality Directive, the applicant should undertake an assessment of the impacts of the proposed project as part of the environmental statement.'* The ES should describe;

- *'existing air quality levels';*
- *'forecasts of air quality at the time of opening, assuming that the Proposed Scheme is not built (the future baseline) and taking account of the impact of the Proposed Scheme'; and*
- *'any significant air quality effects, their mitigation and any residual effects, distinguishing between the construction and operation stages and taking account of the impact of road traffic generated by the project'.*

6.2.10. The applicant's assessment should be consistent with Defra's published future national projections of air quality based upon evidence of future emissions, traffic and vehicle fleet.

6.2.11. In addition to information on the likely significant effects of a project in relation to EIA, the SoS must be provided with a judgement on the risk as to whether the project would affect the UK's ability to comply with *the EU Ambient Air Quality Directive*[36]. This will be included in the ES.

National Policy Statement for Ports

6.2.12. The Ports NPS requires applicants to consider the effects of a project during both the construction and operational phases upon air quality taking into account the existing air quality levels.

Local Air Quality Management

6.2.13. Under Part IV of the Environment Act 1995[38], the UK Government and the devolved administrations are required to prepare and publish a national Air Quality Strategy. The most recent version of the Strategy was published in 2007[39] and establishes the UK's air quality standards and objectives, in addition to providing guidance, where needed, on air quality action planning at national, regional and local scales.

6.2.14. Air quality standards are concentrations recorded over a given averaging period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutants on health and the

[38] HMSO (1995) Environment Act 1995

[39] Department for Environment, Food and Rural Affairs (Defra) (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, London: HMSO

environment. An objective is the target date on which exceedances of a standard must not exceed a prescribed number.

6.2.15. Local authorities in England are required to review air quality within their jurisdiction, under *Part IV of the Environment Act 1995*, and designate air quality management areas (AQMAs) where air quality standards or objectives are not being met (or will not be within a specified period). Local authorities are then required to prepare assessments and action plans, and the SoS has default powers.

Relevant UK Air Quality Objectives and EU Limit Values

6.2.16. The national air quality objectives and European Directive limit values that the UK must comply with, specifically for traffic-related pollutants NO_2, PM_{10}, and $PM_{2.5}$, are presented in Table 6.1 - National (England) air quality objectives and European Directive limit values. The respective UK objective and EU limit value concentration standards and averaging periods are numerically identical for each pollutant, based on air quality standards set for the protection of human health. For NO_x, the objective and limit value is set for the protection of ecosystems and vegetation.

Table 6.1 - National (England) air quality objectives and European Directive limit values

Pollutant	Objective/ Limit Value Concentration	Concentration Measured As	Date to be achieved by:	
			UK Air Quality Strategy Objective	EU Ambient Air Quality Directive
Nitrogen Dioxide (NO2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005	01.01.2010
	40 µg/m^3	Annual mean	31.12.2005	01.01.2010
Particulate Matter (PM10)	40 µg/m^3	Annual mean	31.12.2004	01.01.2005
	50 µg/m3 not to be exceeded more than 35 times a year	24-hour mean	31.12.2004	01.01.2005
Particulate Matter (PM2.5)	25 µg/m^3	Annual mean	2020	01.01.2015
Nitrogen oxides (NOx)*	30 µg/m^3	Annual mean	31.12.2000	19.07.2001
*For the protection of ecosystems and vegetation				

United Nations Economic Commission for Europe Critical Loads

6.2.17. The United Nations Economic Commission for Europe (UNECE) defines the critical load for nitrogen deposition as "*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on sensitive elements of the environment do not occur according to present knowledge*"[40].

6.2.18. The UNECE provides critical load values for nutrient nitrogen deposition as a range based upon the habitat type, the critical load is used as a component of the assessment to identify the ecological impacts of the Proposed Scheme.

Guidance Informing Assessment of the Significance of the Proposed Scheme upon Local Air Quality

6.2.19. The following guidance documents set out the circumstances of when an assessment may be required providing details of the information required to undertake such an assessment and the steps required to assess the significance of a scheme upon Local Air Quality. Where relevant the criteria provided in the following guidance will be applied to the ES.

- Design Manual for Roads and Bridges (DMRB) HA207/07 Air Quality[41]
- Institute of Air Quality Management (IAQM) Land Use Planning and Development Control Planning for Air Quality (2017)[42].

Risk Assessment related to Compliance with the EU Directive on Ambient Air Quality

6.2.20. Highways England IAN 175/13[43] provides advice on conducting risk assessment related to compliance with the EU Directive on ambient air quality. The IAN is withdrawn pending the issue of new guidance; however, the compliance risk assessment for the Proposed Scheme will be conducted following the methodology of IAN 175/13 in the absence of updated guidance.

6.3 ASSESSMENT METHODOLOGY

6.3.1. The PEIR assessment considers the available data at the time of writing, information on the baseline air quality and scheme specific air quality monitoring data within the area covered by the traffic modelling for environmental disciplines are presented. The policy and guidance appropriate to the assessment of the impact of the scheme upon local and regional air quality is discussed and a preliminary assessment of construction phase dust emissions and the associated potential local air quality impacts based upon the construction and demolition information currently available is presented in detail in Appendix 6A; this assessment will be updated within the ES. The approach to be the Operational Air Quality Assessment is discussed; the Operational Air Quality Assessment, Regional Air Quality Assessment and assessment of implications for compliance with the EU Ambient Air Quality Directive as a result of the operation of the scheme will be presented in the ES.

[40] Atmospheric Pollutant Information System (APIS) http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm#_Toc279788050 as accessed 25/05/18
[41] Highways Agency 2007. Design Manual for Roads and Bridges Volume 11, Section 3, Part 1 Air Quality
[42] Institute of Air Quality Management 2015. Guidance on land-use planning and development control: Planning for Air Quality.
[43] Highways Agency 2013. Updated air quality advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans for user of DMRB Volume 11, Section 3, Part 1 'Air Quality'.

BASELINE ENVIRONMENT

6.3.1. The 2017 Air Quality Annual Status Report (ASR)[44] published by Great Yarmouth Borough Council was reviewed to establish baseline air quality conditions within the likely Operational Study Area based upon the area that has been included in traffic modelling, the Operational Study Area will be defined in the ES. The ASR provides the annual mean NO_2 monitored levels at a number of monitoring sites relevant to the Proposed Scheme location. In addition, a scheme specific baseline NO_2 monitoring survey was completed between August 2017 and January 2018 to inform the review of existing conditions.

6.3.2. Background air pollutant concentrations corresponding to the 1 km^2 grid squares covering the Operational Study Area were obtained from Defra's published national pollutant mapping data[45]. Background concentrations for 2018 and 2023 were obtained to represent current and future baseline air quality conditions within the assessment scenarios.

6.3.3. Ordnance Survey (OS) mapping and address layer data were used to identify potentially sensitive receptors in proximity to the Proposed Scheme and surrounding area.

CONSTRUCTION PHASE ASSESSMENT

6.3.4. The assessment of local air quality impacts due to the release of fugitive dust, including particulates, during the construction phase will be undertaken in accordance with the methodology detailed in the Institute of Air Quality Management (IAQM) guidance[34], with reference to DMRB HA207/07. Full details of the construction assessment methodology are provided in Appendix 6A.

6.3.5. In terms of emissions from construction vehicles on the local road network and associated traffic management measures, DMRB HA 207/07 states that these should be considered where construction is predicted to last for more than 6 months. The criteria provided by DMRB HA207/07 stipulates that further assessment of vehicle emissions is required where a change in vehicle flow volume of 1,000 annual average daily traffic (AADT) movements or more is expected, or the heavy-duty vehicle (HDV) flow will change by 200 AADT or more.

6.3.6. Specific information on traffic management measures, the exact location of construction site entrances, and the number of vehicle movement's related construction were not available at the time of assessment. The availability of this information will be revisited in the ES and, where applicable, this will be incorporated into the construction phase assessment.

6.3.7. The construction phase air quality assessment has therefore focussed on potential impacts associated with fugitive dust and particulate emissions from the following types of activity that will occur throughout the works:

- Demolition;
- Earthworks;
- Construction; and
- Trackout (dust generating material which leaves the site via attachment to vehicle tyres).

6.3.8. Dust impacts associated with annoyance due to soiling will be assessed, in addition to potential human health effects due to an increase in exposure to PM_{10} and $PM_{2.5}$, and potential harm to identified ecological receptors. Factors including the scale and nature of the activity, in addition to the sensitivity of the area will be considered when assessing the risk of impacts which are determined prior to assigning mitigation measures.

[44] Great Yarmouth Borough Council (2017). 2017 Air Quality Annual Status Report (ASR).

[45] Defra (2017).UK Air Background Mapping data for local authorities, 2015 based background maps available at https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015, as accessed 28/05/18.

6.3.9. The Construction Study Area has been defined by the location of sensitive receptors identified within 350m of the Proposed Scheme alignment; this being the worst case maximum distance from source to receptor for any construction activities that could be a source of dust emissions, as defined by the screening criteria within the IAQM guidance on the assessment of dust from demolition and construction.

6.3.10. The demolition element of the construction phase assessment will be prepared once the finalised extent of the existing structures to be removed is known. The volume of material being demolished and the nature of the material is key to making an assessment of the potential risk of dust emissions from demolition activities. The findings of the assessment will be incorporated as a component of *step two* of the assessment as detailed in Appendix 6A, paragraph 6.3.7. Based upon preliminary information on demolition, a risk rating of *high* has been applied.

6.3.11. The outcomes of the construction phase assessment are used to define appropriate mitigation measures that should be implemented through the full Construction Environmental Management Plan (CEMP), which the contractor will be required to work to and will be commensurate to the scale and duration of the activities. The potential for significant effects with respect to both fugitive dust and exhaust emissions will be assessed with the assumption that the recommended mitigation measures are in place during construction.

Significance Criteria

6.3.12. The significance of any dust emissions from the construction of the Proposed Scheme is assessed in accordance with guidance provided by the IAQM.

6.3.13. Step four of the IAQM guidance states that *"…For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation."*

6.3.14. The outcomes of the construction dust assessment are used to define appropriate mitigation measures to reduce the possibility of adverse effects from the construction phase of the project and, as such, does not identify specific assessment significance criteria.

6.3.15. The IAQM guidance states that *"in the context of construction impacts any effect will usually be adverse, however professional judgement is required to determine whether this adverse effect is significant based on the evidence presented" and that "it is anticipated that with the implementation of effective site-specific mitigation measures the environmental effect will not be significant in most cases".*

OPERATION PHASE ASSESSMENT

6.3.16. The assessment of local air quality and regional emissions impacts associated with operation of the Proposed Scheme will be informed by the approaches detailed in DMRB HA207/07[35] and relevant Highways England Interim Advice Notes (IAN's) with reference to respective Defra air quality technical guidance[46] and IAQM guidance.

Local Air Quality Assessment

6.3.17. The local air quality assessment will focus on the following scenarios, for which traffic data will be provided to facilitate atmospheric dispersion modelling of vehicle emissions:

- Base year (2018)
- Opening year (2023) without Proposed Scheme (Do Minimum); and
- Opening year (2023) with Proposed Scheme (Do Something).

[46] Defra 2016. Local Air Quality Management Technical Guidance TG(16).

6.3.18. Screening of the Do Minimum and Do Something traffic data will be completed to identify affected road links that adhere to the following criteria as provided by DMRB HA207/07[35]:

- Road alignment will change by 5 m or more; or
- Daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr or more.

6.3.19. Based on the advice of the project Transport Planning consultant on the likely traffic flow changes as a result of the Proposed Scheme and the changes in road alignment proposed as part of the Proposed Scheme design, a detailed assessment of local air quality is warranted, with reference to the respective DMRB traffic screening criteria.

6.3.20. Emissions inventory databases for each pollutant (NO_x, PM_{10}, $PM_{2.5}$) will be developed for all three of the above scenarios using Defra's latest emission factor toolkit[47] (currently EFT v8.0.1), which accounts for vehicle flow characteristics, such as:

- Link flow volumes as annual average daily traffic (AADT);
- Link average speed (km/hr);
- Vehicle breakdown (e.g. percentage HDVs); and
- Link length.

6.3.21. Each scenario emissions database will be entered to an atmospheric dispersion model (ADMS-Roads v4.1) to enable prediction of pollutant concentrations at the identified sensitive receptor locations. The modelling exercise will utilise hourly sequential meteorological data from the most representative observation site within proximity to the Proposed Scheme.

6.3.22. The base year dispersion model results will be verified with reference to Defra's technical air quality guidance[46]. Model verification requires analysis of model outputs versus monitored data for equivalent locations within the study area. Therefore, the results of a scheme-specific baseline air quality monitoring (see Paragraph 6.4.8) will be used facilitate verification.

Sensitive Receptor Identification

6.3.23. There is the potential for vehicle emissions to impact local concentrations of air pollutants at sensitive receptors situated within the likely Operational Study Area. The finalised Operational Study Area, based upon the screening of traffic data, will be defined in the ES.

6.3.24. According to DMRB HA207/07[35], the influence of vehicle emissions on ambient air quality is negligible beyond 200m of the respective road source, predominantly due to horizontal and vertical atmospheric mixing. As such, a desk-based review of potentially sensitive receptors to air quality was undertaken using OS mapping to identify those located within 200m of the Proposed Scheme alignment and associated affected links.

6.3.25. Sensitive receptors as defined in the Design Manual for Roads and Bridges (DMRB) Section 11.3.1 (DMRB HA207/07[35]) include:

- Residential dwellings;

[47] Defra 2018. Emission Factors Toolkit available at https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

- Designated ecological sites;
- Locations of the young and elderly;
- Hospitals; and
- Schools.

6.3.26. The sensitive receptors most susceptible to changes in air quality as a result of the Proposed Scheme are likely to be those situated closest to the identified affected roads within the study area.

6.3.27. Designated ecological sites (Ramsar, SPAs, SACs or SSSIs) will be assessed with reference to the DMRB HA207/07[35] Annex F, which provides the relevant assessment procedure.

Significance Criteria

6.3.28. The results of the local air quality impact assessment will be evaluated with reference to IAQM Guidance. This Guidance describes the magnitude of incremental concentration change (Do Minimum versus Do Something) at each individual sensitive receptor as a proportion of a relevant Air Quality Assessment Level (AQAL). In this assessment, the AQALs are the annual mean NO_2, PM_{10} and $PM_{2.5}$ objectives. The incremental change at each receptor is examined in the context of the total predicted annual mean concentration and its relationship with the AQAL. This allows an impact descriptor to be assigned to each receptor, with the overall significance of the effects of any impacts assigned by professional judgement.

Regional Emissions Assessment

6.3.29. The regional emissions assessment will focus on total annual mass emissions of NO_x, PM_{10}, $PM_{2.5}$, and carbon dioxide (CO_2) associated with the aforementioned opening-year scenarios, in addition to:

- Design year (2038) without the Proposed Scheme (Do Minimum); and
- Design year (2038) with the Proposed Scheme Do Something).

6.3.30. Screening of the Do Minimum and Do Something traffic data was undertaken to identify affected road links that adhere to the following criteria as provided by DMRB HA207/07[35]:

- A change of more than 10% in AADT; or
- A change of more than 10% to the number of heavy duty vehicles; or
- A change in daily average speed of more than 20 km/hr.

6.3.31. Traffic data for the identified affected road links in each scenario will be entered to Defra's EFT v8, enabling the calculation of total annual mass emissions of the respective vehicle exhaust species. This will allow the magnitude of change of total mass emissions associated with the operation of the Proposed Scheme to be predicted.

6.3.32. There are no relevant published significance criteria in relation to regional emissions assessments and DMRB HA207/07[35] acknowledges that changes in regional emissions associated with road schemes such as the Proposed Scheme are expected to be small within the context of national emissions. However, regional and national emissions data published by the National Atmospheric Emissions Inventory (NAEI) will be utilised to provide context to the predicted change in emissions during the operational phase of the Proposed Scheme.

Assessing Implications for UK Compliance with the EU Ambient Air Quality Directive

6.3.33. The Defra Pollution Climate Mapping (PCM) model is used to fulfil the UK's requirements to report on the concentrations of particular pollutants in the atmosphere to the EU. The PCM model contains key road sources across the UK for which projected representative roadside pollutant concentrations are published. Highways England Interim Advice Note IAN 175/13[43] provides guidance on how to assess the risk from a road development upon compliance with the EU Directive on Ambient Air Quality and Clean Air for Europe (2008/50/EC). IAN

175/13 has a status of 'withdrawn' pending an update, however, in the absence of updated or an alternative guidance, it is still considered appropriate to apply it to the assessment to be presented in the ES.

6.4 BASELINE ENVIRONMENT

LOCAL AIR QUALITY MANAGEMENT REVIEW

6.4.1. A review of the latest LAQM report published by GYBC[48] confirms that there are no Air Quality Management Area (AQMAs) declared within the District and with no requirement for GYBC to progress to a detailed assessment of air quality for any pollutant.

LOCAL AIR QUALITY MONITORING

6.4.2. GYBC operated an automatic continuous air quality monitor at Gorleston to monitor levels of NO_2 and PM_{10} within Great Yarmouth until it was decommissioned in 2016. A continuous monitor was subsequently installed at South Denes and is now operational, measuring concentrations of NO_2, PM_{10} and $PM_{2.5}$. The Gorleston continuous monitor was situated to the south of the Proposed Scheme to the west of the River Yare close to Malthouse Lane approximately 410 m to the south west of the Proposed Scheme. The new South Denes monitor is situated to the east of the River Yare close to Fenner Road, approximately 570 m to the south east of the Proposed Scheme.

6.4.3. The annual mean PM_{10} and NO_2 concentrations at these locations, as presented in Table 6.2 - Local Authority PM10 Automatic Monitoring Results and Table 6.3 - Local Authority NO2 Automatic Monitoring Results below, demonstrate that there have not been any exceedances of the respective air quality objective's (40 µg/m^3) for the period reviewed (2012-2016).

Table 6.2 - Local Authority PM10 Automatic Monitoring Results

Site ID	Monitoring Type	Monitoring Site	X,Y	PM_{10} Annual Mean Concentration (µg/m^3)				
				2012	2013	2014	2015	2016
CM1 Gorleston	Automatic	Urban Background	652498,305600	19.9*	20.7*	16.6*	16.8*	15.5*
CM2 South Denes	Automatic	Urban Background	652983,305664	Monitoring started December 2017, the average hourly measurement to date is 25.5 µg/m^3				
Annual mean objective				**40**				

*Values represent annualised concentrations derived by GYBC as per Technical Guidance LAQM.TG16.

Table 6.3 - Local Authority NO_2 Automatic Monitoring Results

Site ID	Monitoring Type	Monitoring Site	X,Y	NO_2 Annual Mean Concentration (µg/m^3)				
				2012	2013	2014	2015	2016
CM1 Gorleston	Automatic	Urban Background	652498,305600	18.8*	18.2*	17.1*	16.8*	14.5*
CM2 South Denes	Automatic	Urban Background	652983,305664	Monitoring started December 2017, the average hourly measurement to date is 13.9 µg/m^3				

[48] Great Yarmouth Borough Council 2017. Air Quality Updating and Screening Assessment

Annual mean objective	40
*Values represent annualised concentrations derived by GYBC as per Technical Guidance LAQM.TG16.	

6.4.4. GYBC also operates a network of 15 passive NO_2 diffusion tubes located across 12 monitoring sites, adjacent to roads that are likely to be affected by the Proposed Scheme, as detailed in Figure 6.3.

6.4.5. The annual mean NO_2 concentrations at these locations, as presented in Table 6.4 - Local Authority NO2 Diffusion Tube Monitoring Results below, demonstrate that there have not been any exceedances of the respective air quality objective (40 µg/m^3) for the period reviewed (2012-2016).

6.4.6. The maximum monitored annual mean concentrations recorded in 2016 were 33.2 µg/m^3 at a site located adjacent to Bridge Road located to the west of the existing bascule bridge over the River Yare and 33.7 µg/m^3 at a site located adjacent to South Quay on the approach to the existing Haven bridge.

Table 6.4 - Local Authority NO_2 Diffusion Tube Monitoring Results

Site ID	Site Type	X,Y	NO_2 Annual Mean Concentration (µg/m^3)				
			2012	2013	2014	2015	2016
DT1	Roadside	652053,308188	25.8	22.1	22.0	21.9	21.1
DT2	Roadside	652079,307828	24.8	24.0	24.1	22.5	21.2
DT3a	Roadside	652104,307665	25.6	25.4	26.9	25.4	24.4
DT3b	Roadside	652104,307665	27.7	N/A	N/A	N/A	N/A
DT5	Roadside	652092,307419	38.8	37.5	37.8	37.4	33.2
DT6	Roadside	652520,306862	25.1	25.3	23.5	23.8	22.9
DT7	Roadside	652569,306537	26.4	25.8	25.6	24.4	22.2
DT4	Roadside	652611,306223	23.8	20.8	22.9	20.9	20.3
DT8a	Urban Background	652492,305612	18.5	18.2	17.8	16.0	17.7
DT8b	Urban Background	652492,305612	18.3	14.3	16.9	16.3	17.7
DT8c	Urban Background	652492,305612	17.8	17.2	15.4	15.7	17.1
DT9	Roadside	652066,307874	20.0	20.2	18.7	19.9	18.5
DT10	Roadside	652326,307376	33.2	34.0	30.6	32.8	33.7
DT11	Roadside	652490,307174	28.8	N/A	N/A	31.6	27.4
DT12	Roadside	651993,307370	N/A	N/A	N/A	N/A	24.9
Annual mean objective			**40**				
2017 monitoring data has been provided by GYBC and will be included in the ES							

SCHEME SPECIFIC MONITORING

6.4.7. Monitoring for NO_2 has been undertaken at a number of locations in Great Yarmouth, as shown in Figure 6.3, which were sited specifically in relation to the Proposed Scheme. The monitoring locations were agreed with GYBC and the survey commenced in August 2017 and continued until January 2018. The annualised mean monitoring data collected are summarised in Table 6.5 - Summary of Scheme Specific NO2 Diffusion Tube Monitoring.

6.4.8. All monitored values are well below the respective annual mean NO_2 objective, with the highest concentrations observed along Nottingham Way and St Peters Road (WSP12 and WSP7), a route running between Marine Parade and South Quay, which is one of the approach roads to the existing crossing over the River Yare.

Table 6.5 - Summary of Scheme Specific NO_2 Diffusion Tube Monitoring

Site	Location Description	X	Y	Annualised mean NO_2 Concentration for 2017 ($\mu g/m^3$)*
WSP1	Runham Rd	651935	308536	26.6
WSP2	School Rd	651964	308314	23.8
WSP3	Northgate Street	652340	308077	23.9
WSP4	Priory Gardens	652491	307941	20.3
WSP5	Nelson Rd/ N Jury St	652842	307991	25.7
WSP6	Nelson Rd/ N Trafalgar St	652850	307378	26.4
WSP7	Nelson Rd N/ St Peters Rd	652873	307074	30.8
WSP8	Queens Rd	652756	306572	22.3
WSP9	Admiralty Rd	652769	306047	21.3
WSP10	Sutton Rd	652658	306040	23.2
WSP11	Southgates Rd	652611	306229	22.2
WSP12	S Quay Nottingham Way	652468	307090	32.8
WSP13	Yarmouth Way	652459	307304	28.5
WSP14	Stonecutters Way	652178	307619	25.7
WSP15	Greyfriars Way	652371	307422	27.9
WSP16	Trafalgar College	651732	306714	26.2
WSP17	Gaton Hall Rd	651531	306309	22.2
WSP18	Vincent Close	651517	307179	23.2
WSP19	Mill Rd	651627	307643	14.5
WSP20	Bridge Rd	652016	307412	22.4
WSP21	Southtown Rd	652042	307298	18.4
WSP22	Station Rd	651865	306968	18.7
WSP23	Southtown Rd 2	652231	306856	23.6
WSP24	Boundary Rd	652373	306231	24.1
WSP25	Cromwell Rd	652386	306036	24.5
WSP26	Queen Anne's Rd	652360	305868	19.6
WSP27	Queen Anne's Rd 2	652166	305970	22.4
WSP28	Southtown Rd 3	652408	305818	29.4
WSP29	Manby Rd	652404	305357	21.8
WSP30	Burgh Rd	652309	305188	21.6
WSP31	Alpha Rd	652396	305674	18.7
WSP32	A143	652071	304949	29.8
WSP33	Plane Rd	651959	304891	16.2

Site	Location Description	X	Y	Annualised mean NO_2 Concentration for 2017 ($\mu g/m^3$)*
WSP34	Lynn Grove	651514	304700	18.1
WSP35	Beccles Rd	651224	304384	19.6
WSP36	Baliol Rd	652306	304368	12.1
WSP37	Middleton Rd	652270	303862	18.2
WSP38	Brasenose Avenue	652278	302742	21.7
WSP39	Horsley Drive	651967	301967	10.7
WSP40	Cormorant Rd	650866	305188	15.4
WSP41	Norwich Lakenfields Colocation	623681	307013	13.1
Annual mean objective				40
*Concentrations have been bias adjusted and annualised based on data retrieved for 5 months of monitoring. The 6th month of monitoring data was not analysed due to sample loss in transit to the laboratory.				

6.4.9. Scheme-specific monitoring of PM_{10} and $PM_{2.5}$ was not undertaken as the monitoring data published by GYBC (see Table 6.2 and Table 6.3) for years 2012-2016 demonstrated that urban background levels of PM_{10} have remained consistently well below the respective annual mean objective. GYBC has recently commissioned a new continuous air quality monitoring station at South Denes, which will provide additional measurements for PM_{10} and $PM_{2.5}$, the data from which could be incorporated into the model verification procedure for local air quality assessment.

BACKGROUND POLLUTANT CONCENTRATIONS

6.4.10. Defra publishes modelled background air pollutant data for the UK, based on a 1 km^2 grid[49], which accounts for a multitude of local emissions sources including road vehicles, industrial installations, domestic heating and other transport modes, in addition to regional sources and imported emissions. The modelled background data are available for year's 2015 to 2030 inclusive.

6.4.11. Existing operations at the Peel Ports (PP) Port of Great Yarmouth generate funnel emissions and dust. The funnel emissions are included within the Defra Local Air Quality Management (LAQM) background maps.

6.4.12. For the purposes of reviewing the existing background and predicted future background levels, the maximum, minimum and average annual mean concentrations of each pollutant (NO_2, PM_{10}, $PM_{2.5}$) based on the 1 km^2 grids encompassing the Proposed Scheme and surrounding area are presented in Table 6.6.

[49] Defra Background Mapping, UK Air available at https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015 as viewed on 29/05/18

Table 6.6 - Defra Mapped Background Annual Mean Concentrations for Each Pollutant in Base (2018) and Opening (2023) Years

Pollutant	2018 Background Concentration (µg/m^3)			2023 Background Concentration (µg/m^3)		
	Maximum	Minimum	Average	Maximum	Minimum	Average
NO_2	15.2	7.2	9.1	13.0	6.2	7.9
NO_X	21.2	9.4	12.1	17.9	8.1	10.4
PM_{10}	18.6	10.4	13.4	18.2	10.1	13.1
$PM_{2.5}$	14.1	7.1	9.0	13.7	6.8	8.7

6.4.13. The predicted current and future background concentrations presented in Table 6.6 are well below the respective health –based annual mean objective concentrations for NO_2 (40 µg/m^3), PM_{10} (40 µg/m^3), and $PM_{2.5}$ (25 µg/m^3). Similarly, the annual mean NO_x EU limit value (30 µg/m^3), set for the protection of vegetation and ecosystems, is not predicted to be exceeded.

POLLUTION CLIMATE MAPPING

6.4.14. A number of Defra PCM links are likely to overlap the identified affected road network considered within the local air quality assessment including the following roads classified as PCM links;

- A1243;
- A47 (including either side of the existing crossing over the River Yare);
- A143;
- Pasteur Road (to the west of the existing crossing over the River Yare);
- Acle New Road;
- North Quay;
- Lawn Avenue and
- Caister Road.

6.4.15. Once the identified Operational Study Area to be presented in the ES is confirmed through the screening of traffic data for the local air quality assessment, the extent of PCM links to be included in the compliance assessment, as detailed in Paragraph 6.2.20, can be identified and reported in the ES.

POTENTIALLY SENSITIVE RECEPTORS (LOCAL AIR QUALITY ASSESSMENT)

The local air quality assessment will likely include the receptor locations that are considered to be most susceptible to changes in vehicle emissions as a result of the operational scheme. At this stage, in the absence of a defined Operational Study Area, indicative numbers of potentially sensitive receptors based upon a review of properties located within 50m of the likely affected road links are outlined in Table 6.7. The approach of modelling the most sensitive and worst-case receptor locations has been agreed with GYBC Environmental Health[50].

[50] Telephone conversation between WSP Senior Air Quality Consultant and GYBC Environmental Health Officer on 22/06/18.

6.4.16. In terms of ecologically sensitive receptors, the Outer Thames Estuary Special Protection Area (SPA) includes the River Yare area within which the Proposed Scheme will be located. Natural England will be consulted on the most appropriate level of assessment for the Outer Thames Estuary SPA regarding changes in air quality and the sensitivity of the site to changes in nitrogen deposition. The SPA is designated for the conservation of foraging areas for wild birds.

6.4.17. The Breydon Water Site of Special Scientific Interest (SSSI), SPA, and RAMSAR are situated adjacent to the A47, which could be identified as a potentially affected road. Similarly, the Great Yarmouth North Denes SSSI and SPA are situated adjacent to North Drive, which could form potentially affected road links. This will be reviewed in the ES once the Operational Study Area is confirmed and, if appropriate, both sites will be included in the ecological assessment for air quality impacts.

Table 6.7 - Identified Potentially Sensitive Receptor Locations

Receptor Type	Count
Residential (within 50m)	16,975*
Designated ecological sites (within 200m)**	6
Education (within 200m)	39
Health care (Hospitals, Residential Care Homes etc.) (within 200m)	102

* The final number of sensitive receptors to be included in the local air quality assessment will be confirmed once the Operational Study Area has been identified.
**As defined by HA207/07 (SACs, SCI's, cSCIs, SPAs, SSSI's and Ramsar sites).

6.5 PREDICTED EFFECTS

CONSTRUCTION PHASE ASSESSMENT: DUST EFFECTS

6.5.1. Construction works have the potential to generate fugitive dust emissions during earthworks and construction activities, as well as from the trackout of dust and dirt by vehicles onto public highways. Dust emissions can cause annoyance through soiling of buildings and surfaces and/or adversely impact human health.

6.5.2. Potential construction phase air quality impacts assessed in this section are considered prior to the application of site-specific mitigation measures. However, the contractor for the Proposed Scheme will be required to implement mitigation measures within the full CEMP, which will include the measures as outlined in Section 6.6.

6.5.3. Major construction activities that are likely to be required during construction of the Proposed Scheme include, but may not be limited to, the following:

- Demolition;
- Site clearance;
- Topsoil strip;
- Excavation;
- Landscaping;
- Material import/export;
- Temporary stockpile of resources;
- Construction of compounds and access points; and
- Construction of road/bridge and footpath.

6.5.4. The main potential air quality impacts that may arise from the aforementioned activities are;

- Dust deposition, resulting in the soiling of surfaces and water (chapter 11);
- Dust plumes, affecting visibility and amenity; and
- Elevated ambient PM_{10} concentrations due to fugitive dust releases.

6.5.5. The potential for sensitive receptors to be affected is dependent on the scale and locations of the dust generating activities, the nature of the activity, and local meteorological conditions.

6.5.6. There are existing sensitive receptors located within 350m of the Proposed Scheme Boundary and approach roads, where the aforementioned activities could occur. The nearest sensitive residential receptors are located within <20m of the current Proposed Scheme boundary.

6.5.7. Distance bandings contained within Table 3, Table 4 and Table 5 of Appendix 6A were analysed based on the redline boundary (Figure 6.1). The number and location of existing 'human' receptors from the Proposed Scheme boundary are detailed in Table 6.8 - Receptor Count within 350m of Earthworks and Construction Activities.

Table 6.8 - Receptor Count within 350m of Earthworks and Construction Activities

Distance Bandings				
Distance from construction boundary (m)	**Sensitive Receptor Count**			
	Residential	**Educational**	**Medical**	**Total**
<20	149*	1	0	132
20-50	185	2	0	187
50-100	457	0	1	458
100-200	1602	1	7	1610
200-350	2635	5	4	2644
*Count excludes 20 residential properties to be demolished as part of the proposed scheme.				

6.5.8. There is one statutory designated ecological site within 50m of the Proposed Scheme boundary, the Outer Thames Estuary SPA, which includes the River Yare. This site will be considered as part of the construction phase dust assessment completed the ES, given that the approach to assessing potential impacts at the SPA will be subject to the outcomes of a consultation with Natural England.

6.5.9. The Port of Great Yarmouth is situated close to the Proposed Scheme boundary, and there is the potential for operations at the Port to be adversely affected by construction dust. Therefore, when considering appropriate mitigation, the operations at the Port should be accounted for as being potentially sensitive to construction dust.

6.5.10. The highest risk receptors are those that are located downwind of potential dust-generating construction activities. A wind rose derived from 2016 data recorded at the coastal Weybourne meteorological station, which is situated 56 km to the northeast of the Proposed Scheme, demonstrates a prevailing south-westerly wind. Therefore, those receptors located within 50m to the northeast and east of the aforementioned construction activities are more likely to be affected by fugitive dust releases. As the precise location of dust generating activities within the construction site is not known at this stage, a conservative approach is taken assuming that these activities could be occurring up to the Application Site boundary. A wind rose showing the recorded data is presented in Appendix 6B.

6.5.11. The effects of construction dust generated during dry conditions could lead to annoyance through dust deposition and also localised increases in PM_{10} concentrations with the potential to adversely affect human health. The urban background annual mean PM_{10} concentration for the study area –from the Gorleston automatic monitoring station is 15.5 µg/m^3 (2016), which is well below the annual mean limit value of 40 µg/m^3. Therefore, it is unlikely that the short-term construction operations would cause the daily (50 µg/m^3) or annual

mean (40 µg/m^3) objectives to be either approached or exceeded at sensitive receptors near to the construction area.

6.5.12. The overall risk of construction dust impacts occurring; namely annoyance due to soiling (deposition) and impacts to human health, in the absence of mitigation, is detailed in Appendix 6A and was undertaken with reference to the IAQM guidance document.

6.5.13. The risks of dust soiling and human health impacts caused by the Proposed Scheme construction activities were identified to be *medium to high* and mitigation would be required to minimise the risk of impact, as outlined in Section 6.6.

OPERATION PHASE ASSESSMENT

Local Air Quality Assessment

6.5.14. The Operational Study Area is yet to be defined, given that the Proposed Scheme traffic data is still under development. Once these data are available, the affected road network and associated sensitive receptor locations to be included in the local air quality assessment will be confirmed. This will facilitate a detailed atmospheric dispersion modelling study with reference to DMRB HA207/07[35] and associated technical guidance, thus enabling an assessment of likely significant effects on local air quality at identified sensitive receptors to be reported in the ES. The assessment will focus on changes to total annual mean concentrations of NO_2, PM_{10}, and $PM_{2.5}$.

6.5.15. The outcomes of the dispersion modelling study will also enable the assessment of air quality effects associated with ecologically sensitive receptors and the potential impact of the operational scheme on PCM compliance. Ecologically sensitive receptors will be considered in the Operational Study Area where situated within 200m of an affected road.

Regional Emissions Assessment

6.5.16. Similarly, the regional emissions study area will be defined once the traffic data are available. Once identified, the predicted change in total annual mass emissions of NO_x, PM_{10}, and CO_2 will be assessed and reported in the ES.

6.6 PROPOSED MITIGATION

CONSTRUCTION PHASE

6.6.1. In the absence of mitigation, construction of the Proposed Scheme is considered to represent a *medium* to *high* risk with respect to potential dust impacts at nearby sensitive receptors. As such, a number of mitigation measures are recommended, with reference to IAQM guidance, that are commensurate to the scale and nature of the proposed construction activities.

6.6.2. The mitigation measures focus on controlling fugitive releases of construction phase dust and will be implemented by the contractor through the full CEMP. Such measures include, but may not be limited to:

- Dust generating activities (e.g. cutting, grinding and sawing) will be minimised and weather conditions considered prior to conducting potentially dust emitting activities;
- Fine material will not be stockpiled to an excessive height in order to prevent exposure to wind and/or dust nuisance;
- Roads and accesses will be kept clean;
- Where possible, plant will be located away from site boundaries that are close to residential areas;

- Water will be used as a dust suppressant, where applicable;
- Drop heights from excavators to crushing plant will be kept to a minimum;
- Distances from crushing plant to stockpiles will be kept to the minimum practicable to control dust generation associated with the fall of materials;
- Skips will be securely covered;
- Soiling, seeding, planting or sealing of completed earthworks will be completed as soon as reasonably practicable following completion of earthworks;
- Dust suppression and the maintenance of the surface of access routes will be appropriate to avoid dust as far as practicable, taking into account the intended level of trafficking;
- Wheel wash facilities to minimise trackout of dust;
- Material will not be burnt on site; and
- Engines will be switched off when not in operation.

6.6.3. The interim CEMP will stipulate the following to ensure the aforementioned mitigation is implemented effectively, continually monitored and updated accordingly:

- Identification of a nominated Environmental Site Manager;
- Notification procedures where potentially significant dust generating activities are required;
- Method statements for the control of dust in such locations;
- Management procedures to ensure issues are addressed should they be raised by the public; and
- Dust monitoring equipment should be deployed in order to monitor the dust levels at the construction site.

6.6.4. The mitigation measures will reduce both the magnitude and duration of fugitive dust releases throughout the construction phase. With these measures in place, the residual dust impact will be, at worst, slight adverse at the highest risk receptors located downwind and within 50m of construction activities.

6.6.5. Any such impacts are expected to be intermittent and temporary for the duration of the respective activities and therefore would not constitute a significant environmental effect.

OPERATION PHASE

6.6.6. At this stage, an assessment of likely significance and the need for mitigation measures associated with the operation of the Proposed Scheme on local air quality cannot be made. This will be provided within the ES.

6.7 CONCLUSIONS AND EFFECTS

BASELINE

6.7.1. Air quality monitoring undertaken by GYBC and scheme-specific monitoring has demonstrated that NO_2 concentrations are greatest in the vicinity of the approaches to Haven Bridge in the town centre. However, there were no monitored exceedances of the annual mean objective for NO_2 throughout Great Yarmouth.

6.7.2. Background air quality in Great Yarmouth is good, with NO_2, PM_{10} and $PM_{2.5}$ annual mean background concentrations reported to be below the respective objective values.

6.7.3. There are no Air Quality Management Areas (AQMA) designated within Great Yarmouth.

CONSTRUCTION PHASE

6.7.4. The construction phase air quality assessment has demonstrated that, in the absence of mitigation, the scale and nature of the proposed works, excluding demolition, represent a *medium* to *high* risk of dust related impacts. The highest risk sensitive receptors are those located within 50m and downwind of potential dust-generating activities. The background PM_{10} concentrations are well below the annual mean objective concentration of 40 µg/m^3 for the protection of human health.

6.7.5. Appropriate mitigation measures are recommended, which will be implemented via the interim CEMP to prevent or minimise potential fugitive dust emissions. With these measures in place, the residual dust impact will be, at worst, slight adverse at the highest risk receptors.

6.7.6. Any such impacts are expected to be intermittent and temporary for the duration of the respective activities only and would not constitute a significant environmental effect.

OPERATIONAL PHASE

6.7.7. At this stage, an assessment of likely significance and the need for mitigation measures associated with the operation of the Proposed Scheme on local air quality cannot be made. This will be provided within the ES.

6.8 ASSESSMENTS STILL TO BE COMPLETED

6.8.1. The construction assessment described in this chapter will be updated in the ES to account for the latest information that is available with regard to proposed construction activities.

6.8.2. An operation phase assessment of local air quality and regional emissions, based upon finalised traffic data, will be completed following the approach outlined in Section 6.3. The findings of this will be presented in the ES.

7

ACOUSTICS

7 ACOUSTICS

7.1 INTRODUCTION

7.1.1. This chapter provides preliminary information with regard to noise and vibration as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process

7.1.2. With regard to noise and vibration impacts resulting from the Proposed Scheme, this chapter outlines the currently available information, including relevant policy and guidance, the assessment method and the baseline environment. The assessments still to be completed include the construction and operation phase quantified assessments. The scope of this chapter relates to human response to noise and vibration; impacts on ecological sensitive receptors are considered within the Chapter 8 Nature Conservation.

7.1.3. During the construction of the Proposed Scheme there will be temporary noise and vibration impacts caused by machinery and equipment. The construction assessment will be based on the guidance detailed in BS 5228-1[51] and BS 5228-2[52], further guidance being taken from applicable local and national guidance documents.

7.1.4. Once the Proposed Scheme is completed and open to traffic, the operational noise and vibration impacts will be experienced. The assessment will be based on the detailed methodology of the Design Manual for Roads and Bridges Volume 11 Section 3 Part 7 HD 213/11 Revision 1[53] (HD 213/11).

7.1.5. At this stage of the Proposed Scheme, where information for a detailed construction noise assessment is not yet available, the assessment has involved:

- Defining the assessment methodology;
- Description of likely construction activities;
- Identification of Noise Sensitive Receptors (NSR) close to the working area boundaries; and
- Description of BPM mitigation measures.

7.1.6. In addition, where information for a detailed construction vibration assessment is not yet available, the assessment has involved:

- Defining the assessment methodology;
- Identification of likely vibration generating activities;
- Identification of NSR close to the vibration working area boundaries; and
- Description of BPM mitigation measures.

[51] The British Standards Institution (2014), BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Part 1: Noise

[52] The British Standards Institution (2014), BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration

[53] The Highways Agency, Scottish Government, Welsh Assembly Government and the Department for Regional Development Northern Ireland (2011), Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7, HD 213/11 revision 1. Noise and Vibration

7.1.7. Where information for an operational noise and vibration assessment is not yet available, the assessment has involved:

- Defining the assessment methodology; and
- Identification of NSR within a provisional Study Area.

7.1.8. This report is necessarily technical in nature, to assist the reader, a glossary of acoustic terminology is provided in Appendix 7A.

STUDY AREAS

7.1.9. A provisional Study Area for operational noise is a 1.6 km buffer around the Proposed Scheme and bypassed routes, as shown in Figure 7.1. It is not yet possible to define the operational phase Study Area in line with HD213/11[53], as this requires traffic data for the Proposed Scheme, which is not currently available.

7.1.10. A provisional Study Area for operational vibration is a 40m buffer around all roads within the provisional operational noise Study Area.

LIMITATIONS

7.1.11. This chapter of the PEIR provides preliminary information and is based on data currently available at this point of the assessment process.

7.1.12. The information is intended to inform consultation responses. A more detailed and quantified assessment of likely significant impacts will be completed and included in the ES.

7.1.13. Any gaps in information identified at this PEIR stage will be considered and addressed along with specific mitigation measures as part of the assessments for the production of the ES.

7.2 RELEVANT POLICES

7.2.1. The policies relevant to this assessment address the national priorities with regards to noise and vibration from developments and their impact on the human and natural environment. Their aim is to control the activities likely to lead to both temporary and permanent increases in noise and vibration and their associated environmental impacts.

7.2.2. National policy emphasises the need to avoid noise giving rise to impacts on health and quality of life as a result of the construction and operation of developments. It stresses the need to reduce noise at source and where this is not possible, highlights the need for measures to reduce noise levels between the source of the noise and the receptor.

NATIONAL POLICY

National Planning Policy Framework (2018) and the Noise Policy Statement for England (NPSE)[54]:

7.2.3. The guidance contained within these documents that is most relevant to the assessment of road traffic noise is contained within the Explanatory Note to the NPSE, which introduces the concept of noise ‘Effect Levels’ as follows:

[54] Department for Environment, Food and Rural Affairs (2010). Noise Policy for England (NPSE). [online] available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf (Accessed June 2018)

- NOEL - No Observed Effect Level - This is the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise;
- LOAEL - Lowest Observable Adverse Effect Level - This is the level above which adverse effects on health and quality of life can be detected; and
- SOAEL - Significant Observed Adverse Effect Level - This is the level above which significant adverse effects on health and quality of life occur.

7.2.4. None of these three levels are defined numerically in the NPSE, and for the SOAEL the NPSE makes it clear that the noise level is likely to vary depending upon the noise source, the receptor and the time of day/day of the week, etc. The need for more research to investigate what may represent a SOAEL for noise is acknowledged and the NPSE asserts that not stating specific SOAEL values provides policy flexibility in the period until further evidence and guidance is published.

National Planning Practice Guidance (PPG)[55]

7.2.5. The Government's web-based Planning Practice Guidance (PPG)55 includes a table which summarises the noise exposure hierarchy and offers examples of outcomes relevant to the NOEL, LOAEL and SOAEL effect levels described in the NPSE, the table is reproduced in

7.2.6. Table 7.1 - Noise Exposure Hierarchy. The term Unacceptable Adverse Effect (UAE) level is introduced which equates to noise perceived as "noticeable and very disruptive". The PPG states that UAEs should be prevented.

[55] Department for Communities and Local Government (2012). National Planning Policy Framework Planning Practice Guidance. [online] Available at https://www.gov.uk/government/collections/planning-practice-guidance Accessed June 2018

Table 7.1 - Noise Exposure Hierarchy

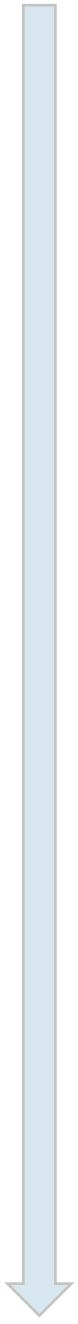
Perception	Examples of Outcomes	Increasing Effect Level	Action	Increasing Noise Level
Not noticeable	No Effect	No Observed Effect	No specific measures required	
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required	
Lowest Observed Adverse Effect Level				
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum	
Significant Observed Adverse Effect Level				
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid	
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent	

Table source: PPG Paragraph: 005

National Policy Statement for National Networks

7.2.7. The NPS NN provides planning guidance for promoters of nationally significant infrastructure projects on the road and rail networks. It states that developments must be undertaken in accordance with the statutory requirements for noise and that due regard must be given to the relevant sections of the NPSE and the updated National Planning Policy Framework (NPPF)[56].

7.2.8. The document also confirms that for most national network projects, the relevant Noise Insulation Regulations (NIR) will apply.

National Policy Statement for Ports

7.2.9. The NPS for Ports requires an applicant to assess the noise generating aspects of a development on the marine and terrestrial environment including noise sensitive areas and noise sensitive species which has been informed by the existing marine and terrestrial noise environment. These assessments should then identify any measures that are included to mitigate the effects of noise.

RELEVANT GUIDANCE DOCUMENTS

BS 5228 Code of Practice for Noise and Vibration Control on Construction and Open Sites (BS 5228)

7.2.10. Part 1[51] Noise and Part 2[52] Vibration sets out a methodology for assessing construction impacts on sensitive receptors.

7.2.11. Further details of the technical content of BS 5228 and how it will be applied to the assessment of construction noise and vibration from the Proposed Scheme are set out in the Assessment Methodology section.

Calculation of Road Traffic Noise (CRTN)

7.2.12. The former Department of Transport/Welsh Office technical memorandum Calculation of Road Traffic Noise (CRTN) sets out a standardised method for the calculation of noise from road traffic.

7.2.13. The factors which may influence road traffic noise levels can be divided into three groups:

- Road related factors - gradient and surface type;
- Traffic related factors - flow, speed and the proportion of heavy duty vehicles; and
- Propagation factors – the distance between the road and the receptor location and either the type of ground cover between the road and receptor location or the presence of screening (i.e. barriers or buildings).

7.2.14. The propagation of noise is also covered in CRTN and can influence the noise levels at receptor locations.

Design Manual for Roads and Bridges (DMRB)

7.2.15. The DMRB Volume 11, Section 3, Part 7, HD 213/11 Revision 1 Noise and Vibration (HD 213/11)[53] sets out a methodology for assessing road traffic noise and vibration.

7.2.16. Further details of the technical content of HD 213/11 and how it will be applied to the assessment of traffic noise from the Proposed Scheme are set out in the Assessment Methodology section.

[56] Ministry of Housing, Communities and Local Government (2018) National Planning Policy Framework

7.3 ASSESSMENT METHODOLOGY

7.3.1. NPSE guidance has been incorporated in both the operation and construction assessment methods.

CONSTRUCTION PHASE

7.3.2. The assessment of predicted noise impacts takes into account the guidance set out in the NPSE and the guidance contained within BS 5228.

7.3.3. It is noted that LOAEL and SOAEL in the NPSE is defined in terms of observed health effects based on the magnitude of the noise levels, i.e. absolute levels. In BS 5228 impacts are defined in terms of existing ambient noise level and change in noise levels. To date, there has been no official guidance published on how to reconcile these two methodologies.

7.3.4. The approach adopted for this assessment is to use both the NPSE and BS 5228 methods and to consider the results in combination to provide an overall assessment. This approach is described in more detail below.

7.3.5. The assessment will focus on potential impacts associated with different phases of construction which generate noise and vibration, the works required for a scheme of this type would typically include:

- Site preparation and earthworks;
- Compound construction;
- Demolition;
- Bridge construction, including piling; and
- Road paving.

7.3.6. Consultation with NCC and GYDC will be undertaken in order to agree an appropriate level of assessment.

7.3.7. Prediction of noise levels from construction activities will follow BS 5228-1 guidance. Machinery source sound level data will also be taken from BS 5228-1.

7.3.8. The criteria for the assessment of potential significance of noise effects is presented in Table 7.2- Construction Noise Thresholds of Potential Adverse Effects at Dwellings, LAeq,T (dB). Ambient noise is the all-encompassing noise in a given situation at a given time, usually composed of sound from many sources near and far, but excluding site (construction) noise. Site noise is the noise originating from the construction site. Total noise ($L_{Aeq,T}$) is ambient noise plus site noise.

Table 7.2- Construction Noise Thresholds of Potential Adverse Effects at Dwellings, LAeq,T (dB)

Period	Time	LOAEL	SOAEL
Daytime weekday, Saturdays, Sundays	07:00 - 19:00	70	75
Night-time	23:00 - 07:00	50	55

Note 1: A significant effect is indicated where total noise level (pre-construction ambient noise plus site noise) exceeds LOAEL or SOAEL for a period of ten or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months.

Note 2: If the pre-construction ambient noise is greater than LOAEL and less than SOAEL, then a potential observed effect is indicated if the total noise level (pre-construction ambient plus site noise) for the period increases by more than 3 dB, and subject to the SOAEL limit. A potential significant observed effect is indicated if the total noise level (pre-construction ambient plus site noise) exceeds the SOAEL.

Note 3: If the pre-construction ambient noise level exceeds the SOAEL, then a potential significant observed effect is indicated if the total noise level (pre-construction ambient noise plus site noise) for the period increases by more than 3 dB due to site noise.

7.3.9. The adopted construction noise threshold value for the SOAEL is based on the BS 5228-1 ABC method Category C threshold noise levels, Advisory Leaflet 72: 1976 (as reproduced in BS 5228-1), and takes into account practice implemented on Highways England Smart Motorways Programme schemes.

7.3.10. The adopted threshold value for the LOAEL is based on the BS 5228-1 ABC method Category B threshold noise levels, Advisory Leaflet 72: 1976 (as reproduced in BS 5228-1), and takes into account practice implemented on Highways England Smart Motorways Programme schemes.

7.3.11. Where pre-construction ambient noise levels are significantly different than levels given in Table 7.2, then the Table 7.2 levels will be modified.

7.3.12. Vibration impacts during construction works are most frequently related to piling activities. BS 5228-2 provides a range of empirical piling vibration data as well as a prediction methodology.

7.3.13. TRL Report 429 contains data acquired from various other highway construction activities. This data indicates that vibration level typically falls to imperceptible level at a distance of 50 m from the activity.

7.3.14. The criteria for the assessment of potential significance of vibration effects is presented in Table 7.3 - Construction Vibration Thresholds of Potential Adverse Effects at Dwellings, PPV (mm/s)

Table 7.3 - Construction Vibration Thresholds of Potential Adverse Effects at Dwellings, PPV (mm/s)

Period	Time	LOAEL	SOAEL
Day and Night	00:00 – 00:00	1.0	10.0

7.3.15. The adopted construction vibration threshold value for the SOAEL is based on BS 5228-2. Vibration at this level is likely to be intolerable for any more than a very brief exposure. The level is also in line with current practice implemented on Highways England Smart Motorways Programme schemes. The onset of cosmetic damage in buildings due to vibration is greater than the SOAEL.

7.3.16. The adopted construction vibration threshold value for the LOAEL is based on the BS 5228-2 guidance on human response to vibration. This is the vibration level that is likely to cause complaint, but can be tolerated if prior warning and explanation is given. The level is also in line with current practice implemented on Highways England Smart Motorways Programme schemes.

7.3.17. Where construction noise or vibration levels are expected to exceed the SOAEL after the contractor has applied BPM to the provision of mitigation, special dispensation may be sought to complete required works; the contractor may apply to the local authority for prior consent under Section 61 of the CoPA.

7.3.18. Structural damage resulting from construction and demolition vibration is rare. Table 7.4, taken from BS 5228-2, provides guide vibration values, above which in cosmetic damage may occur.

Table 7.4 Transient Vibration Guide Values for Cosmetic Damage to Buildings

Building Type	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above

Building Type	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1: Values referred to are at the base of the building.		
NOTE 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

Table source: BS 5228-2 Table B.2[52]

OPERATION

7.3.19. The assessment of predicted noise impacts takes into account the guidance set out in the NPSE and the guidance contained within HD 213/11.

7.3.20. It is noted that LOAEL and SOAEL in the NPSE is defined in terms of observed health effects based on the magnitude of the noise levels, i.e. absolute levels. Whereas, in HD 213/11, impacts are defined in terms of change in noise levels. To date, there has been no official guidance published on how to reconcile these two methodologies.

7.3.21. The proposed approach for this assessment is to use HD 213/11 to classify the magnitude of effect for given increases or decreases in noise level. Then to use NPSE guidance to consider whether the impacts are significant based on absolute noise level.

7.3.22. To consider the impacts of road schemes in the context of the NPSE, it is necessary to define noise levels above which noise increases may be regarded as significant, these are given in Table 7.5 - Traffic noise levels and significance.

Table 7.5 - Traffic noise levels and significance

Effect Level	Traffic Noise Level, $L_{A10,18h}$ (dB)* façade level
NOEL	≤54.4
LOAEL	54.5 to 67.5
SOAEL	≥67.5

7.3.23. The adopted threshold value for the SOAEL is based on the 'Relevant Noise Level', as set out in the Noise Insulation Regulations 1975 (NIR). This is the level of noise that would (provided that other criteria are met) trigger entitlement to the provision of sound insulated glazing (and, where necessary, ventilation) for residential properties located within 300 m of a new road scheme. The Relevant Noise Level specified in the NIR is 68 dB $L_{A10,18h}$, although the regulations require that noise levels calculated to be between 67.5 and 67.9 dB are rounded up to 68 dB.

7.3.24. The adopted threshold value for the LOAEL is based on guidance contained within the WHO Guidelines for Community Noise. This states that the lowest observed threshold for the onset of community annoyance occurs for situations where the outside free-field noise level exceeds 50 dB $L_{Aeq,16h}$ (07.00 to 23.00 hours). This uses a different noise measure, $L_{Aeq,16h}$ which is used as a general measure of noise from all sources, and time period to that used to quantify road traffic noise, $L_{A10,18h}$ (06.00 to 24.00 hours). Where road traffic noise dominates conversion from $L_{Aeq,16h}$ to $L_{A10,18h}$ uses the relationship set out in TAG Unit A3 Environmental Impact Appraisal ($L_{Aeq,16h} = L_{A10,18h} - 2$ dB) with a further addition of 2.5 dB applied to account for the conversion from a free-field noise level to a façade noise level (in accordance with CRTN).

7.3.25. The noise Effect Levels set out in the above table are based on the absolute noise level. In terms of the change in noise level as a result of a new road scheme, HD 213/11 states "in terms of permanent impacts, a change of 1 dB(A) in the short-term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long-term, a 3 dB(A) change is considered perceptible. Such increases in noise should be mitigated if possible".

7.3.26. Therefore, for the purposes of this assessment, the following road traffic noise change thresholds have been used, to indicate the potential for a significant effect to arise:

- ≥ ±1 dB $L_{A10,18h}$ in the Do-Minimum Opening Year to Do-Something Opening Year (short term); and
- ≥ ±3 dB $L_{A10,18h}$ in the Do-Minimum Opening Year to Do-Something Design Year (long term).

7.3.27. In addition to the above, in the long term an increase of 1 dB $L_{A10,18h}$ where the Do-Minimum Opening Year noise level is already above the SOAEL is considered a potentially significant change. In other words, a lower magnitude of impact is applied where road traffic noise levels are particularly high.

7.3.28. The approach taken for this assessment is to analyse the change in all noise levels for both short-term and long-term scenarios. Where no individual change exceeds the thresholds given in 7.3.26 above, then it is assumed that there would most likely be no significant adverse effect. However, where noise levels exceed the stated thresholds, this provides an indication that there is potential for a significant adverse effect which triggers the need to consider mitigation. In these instances, the predicted noise levels will be considered in more detail and, where necessary, mitigation measures will be explored.

7.3.29. Where long term significant adverse effects are identified, the traffic flow data for the Do-Minimum Design Year scenario will be interrogated to assist in determining whether the effects are as a result of the Proposed Scheme itself, or are rather a result of general traffic growth or other developments.

7.3.30. Table 7.6 summarises the classification of magnitude of noise impacts associated with short- and long-term changes in noise levels, using the scales set out in HD213/11; and a semantic scale using the terms, *No Change*, *Slight*, *Low*, *Medium* and *High*. Both adverse and beneficial changes are considered in the assessment. However, only noise increases are considered to be significant.

Table 7.6 - Classification of Magnitude of Noise Impacts

Magnitude of Impact	Short-term Noise Change, $L_{A10,18h}$ (dB)	Long-term Noise Change, $L_{A10,18h}$ (dB)
No change	0.0	0.0
Negligible	0.1 – 0.9	0.1 – 2.9
Minor	1.0 – 2.9	3.0 – 4.9
Moderate	3.0 – 4.9	5.0 – 9.9
Major	5.0+	10.0+

7.3.31. In order to reconcile the different assessment methodologies set out in the NPSE[54] and HD213/11[53], consideration has been given to the current convention, as set out in Table 5.4 in Chapter 5.

7.3.32. For the purposes of classifying the overall noise impact against this semantic scale, the guidance contained within the NPSE and HD 213/11 has been combined as shown in Table 7.7 and Table 7.8. Table 7.7 relates to the potential short-term impact (based on Do-Something compared against Do-Minimum in the opening year of the Proposed Scheme) and Table 7.8 relates to the potential long-term impact (based on Do-Something in the future assessment year, taken to be 15 years after the opening year compared against Do-Minimum in the year of opening). The overall impact classification (negligible, minor, moderate or major) applies to situations where there is a beneficial impact as well as to situations where there is an adverse impact.

7.3.33. When the HD 213/11 magnitude of noise impacts are combined with the NPSE significance criteria In Table 7.7 and Table 7.8, 'Noise Level' refers to the Do-Something $L_{A10,18h}$ (06.00 to 24.00 hours) road traffic façade noise level predicted at 1 m from the sensitive receptor building.

Table 7.7 - Significance criteria for operational traffic noise based on short-term noise change

Noise Increase, $L_{A10,18h}$ dB	Noise Level < LOAEL	Noise Level > LOAEL and < SOAEL	Noise Level > SOAEL
<0.9	Negligible	Negligible	Negligible
1.0 – 2.9	Negligible	Minor	Minor
3.0 – 4.9	Negligible	Moderate	Moderate
>5.0	Negligible	Major	Major

Table 7.8 - Significance criteria for operational traffic noise based on long-term noise change

Noise Increase, $L_{A10,18h}$ dB	Noise Level < LOAEL	Noise Level > LOAEL and < SOAEL	Noise Level > SOAEL
<0.9	Negligible	Negligible	Negligible
1.0 – 2.9	Negligible	Negligible	Minor
3.0 – 4.9	Negligible	Minor	Moderate
5.0 – 9.9	Negligible	Moderate	Major
>10.0	Negligible	Major	Major

7.3.34. Based on the above, and in line with the goals of the NPSE, the provision of noise mitigation will aim to:

- Reduce, where practicably possible, Minor, Moderate or Major significant increases, where the absolute noise level is above LOAEL; and
- Avoid Minor, Moderate or Major significant increases, where the absolute noise level is above SOAEL.

7.3.35. Mitigation measures are required to perform to an acceptable level in traffic, road safety, economic and other environmental terms.

7.3.36. It should also be noted that the assessment methodology detailed above is based on daytime (06.00 to 24.00 hours) traffic noise levels. For most roads, the diurnal patterns in road traffic flows are such that noise levels during the night-time (00.00 to 06.00 hours) are approximately 10 dB lower than those during the daytime. The threshold criteria for LOAEL and SOAEL would also be approximately 10 dB lower. An assessment of daytime noise levels against the significance criteria detailed above is therefore considered to be sufficient to provide an overall assessment that would be equally applicable to the night-time period.

7.4 BASELINE ENVIRONMENT

SENSITIVE RECEPTORS

7.4.1. In accordance with HD 213/11 and BS 5228-1, NSRs to be considered in this assessment include residential dwellings, schools, hospitals and community facilities.

7.4.2. Using OS AddressBase Plus data, 16,504 residential receptors and 372 other sensitive receptors are identified within the provisional Study Area. All receptors are considered to be of high sensitivity.

7.4.3. Other sensitive receptors located close to the Proposed Scheme include:

- The Kings Centre, Queen Anne's Road;
- Great Yarmouth and Waveney Mind Community Allotments;
- Great Yarmouth and Gorleston Allotment Association Allotments;
- Great Yarmouth Community Hub, Suffolk Road;
- Shine Alpha Centre, Alpha Road;
- Avery Lodge Nursing Home, Southtown Road;
- St. James Church, Admiralty Road; and
- Great Yarmouth Primary Academy, Dickens Avenue.

7.4.4. The Outer Thames Estuary SPA designated area is within the provisional Study Area. However, the scope of this chapter relates to human response to noise and vibration. Impacts on ecologically sensitive receptors are considered within the Chapter 8 Nature Conservation.

DEFRA NOISE IMPORTANT AREAS

7.4.5. Defra Noise Important Areas (NIA) are locations where the 1% of the population are affected by the highest noise levels from major roads according to the results of Defra's strategic noise maps.

7.4.6. There are six NIAs within the provisional Study Area:

- NIA 4985 - Asset owner NCC;
- NIA 4986 - Asset owner NCC;
- NIA 4987 - Asset owner NCC;
- NIA 4989 - Asset owner Highways England;
- NIA 4990 - Asset owner Highways England; and
- NIA 11282 - Asset owner Highways England.

EXISTING NOISE CLIMATE

7.4.7. Baseline noise surveys were completed in March and April 2018. Weekday surveys were done between 26 March and 27 March 2018; and a weekend survey was done between 21 April and 22 April 2018.

7.4.8. The noise survey is used to identify existing noise sources which are not taken into account in the operational noise assessment, for example, air traffic, industrial/commercial activities.

7.4.9. Noise monitoring locations were selected to be representative of sensitive receptors located close to the development. The survey positions and measurement timing were agreed with GYBC. The survey dates were chosen to be representative of normal conditions, local road works and any maintenance activities were avoided.

7.4.10. Noise measurements were taken in accordance with the general guidance in BS 7445-2[57] and based on the shortened measurement procedure set out in CRTN. The shortened measurement procedure requires that measurements of L_{A10} are undertaken during three consecutive hours between the hours of 10:00 and 17:00 on a normal working day. The $L_{A10,18h}$ is estimated from these measurements by taking an arithmetic average of

[57] The British Standards Institution (1991), BS 7445-1:2003 Description and measurement of environmental noise. Part 1: Guide to quantities and procedures.

the three results and subtracting 1 dB. Each daytime measurement was 15 minutes long. The measurements are considered to be representative of the hourly noise level.

7.4.11. Measurements were taken in free-field conditions and at a height of 1.5 m above local ground level.

7.4.12. Short-term attended noise measurements were taken at six locations, detailed in Table 7.9 - Baseline Noise Survey Locations and Figure 7.2.

Table 7.9 - Baseline Noise Survey Locations

Measurement ID	Location	Closest NSR	Distance between NSR and construction boundaries
L01	Beccles Road	3 Alpha Road	18 m
L02	Queen Anne's Road	12 Queen Anne's Road	0 m
L03	Southtown Road	145 Southtown Road	0 m
L04	Cromwell Road	10 Cromwell Road	0 m
L05	South Denes Road	1 South Denes Road	0 m
L06	Southgates Road	31 Southgates Road	0 m

7.4.13. Long-term unattended noise measurements were not taken as representative and secure locations were not available.

7.4.14. The sound level meters were field calibrated before and after the surveys, with no significant calibration drift observed. Details of the equipment used, including the expiry dates of their laboratory calibration, are shown in Table 7.10 - Equipment Details.

Table 7.10 - Equipment Details

Type	Make	Model	Serial Number	Certificate Number	Calibration Expiry
Duo 2					
SLM	01 dB	Stella Dou	10618	20/09/2019	SLM
Microphone	01 dB	G.R.A.S 40CD	162008	20/09/2019	Microphone
Pre-amplifier	01 dB	G.R.A.S Type 21	10627	20/09/2019	Pre-amplifier
Calibrator	01 dB	01 dB Cal	3494010	21/09/2018	Calibrator
Solo 2					
SLM	01 dB	METRAVIB	61332	14/02/2019	SLM
Microphone	01 dB	METRAVIB MCE 212	57685	14/02/2019	Microphone
Pre-amplifier	01 dB	METRAVIB 21 S	14425	14/02/2019	Pre-amplifier
Calibrator	01 dB	01 dB Cal	3494010	21/09/2018	Calibrator

7.4.15. Weather conditions were recorded during the noise surveys and are summarised below:

- 13:30 Monday 26 March 2018
  Temperature 7°C, south westerly wind, 0.3 m/s average (max. 1.0 m/s), humidity 85%, no precipitation, 50% cloud cover, road surfaces dry.

- 21:45 Monday 26 March 2018
  Temperature 5°C, south westerly wind, 1.2 m/s average (max. 1.9 m/s), humidity 45%, scattered clouds, road surfaces dry.

- 10:45 Tuesday 27 March 2018
  Temperature 6°C, no wind direction to report, 0.2 m/s average (max. 0.9 m/s), humidity 60%, clear skies, road surfaces dry.

- 14:05 Saturday 21 April 2018
  Temperature 16°C, westerly wind, humidity 80%, light winds and dry conditions clear skies, road surfaces dry.

- 21:00 Sunday 22 April 2018
  Temperature 12°C, south easterly wind, humidity 80%, 0.8 m/s average (max 1.6 m/s) and dry conditions clear skies, road surfaces dry.

7.4.16. Summaries of the attended measurements at each location during the weekday and weekend period are given in Table 7.11 to table 7.16.

7.4.17. At Locations 1, 2, 3 and 4 in the vicinity of Harfrey's Roundabout, the dominant noise sources during all periods was from vehicles on local roads. Secondary noise sources included more distant road traffic noise, seagull calls, domestic activities and emergency service sirens.

7.4.18. At Locations 5 and 6 on South Denes, the dominant noise sources during the day was from vehicles on local roads including regular HGV movements and intermittent commercial/industrial activities. During the weekend evening measurements police sirens dominated the noise levels. And during the night the dominant noise source was again from vehicles on local roads.

Table 7.11 - Summary of measured noise levels at Location 1, free-field

Period	Time	Duration	Noise Level (dB)			
			L_{Aeq}	L_{AFmax}	L_{A90}	L_{A10}
Weekday	13:00 - 15:00	3 x 15 min	66.0	81.2	59.0	68.9
	20:48 - 21:03	1 x 15 min	62.3	73.1	49.9	66.7
	00:36 - 00:51	1 x 15 min	58.0	74.3	45.1	62.6
Weekend	12:25 - 14:00	3 x 15 min	64.5	79.8	55.2	67.7
	21:18 - 21:33	1 x 15 min	60.4	71.8	48.5	64.2
	00:37 - 00:52	1 x 15 min	59.8	71.8	45.0	65.3

Table 7.12 - Summary of measured noise levels at Location 2, free-field

Period	Time	Duration	Noise Level (dB)			
			L_{Aeq}	L_{AFmax}	L_{A90}	L_{A10}
Weekday	13:15 - 16:15	3 x 15 min	53.8	69.9	49.5	55.4

Period	Time	Duration	Noise Level (dB)			
			L_{Aeq}	L_{AFmax}	L_{A90}	L_{A10}
	21:07 - 21:22	1 x 15 min	56.3	80.1	48.7	55.6
	00:58 - 01:13	1 x 15 min	44.8	57.2	42.8	48.0
Weekend	13:08 - 14:55	3 x 15 min	59.5	87.8	53.5	59.5
	20:55 - 21:11	1 x 15 min	53.6	63.4	48.9	56.3
	00:58 - 01:13	1 x 15 min	49.7	66.9	41.9	50.9

Table 7.13 - Summary of measured noise levels at Location 3, free-field

Period	Time	Duration	Noise Level (dB)			
			L_{Aeq}	L_{AFmax}	L_{A90}	L_{A10}
Weekday	13:00 - 16:00	3 x 15 min	69.1	84.2	56.2	72.7
	21:37 - 21:52	1 x 15 min	62.6	76.9	45.9	67.0
	01:37 - 01:52	1 x 15 min	57.8	79.0	46.4	55.1
Weekend	12:17 - 14:15	3 x 15 min	67.9	86.6	54.1	71.2
	20:52 - 21:07	1 x 15 min	65.2	82.0	48.3	69.3
	01:18 - 01:33	1 x 15 min	61.7	77.9	44.6	65.2

Table 7.14 - Summary of measured noise levels at Location 4, free-field

Period	Time	Duration	Noise Level (dB)			
			L_{Aeq}	L_{AFmax}	L_{A90}	L_{A10}
Weekday	13:00 - 16:00	3 x 15 min	50.8	66.1	46.3	52.3
	21:32 - 21:47	1 x 15 min	43.9	54.3	41.0	45.7
	01:20 - 01:35	1 x 15 min	39.1	47.4	37.4	40.4
Weekend	12:36 - 14:32	3 x 15 min	52.3	65.7	48.5	54.3
	21:09 - 21:24	1 x 15 min	48.5	68.1	43.4	47.7
	01:36 - 01:51	1 x 15 min	42.0	55.1	37.0	44.0

Table 7.15 - Summary of measured noise levels at Location 5, free-field

Period	Time	Duration	Noise Level (dB)			
			L_{Aeq}	L_{AFmax}	L_{A90}	L_{A10}
Weekday	10:00 - 13:00	3 x 15 min	70.7	88.4	55.7	74.7
	22:01 - 22:16	1 x 15 min	59.9	77.1	42.6	61.2
	02:04 - 02:19	1 x 15 min	52.1	77.7	37.1	42.2
Weekend	14:05 - 16:15	3 x 15 min	65.4	83.5	49.0	69.6
	21:43 - 21:58	1 x 15 min	64.3	81.5	49.8	67.1
	02:09 - 02:24	1 x 15 min	56.4	79.4	44.0	49.6

Table 7.16 - Summary of measured noise levels at Location 6, free-field

Period	Time	Duration	Noise Level (dB)			
			L_{Aeq}	L_{AFmax}	L_{A90}	L_{A10}
Weekday	10:00 - 12:00	3 x 15 min	72.4	86.8	56.7	76.1
	02:23 - 02:38	1 x 15 min	62.9	86.1	46.9	56.4
Weekend	14:24 - 16:35	3 x 15 min	68.3	86.6	46.7	72.7
	21:45 - 22:00	1 x 15 min	69.3	92.7	47.5	68.1
	02:28 - 02:43	1 x 15 min	51.9	75.4	39.2	52.4

7.5 PREDICTED EFFECTS

CONSTRUCTION PHASE

7.5.1. Noise and vibration from construction activities can cause disturbance to people living and working in the vicinity of, and to those working on, the site. Noise and vibration can interfere with activities and processes in buildings; in extreme circumstances it can be a hazard to health and very high vibration can cause damage to buildings.

7.5.2. The assessment will focus on potential impacts associated with different phases of construction which generate noise and vibration, the works required for a scheme of this type would typically include:

- Site preparation and earthworks;
- Compound construction;
- Demolition;
- Bridge construction, including piling; and
- Road paving.

7.5.3. The risk and severity of potential construction impacts occurring is typically a function of the proximity of the activity to receptor, and the nature and duration of the activity. The highest risk receptors are those that are located closest to construction activities.

7.5.4. There are existing sensitive receptors located within 300 m of the construction boundaries. The nearest sensitive residential receptors are located within <20m of the current Proposed Scheme boundary.

7.5.5. The number and location of sensitive receptors from Proposed construction boundary are detailed in Table 17.7. The count of properties is based on OS AddressBase data classification, a single building may contain several properties, e.g. flats.

Table 7.17 - Receptor Count within 300 m of Construction Boundaries

Distance from Construction boundaries (m)	Sensitive Receptor Count			
	Residential	Educational	Medical	Total
<20	149*	1	0	132
20-50	185	2	0	187
50-100	457	0	1	457
100-200	1602	1	7	1610
200-300	1681	4	3	1688
* Count excludes 20 residential properties to be demolished as part of the proposed scheme.				

OPERATION PHASE

7.5.6. Once the Proposed Scheme is built and open to vehicles, traffic noise and vibration can cause disturbance to people living and working near the Proposed Scheme and the surrounding area.

7.5.7. The operational Study Area is yet to be defined, given that the Proposed Scheme traffic data is currently under development. Once this data is available, the affected road network and associated sensitive receptor locations to be included in the assessment will be confirmed.

7.5.8. As an indication of the potential impact, receptor counts split into distance bands are given in Table 7.18 - Receptor Count within 300 m of Proposed Scheme Carriageway Edge. The distance bands are calculated from the carriageway edge of new or improved routes associated with the Proposed Scheme. This is done because typically it is the immediate areas around the Proposed Scheme which experience adverse noise impacts. Receptors located closer to the Proposed Scheme are expected to experience higher adverse impact. The count of properties is based on OS AddressBase data classification, a single building may contain several properties, e.g. flats.

Table 7.18 - Receptor Count within 300 m of Proposed Scheme Carriageway Edge

Distance from Proposed Scheme Carriageway Edge (m)	Sensitive Receptor Count			
	Residential	Educational	Medical	Total
<50	109*	1	0	92
50-100	240	1	0	241
100-150	280	1	0	281
150-200	245	0	0	245
200-250	214	0	0	214
250-300	245	1	0	246

* Count excludes 20 residential properties to be demolished as part of the proposed scheme.

7.5.9. The Outer Thames Estuary SPA, which includes the River Yare, will be considered as part of the operation phase noise and vibration assessment completed in the ES, the approach to assessing potential impacts in the SPA will be subject to the outcome of a consultation with Natural England. The scope of this chapter relates to human response to noise and vibration, impacts on ecological sensitive receptors are considered within the Chapter 8 Nature Conservation.

7.6 PROPOSED MITIGATION

CONSTRUCTION PHASE

7.6.1. The majority of construction noise and vibration impacts will be suitably controlled following Best Practicable Means (BPM), whereby the Contractor will employ appropriate measures to control and minimise adverse effects associated with noise and vibration resulting from on-site activities, so that significant impacts are avoided. These will include:

- Maintaining good public relations with people living and working in the vicinity of the site. Effective communication should be established, keeping local residents informed of the type and timing of works involved. Effective methods of keeping local residents informed include leaflet drops, posters, public meetings, exhibitions and guided site visits;
- Provision of contact details for a site representative;
- Noise and vibration complaints arising will be dealt with pro-actively and subsequent resolutions are communicated to the complainant;
- Prior notice given to local residents for operations that are particularly noisy or generate high levels of vibration;
- Careful planning of construction activities and selection of plant to reduce noise emissions;
- The use of temporary screening (such as Heras mounted acoustic barriers or site hoarding) where appropriate;
- Locating static noisy plant in use as far away from NSRs as is feasible for the particular activity;
- Using suitable equipment and ensuring such equipment is properly maintained and operated by trained staff;
- Using silenced equipment where possible, in particular silenced power generators, if night-time power generation is required for site security or lighting;
- Ensuring that vehicles and mobile plant are well maintained such that loose body fittings or exhausts do not rattle or vibrate;
- Engine compartments should be closed when equipment is in use and the resonance of body panels and cover plates reduced through the addition of suitable dampening materials.
- Ensuring plant machinery is turned off when not in use;
- Speed limits on access roads for HGVs and ensuring that vehicles do not park or queue for long periods outside NSRs with engines running unnecessarily;
- Generators and water pumps required for 24-hour operation should be silenced and/or screened as appropriate;

- Crane spindles, pulley wheels, telescopic sections and moving parts of working platforms should be adequately lubricated in order to prevent undue screeching and squealing;
- Where possible, the use of mains electricity rather than generators.

7.6.2. It is recommended that periodic noise monitoring is undertaken to compare construction noise levels with the thresholds for sensitive receptors set out in Table 12-18 and Table 12-19. The monitoring will be undertaken by a suitably competent person. The instrumentation will conform to the requirements for integrating averaging sound level meters, preferably of Type 1 as specified in BS 7580-1: 1997 (or Class 1 specified in BS EN 61672-1: 2013, but at east of Type 2 as specified in BS 7580-2: 1997 (or Class 2 specified in BS EN 61672-1: 2013), with verification of conformity being undertaken by periodic testing in accordance with these standards. In addition to the periodic testing, sound calibrators (preferably conforming to BS EN 60942: 2003, class 1) will be used whenever monitoring takes place; typically, before and after each measurement session.

7.6.3. Where vibratory construction activities are predicted to cause significant levels of vibration at nearby receptors, vibration monitoring may also be necessary.

7.6.4. A CoCP will be prepared and implemented to control noise emissions from the construction site, so that significant impacts are avoided, and will include the following:

- Arrangements for communicating construction details, and likely noisy activities, with local communities and residents, including points of contact;
- Detailed methodologies for each construction activity;
- Detailed programmes for each phase of construction;
- Identification of the construction activities likely to generate the highest levels of noise, based on working areas;
- Prediction of noise levels from these activities following method given in BS 5228-1;
- Identification, in consultation with NCC/GYBC, of appropriate hours of working and construction noise limits;
- An assessment of predicted impacts against the agreed construction noise limits;
- Identification of appropriate noise mitigation measures; and
- Noise monitoring and reporting procedures.

OPERATION PHASE

7.6.5. At this stage, an assessment of likely significance and the need for mitigation measures associated with the operation of the scheme cannot be made. This will be provided within the ES.

7.7 CONCLUSIONS AND EFFECTS

BASELINE

7.7.1. Baseline noise surveys were completed in March and April 2018 at six locations in the vicinity of the Proposed Scheme. Attended noise surveys were completed during the day, evening and night; and covered a weekday and weekend period.

7.7.2. There are six NIAs within the provisional operational noise Study Area. The noise making authority for three NIAs is NCC and Highways England is the noise making authority for the remaining three NIAs.

CONSTRUCTION PHASE

7.7.3. At this stage, a quantitative assessment of likely significance and the need for mitigation measures associated with the construction has not been made. This will be provided within the ES.

7.7.4. The highest risk sensitive receptors are those located closest to noise and vibration generating activities.

7.7.5. Appropriate mitigation measures are recommended, which will be implemented via the interim CoCP to reduce and minimise potential noise and vibration impacts.

7.7.6. Any such impacts are expected to be intermittent and temporary for the duration of the respective activities only and it is not anticipated that construction related noise and vibration will constitute a significant effect.

OPERATION PHASE

7.7.7. At this stage, an assessment of likely significance and the need for mitigation measures associated with the operation of the Proposed Scheme cannot be made. This will be provided within the ES.

7.8 ASSESSMENTS STILL TO BE COMPLETED

7.8.1. The construction assessment described in this chapter will be updated in the ES to account for the latest information that is available regarding proposed construction activities.

7.8.2. An operation phase assessment, based upon finalised traffic data, will be completed following the approach outlined in Section 7.3. The findings of this will be presented in the ES.

8

NATURE CONSERVATION

8 NATURE CONSERVATION

8.1 INTRODUCTION

8.1.1. This chapter provides preliminary information with regard to biodiversity and nature conservation as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process. It is supported by Figures 8.1 – 8.6 and Appendices 8A and 8B.

8.1.2. The assessment of this topic area considered potential effects relating to the following aspects:

- Statutory and non-statutory designated sites;
- Important or protected habitats; and
- Legally protected species and/or species of conservation concern.

STUDY AREA

8.1.3. The study area for the proposed assessment is comprised of three different levels as informed by legislation and guidance (see Section 8.2 below):

- Main – 500m from the Proposed Scheme Boundary (presented in Figure 8.1). This study area has been used for assessing habitats and suitability for protected species (hereafter referred to as 'Main Study Area');
- Broad – 2km from the Proposed Scheme boundary (presented in Figure 8.1). This study area is used for a desk study of international and national statutory nature conservation designations, non-statutory nature conservation designations and records of protected and/or notable habitats and species (hereafter referred to as 'Broad Study Area'; and
- Extended – up to 30km from Proposed Scheme boundary (presented in Figure 8.2). This study area has been used to extend the Broad Study Area where there are potential hydrological connections present and to take into account international nature conservation designations where bats are listed as a qualifying species (hereafter referred to as 'Extended Study Area').

LIMITATIONS

8.1.4. This chapter of the PEIR provides preliminary information as it relates to the Proposed Scheme to date and to data currently available and gathered at this point of the assessment process.

8.1.5. The information contained herein is intended to inform consultation responses at this stage. A more detailed assessment of potential significant effects as a result of the Proposed Scheme on identified sensitive receptors will be undertaken at subsequent stages to inform the ES.

8.1.6. Any gaps in information identified at this PIER stage will be considered and addressed along with specific mitigation measures as part of the assessments for the production of the ES.

8.1.7. At the time of writing, the following surveys were either in progression or pending:

- Breeding bird surveys, with a particular focus on black redstart *Phoenicurus ochruros*;
- Bird vantage point surveys, focussing on the River Yare;
- Internal and external inspections for bat species on properties due to be demolished;
- Repeat water vole *Arvicola amphibius* surveys; and
- Surveys of aquatic ecology.

8.2 DIRECTIVES, STATUTES AND RELEVANT POLICIES

8.2.1. Ecological features receive protection through legislation and planning policy. Legislation and planning policy relevant to the Proposed Scheme will be identified following a determination of ecological receptors relevant to the Proposed Scheme following completion of the surveys that are proposed.

8.2.2. The appraisal has been compiled with reference to the following relevant nature conservation legislation, planning policy and the UK Biodiversity Framework from which the protection of sites, habitats and species is derived in England.

The Conservation of Habitats and Species Regulations (Habitats Regulations) 2017

8.2.3. The EC Habitats Directive (92/43/EEC) and EC Birds Directive (2009/147/EC) are transposed into UK law via the Conservation of Habitats and Species Regulations 2017, referred to as the Habitats Regulations. All species listed under Annex IV of the Habitats Directive are subject to a strict protection and are known as European Protected Species (EPS). Certain EPS are also listed under Annex II of the Habitats Directive and are afforded protection by the establishment of core areas of habitat known as Special Areas of Conservation (SAC). The effect of proposed developments on SACs is regulated by means of the requirement to carry out Habitats Regulations Assessment (HRA).

8.2.4. The Birds Directive seeks to maintain populations of all wild bird species across their natural range (Article 2). All bird species listed under Annex I of the Birds Directive are rare or vulnerable and afforded protection by the classification of Special Protection Areas (SPAs), these are also designated to protect all regularly occurring migratory species, paying special attention with regard to the protection of wetlands, particularly those of international importance (Article 4). The requirement to carry out HRA also applies to SPAs.

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

8.2.5. Under the WCA (England and Wales) all birds, their nests and eggs (with exception of species listed under Schedule 2) are protected by the WCA. It is an offence to intentionally kill, injure, or take any wild bird, take or destroy their eggs or to damage or destroy the nest of any wild bird (but only, with specified exceptions, whilst being built, or in use). In addition, species listed on Schedule 1 of the act are afforded special protection year-round, regardless of whether they are nesting or not.

8.2.6. Animal species listed at Schedule 5 of the WCA, which includes species of reptile native to the UK, are afforded either full or partial protection against the killing, injuring or taking, the possession or control of individuals (live or dead) and the damage, destruction, disturbance or obstruction of places of shelter or protection.

8.2.7. Section 14 of the WCA also makes provision for the control of invasive non-native animal and plant species and makes it illegal to allow these species to spread in the wild.

8.2.8. In addition, section 13 of the WCA makes it an offence (subject to exceptions) to pick, uproot, trade in, or possess (for the purposes of trade) any wild plant listed in Schedule 8, and prohibits the unauthorised intentional uprooting of such plants.

Countryside and Rights of Way (CRoW) Act 2000

8.2.9. The CRoW Act has amended the WCA in England and Wales, strengthening the protection afforded to Sites of Special Scientific Interest (SSSI) and the legal protection for threatened species.

The Natural Environment and Rural Communities (NERC) Act 2006

8.2.10. Section 41 of the Act provides for the publication of a list of living organisms and habitats that are of principal importance for the conservation of biodiversity in England. The list guides public authorities who are required by section 40 to have regard to the purpose of conserving biodiversity in the exercise of their functions.

The Wild Mammals (Protection) Act 1996

8.2.11. The Wild Mammals Act is designed to prohibit specified forms of animal cruelty and makes it an offence to intent to inflict unnecessary suffering on a wild mammal through such acts as mutilation, beating or drowning.

The UK Post-2010 Biodiversity Framework (2011-2020)[58]

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

Biodiversity 2020: A strategy for England's wildlife and ecosystem services[59]

8.2.13. This document provides a strategy on the implementation of international legislation and provides a strategic plan for biodiversity policy for terrestrial, aquatic and marine habitats.

The National Planning Policy Framework (July 2018)[60]

8.2.14. The revised NPPF (which replaced the previous 2012 NPPF on 24 July 2018) policy concerning the conservation and protection of the natural environment requires that decision making should seek to minimise impacts on, and provide net gains for biodiversity. This includes the establishment of ecological networks that are resilient to existing and future pressures (paragraph 170).

The National Planning Policy Statement for National Networks

8.2.15. The NPS NN sets out the need for, and Government's policies to deliver, NSIPs on the national road and rail networks in England. It provides planning guidance for NSIPs on the road and rail networks, and the basis for the examination by the Examining Authority and for the primary decision-making process by the SoS.

8.2.16. The NPS NN states that for projects that are subject to the Environmental Impact Assessment Directive, that a full Environmental Statement taking into account impacts on biodiversity must be prepared.

8.2.17. Furthermore, the NPS NN states that any scheme must establish whether there are likely to be impacts on a Natura 2000 site covered under the Habitats Regulations prior to the granting of a DCO.

National Policy Statement for Ports

8.2.18. The NPS for Ports sets out the Government's strategy for new port infrastructure to meet current and future needs. It determines the approach planning decision-makers should take with respect to ports and port infrastructure proposals.

[58] JNCC and DEFRA (on behalf of the Four Countries' Biodiversity Group). 2012. UK Post- 2012 Biodiversity Framework, July 2012. Available from http://jncc.defra.gov.uk/pdf/UK_Post2010_Bio-Fwork.pdf

[59] DEFRA (2011). Biodiversity 2020: A Strategy for Englands Wildlife and ecosystem services. [online] Available here https://www.gov.uk/government/publications/biodiversity-2020-a-strategy-for-england-s-wildlife-and-ecosystem-services Accessed June 2018

[60] Ministry of Housing, Communities and Local Government (July 2018) National Planning Policy Framework. Available here:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/728643/Revised_NPPF_2018.pdf

8.2.19. The NPS for Ports requires investigation into the effects of the project on marine ecology, biodiversity and protected sites, and to take into account discharges to water and physical modifications of the water environment that may affect ecological resources. Consideration should be made of the effects of noise on sensitive marine resources and the Environment Agency, Natural England and the Marine Management Organisation should be consulted as necessary.

8.2.20. In Paragraph 5.1.22, the NPS for Ports states that capital dredging requirements will need to be subject to assessment within the ES.

Norfolk Biodiversity Action Plan[61].

8.2.21. The Norfolk Biodiversity Action Plan identifies objectives and targets to promote and protect biodiversity within the county during the development planning process.

8.3 ASSESSMENT METHODOLOGY

8.3.1. The assessment will be based on the methods outlined in the following guidance:

- DMRB Volume 11, Section 3, Part 4 Ecology and Nature Conservation[62];
- IAN 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment, Highways Agency (2010)[63];
- Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland published by the Chartered Institute of Ecology and Environmental Management (CIEEM) (2016)[64]; and
- Guidelines for the Ecological Impact Assessment in Britain and Ireland: Marine and Costal published by Chartered Institute of Ecology and Environmental Management (CIEEM) (2010[65]).

8.3.2. Establishment of the baseline environment for nature conservation has involved a review of the existing information relating to designated and non-designated sites, habitats and fauna.

8.3.3. In addition to the guidance detailed above, the assessment of ecological impacts has been undertaken in accordance with the following guidance:

- Institute of Environmental Assessment (IEA) (1995) Guidelines for Baseline Ecological Assessment (Ref 1.21)[66];
- Highways Agency (2001) Design Manual for Roads and Bridges (DMRB) Volume 10 Section 4 Nature Conservation (Ref 1.22)[67];

[61] Norfolk Biodiversity Action Plan (BAP) (1999) Available at http://www.norfolkbiodiversity.org/actionplans/
[62] DMRB (1993) Design manual for roads and bridges (DMRB) Volume 11 Environmental Assessment [online] available at: http://www.standardsforhighways.co.uk/dmrb/vol11/section3.htm (Accessed November 2017).
[63] Highways England (2010). Interim Advice Note 130/10 - Ecology and Nature Conservation: Criteria for Impact Assessment Interim Advice Note 130/10. Highway England
[64] Chartered Institute of Ecology and Environmental Management (2006) Guidelines for Ecological Impacts Assessment in the United Kingdom CIEEM. Winchester. Ratcliffe, D.A (Ed.) (1977) A Nature Conservation Review. Cambridge University Press
[65] Chartered Institute of Ecology and Environmental Management (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal.
[66] Institute of Environmental Assessment (1995) Guidelines for Baseline Ecological Assessment. First Edition published by E & FN Spon, London UK
[67] Highways Agency 2001. Design Manual for roads and Bridges Volume 11, Section 4 Nature Conservation.

- Highways Agency Best Practice in Enhancement of Highways Design for Bats[68] (Ref 1.23); and
- Highways Agency (Oct 2008) IAN 116/08 Nature Conservation Advice in Relation to Bats (Ref 1.24)[69].

8.3.4. A number of surveys have been, or will be, undertaken (detailed in Table 8.3) and are proposed to verify and update baseline information related to habitats and fauna and where the results of these surveys are available they are presented in this PEIR chapter. The species-specific surveys are:

- Black redstart breeding surveys;
- Breeding bird surveys;
- Vantage point surveys for birds;
- Bat roost surveys: building inspections and emergence/re-entry surveys; and
- Water vole surveys.

8.3.5. The surveys proposed to be undertaken have been discussed with Natural England and NCC and additional representation has been made in the Scoping Opinion[6].

8.3.6. Characterisation of ecological impact is a process that starts with the 'evaluation of ecological resources', which identifies the most valuable resources that may be impacted by the Proposed Scheme.

8.3.7. The value given to an ecological receptor takes into account any statutory or non-statutory designations, the intrinsic value of the receptor and whether it supports legally protected or notable species. Consideration will be given to the value of the species or habitat and its conservation status at a geographic level taking population size, life cycle, rarity and/or distribution into account. Each ecological resource will be assessed as being valuable, or potentially valuable, within a geographic frame of reference as set out in Table 1 of IAN 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment. The resource valuation will be further informed by CIEEM Guidelines.

8.3.8. Once the evaluation of ecological resources has been carried out, the assessment will identify potential biophysical changes arising from proposed activities during the construction and operation of the Proposed Scheme that may affect receptors. In accordance with the DMRB and CIEEM, this will take account of design mitigation measures only (i.e. in the absence of any other mitigation), thus providing clear information regarding the unmitigated impacts to inform the identification of appropriate mitigation and/or compensation requirements.

8.3.9. Characterisation of ecological impacts upon each receptor requires the determination of a range of parameters as shown in Table 8.1 – Characterisation of ecological impacts on each receptor developed from IAN 130/10) to inform the determination of impact significance. These criteria take account of both direct loss of habitat and ecological resources through land take, and perceived indirect impacts such as pollution and habitat fragmentation.

[68] Highways Agency, March 2006. Best practice in enhancement of highway design for bats literature review. [online[Available at http://webarchive.nationalarchives.gov.uk/20120810191207/http://www.highways.gov.uk/knowledge_compendium/assets/documents/Portfolio/Best%20Practice%20in%20Enhancement%20of%20Highway%20Design%20for%20Bats%20-%20775.pdf

[69] Highways Agency 2008. Interim Advice Note 116/08 Nature Conservation in Relation to Bats

Table 8.1 – Characterisation of ecological impacts on each receptor

Impact Character	Description
SI – Sign	Positive (Beneficial) or Negative (Adverse).
PO – Probability of Occurring	Certain, Probable, Unlikely.
CO – Complexity	Direct, Indirect, Cumulative.
EC – Extent	Area measures and percentage of total (e.g. area of habitat/ territory lost).
SZ – Size	Description of level of severity of influence (e.g. complete loss, number of animals affected).
RE – Reversibility	Reversible or Not Reversible (can the effect be reversed, whether or not this is planned?).
DU – Duration	Permanent (P) or Temporary (T) in ecological terms. Where differing timescales are determined in relation to the life-cycle of the receptor, these should be defined.
TF – Timing and Frequency	Important seasonal and/ or life-cycle constraints and any relationship with frequency considered.

8.3.10. Having characterised impacts, proposals for mitigation, compensation and enhancement will be considered, with the aim of avoiding or reducing the significance of impacts. Subsequent to the mitigation proposals, the overall residual significance of impacts on each receptor will be assessed.

8.3.11. Using the receptor value ascertained from Table 1 of IAN 130/10 and the characterisation impact table from Table 8.1 – Characterisation of ecological impacts on each receptor , it is possible to assign an 'overall significance category'. Table 3 of IAN 130/10 illustrates the approach taken to relating significant impacts at different levels of value.

8.3.12. Based on the findings of the assessments, mitigation measures leading to avoidance, reduction or compensation of adverse effects will be identified prior to an evaluation of the effects of impacts. Typical mitigation measures could include wildlife fencing, compensatory planting, habitat creation, adoption of working practices and programming to avoid or reduce disturbance.

8.4 BASELINE ENVIRONMENT

8.4.1. A desk study, Phase 1 Habitat survey and species-specific surveys for breeding birds, black redstarts, bats and water vole have been undertaken to date to identify changes to known biodiversity resources and include both designated and non-designated sites.

8.4.2. The surveys are being undertaken with reference to the following guidance:

- TAG Unit A3 Chapters 5 and 9 (which also references DMRB Volume 11 and Section 3 Part 4)[70];
- Chartered Institute for Ecology and Environmental Management (CIEEM) (2016) Guidelines for Ecological Impact Assessment in the UK. CIEEM, Winchester[64];

[70] Department for Transport (2015). TAG Unit A3 Environment Impact Appraisal Chapters 5 and 9. [online] Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/638648/TAG_unit_a3_envir_imp_app_dec_15.pdf (Accessed January 2018)

- DMRB Volume 11 Section 4 Assessment of the Implications (of Highways and/or Road Projects) on European Sites (including Appropriate Assessment)[67];
- Bibby, C., N. Burgess, D. Hill and S. Muste (2000). Bird Census Techniques: 2nd edition. Academic Press;
- Collins, J. (Ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition) The Bat Conservation Trust, London; and
- Strachan, R. and Moorhouse, T. (2006). Water Vole Conservation Handbook, 2nd Edition. Wildlife Conservation Research Unit (WildCRU), Oxford University.

DESK BASED STUDIES

Statutory Designated Sites

8.4.3. The desk-based search established that there is one internationally designated statutory nature conservation designation within the Broad Study Area. This is the Outer Thames Estuary Special Protection Area (SPA) (see Figure 8.6). It covers an area of c. 3,924km^2, classified for the protection of wintering red-throated diver. This area supports the largest aggregations of wintering red-throated diver in the UK, 38% of the GB population. The foraging areas protected for little tern *Sternula albifrons* and common tern *Sterna hirundo*, enhance the protection afforded to their feeding and nesting areas in the adjacent coastal SPAs.

8.4.4. It is noted that the River Yare and the River Bure are now included within the Outer Thames Estuary SPA. The extension was proposed in 2016 and formally implemented in 2017. The reason for the inclusion of the River Yare channel in the extended SPA, to abut the eastern boundary of the existing Breydon Water SPA, and the lower River Bure, was to provide continuous SPA coverage for common terns foraging from the latter SPA. In the Scoping Report[5] the following designated sites within the Extended Study Area were identified as requiring consideration and this has informed the Extended Study Area:

- Breydon Water SPA, Ramsar and Site of Special Scientific Interest (SSSI), located approximately 2.2km to the north/northwest of the Proposed Scheme;
- Great Yarmouth North Denes SPA and SSSI, located approximately 3.2km north/northeast of the Proposed Scheme; and
- The Broads National Park, located approximately 1km to the northwest of the Proposed Scheme.

Non-Statutory Designated Sites

8.4.5. There are no non-statutory designated sites within the Broad Study Area.

8.4.6. Breydon Water, located approximately 2.2km to the north/northwest of the Proposed Scheme is also designated as an RSPB Reserve, in additional to the statutory designations detailed in Paragraph 8.4.5.

Species Records

8.4.7. A review of desk study data has established records of the following protected species within the Broad Study Area:

- Records of seven species of bat (common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *Pipistrellus pygmaeus*, Nathusius' pipistrelle *Pipistrellus nathusii,* Daubenton's bat *Myotis daubentonii*, noctule *Nyctalus noctula*, serotine *Eptesicus serotinus* and brown long-eared bat *Plecotus auritus*). Brown long-eared bat, noctule and soprano pipistrelle are also listed as target species on the Norfolk Biodiversity Acton Plan (BAP);
- Records of otter *Lutra lutra*, water vole *Arvicola amphibious* and badger *Meles meles*. Otter and water vole are also both included on the Norfolk BAP;

- Records of natterjack toad *Epidalea calamita*, common lizard *Zootoca vivipara* and slow worm *Anguis fragilis*; and

- A large number of bird species, including 50 species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) which are protected at all times of the year. Sixteen species of bird are included on the Norfolk BAP, including little tern and swift *Apus apus*.

8.4.8. The desk study data also included records of several priority species (S41 NERC Act as amended) that have been recorded within the Broad Survey Area. These include European hedgehog *Erinaceous europaeus*, brown hare *Lepus europaeus*, common toad *Bufo bufo* and goat moth *Cossus cossus*. These species are afforded no formal protection within the UK but must be taken into consideration during the planning phase.

FIELD STUDIES

Habitats

8.4.9. The type and extent of habitats identified within the Main Study Area are described in Table 8.2 and shown in the Great Yarmouth Third River Crossing Preliminary Ecological Appraisal [PEA] Report[71] (Mouchel, 2016) (Appendix 8A).

Table 8.2 – Habitats Present within the Main Study Area

Habitat	Description
Amenity grassland	Southtown Common recreation ground lies to the south of William Adams Way. This area contains amenity grassland dominated by perennial rye-grass *Lolium perenne*, with some white clover *Trifolium repens*, ribwort plantain *Plantago lanceolata* and common dandelion *Taraxacum officinale* also present.
Allotments	The area to the east of Suffolk Road contains several allotments which, in addition to scattered native tree species, contained varieties of arable crops and introduced garden plants.
Hardstanding and Buildings	The area to the east of the river Yare is well built up with roads, industrial buildings and concrete storage space for materials being shipped. Butterfly bush *Buddleja davidii*, creeping thistle *Cirsium arvense* and ragwort *Jacobaea vulgaris* were seen to be growing amongst the concrete.
Hedgerow	There are several species poor hedgerows surrounding properties east of the River Yare.
Ditch	The north and west of Southtown Common is bordered by a ditch containing standing water. The banks are covered by common nettle *Urtica dioica*, bramble *Rubus fruticosus*, great willowherb *Epilobium hirsutum*, dog rose *Rosa canina* and creeping thistle. To the north of William Adams Way and to the west of Suffolk road, is a wet ditch and associated scrub habitat. The ditch passes under William Adams Way and runs north away from the road. The area around the ditch contains willow *Salix* sp., great willowherb, bramble, common nettle, hawthorn *Crataegus monogyna*, poplar *Populus* sp. and field bindweed *Convolvulus arvensis* and hogweed *Heracleum sphondylium*.
River	The proposed bridge will cross the River Yare. At this location the river is tidally influenced. Mud and silt, typically associated with this habitat are likely to support benthic invertebrate communities and fish stocks. Common terns *Sterna hirundo* are known to forage on the River Yare. This stretch of the Yare is in use as a working port.

[71] Mouchel 2016. Great Yarmouth Third River Crossing Preliminary Ecological Appraisal Produced for Norfolk County Council

Habitat	Description
Scattered trees	A mixture of broadleaf trees are present in the margins of Southtown Common, as well as bordering William Adams Way to the north and south. Pedunculate oak *Quercus robur*, beech *Fagus sylvatica*, poplar *Populus* spp., willow *Salix* spp., hawthorn *Crataegus* spp., sweet chestnut *Castanea sativa* and horse chestnut *Aesculus hippocastanum* are all present alongside ash *Fraxinus excelsior* and elder *Sambucus nigra*.

Species

8.4.10. A summary of species potential and results of surveys undertaken to date within are provided in Table 8.3 – Species Surveys Proposed and Undertaken.

Table 8.3 – Species Surveys Proposed and Undertaken

Species	Description
Aquatic Ecology	The River Yare has the potential to support a range of aquatic species and communities including fish and benthic invertebrates. Aquatic ecological assessment work, including fish trawl surveys are yet to commence, however it has been identified as a future survey requirement. Discussions with Natural England, the Environment Agency and the Marine Management Organisation (MMO) are ongoing in relation to surveys in respect of the marine environment.
Bats	Thirteen structures were assessed for their suitability to support roosting bats during August 2017 (described within the Protected Species Survey Report, presented in Appendix 8B). Ten were assessed as having Low Roost Suitability, and two as having Negligible Roost Suitability. One building was inaccessible. Further surveys, comprising internal inspections and dusk emergence/dawn re-entry surveys will be undertaken and the results, along with any subsequent mitigation measures required, will be incorporated into the ES. Foraging habitats such as open water, domestic gardens and allotments within the vicinity of the Proposed Scheme were fragmented and unconnected. This foraging habitat is of low suitability for use by foraging and commuting bats. Two transects were undertaken in July and August 2017. No bats were recorded along Transect 1. This was likely to be a result of the absence of vegetation and high levels of artificial lighting. One species of bat, common pipistrelle, was recorded along Transect 2. Four commuting passes were recorded along the northern edge of Southtown Common, where it meets William Adams Way. No bat foraging activity was recorded.
Badgers	No evidence of badger was recorded during the survey work undertaken. There are no habitats suitable for badger within the Main Survey Area. Accordingly, no further surveys will be undertaken for this species.
Otter	The main channel of the River Yare, through the centre of the Survey Area, is canalised and with no suitable locations for otter holts. It is therefore unlikely that this species could be affected by the Proposed Scheme and no further surveys will be undertaken for this species.
Water vole	A ditch is present on the northern and western edge of Southtown Common. A water vole survey, undertaken in August 2017 (described within the Protected Species Survey Report, presented in Appendix 8B), recorded feeding remains and water vole droppings along this section of the ditch. Although the ditch continues to the north of William Adams Way, this could not be surveyed as access to the channel and banks could not be safely achieved. Further surveys for water vole will be undertaken following a change in the scheme alignment since the previous surveys were undertaken. The results of these surveys will be reported in the ES.

Species	Description
Other mammals	The habitats within the footprint of the Proposed Scheme, including residential gardens and an area of allotments on Queen Anne's Road are suitable habitat for hedgehog, although no evidence of hedgehog was recorded during the survey work undertaken. Measures to mitigate the impact of the Proposed Scheme on hedgehogs will be included within the ES. Further surveys for hedgehogs will not be undertaken.
Amphibians	There is a small pond located roughly within the centre of the Main Survey Area, adjacent to William Adams Way and Queen Anne's Road (approximate Ordnance Survey grid reference: TG523058). The pond and the surrounding habitat, which comprises grassland, scrub and woodland, is suitable for amphibians. In addition, a ditch is present within the Survey Area, located on the northern and western edge of Southtown Common. At the time of survey, the ditch contained standing water. The ditch and adjacent terrestrial habitat within Southtown Common is also suitable for amphibians. Both the pond and the ditch were subject to a Habitat Suitability Index (HSI) assessment in September 2016 to assess suitable for great crested newts *Triturus cristatus*. The ditch scored 0.49 and the pond scored 0.52 which corresponds as 'poor' and 'below average' suitability. These scores indicate that great crested newts are unlikely be present in these waterbodies, and therefore further surveys will not be undertaken.
Reptiles	The majority of habitats within the footprint of the Proposed Scheme comprise either short or open sward grassland, or concrete urban areas which are of negligible value for reptiles. The allotments south of Queen Anne's Road (approximate Ordnance Survey grid reference: TG523058) provide suitable habitat for reptiles, including a mix of tall ruderal vegetation and long sward grassland, with areas of compost and logs which could be used as refugia. However, this habitat is limited in extent, subject to frequent disturbance and surrounded by entirely by urban development with no connectivity to other suitable habitats within the wider area. Accordingly, the suitability of this habitat for reptiles is limited such that should reptiles be present, it is likely that they will occur in low numbers only. Measures to mitigate the impact of the Proposed Scheme on reptiles will be included within the ES. Further surveys for reptiles will not be undertaken.
Birds	Trees, areas of scrub and a number of buildings within and adjacent to the Proposed Scheme are suitable for use by breeding birds. Breeding bird surveys, comprising transect and vantage point surveys, are ongoing through 2018. These surveys will provide information on the assemblage of species using the habitats within the Main Study Area, including bird species that may be using the River Yare. The mosaic of urban areas with scattered ruderal vegetation and scrub is suitable for black redstart Phoenicurus ochruros. Dedicated surveys for this species are ongoing throughout 2018.

8.5 PREDICTED EFFECTS

8.5.1. The DMRB recognises a number of nature conservation resources which could be affected by the construction and future use of a road scheme of the type proposed. These comprise designated and non-designated sites, important habitats and habitat-types and protected and notable species.

8.5.2. Taking into account the intended design form and likely construction requirements of the Proposed Scheme, and the data derived from desk studies, the PEA and the species-specific surveys undertaken to date, impacts which could result from implementation and future use of the Proposed Scheme have been identified. These are described below and will form the focus of the assessments which are yet to be undertaken and will be reported within the ES, alongside any mitigation measures which may be required.

8.5.3. CONSTRUCTION

- Killing, injuring and disturbance of protected species during construction;
- Temporary reduction in water quality through sedimentation caused by construction works within the River Yare, with consequent effects upon habitats, aquatic species and conservation designations;
- Contamination of watercourses through accidental spillage of fuels/chemicals with consequent effects upon aquatic habitats, aquatic species and conservation designations;
- Contamination of watercourses as a result of mobilisation of existing ground contamination. Consequent effects upon aquatic habitats, aquatic species and conservation designations;
- Potential contamination of nearby habitats, watercourses and designated sites as a result of a reduction in air quality (including construction related dust).
- The works may disturb foraging and commuting bats using affected habitats. This is considered to be a minor effect on bats as the works are of temporary duration and bat activity is low throughout the area of works.
- Floodlighting used during nights works (if required) could disturb bats or prevent them from using, or cause severance of, regular commuting routes or foraging areas.

8.5.4. OPERATION

- Direct loss of habitat through land-take;
- Direct loss of the river banks/aquatic habitats, through the construction of the bridge structure, including areas that fall within the Outer Thames Estuary SPA;
- Potential for effects upon the Conservation Objectives of the SPA for bridge works, in terms of any piers, which will be located within the SPA;
- Fragmentation of retained habitats and/or severance of wildlife corridors;
- Wildlife fatalities as a direct result of severance of foraging routes, breeding sites or territories;
- Contamination of watercourses and/or waterbodies associated with road related run-off. Consequent effects upon aquatic habitats aquatic species and conservation designations;
- Disturbance of nocturnal animals, such as bats, where road lighting introduces a new light source;
- Disturbance of wildlife as a result of increased noise and vibration; and

8.5.5. Pursuant to the Conservation of Habitats and Species Regulations 2017[72] an assessment will be undertaken of the Proposed Scheme's effects on the Breydon Water SPA and Ramsar site, the Great Yarmouth North Denes SPA and the Outer Thames Estuary SPA (including the River Yare SPA) (the European Sites). It is proposed that Information relating to HRA will not be duplicated in the ES but will be cross-referenced within the ecology chapter as appropriate.

[72] S.I. 2017/1012

8.6 PROPOSED MITIGATION

8.6.1. Mitigation measures will be included within the interim CoCP that will accompany the ES and will be secured through the full CEMP. The opportunity for these will be considered following consultation and will be presented in the ES.

GENERAL MEASURES

8.6.2. At this PEIR stage, prior to completion of internal inspection surveys and emergence/re-entry surveys, it is not possible to determine the impact of the Proposed Scheme on bats. Mitigation and enhancement measures will be informed as appropriate by the results of these surveys and presented in the ES.

8.6.3. Fish trawl surveys are due to be undertaken in conjunction with the benthic ecology surveys. The effect of the Proposed Scheme on fish passage, and any mitigation measures required, will be presented in the ES.

8.6.4. Further mitigation and enhancements will be proposed after the completion of surveys.

8.6.5. Generic measures adopted as best practice to avoid predicted effects of degradation of terrestrial habitats, watercourses and species adjacent to work sites include the following:

- All site works should be carried out in accordance with best environmental working practices e.g. CIRIA publications.
- Polluting materials should not be stored in works areas located within areas of significant biodiversity value, particularly within 50m of watercourses.
- Methods to minimise/prevent contamination of the watercourses during the construction works should be implemented in accordance with most recent guidance.
- As many trees as possible should be retained. Essential tree surgery to the crown or roots of trees should be undertaken in accordance with British Standard (BS) 3998:2010 Tree Work Recommendations and appropriate Arboricultural Association advice notes, along with the protection of trees.
- Works that disturb drainage features should include measures to mitigate adverse effects or reinstate drainage to ensure the features retain their correct working function.
- The presence of significant ecological receptors has implications for the timing of the development work. The avoidance of periods of particular sensitivity is considered best practice and should be considered.
- All trenches and work excavations should be covered overnight or fenced off to prevent animals becoming trapped, and trenches should include an earth ramp to allow animals to climb out.
- A watching brief should be maintained throughout the works. If any protected species are found, a clerk of works or ecologist should advise how best to proceed.
- Areas of verge that are temporarily disturbed should be re-instated after completion of the works. Habitats should be encouraged to regenerate naturally.
- In view of the current national issue with the fungal infection of ash trees by *Chalara fraxinea*, a walkover survey for signs of ash dieback is recommended prior to works within areas containing ash or which require the felling of ash trees. If infected ash trees are identified, appropriate bio-security advice issued by Highways England and the Forestry Commission should be followed.

CONSTRUCTION

8.6.6. In order to minimise the risk of disturbing breeding birds, the removal of woody vegetation should be undertaken outside of the breeding season (typical breeding season is March to July inclusive). If tree and vegetation removal has to take place during this period, the vegetation should be checked prior to removal for the presence of nests by an appropriately experienced ecologist. If nests that are in use are present, it may be necessary to delay work in immediate proximity to the nest until the young have fledged.

8.6.7. Given the known presence of water vole within the Application Site, it is likely that mitigation measures will include measures to avoid incidental mortality during site clearance or construction and provision of replacement habitat to compensate for habitat lost to the footprint of the Proposed Scheme. The results of the update surveys and details of the proposed mitigation strategy will be reported in the ES.

8.6.8. Suitable habitat for reptiles is limited and isolated within the Main Study Area such that large populations of reptiles are unlikely to be present. During construction, it is possible, though unlikely, that individual animals may be present in these isolated areas of suitable habitat. Precautionary measures as follows are at this stage considered likely to be effective to ensure that individual animals are not affected during the works.

- Reptiles will be excluded from the proposed works area through habitat manipulation and natural refugia removal.
- Habitat manipulation will involve strimming the vegetation within the works area prior to commencement of works to reduce the vegetation to a sward height that would encourage reptiles to move offsite and into adjacent areas. This should be undertaken when reptiles are active, i.e. between mid-April to mid-October when the temperature is at least 12ºC

8.6.9. The habitats within and around the Main Study Area are suitable to support hedgehogs. A watching brief will be maintained during the works to protect individual hedgehogs that may be present.

OPERATION

8.6.10. New planting should aim to restore the ecological value of the soft estate where affected, and should aim to enhance the local biodiversity where possible. This could include re-instating and re-linking severed linear wildlife corridors with new planting. Consideration should be given to the inclusion of locally sourced native plant species within planting proposals and the application of sensitive management and monitoring regimes.

8.6.11. Swifts and black redstarts are species for which enhancement may be possible, subject to further design. The results of the breeding bird surveys, which are currently being undertaken, will inform the need for mitigation and identify opportunities for further enhancement.

8.7 CONCLUSIONS AND EFFECTS

8.7.1. A Habitat Regulations assessment will be undertaken to determine whether the Proposed Scheme will have an adverse effect on the integrity of the European sites identified within the Broad and Extended Study Areas. Until this stage of assessment is completed, insufficient information is available to reach conclusions on the impact on these sites.

8.7.2. No habitats of ecological importance or with legal protection have been identified within the Main Study Area, although as stated in this chapter, a benthic ecology survey is still to be undertaken. As assessment of the likely effects of the Proposed Scheme on these habitats will be undertaken after these surveys are complete.

8.7.3. The assessments undertaken within the survey data collected to date have not identified any significant impact on hedgehogs, amphibians or reptiles. At this current stage of the assessment, there is insufficient information available to assess the effects upon bats, breeding birds, fish and water vole.

8.8 ASSESSMENTS STILL TO BE COMPLETED

8.8.1. Surveys for the following species and habitats are ongoing and will be presented within the ES along with conclusions on the nature of any significant effect upon them:

- Additional bats (internal inspections and dusk emergence/dawn re-entry surveys);
- Breeding birds (transect and vantage point surveys);
- Benthic ecology;
- Fish trawls; and
- Water vole.

9

CULTURAL HERITAGE

9 CULTURAL HERITAGE

9.1 INTRODUCTION

9.1.1. This chapter provides preliminary information with regard to cultural heritage as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process. It is supported by Figures 9.1 - 9.3 and Appendix 9A, 9B and 9C.

9.1.2. For the purposes of this assessment, the Proposed Scheme refers to the main area of works as presented in Figures 2.4, 2.5 and 2.6. Six outlying sites for the installation of VMS and vessel waiting facilities in the River Yare are addressed separately where appropriate.

9.1.3. The preliminary assessment in relation to cultural heritage has focused on:

- Establishment of the baseline environment relative to archaeological remains, historic buildings and historic landscapes; and
- Identification and description of predicted impacts on identified assets and resources.

STUDY AREA

9.1.4. The study area which has been adopted for the assessment of cultural heritage features extends to:

(i) 1km around the Proposed Scheme for designated assets (World Heritage Sites, Scheduled Monuments, Listed Buildings, Registered Park and Gardens, Registered Battlefields and Conservation Areas), presented in Figure 9.1;

(ii) 500m around the Proposed Scheme for non-designated cultural heritage assets, presented in figure 9.2; and

(iii) 250m around the proposed locations of the VMS signs and vessel waiting facilities, for designated cultural heritage assets presented in Figure 3a – 3g.

9.2 DIRECTIVES, STATUTES AND RELEVANT POLICES

NATIONAL LEGISLATION

Ancient Monuments and Archaeological Areas Act 1979

9.2.1. Ancient Monuments are heritage assets which can be either Scheduled Monuments (SM) or "any other monument which in the opinion of the SoS is of public interest by reason of the historic, architectural, traditional, artistic or archaeological interest attaching to it". The Act states that consent must be obtained from the SoS for works of demolition, destruction, damage, removal, repair or alteration that to a SM or assets being considered for adoption as an SM.

9.2.2. Development affecting the setting of a SM is dealt with wholly under the planning system (where the effect on setting is a material consideration) and does not require Scheduled Monument Consent. SMC. Geophysical prospection (including the use of a metal detector) on a Scheduled Monument requires prior consent from Historic England.

The Planning (Listed Buildings and Conservation Areas) Act 1990

9.2.3. The Act sets out the legal requirements for the control of works to listed buildings. Grade I buildings are those of exceptional interest. Grade II* are particularly significant buildings of more than special interest. Grade II are buildings of special interest, which warrant every effort being made to preserve them.

9.2.4. Once listed, Listed Building Consent must be obtained from the local planning authority before works to demolish, alter or extend a listed building can be carried out. In considering applications for consent the authority must have special regard to the desirability of preserving the building or its setting or any features of special architectural or historic interest which it possesses.

9.2.5. The Act imposes a duty on Local Planning Authorities to determine which parts of their area are areas of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance, and to designate these areas as Conservation Areas. Consent must be obtained under the TCPA 1990 for the demolition of buildings in a Conservation Area, and when exercising any functions under the planning acts (including the grant of planning permission for new development), local planning authorities and the SoS (as the case may be) must pay special attention to the desirability of preserving or enhancing the character or appearance of conservation areas. In addition, when considering whether to grant planning permission for development which affects a listed building or its setting, special regard must be had to the desirability of preserving the building or its setting or any features of special architectural or historic interest. These statutory duties apply in addition to the relevant policies in part 16 of the NPPF[73]..

Section 33 Planning Act 2008

9.2.6. It should be noted that where development requires a DCO under the Planning Act 2008, section 33 disapplies the need for Scheduled Monument Consent, Listed Building Consent or planning permission for the development. However, the objectives of these regulatory controls and associated policies remain an important consideration in the assessment of an application for a DCO.

NATIONAL POLICY

National Policy Statement for National Networks

9.2.7. The NPS NN states the requirements that the SoS has for DCO applications. The NPS clarifies that a heritage asset can be a building, monument, site, place, area or landscape and that the significance of the asset is a factor both its physical presence as well as its setting.

9.2.8. Within an Environmental Statement, an applicant is required to "*undertake an assessment of any likely significant heritage impacts of the proposed project ….and describe the significance of any heritage assets affected, including any contribution made by their setting. The level of detail should be proportionate to the asset's importance*."

National Policy Statement for Ports

9.2.9. The PNPS states the requirements for Port and related infrastructure. Similar to the NPS NN, an applicant is required to provide a description of the significance of affected heritage assets affected by a proposed development and the level of detail should be proportionate to the importance of the heritage asset.

National Planning Policy Framework 2018[74]

9.2.10. The Government issued the revised NPPF in July 2018 and further guidance is provided in the Planning Policy Guidance. Chapter 16 brings together the way plan making and decision making should adopt a positive strategy to ensure the conservation and enjoyment of the historic environment and how to approach consideration of the potential impacts of development on such assets. The strategy should take into account the '*desirability of new*

[73] Ministry of Housing, Communities and Local Government (July 2018) National Planning Policy Framework. Available here:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/728643/Revised_NPPF_2018.pdf

[74] Ministry of Housing, Communities and Local Government (July 2018) National Planning Policy Framework. Available here:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/728643/Revised_NPPF_2018.pdf

development making a positive contribution to local character and distinctiveness' (paragraph 185). It also requires that a high level of detail should be provided when considering proposals with the potential to affect heritage assets. In determining applications, account should be taken of the desirability of sustaining and enhancing the significance of heritage assets, the positive contribution that conservation of heritage assets can make to sustainable communities, and the desirability of new development making a positive contribution to local character and distinctiveness (paragraph 192).

9.2.11. When considering the impact of a proposal on a heritage asset, great weight should be given to its conservation (paragraph 193). Justification for any harm should be clear and convincing (paragraph 194). Where any harm to the significance of a designated heritage asset would be less than substantial, the harm should be weighed against the public benefits of the proposal. Proposals involving substantial harm to (or total loss of) significance should be refused unless it can be demonstrated that the harm or loss is necessary to achieve substantial public benefit that outweighs that harm or loss (paragraphs 195 and 6).

Local Policy

9.2.12. The Great Yarmouth Local Plan: Core Strategy[75] was adopted in 2015 and sets out the overall planning strategy for the Borough until 2030. The Council's approach to managing the historic environment is addressed in Policy CS10 – Safeguarding local heritage assets[76] and in the Saved Policies from the 2001 Great Yarmouth Borough-Wide Local Plan - BNV2: Areas of archaeological significance and BNV8 Buildings of local importance[77].

9.3 ASSESSMENT METHODOLOGY

9.3.1. The preliminary assessment examines four topic areas:

- Archaeological assets: materials created or modified by past human activities, which include a wide range of visible and buried artefacts, field monuments, structures and landscape features. This includes areas which have been identified as being of archaeological potential;
- Built heritage assets: architectural, designated or other structures with historical value (significance), such as listed buildings;
- The historic landscapes; and
- Palaeoenvironmental assets.

9.3.2. The preliminary assessment is informed by:

(i) Historic Environment Good Practice Advice in Planning Policy Notes 2-3 managing significance and setting;

(ii) DMRB, Volume 11, Section 3, Part 2; Appendix 8 (DMRB: HA208/07)[78]; and

[75] Great Yarmouth Local Plan Core Strategy 2013-2030. Adopted December 2015. [online] Available at https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1884&p=0

76 https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1884&p=0

77 https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1585&p=0

[78] Highways England (2007) Design Manual for Roads and Bridges, Cultural Heritage, Volume 11, Section 3, Part 2 [online] available at: http://www.standardsforhighways.co.uk/dmrb/vol11/section3/ha20807.pdf (Accessed November 2017).

(iii) Volume 5, Section 1, Part 2 (TA37/93)[79] and Chartered Institute for Archaeologists standards and guidance documents (refs).

9.3.3. For ease of reference, summary findings regarding identified individual heritage assets are presented in DMRB Annexes 5, 6 and 7 tabular format although the contribution of immediate, wider and extended setting, including association with other heritage assets, and the contribution these factors make to significance is presented in other sections of this chapter. The tables include consideration of the value (significance) of archaeological remains, historic landscapes, built heritage and set out the assessed magnitude of impact and significance of effect of the Proposed Scheme after mitigation has been taken into account.

ESTABLISHMENT OF THE BASELINE ENVIRONMENT

9.3.4. The identification and description of the baseline environment has used data from the following sources:

- Data has been gathered on designated heritage assets from the National Heritage List for England (NHLE)[80];
- Details of non-designated heritage assets have been gathered from the Norfolk Historic Environment Record (NHER)[81];
- Information on Conservation Areas held by Great Yarmouth Borough Council[82];
- A preliminary assessment of the potential of the study area presented in the Cultural Heritage Desk-based Assessment (WSP 2017), presented in Appendix 9B;
- Geoarchaeological Feasibility Study (Wessex Archaeology 2018), Presented in appendix 9C.

9.3.5. Initial value assessments have been made for each cultural heritage asset following the guidance set out in DMRB volume 11, Section 3, Part 2 (HA 208/07)[78].

VALUE OF CULTURAL HERITAGE ASSETS

9.3.6. Assessment of the value of cultural heritage assets will involve consideration of the heritage interest of the asset to this and future generations. That interest may be archaeological, architectural, artistic or historic, and may derive not only from the asset's physical presence, but also from its setting, and from individual or group qualities, either directly or potentially. These are professional judgements, but they are also guided by legislation, national policies, acknowledged standards, designations, criteria and priorities. The assessment of value (also referred to as significance) will be undertaken in line with DMRB guidance, and in compliance with the NPPF and the following relevant professional guidelines: Chartered Institute for Archaeologists (CIfA) Standard and Guidance for Historic Environment Desk-based Assessment (2017)[83] and CIfA Code of Conduct (2014)[84].

9.3.7. The DMRB recommends the adoption of six ratings for value in relation to archaeological remains and built heritage: very high, high, medium, low, negligible and unknown. Definitions for each rating are outlined in Table 9.1 - Factors for assessing the value of archaeological remains.

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[79] Highways Agency 1993. Scheme Assessment Reporting Part 2, TA37/93. [online] Available at http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol5/section1/td3793.pdf (Accessed June 2018.

[80] https://historicengland.org.uk/listing/the-list/

[81] Norfolk Historic Environmental Record. [online] Available https://www.norfolk.gov.uk/libraries-local-history-and-archives/archaeology-and-historic-environment/historic-environment-record. Accessed May 2018

82 https://www.great-yarmouth.gov.uk/conservation-areas

[83] Chartered Institute for Archaeologists (2017) Standard Guidance for Historic Environment Desk Based Assessment [online] Available at: http://www.archaeologists.net/sites/default/files/CIfAS&GDBA_2.pdf Accessed January 2018

[84] Chartered Institute for Archaeologists (2014) Code of Conduct [online] Available at; https://www.archaeologists.net/sites/default/files/CodesofConduct.pdf Accessed January 2018

Table 9.1 - Factors for assessing the value of archaeological remains

Value	Criteria: Built Heritage	Criteria: Archaeology	Criteria: Historic Landscape
Very High	Structures inscribed as of universal importance as World Heritage Sites Other buildings of recognised international importance	World Heritage Sites (including nominated sites) Assets of acknowledged international importance Assets that can contribute significantly to acknowledged international research objectives	World Heritage Sites inscribed for their historic landscape qualities. Historic landscapes of international value, whether designated or not. Extremely well preserved historic landscapes with exceptional coherence, time-depth, or other critical factor(s).
High	Scheduled Monuments with standing remains Grade I and II* Listed Buildings Other listed buildings that can be shown to have exceptional qualities in their fabric or historical associations not adequately reflected in the category Conservation Areas containing very important buildings Undesignated structures of clear national importance	Scheduled Monuments (including proposed sites) Undesignated assets of schedulable quality and importance Assets that can contribute significantly to acknowledged national research objectives	Designated historic landscapes of outstanding interest. Undesignated landscapes of outstanding interest. Undesignated landscapes of high quality and importance, and of demonstrable national value. Well preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factor(s).
Medium	Grade II Listed Buildings Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations Conservation Areas containing buildings which contribute significantly to their historic character Historic Townscape or built-up areas with important historic integrity in their buildings, or built settings (e.g. including street furniture and other structures)	Designated or undesignated assets that contribute to regional research objectives	Designated special historic landscapes. Undesignated historic landscapes that would justify special historic landscape designation, landscapes of regional value. Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor(s).
Low	Locally Listed Buildings Historic (unlisted) buildings of modest quality in their fabric or historical association Historic Townscape or built-up areas of limited historic integrity in their buildings, or built settings (e.g. including street furniture and other structures)	Designated and undesignated assets of local importance Assets compromised by poor preservation and/or poor survival of contextual associations Assets of limited value, but with potential to contribute to local research objectives	Robust undesignated historic landscapes. Historic landscapes with importance to local interest groups. Historic landscapes whose value is limited by poor preservation and/or poor survival of contextual associations.

Value	Criteria: Built Heritage	Criteria: Archaeology	Criteria: Historic Landscape
Negligible	Buildings of no architectural or historical note; buildings of an intrusive character	Assets with very little or no surviving archaeological interest	Landscapes with little or no significant historical interest.
Unknown	Buildings with some hidden (i.e. inaccessible) potential for historic significance	The value of the site has not been ascertained	The value of the historic landscape has not been ascertained.

MAGNITUDE OF IMPACT

9.3.8. Assessment of the magnitude of impact of the Proposed Scheme on cultural heritage assets will involve consideration of the degree of change that would be experienced by the asset and its setting if the Proposed Scheme were to be completed as compared with a 'do nothing' situation. The assessment will take into account any mitigation that is part of the design.

9.3.9. The DMRB recommends the adoption of six ratings for magnitude of impact: no change, negligible, minor adverse, moderate and major. Factors for assessing the magnitude of impact are summarised in Table 9.2 – Factors for assessing the magnitude of impact.

Table 9.2 – Factors for assessing the magnitude of impact

Magnitude of Impact	Example
Major	Change to most or all aspects of a cultural heritage asset, such that the resource is totally altered Comprehensive changes to setting
Moderate	Clear alteration to many aspects of a cultural heritage asset Considerable change to setting that affect the character of the asset
Minor	Slight alteration to cultural heritage asset. Sight alteration to setting
Negligible	Very minor changes to cultural heritage assets and their setting
No Change	No change to cultural heritage assets and their setting

SIGNIFICANCE OF EFFECT

9.3.10. Assessment of the significance of effect of the Proposed Scheme on cultural heritage assets combines the value of the resource and the magnitude of the impact (incorporating the agreed mitigation), for each cultural heritage asset.

9.3.11. The DMRB recommends the adoption of five ratings for significance of effect: neutral, slight, moderate, large and very large. The matrix used for establishing significance of effect is presented in Table 5.3.

SETTING ASSESSMENT

9.3.12. In order to determine the magnitude of impact and the significance of effects on a heritage asset due to a change in setting, an assessment is required in order to determine how the setting contributes to the significance of the heritage asset.

9.3.13. The definition of setting used here is taken from the revised NPPF: "*The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral".*' (Annex 2). Historic England in their Setting of

Heritage Assets: Historic Environment Good Practice Advice in Planning[85] that the importance of setting lies in what it contributes to the significance of the heritage asset. This depends on a wide range of physical elements within, as well as perceptual and associational attributes pertaining to, the heritage asset's surroundings.

9.3.14. Historic England discuss several other general considerations including: cumulative change; change over time; appreciating setting; buried assets and setting; designated settings; setting and urban design; and setting and economic and social viability and has provided a stepped approach to the assessment and importance of setting to heritage assets. Following Step 1, which is the initial identification of the heritage assets the subsequent steps comprise:

- Step 2: Assessing whether, how and to what degree the settings make a contribution to the cultural heritage significance of the heritage assets.
- Step 3: Assessing the effect of a proposed development on the setting, and the resulting implications for the cultural heritage significance of the heritage asset(s).
- Step 4: Maximising enhancement and minimising harm (mitigation).

9.3.15. Step 2: In assessing whether, how and to what degree the settings make a contribution to the cultural heritage significance of the heritage assets, a number of potential attributes of a setting are considered.

9.3.16. The attributes of setting contribute to its sensitivity and its contribution to the significance of the asset. Table 2 presents examples of definitions for the sensitivity of settings but these should not be seen as exhaustive.

Table 9.3 - Step 2 - Definitions of Sensitivity for the Settings of Heritage Assets

Examples of sensitivity of settings	Contribution to significance of the asset
A defined setting that is contemporary with and historically and functionally linked with the heritage asset, may contain other heritage assets of international or national importance, has a very high degree of indivisibility with the asset and makes a very substantial contribution to both the significance of the heritage asset and to the understanding and appreciation of the significance of the asset	Very substantial (very high)
Contemporary with and historically and functionally linked with the heritage asset, with minor alterations (in extent and/or character), has a high degree of intervisibility with the asset and which makes a substantial contribution to both the significance of the heritage asset and to the understanding and appreciation of the significance of the asset.	Substantial (high)
Contemporary with and/or historically and/or functionally linked with the heritage asset but with alterations which may detract from the understanding of the heritage asset, and/or with a moderate degree of indivisibility with the asset and/or which makes a moderate contribution to the significance of the heritage asset and/or a moderate contribution to the understanding and appreciation of the significance of the asset.	Moderate (medium)
Largely altered so that there is very little evidence of contemporaneous and/or historic and/or functional links with the heritage asset, and/or with a low degree of indivisibility with the asset and/or which makes a minor contribution to both the significance of the heritage asset and to the understanding and appreciation of the significance of the asset.	Minor (low)

[85] Historic England (2017) The Setting of Heritage Assets (2nd edition)

9.3.17. Step 3: Having assessed the contribution of the setting to the cultural heritage significance of the asset, the effect of a proposed development on the setting can be determined by consideration of the potential attributes of a proposed development affecting setting.

9.3.18. Once the sensitivity and contribution of the setting has been determined and the potential attributes of a proposed development identified, the level of harm or beneficial impact of a proposed development needs to be evaluated. The criteria for assessing the level of harm is presented below (Table 9.5 - Step 3 - Criteria for Assessment of the level of harm/benefit on the setting of a heritage asset). This presents definitions of varying scales of harm or benefit to the contribution of the setting.

Table 9.5 - Step 3 - Criteria for Assessment of the level of harm/benefit on the setting of a heritage asset

Level of Harm and Benefit	Guideline Criteria
Major beneficial	The contribution of setting to the cultural heritage asset's significance is considerably enhanced as a result of the development; a lost relationship between the asset and its setting is restored, or the legibility of the relationship is greatly enhanced. Elements of the surroundings that detract from the asset's cultural heritage significance or the appreciation of that significance are removed.
Moderate beneficial	The contribution of setting to the cultural heritage asset's significance is enhanced to a clearly appreciable extent as a result of the development; as a result, the relationship between the asset and its setting is rendered more readily apparent. The negative effect of elements of the surroundings that detract from the asset's cultural heritage significance or the appreciation of that significance is appreciably reduced.
Minor beneficial	The setting of the cultural heritage asset is slightly improved as a result of the development, slightly improving the degree to which the setting's relationship with the asset can be appreciated.
Negligible	The setting of the cultural heritage asset is changed by the development in ways that do not alter the contribution of setting to the asset's significance.
Minor harm (Minor Adverse) Less than substantial harm	The contribution of the setting of the cultural heritage asset to its significance is slightly degraded as a result of the development, but without adversely affecting the interpretability of the asset and its setting; characteristics of historic value can still be appreciated, the changes do not strongly conflict with the character of the site, and could be easily reversed to approximate the pre-development conditions.
Harm (Moderate Adverse) Less than substantial harm	The contribution of the setting of the cultural heritage asset to its significance is reduced appreciably as a result of the development. Relevant setting characteristics can still be appreciated but less readily.
Substantial harm (Major Adverse)	The contribution of the setting of the cultural heritage asset to its significance is effectively lost or substantially reduced as a result of the development, the relationship between the asset and its setting is no longer readily appreciable.

9.3.19. Changes may occur to the settings of an asset that neither affect their contribution to the cultural heritage significance of the asset, nor the extent to which its cultural heritage significance can be experienced. In such instances, it will be considered that there is no impact upon setting

9.4 BASELINE ENVIRONMENT

9.4.1. All designated and non-designated heritage assets within the study area are listed in the gazetteer presented within Appendix 9.1

9.4.2. No World Heritage Sites, Registered Battlefields, Registered Parks or Gardens or Protected Wreck sites have been identified within 1km of the Proposed Scheme.

9.4.3. The Grade II listed Dolphin Public House (NHLE 1096829), an early 20th century building, is located within the Proposed Scheme boundary.

9.4.4. Designated heritage assets (see Figure 9.1) in the wider (1km) Study Area consist of:

- Four Scheduled Monuments;
  - Town Walls (NHLE 1003782);
  - Nos 6, 7, and 8, Row 111 South Quay (NHLE 1003958, and also Grade II Listed Building NHLE 1245916);
  - Merchant's House, Row 117, South Quay (NHLE 1004020, see also Grade II* below); and
  - Greyfriars Franciscan Friary (NHLE 1017910).
- Four Grade I Listed Buildings;
  - The Tollhouse (NHLE 1245560);
  - Remains of the Church of the Greyfriars (NHLE 1245915);
  - St Georges Theatre (NHLE 1245919); and
  - Nelson's Monument (NHLE 1246057).
- Eight Grade II* Listed Buildings;
  - Great Yarmouth Potteries (NHLE 1245561);
  - Custom House (NHLE 1245800);
  - 25, South Quay (NHLE 1245803);
  - Old Merchant House (NHLE 1245917, see also Scheduled Monument above);
  - The Hippodrome (NHLE 1245922);
  - St Nicholas Hospital Main Entrance Range (NHLE 1245984);
  - Old White Lion Public House (NHLE 1271278); and
  - The Winter Gardens (NHLE 1271608).
- 102 Grade II Listed Buildings, including;
  - Hotels and Public Houses;
  - Residential properties;
  - Churches;
  - Public and Leisure facilities; and
  - Industrial buildings.
- Six Conservation Areas;
  - Camperdown;
  - Gorleston Extension;
  - King Street;
  - Seafront;
  - Hall Quay and South Quay; and
  - St George's.

9.4.5. There are a further 119 non-designated heritage assets recorded on the NHER in the 500m study area (see Figure 9.2). Eight lie within the Proposed Scheme:

- The Route of Norfolk and Suffolk Joint Railway (HER 13575);

- Routes of Great Yarmouth urban railways (HER 13576);
- Site of World War Two defences (HER 27967) – evidence from aerial photographs from the late 1940s of fencing and barbed wire along with several small buildings;
- Site of late 19th century icehouse and three salt stores (HER 55685);
- Site of World War II craters (HER 27700 and 43589); and
- Site of World War II anti invasion defences at Southtown (HER 42355 and 42353).

9.4.6. The vast majority of these assets in the Study Area represent World War II structures, camps and bomb crater sites, with the remaining sites comprising finds and structures which reflect the important Naval and shipping history of the town. The majority of the remaining recorded assets date to the post medieval period. Within the wider study are there is evidence of buried urban and riverfront remains dating to the Medieval period, as well as a single findspot of a Neolithic scraper (HER 12936).

9.4.7. A deposit model for soils in Great Yarmouth has been created by the Great Yarmouth Archaeological Map project using data from 142 boreholes which were drilled by the Norfolk County Laboratory. The model shows that the area where Great Yarmouth now stands started out as the mouth of a large estuary. Since the last Ice Age, a south bound current has laid a spit of sand across the north of the estuary, from the north end to the south. The sand spit blocked off the estuary, leading to the formation of the peat in the Broads. The sand spit was breached by the sea, and left as either a low tidal island or a shoal until about 1300 years ago, gradually rising to become permanently dry. When it was first occupied, probably at some point during the tenth century, it was a low-lying sand bank about 1m above sea level. Throughout the first centuries of habitation, large drifts of windblown sand buried dwellings and shifted sand dunes, and by the time the walls were built around the medieval town in the 13th and 14th centuries the ground level was over 1m higher.

9.4.8. The boreholes and evidence from archaeological excavations in the area suggest the presence of buried medieval shorelines (evidence of this has been found just outside the 500m study area at the site of the Power Station during its construction).

9.4.9. The medieval walled town lies to the north of the Proposed Scheme options, just outside the 500m study area. The boundary of the medieval town is represented by the well-preserved remains of the defensive walls, built in the 13th century and now designated as a Scheduled Monument (NHLE 1003782). The southern end of the town wall lies approximately 350m north of the Proposed Scheme and extends for distance of around 2km northwards. Just inside the walls, within the 500m study area, lies the site of the 13th century Dominican or Blackfriars Friary (HER 4266). Approximately 500m north of this site, just within the 1km study area, is the Scheduled Monument Greyfriars Franciscan friary, also established in the 13th century (NHLE 1017910). A third ecclesiastical site, an Augustinian Friary, is located 250m to south of Proposed Scheme (HER 60531). The presence of these establishments demonstrates the importance of the medieval settlement of Great Yarmouth.

9.4.10. Within the study area, the remains of boats have been found on an earlier buried shoreline at around 3m below the current ground level. An old landing place was also recorded below the Town Hall site in 1887. All of the above suggests that buried medieval deposits may survive deep below the current ground level on either side of the River Yare within the study area.

9.4.11. As stated above, the vast majority of features within the inner study area date to the Modern period, and specifically the period of the Second World War. Most, if not all, of these features recorded on the NHER have since been demolished and replaced by modern development.

9.4.12. The town was first bombed during World War I in 1915 (the first aerial bombardment in the UK) however, the majority of wartime features date to World War II. During this time the town suffered extensive bombing by the Luftwaffe as it was one of the last significant places German bombers could drop bombs before returning to base. Despite this, two-thirds of the medieval town wall survived. World War II sites within the inner study area include air raid shelters Anti-Aircraft batteries, pill boxes, gun emplacements, barbed wire obstructions, blast walls, beach defences, anti-tank defences and military camps. There are also at least 12 recorded bomb craters.

The presence of these known bomb craters and historic bombing activity suggests a significant risk of unexploded ordnance, particularly in softer riverbed deposits.

9.4.13. The former Norfolk and Suffolk Joint Railway, which follows the route of the A47, was opened in 1903 and was in use until 1970. Three sections of the former route of the Great Yarmouth urban railway lie on the east side of the River Yare. The urban railway was constructed from the mid-19th century and were used until the late 1920s.

BUILT HERITAGE

9.4.14. The majority of the built heritage remains within the study area are listed buildings. The area has undergone substantial industrial redevelopment in the 20th century. Earlier buildings are now isolated, although still maintain visual and/or transport links to the wharfs and river. The listed buildings consist of a mixture of uses, but a number of these are related to the Naval Hospital which dates from 1806 and was built to treat the sick and wounded from the North Sea Fleet which was engaged in war with France (NHLE 1245982 to 1245986). Great Yarmouth was an important naval base throughout the Napoleonic Wars, and Admiral Lord Horatio Nelson is known to have landed at Great Yarmouth on three occasions. Following Nelson's death, funds were raised to erect a monument in the town, 30 years before a monument was erected in Trafalgar Square. The monument is also a Grade I listed building, and lies within the study area (NHLE 1246057). It is 144 feet high and can be seen from some parts of the study area.

9.4.15. One built heritage asset lies within the Proposed Scheme Boundary, the Grade II Dolphin Public House (NHLE 1096829), which will be retained. Residential properties are located within the Proposed Scheme which correspond to buildings shown on the late 19th century Ordnance Survey Map, including those along Queen Anne's Road and Southtown Road which are to be demolished as part of the Proposed Scheme. Further assessment is required to determine whether these may appropriately be categorised as cultural heritage assets.

9.4.16. The Proposed Scheme does not lie within a Conservation Area.

HISTORIC LANDSCAPES

9.4.17. There are no designated landscapes within the study area. Historic Landscape Characterisation (HLC) has been completed for the surrounding area, however this study specifically excluded an analysis of the areas within the town and village development limits. Therefore, although the smaller villages were considered as a part of a wider landscape context and character, no specific townscape or urban character assessments were undertaken. Some areas have had Historic Landscape Character completed as part of the NCC HER Character Area Report. The study area falls across two different character types, with a linear strip of Coastal - Managed Wetland to the east of the study area. This land was previously Unimproved Intertidal land. There are also small blocks of Coastal - Drained Enclosure to the west, which were previously Coastal - Managed Wetland, Unimproved Marine Marsh or Brackish Fen.

9.4.18. Based on a preliminary study, the historic landscape of the study area is dominated by the late 19th and 20th century residential, industrial and commercial townscape, with the largely modern riverfront and harbour. The beach front is very strongly differentiated from the surrounding townscape with its 19th and 20th century leisure and tourist-focused landscape. These combined landscape types illustrate the evolution of Great Yarmouth in the recent past but are not readily indicative of the medieval or early post medieval history of the town. There are some indications of the earlier history of the settlement preserved in the street layout in the northern parts of town around Market Street.

PALAEOENVIRONMENTAL DEPOSITS

9.4.19. An appraisal of the palaeoenvironmental resource has been undertaken by Wessex Archaeology and is presented in full in Appendix 9C.

9.4.20. The early Holocene geomorphology of the Great Yarmouth area has recently been modelled by Jordan et al[86] based on 467 borehole records held by the BGS. The base of the early Holocene deposits in the area ranged between -30.46 to +7.61mOD, but within the site boundary this varies between topographic lows of -12mOD (northern limits of the site on the line of the A1243) and -6 to -8mOD (western limits of the site at the A12 and William Adams Way) to highs of -2m to 0mOD within the central sections of the site within the footprint of the proposed bridge crossing.

9.4.21. Based on an examination of borehole records held by the BGS within the scheme model, and modelling of the early Holocene geomorphology[87], a series of key deposits are identified and outlined below, with specific reference made to their geoarchaeological potential

Sands and Gravels (North Denes Formation)

9.4.22. Sands and gravels of the North Denes Formation represent marine beach deposits, mapped by the BGS to the east of the River Yare and overlying Holocene estuarine clays, silts and peats of the Breydon Formation[88]. Shelly sands are recorded in boreholes to the east of the River Yare below made ground to a depth of approximately -6mOD. It is unclear from some descriptions in borehole records whether these sands are gravels also represent Pleistocene deposits of the Yare Valley Formation. Although the North Denes Formation is of low geoarchaeological potential, the deposits do have the potential to bury and preserve archaeology, although this may be largely eroded and reworked given the marine nature of the deposits.

Fine-Grained alluvium (Breydon Formation)

9.4.23. Alluvium is a generalised term covering unconsolidated sediments transported by water in a non-marine environment (e.g. rivers and lakes). It has been used as a banner term including other sediment such as peat, which has different formation processes, but that often occur as distinct bands or discrete features within the alluvium. Both alluvium and peat are classified as part of the Breydon Formation, but are here considered separately because of their differing geoarchaeological potential. Pleistocene and Holocene sands and gravels are technically alluvium, but the term here is applied to fine-grained deposits of Holocene date.

9.4.24. Fine-grained deposits are recorded in boreholes across the Site, represented by deposits of silt and clay, often with a subordinate sand component. Along the eastern banks of the River Yare deposits of clayey-silty sand are recorded below made ground to depths between -0.57 to -6.18mOD. The variable depth may reflect the presence of a deeper channel and topographic lows suggested by deposit modelling to the south of the Site[89]. Deposits of alluvium to the east of the River Yare may also form part of the North Denes Formation.

9.4.25. Boreholes along both the eastern and western bank of the River Yare record deposits of alluvial clays, silts and sands interbedded with layers of black organic silty clay (BGS boreholes TG50BW809-893). Here the alluvium is variously sealed by made ground of between 0.75 to 3.6m thick, with the underlying alluvium outcropping between approximately 1-4mbgs, underlain by clayey-silty sands and sands and gravels. Where OD heights are available the surface of the alluvium at this location occurs at -1.27mOD (borehole TG50NW587).

9.4.26. Silty clay alluvial deposits are also recorded within boreholes along the western section of the Site, typically preserved beneath made ground at depths from 0.5mbgs and with a maximum recorded thickness of alluvium of approximately 2.5m.

9.4.27. Minerogenic alluvial deposits are not ideal for either palaeoenvironmental analysis or radiocarbon dating and are of low geoarchaeological potential. Organic material is both sparse and likely to have been transported by

[86] Jordan, H., Holbrook, H and Lawley, R. 2016. Early Holocene geomorphology of the Great Yarmouth area, Norfolk, UK. *Journal of Maps* 12, 122-130.
[87] Jordan et al. 2016.
[88] Arthurton, R S, Booth, S J, Morigi, A N, Abbott, M A W, Wood, C J, 1994, *Geology of the country around Great Yarmouth*. Memoir of the British Geological Survey, Sheet 162 (England and Wales).
[89] Jordan et al 2016, fig. 1

water over variable distances, included material eroded and redeposited from contexts of variable date. Palaeoenvironmental remains such as pollen are often poorly preserved and present in lower concentrations, often derived from large ill-defined source areas within the river catchment or tidally deposited, and with a reservoir component including pollen of varying age.

9.4.28. Deposits of organic silty clays recorded in several boreholes along the west and eastern banks of the River Yare suggest lower energy deposits, perhaps formed within a backswamp or marginal aquatic environment. Palaeoenvironmental remains in these deposits may be better preserved and derive from a more localised source area; where present such deposits are of medium geoarchaeological potential.

Peat (Breydon Formation)

9.4.29. Peat comprises partially decomposed organic matter preserved within waterlogged anaerobic (oxygen-free) conditions. In the context of the Breydon Formation, peat deposits would have developed under the background influence of sea-level rise, forming during periods of stable or falling sea-levels during which semi-terrestrial plant communities encroached into areas of former tidal mudflats and saltmarsh. Peat deposits in coastal contexts are typically a mid-Holocene phenomenon, representing a period of fluctuating sea-level tendencies.

9.4.30. Within the Proposed Scheme boundary, peat deposits are widely identified in boreholes approximately 100 m to the west of the River Yare in the area of William Adams Way, Queen Anne's Road and the Suffolk Road. The surface of the peat is recorded (where OD heights are available) at depths of between -1.49mOD (BGS borehole TG50NW429) to -2.35mOD (BGS borehole TG50NW29), ranging from 0.6 to 1.1m thick and located between 2.5 to 4mbgs.

9.4.31. Where peat deposits are present they will be of high geoarchaeological potential. Peat deposits are ideal contexts for the preservation of plant micro and macrofossils and invertebrate remains that provide key data on past vegetation environments, climate, land-use and the impact of human communities on the landscape.

Pleistocene sands and gravels (Yare Valley Formation)

9.4.32. Sands and gravels are recorded in several boreholes within the Proposed Scheme boundary, varying in surface elevation (where OD heights are available) from between -2.6mOD (borehole TG50NW582) to -6.45mOD (borehole TG50NW29), and reaching depths of up to 15mbgs. Pleistocene sands and gravels of the Yare Formation are not present on BGS maps for Great Yarmouth (BGS Geology of Britain Viewer), but are present underlying the Holocene alluvium and peat of the Breydon Formation, and may correspond to River Terrace deposits of Anglian (MIS 12) to Devensian (MIS 5-2) date.

9.4.33. River terrace deposits are preserved as evidence of former floodplains, representing phases of aggradation and incision, typically comprising coarse grained fluvial sands and gravels. The sands and gravels grade into the underlying Crag deposits, the latter typically described as dense orange-brown silty fine to coarse sands and gravels.

9.4.34. Pleistocene sands and gravels have the potential for recovery of Palaeolithic artefacts and faunal remains, although likely to be largely eroded and redeposited, with potential for preservation of in-situ organic horizons of geoarchaeological significance.

Tills (Happisburgh Glacigenic Formation and Lowestoft Formation)

9.4.35. Tills are poorly sorted sediments deposited directly by ice sheets and are mapped extensively to the immediate south of the Proposed Scheme, largely comprising Happisburgh Glacigenic Formation with small patches of the Lowestoft Formation. Both Formations were deposited during the Anglian glaciation (MIS 12, 423-480 ka). The Happisburgh Glacigenic Formation comprises a sandy till whilst the Lowestoft Formation is characterised as a chalky sandy till.

9.4.36. Description of sediments in BGS boreholes from within the Proposed Scheme boundary indicate where sandy deposits are present they typically contain a shelly and gravelly component, and are therefore likely to be marine

in origin, rather than till. Till deposits are therefore considered unlikely to be present within the Proposed Scheme boundary, but where present are of a low geoarchaeological potential.

VARIABLE MESSAGE SIGNS AND VESSEL WAITING FACILITIES

9.4.37. Six sites are proposed for the introduction of VMS and one for an vessel waiting facilities. They are discussed below by area and designated heritage assets are identified. Where data is available, non-designated heritage assets are also identified (Figure 9.3).

A47 South

9.4.38. No designated heritage assets lie within 250m of the proposed VMS on the A47 South.

9.4.39. One non-designated heritage asset lies within the proposed VMS location. This is a World War Two Light Anti-Aircraft Battery (HER 19084). Within a 250m buffer there are nine archaeological non-designated assets of World War Two date consisting of five air raid shelters (HER 43597, HER 43595, HER 43594, HER 43300 and HER 43618), an emergency water supply tank (HER 43312), pillboxes (HER 19949), road block (HER 27570) and a bomb crater (HER 27663).

Gapton Hall Road

9.4.40. No designated heritage assets are recorded within the location of the VMS n on Gapton Hall Road.

9.4.41. Within the 250m Study Area are nine non-designated heritage assets. They comprise of the site of 19th century drainage mill (HER 34996), probable post-medieval drains (HER 43474 and 43475), the route of the East Suffolk Railway (HER 13574) and Midland and Great Northern Joint Railway (HER 13581) and five World War Two sites (railway block (HER 42519), pill box (HER 32662) structure (HER 42531), and a bomb crater (HER 43470).

North Quay

9.4.42. The proposed VMS location is within the St Nicholas and Northgate Street Conservation Area. Immediately to the north of the proposed VMS location is the Scheduled Monument medieval Town Walls (NHLE 1003782). One Grade I, two Grade II* and 21 Grade II Listed Buildings lie within the 250m area around the proposed VMS location.

9.4.43. The non-designated heritage asset data was unavailable for this area at the time of the assessment.

Fuller Way

9.4.44. The proposed VMS location lies within the St Nicholas and Northgate Street Conservation Area. The Scheduled Monument medieval Town Walls (NHLE 1003782) are located approximately 150m from the proposed VMS location. Two Grade I, two Grade II* and 32 Grade II Listed Buildings lie within the 250m area around the proposed VMS location.

9.4.45. The non-designated heritage asset data was unavailable for this area at the time of the assessment.

Acle New Road

9.4.46. No designated heritage assets are located within the 250m study area. The non-designated heritage asset data was unavailable for this area at the time of the assessment.

Yarmouth Way

9.4.47. The proposed location lies between the King Street and the Hall Quay South Quay Conservation Areas. There are three Scheduled Monuments located in proximity: Medieval Town Walls (NHLE 1003782), Greyfriars Franciscan Friary (1017910) and Nos 6, 7 and 8 and Row 111, South Quay (NHLE 1003958)). Four Grade I, five Grade II* and 68 Grade II Listed buildings lie within the 250m area around the proposed VMS location.

9.4.48. There is partial data available for non-designated heritage assets and a total of 22 are recorded within proximity of the proposed VMS location and include the site of Great Yarmouth Castle (HER 13375). Most of the assets are of World War Two date.

Vessel Waiting Facilities

9.4.49. The proposed location lies adjacent to the boundary of the Gorleston Extension Conservation Area. Also within the 250m Study Area is the Cliff Hill Conservation Area. A total of seven Grade II Listed Buildings are located within the two Conservation Areas.

9.4.50. The non-designated heritage asset data was unavailable for this area at the time of the assessment.

VALUE OF RECEPTORS

9.4.51. All designated and non-designated heritage assets within the study area are listed in the gazetteer presented within Appendix 9A. The majority of the known archaeological remains found within the study area have been allocated a negligible to low value as they consist of World War 2 defensive sites which are no longer extant. Scheduled Monuments, Grade I and Grade II* Listed Buildings are high value, while Grade II Listed Buildings and Conservation Areas are medium value (see Table 9.1 - Factors for assessing the value of archaeological remains). The non-designated heritage assets are of low to medium value.

9.4.52. There is a reasonable potential to uncover previously unknown heritage assets within the study area, and this may include the buried former shoreline dating to the medieval period. If discovered within the study area, these assets would be of up to high value.

9.5 PREDICTED EFFECTS

9.5.1. The majority of the impacts upon the cultural heritage assets will occur during the construction phase. Development activities such as pilling, stripping of overburden or hardstanding, landscaping, ground compaction access, service installation, stockpiling and storage may all have a negative effect on cultural heritage assets. These construction related impacts could lead to the following effects upon the Historic Environment:

- Permanent complete or partial loss of an archaeological feature or deposit as a result of ground excavation;
- Permanent or temporary loss of the physical and/or visual integrity of a feature, monument, building or group of buildings/monuments;
- Damage to the historic environment resources as a result of ground excavation;
- Damage to historic environment resources due to compaction, desiccation or waterlogging;
- Damage to historic environment resources as a result of ground vibration caused by construction; and
- Permanent or temporary impacts on the setting of heritage assets resulting from the construction works and during operation following the introduction of new infrastructure, and the resulting increase in noise from vehicles using the new crossing.

9.5.2. Overall impacts are considered to be adverse and all are considered to be permanent although mitigation is proposed as necessary to reduce the magnitude of the impact.

9.5.3. It should be emphasised that all impacts are based upon present understanding and knowledge and the overall impact and mitigation will be refined following further assessment and evaluation.

ARCHAEOLOGY

9.5.4. There are eight non-designated heritage assets which represent potential buried archaeological remains within the Proposed Scheme. Of these, two are sites of World War II bomb craters (HER 27700 and 43589) of negligible value and three are sites of World War II defences (HER 27967, 42355 and 42353) of low to negligible value. No physical remains associated with these assets are anticipated and therefore the impact is predicted to be **negligible** or **no change.**

9.5.5. There is a potential for a **major adverse** impact on buried deposits associated with the late 19th century icehouse and salt stores (HER 55685), the Route of Norfolk and Suffolk Joint Railway (HER 13575) and the Routes of Great Yarmouth urban railways (HER 13576). All these are assets are of low value.

9.5.6. There is a potential for a major adverse impact on currently unknown heritage assets in the form of a buried medieval shoreline and associated features or finds. The value of these assets is currently unknown but could potentially be **moderate adverse**.

Variable Message Signs and Vessel Waiting Facilities

9.5.7. The location of VMS on North Quay, Fuller Way and Yarmouth Way lie within the limits of the medieval settlement of Great Yarmouth and there is a potential for buried archaeological deposits within the footprint of these which could be disturbed during the works. Given the urban nature of these three locations, it is anticipated that the archaeological remains will either be heavily disturbed and/or deeply buried. The impacts are therefore judged to be **minor adverse** to **negligible**.

9.5.8. The proposed VMS location on the A47 South lies within the location of a World War Two Light Anti-Aircraft Battery (HER 19084). No below ground remains are anticipated to have survived and therefore the impacts are **negligible** to **no change**.

9.5.9. The potential impacts on buried remains for Acle New Road cannot be assessed at this time as no data was available.

9.5.10. The design of the proposed vessel waiting facilities is currently unknown and therefore the impact is also unknown.

BUILT HERITAGE

9.5.11. The Grade II listed Dolphin Public House (NHLE 1096829) is currently the only built heritage asset identified within the Proposed Scheme, although further assessment may identify additional currently non-designated built assets within the Proposed Scheme. The current designs include the retention of the Dolphin Public House, however there is a potential for **major adverse** impact on this asset through changes to its immediate setting from the Proposed Scheme during construction and operation. Further assessment is required to establish how far the setting of the Dolphin Public House contributes to its value and what the impact of the Proposed Scheme will have on its setting. Moreover, where a heritage asset is a listed building, its beneficial use is of considerable practical importance to its future conservation, and assessment of the Proposed Scheme in this regard will also be required.

9.5.12. The Grade II Listed Gas Holder (NHLE 1096789) lies approximately 100m from the Proposed Scheme. Due to Its proximity there is a potential for **major adverse** impacts during construction and operation due to a change in its setting. There is also a potential for **major adverse** impacts on the nearby Camperdown Conservation Area, The Gorleston Extension Conservation Area and the built heritage assets contained within them due to their proximity. The Grade I listed Nelson's Monument (NHLE 1246057) and the Grade II Scenic Railway Roller Coaster at Great Yarmouth (NHLE 1436976) have also been identified as potential sensitive receptors with a potentially **moderate adverse** impact.

9.5.13. Further assessment is required to establish if there will be any beneficial impacts on all of the Conservation Areas resulting in the change in traffic volumes resulting from the Proposed Scheme.

9.5.14. There is a potential for **major adverse** impacts on currently unconfirmed non-designated built heritage assets within the Proposed Scheme as a result of demolition. It is proposed that residential buildings along Queen Anne's Road and Southtown Road are removed to facilitate the Proposed Scheme, however a review of online historic maps suggests these are of late 19th century date. If confirmed to be of late 19th century date and if they are determined to have significance (historical, archaeological, architectural or artistic), they could be of low to moderate value.

Variable Message Signs and Vessel Waiting Facilities

9.5.15. The locations of VMS on North Quay and Fuller Way are located within the St Nicholas and Northgate Street Conservation Areas and in proximity of the Scheduled Monument of the Town Walls (NHLE 1003782). The VMS location on Yarmouth Way lies between the boundaries of the King Street and Hall Quay South Quay Conservation Areas and in proximity of three Scheduled Monuments. While there is already a high level of street furniture in these areas (e.g. existing road signs, lights, etc.) there is still a potential for an adverse impact on these assets with the addition of further signage. The magnitude of impact is currently unknown but has the potential to be **moderate** to **minor adverse**.

9.5.16. The design of the proposed vessel waiting facilities is currently unknown and therefore the impact is also unknown. Given that the facilities will lie adjacent to the boundary of the Gorleston Extension Conservation Area, there is a potential that features associated with the Conservation Area will be altered. This could either be beneficial or adverse, depending on the nature of the impact.

HISTORIC LANDSCAPES

9.5.17. The historic landscape is predominately a product of late 19th century to modern date activity and is of low value. The impact of the Proposed Scheme is currently unknown as it has not yet been assessed, however there is potential for a **moderate adverse** impact following the removal of buildings of potential late 19th century date and the introduction of new infrastructure.

PALAEOENVIRONMENTAL

9.5.18. Deposits of geoarchaeological interest are expected to be encountered within the maximum depth of pile foundations associated within both the bascule and swing bridge options. The western and eastern piled piers of the bascule bridge option reach a maximum depth of approximately -10 to -11mOD, and approximately -12 to -13mOD for pier piles of the swing bridge option. At these depths the foundations will fully penetrate the Holocene and late Pleistocene deposits into the underlying Crag Group bedrock. While the impacts will be confined to within the Proposed Scheme and the footprint of the piles, they are still judged to be **moderate adverse** at this stage until further assessment has been undertaken. The assessment will comprise initially of a desk-based archaeological review of the borehole, vibrocore and CPT logs generated by geotechnical contractor with the aim of establishing the likely presence of horizons of archaeological interest and broadly characterise them. Where necessary, archaeological recording of selected retained or new core samples will be undertaken.

9.5.19. Smaller foundation depths associated with elements of both designs will also penetrate to a depth of -3mOD, likely penetrating the Holocene deposits and surface of the late Pleistocene deposits. Deposit modelling suggests that the Holocene deposits are thinnest within the footprint of the proposed bridge, with the base of the Holocene sequence occurring at between -2m to 0mOD[90] . Boreholes suggest deposits in this area are likely to be minerogenic alluvium, with possible subordinate layers of organic alluvium, overlying late Pleistocene sands and gravels. At this time the impacts are judged to be **moderate adverse**, however this could be subject to change following further assessment and evaluation.

9.5.20. Construction of new transport links to the west and east of the Third Bridge crossing has the potential to impact deposits of geoarchaeological interest if they are preserved at shallow depth. Deposits to the east of the River

[90] Jordan et al 2016

Yare will most likely comprise sands and gravels of the North Denes Formation of low geoarchaeological potential. However, to the west of the River Yare there is the potential to reveal peat deposits of high geoarchaeological potential, outcropping as part of the Breydon Formation between 2.5 to 4mbgs. Due to the expected ground disturbance expected within the footprints of the new transport links, the impacts at this stage are predicted to be **major adverse**.

9.6 PROPOSED MITIGATION

9.6.1. At this stage it is anticipated that impacts to the cultural heritage assets can be reduced via appropriate mitigation and will be further investigated during the EIA. A full assessment will be carried out, including a site visit to assess impacts, as well as opportunities for enhancement, in more detail.

Archaeology

9.6.2. DMRB Volume 10, Section 6, Part 1[91] states that 'The fundamental aim of archaeological mitigation is to avoid impacts on nationally important or highly significant remains. If this is not possible then such remains should be archaeologically recorded in order to 'preserve by record' the significant aspects of the site'. Preservation in situ of nationally important or highly significant remains which may be affected by the Proposed Scheme options is the preferred option, however, where this is not possible then alternative options will be investigated. Should no acceptable options be identified which would allow for the preservation of a site, detailed excavation (the scope of which will be agreed with the Norfolk Historic Environment Team) would be carried out in order to further understanding of the site affected.

9.6.3. Intrusive investigations in and around the River Yare have the potential to be challenging due to waterlogged conditions and depths of deposits and have the potential to adversely impact on the programme and costs for the Proposed Scheme. The area surrounding the river consists of an urban townscape with very little open ground that is not covered by active roads or buildings. This makes any non-intrusive archaeological investigation problematic as techniques available would be limited by the presence of hardstanding.

9.6.4. An important note for any intrusive investigation of the area is the high risk of previously unknown unexploded ordnance (UXO). Due to the history of this location, the soft surrounding ground surface, and the abundance of known bomb craters within the study area; any staff working on-site must be made aware of the likelihood of discovering UXO's and be given proper training before works can commence. It would also be recommended that a UXO specialist be present during all intrusive works to give their expertise if any such objects are found. While heritage surveys may aid in the identification of potential UXO, they cannot be seen as a replacement for specialist survey.

Built Heritage and Historic Landscape

9.6.5. The Proposed Scheme may result in an impact on the setting of at least one Grade II listed building and directly impact on properties of potential late 19th century date which will be demolished. Further research is required to establish the value of the non-designated built heritage resource within the Proposed Scheme. Consultation will be undertaken with Historic England and the Norfolk Historic Environment Team to discuss appropriate mitigation options to reduce these impacts. This could include a programme of historic building recording prior to demolition.

9.6.6. Where possible, in the first instance, impacts upon the setting of a heritage asset (including historic landscapes) would be mitigated through changes in design, in accordance with Historic England's guidelines[92]. Where design

[91] Highways England (2009) Design Manual for Roads and Bridges Volume 11, Section 6, Part 1 (HD 75/01) Trunk Roads and Archaeological Mitigation, former Highways Agency, November 2009

[92] Historic England (2017) The Setting of Heritage Assets (2nd edition)

adjustments are not practicable, visual or acoustic screening (such as landscape planting or acoustic barriers) may be considered to reduce harm.

9.6.7. No recorded historic landscapes will be impacted upon to a significant degree by the Proposed Scheme however, a new bridge structure may have an impact on the riverfront or 19th century townscape and further work should be done to assess this.

Palaeoenvironmental

9.6.8. A separate palaeoenvironmental desk-based assessment will be prepared in order to understand the potential and significance of the palaeoenvironmental resource. Strategies for mitigating impact to sensitive geoarchaeological deposits will take a structured approach, involving the following stages;

- Geoarchaeological review and assessment of ground investigation (GI) logs;
- GI logs will be assigned a high, medium or low priority status based on the geoarchaeological potential of the contained deposits;
- Specify boreholes to be retained for further geoarchaeological monitoring, recording and sampling;
- Geoarchaeologist attendance at geotechnical laboratory to monitor, record and sample deposits of geoarchaeological potential within retained boreholes;
- Samples from deposits of high geoarchaeological potential will be retained and recommended for subsequent programmes of geoarchaeological assessment and analysis.

9.6.9. Intact sleeved boreholes are preferred to maintain the stratigraphic integrity of deposits, reducing disturbance and contamination and maximising the geoarchaeological potential of the contained deposits.

9.7 CONCLUSIONS AND EFFECTS

9.7.1. Limited assessment work has been undertaken to date based on the current scheme proposals and therefore the conclusions and effects drawn at this stage could be subject to change in the ES. There will be a potential to reduce or remove the effects through mitigation.

Archaeology

9.7.2. There is a potential for major adverse impacts on buried deposits associated with a late 19th century icehouse and salt stores (HER 55685), the Route of Norfolk and Suffolk Joint Railway (HER 13575) and the Routes of Great Yarmouth urban railways (HER 13576) which are all of low value. Where remains are present and subject to disturbance, the effects will be Slight.

9.7.3. Eight heritage assets of World War II date are recorded within the Proposed Scheme and one in the proposed location of the road traffic sign on the A47 South of low value. The anticipated impact on these is judged to be negligible to no change and therefore the effects will be Neutral.

9.7.4. There is a potential for a major adverse impact on currently unknown heritage assets in the form of a buried medieval shoreline and associated features or finds within the Proposed Scheme. The value of these assets is currently unknown but could potentially be medium and the effects Moderate/Large.

9.7.5. There is a potential for minor adverse to negligible impacts on buried remains of medium value within the location of the VMS on North Quay, Fuller Way and Yarmouth Way. Where remains are disturbed, the effects will be Slight/Neutral. The effect of the vessel waiting facilities is unknown.

Built Heritage

9.7.6. A major adverse impact is currently predicted on the Grade II Dolphin Public House (NHLE 1096829), which is located within the Proposed Scheme, and the Grade II Gas Holder (NHLE 1096789), the Camperdown and Gorleston Conservation Areas which lie in proximity due to changes in the setting during construction and operation. The assets are of medium value and therefore the effects are predicted to be Moderate/Large at this stage.

9.7.7. There is also a potential for a moderate adverse impact on the setting of the Grade I Listed Nelson's Monument (NHLE 1246057), which has a high value, and the Grade II Scenic Railway Roller Coaster (NHLE 1436976) which as a medium value. If confirmed through further assessment, the effects on these would be Moderate/Large and Moderate/Slight, respectively.

9.7.8. The demolition of buildings within the Proposed Scheme Site which fit the definition of non-designated heritage assets of low value will result in a major impact and the effects would be Slight.

9.7.9. The introduction of VMS on North Quay, Fuller Way and Yarmouth Way have the potential to result in a moderate to minor adverse impacts on the setting of conservation areas of medium value and Scheduled Monument of high value. The effects could be Moderate to Slight, depending on the value of assets impacted. The effects of the vessel waiting facilities are unknown.

Historic Landscapes

9.7.10. The historic landscape is predominately a product of late 19th century to modern date activity and is of low value and the impact is currently predicted to be moderate adverse with a **Slight** effect.

Palaeoenvironmental

9.7.11. The impacts on the palaeoenvironmental remains of within the River Yare on deposits of medium to high value are judged to be moderate adverse. The effects on these deposits is therefore expected to be Moderate/Large to Moderate/Slight at this stage of assessment.

9.7.12. A major adverse impact is predicted on high value deposits of the Breydon Formation which are thought to be located on west side of the River Yare and the effects will be Large/Very Large where the deposits are disturbed. A major adverse impact is also expected on deposits on the east side of the River Yare, although these are thought to be of low value and the effect Slight. Further assessment is required to ascertain whether these deposits are present in the Proposed Scheme and at what depth below the current ground level.

9.8 ASSESSMENTS STILL TO BE COMPLETED

9.8.1. An additional assessment is underway to assess the potential impacts of the Proposed Scheme on the archaeology, built heritage and historic landscape resource. This will include a walkover survey which will assess the potential visual impacts of the Proposed Scheme in the near vicinity of the Proposed Scheme, but also on the wider landscape. The visual impact assessment on cultural heritage assets and agreement on viewpoints is being progressed in consultation with the Townscape and Visual Impact assessment team. These will be determined in consultation with GYBC and NCC's Historic Environment Team.

9.8.2. The assessment will also assess the buildings within the Proposed Scheme which are to be demolished to establish their cultural heritage value in the first instance. Additional built heritage surveys maybe required to inform a programme of mitigation.

9.8.3. The assessment will include a detailed map regression exercise of the Proposed Scheme and its immediate environs using maps held at the Norfolk Record Office (Norwich). The aim of this will be to identify any further heritage assets within the Proposed Scheme which could be adversely impacted by the Proposed Scheme.

9.8.4. The limitations of undertaking intrusive evaluation investigations in the Proposed Scheme footprint have been outlined in the Scoping Report and are still judged to be accurate. In order to establish the potential impacts of

the Proposed Scheme on buried remains, a palaeoenvironmental assessment will also be undertaken in order to better understand the value geoarchaeological resource and the potential impacts on deposits. This will use data collected during Ground Investigation works undertaken within the Proposed Scheme, including from within the River Yare, and existing information, including that gathered for the Great Yarmouth Archaeological Map.

9.8.5. The assessment reports will be presented in full as technical appendices to the ES chapter.

9.8.6. As part of the assessment work, NCC's Historic Environment Team and Historic England will be consulted in order to discuss the potential impacts and identify where any effects can be reduced through appropriate mitigation.

10

TOWNSCAPE AND VISUAL IMPACTS

10 TOWNSCAPE AND VISUAL IMPACTS

10.1 INTRODUCTION

10.1.1. This chapter provides preliminary information with regard to Townscape and Visual Impacts as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process. The term 'townscape' is used to mean a type of landscape where the built environment is dominant and includes the buildings, the relationships between them, the different types of urban open spaces including green spaces, and the relationship between buildings and open spaces. The assessment of this topic area considers potential impacts of the Proposed Scheme on:

- townscape character; and
- views experienced by visual receptors.

10.1.2. The assessment has incorporated the comments of the SoS in the Scoping Opinion[6]. This chapter should be read in conjunction with Chapter 9: Cultural Heritage.

STUDY AREA

10.1.3. The parameters for the proposed study area are outlined below. The proposed 3km study area has been agreed with the landscape officer at NCC who has been requested to act as consultee on behalf of GYBC.

10.1.4. In line with guidance provided in Guidelines for Landscape and Visual Impact Assessment 3rd Edition (2013) (GLVIA3)[93],the study area is defined as the area in which existing townscape character may change or be influenced, or views available to people and their visual amenity be modified as a direct result of construction and operation of the Proposed Scheme.

10.1.5. The proposed study area is 3 km radius from the centre of the Proposed Scheme based on the current design. However, it has been reduced in the east to follow the coast line. The study area is shown on Figure 10.3. This has been identified through a preliminary review of OS 25K mapping and aerial mapping to establish the likely extents that townscape and visual receptors will potentially be significantly affected by the Proposed Scheme.

10.1.6. The study area will be reviewed through the production of a Zone of Theoretical Visibility (ZTV) through digital modelling and confirmed by site work, with a view to reducing the extent of the study area.

10.1.7. It is anticipated that no significant effects will arise beyond 3km due to the context, scale and nature of the Proposed Scheme. If there is greater visibility than anticipated the study area will be adjusted to reflect this.

10.1.8. It is noted there are ancillary works associated with the main bridge crossing which are included in the study area, these will be reviewed once there is a greater clarity on the design, but it is anticipated to scope these out of the assessment.

LIMITATIONS

10.1.9. This chapter is based on preliminary information relating to the Proposed Scheme and data currently available and gathered at this point of the assessment process.

10.1.10. Currently there is no fixed design solution for the double leaf bascule bridge, the designs being explored are described in Chapter 2 and presented in Figures 2.5 and 2.6. For the assessment, a working envelope is being

[93] Landscape Institute and Institute of Environmental Management and Assessment (2013) Guidelines for Landscape and Visual Impact Assessment 3rd Edition, London: Routledge.

used which covers the various design solutions, the key factor relevant to townscape and visual is the counterweights which will either be above deck level or in two bascule chambers to accommodate their movement. For the purposes of the PEIR the design with above counterweights is deemed to be the most visually intrusive, due to the structure being up to 44.5m (AOD) when open.

10.1.11. The information contained herein is intended to inform consultation responses at this stage. A detailed assessment of potentially significant impacts of the Proposed Scheme on identified sensitive receptors will be undertaken at subsequent stages to inform the ES.

10.1.12. Any gaps in information identified at this PEIR stage will be considered and addressed along with specific mitigation measures as part of the assessment.

10.2 RELEVANT POLICIES

10.2.1. This section provides an outline of policies considered relevant to the Proposed Scheme with respect to its impacts on the townscape character and visual amenity.

National Policy Statement for National Networks

10.2.2. NPS NN states that "*Where the development is subject to EIA the applicant should undertake an assessment of any likely significant landscape and visual impacts in the environmental impact assessment and describe these in the environmental assessment*".

National Policy Statement for Ports (NPSP) (January 2012)

10.2.3. Whilst the Proposed Scheme does not constitute Port development, the NPS for Ports does provide useful context for coastal projects in so far that in paragraph 5.11.1 it clarifies that references to landscape should be taken as "*covering seascape and townscape, where appropriate*."

10.2.4. It is considered at this stage that due to the Proposed Scheme being located within Great Yarmouth on the River Yare inland of the coastline that the resulting changes are unlikely to result in significant effects on views from and towards the coastline and the associated seascape and will be scoped out of the assessment.

National Planning Policy Framework 2018

10.2.5. Paragraph 124 of the NPPF states that: "*The creation of high quality buildings and places is fundamental to what the planning and development process should achieve. Good design is a key aspect of sustainable development, creates better places in which to live and work and helps make development acceptable to communities. Being clear about design expectations, and how these will be tested, is essential for achieving this. So too is effective engagement between applicants, communities, local planning authorities and other interests throughout the process'.*

10.2.6. Paragraph 127 of the NPPF specifies design objectives that development should achieve, and paragraph 170 states that the planning system *"should contribute to and enhance the natural and local environment*" including by protecting and enhancing valued landscapes.

10.2.7. These principles have been taken into account in the development of the Proposed Scheme.

East Inshore and East Offshore Marine Plans[94]

10.2.8. The plans provide for the application or clarification of national planning policy in relation to coastal areas.

10.2.9. Policy SOC3 sets out, in order of preference, how proposals that may affect terrestrial or marine character should avoid, reduce, mitigate or provide justification for potential impacts. This will be tested for its relevance to Great Yarmouth and the River Yare with a view to scoping it out of the assessment due to the context of the River Yare within the urban fabric of Great Yarmouth.

10.3 ASSESSMENT METHODOLOGY

10.3.1. The following methodology for assessment, outlined in sections 10.3 – 10.4 of this chapter has been agreed with the landscape officer at NCC, who has been requested to act as consultee on behalf of GYBC.

10.3.2. The Townscape and Visual Impact Assessment (TVIA) will be undertaken in accordance GLVIA3.

10.3.3. The assessment will also refer to the following guidelines applicable to the Proposed Scheme:

- Highways Agency Interim Advice Note 135/10[95]; and
- An Approach to Landscape Character Assessment (second version) (March 2018)[96].

STAGES IN THE ASSESSMENT PROCESS

10.3.4. There are four key stages in the assessment:

- Recording and analysis of the existing townscape and visual context of the receiving environment (the baseline environment);
- Identification of changes and associated impacts that will be associated with the Proposed Scheme including embedded mitigation and the significance of these impacts in the context of the baseline townscape and visual context of the study area;
- Identification of further mitigation where the assessment identifies potentially significant effects appropriate to the Proposed Scheme and the townscape character and visual context of the receiving local area; and
- Description of the residual effects and their significance associated with the Proposed Scheme following the application of additional mitigation.

[94] HM Government (2014) East Inshore and East Offshore Marine Plans (Online). (Accessed June 2018). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/312496/east-plan.pdf

[95] Highways England (2010) Interim Advice Note 135/10 Landscape and Visual Effects Assessment, former Highways Agency. (Online) (Accessed June 2018). Available at http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian135.pdf

[96] Natural England (2018) An Approach to Landscape Character Assessment. (second version) (online) (Accessed June 2018). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/691184/landscape-character-assessment.pdf (Accessed May2018)

SCOPE OF THE TVIA ASSESSMENT

10.3.5. The GLVIA3 requires that a clear distinction is drawn between townscape and visual effects:

- Townscape effects relate to the degree of change to characteristics or physical components of an urban area, which together form the character of that townscape, including the buildings, the relationships between them, the different types of open spaces, and the relationships between buildings and open spaces; whilst
- Visual effects relate to the degree of change to an individual receptor's or receptor group's view of that townscape, e.g. local residents, users of public footpaths or motorists passing through the area.

10.3.6. The TVIA will consider the potential effects of the Proposed Scheme during:

- The construction phase, which is assumed to be a defined period, during which time cranes and lifting equipment are anticipated to be present on the Application Site, and will include the presence of associated plant, construction compounds and local traffic management;
- During operation, at the opening of the Proposed Scheme, the assessment will assume that the visual context applicable would be experienced during winter months and with the bridge in the raised position, when the degree of visual exposure is potentially greatest and represents the worst-case scenario. However, the bridge will be predominantly in the lowered position and therefore commentary will be provided on this as appropriate.
- The assessment will also include potential night time effects of the associated (including additional highway) lighting where appropriate;
- During operation, at year 15 in the summer months and with the bridge in the lowered position. The analysis at 15 years into operation would demonstrate the effectiveness of any townscape and visual related mitigation proposals associated with the Proposed Scheme, allowing for maturation of any planting.

Scope covered with the PEIR

10.3.7. The PEIR has identified the published national and local landscape character assessments, which have been reviewed and identified the key characteristics of relevance to the study area.

10.3.8. An initial review of the design envelope has been undertaken and the likely visual envelope and visual receptors likely to be affected by the Proposed Scheme which are represented by the proposed viewpoints.

10.3.9. A high-level appraisal of predicted impacts on townscape and visual receptors based on the design envelope has been identified during construction and operation of the Proposed Scheme.

BASELINE ENVIRONMENT IDENTIFICATION

10.3.10. The identification and evaluation of the existing townscape and visual context of the study area and wider area will involve the following tasks:

- Desk based analysis of OS mapping relating to landform, built form, vegetation, settlement patterns and the drainage regime in the wider area;
- Desk based analysis of aerial photography for the area;
- Review of the townscape units, types and relevant landscape or landscape related designations e.g. Conservation Areas, Registered Parks and Gardens;
- Review of any relevant published landscape character and townscape assessments;

- Site surveys and identification of townscape units/types. Site recording involving annotation of 1:1,250 and 1: 25,000 scale OS plans defining the units and the key elements determining character;
- Development and agreement of representative/key viewpoints to be assessed for potential effects on visual amenity;
- Site photography to illustrate character units, notable views / viewpoints and key townscape elements; and
- Drafting and describing local townscape character units within the context of the broader assessment and associated with the Proposed Scheme and wider setting including an evaluation of their quality, value and sensitivity to change in the context of the proposed form of the proposed Scheme.

ASSESSMENT OF EFFECTS ON TOWNSCAPE CHARACTER

10.3.11. As the Proposed Scheme would be located within an urban context it is considered that the appropriate aspect of landscape to be assessed is the townscape. In assessment terms townscape is a subset of landscape and refers to areas where the built environment dominates.

10.3.12. The Great Yarmouth Borough Council Landscape Character Assessment[97] identifies several landscape character areas that extend beyond the limits of the urban area Great Yarmouth and within the 3km radius study area. The above assessment identifies the built environment as 'urban', within which the TVIA will refine the urban area into appropriate local townscape character areas. In addition, the study area extends to cover the eastern fringes of The Broads Landscape Character Assessment[98].

10.3.13. The assessment of townscape effects will be structured around the identification of individual Townscape Character Areas (TCA's) within the study area. TCAs are areas of relatively homogenous townscape character. They are defined by the combination of elements that contribute to townscape context, character and value. Typical townscape elements include landform, street patterns and built development, vegetation and open space. More subjective criteria are also considered such as scale, unity and enclosure. These areas will be created from the baseline assessment within the study area for this assessment in the absence of detailed published townscape areas as set out above.

10.3.14. The sensitivity of the receiving townscape and the magnitude of impact will be assessed to determine a significance of effect rating that will result from the construction and operation of the Proposed Scheme and the effect that this will have on the perception of townscape character.

Townscape Value

10.3.15. High townscape value correlates to areas of scenic merit or those displaying important historic and cultural associations. Townscape value is frequently addressed by reference to international, national, regional and local designations. An absence of a formal designation does not, however, determine that a townscape is necessarily of low value; factors such as accessibility and local scarcity can render areas as an important resource at a local level. For example, an area of relatively insignificant townscape may have increased value associated with it due to its proximity to housing or as an informal recreational space.

[97] Great Yarmouth Borough Council (2008) Great Yarmouth Borough Council Landscape Character Assessment. (Online) (Accessed June 2018). Available at: https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1236&p=0

98 The Broads Authority (2016) The Broads Landscape Character Assessment. (Online) (Accessed June 2018). Available at: http://www.broads-authority.gov.uk/news-and-publications/publications-and-reports/planning-publications-and-reports/landscape-character-assessments

Townscape Susceptibility to change

10.3.16. Townscape susceptibility to change is the ability of the TCA to accommodate the Proposed Scheme without undue consequences for the maintenance of the baseline situation.

10.3.17. A high quality or high value townscape should not, by definition, infer that it has a high susceptibility to future change. Similarly, an area expressing low quality or value does not automatically have a lower susceptibility to change. Susceptibility has been defined in GLVIA3 as, "*The ability of the landscape receptor to accommodate the proposed development without undue consequences for the maintenance of the baseline situation and / or the achievement of landscape policies and strategies'.* Susceptibility to change is therefore likely to reflect the type and nature of the proposed changes.

Townscape Sensitivity

10.3.18. The sensitivity of a TCA is an expression of its suitability to accommodate the Proposed Scheme. Sensitivity is judged based on a combination of its susceptibility to the type of change or development proposed and the value attached to the townscape, as set out in Table 10.1 – Townscape Criteria below.

Table 10.1 – Townscape Criteria

Townscape Sensitivity	Criteria
High	A townscape displaying particularly distinctive character, of good or greater quality which is highly valued and considered susceptible to relatively small changes. Townscape characteristics or features with little or no capacity to absorb the type of change proposed without fundamentally altering current character. Townscape designated for its international or national townscape value or with highly valued features. Outstanding example of well cared for townscape or set of features that combine to give a very strong sense of place.
Medium	A townscape of medium value and considered reasonably tolerant of change. Townscape characteristics or features with moderate capacity to absorb change without fundamentally altering their present character. Townscape designated for its local townscape value or a regional designated townscape where the characteristics and qualities that led to the designation of the area are less apparent or are partially eroded or an undesignated townscape which may be valued locally – for example an important open space. An example of a townscape or a set of features which is relatively coherent, with a good but not exceptional sense of place - occasional buildings and spaces may lack quality and cohesion.
Low	A townscape of relatively low value and considered tolerant of substantial levels of change. Townscape characteristics or features which are tolerant of change without determent to their present character. An area with a weak sense of place and/or poorly defined character /identity. No designation present or of low local value or in poor condition. An example of monotonous unattractive visually conflicting or degraded townscape or set of features.

Magnitude of Impact

10.3.19. The magnitude of impact will be based on the extent and manner in which the Proposed Scheme will form a new component in the townscape and alter the balance between existing components.

10.3.20. Magnitude of change is an expression of the size or scale of change in the townscape, the geographical extent of the area influenced and its duration and reversibility. The variables involved are described below:

- The extent and proportion of existing townscape elements that will be lost and the contribution of those elements to the character of the immediate townscape and wider setting;
- The extent to which aesthetic or perceptual aspects of the townscape are altered either by the removal of existing townscape elements or by the addition of new ones;
- Whether the effect changes the key characteristics of the townscape, which are integral to its distinctive character;
- The geographic area over which the townscape effects will be felt (within the Application Site itself; the immediate setting of the Application Site; at the scale of the townscape type or character area; on a larger scale influencing several townscape types or character areas); and
- The duration of the effects (short term, medium term or long term) and whether it is permanent, temporary or reversible.

10.3.21. A three-point scale is shown in Table 10.2 that provides examples of the magnitude of impact that can be attached to the changes associated with each TCA.

Table 10.2 - Townscape Magnitude of impact criteria

Magnitude of Impact	Criteria
High	Where the development would appear as a significant new component in the townscape and result in the total loss of or major alteration to the existing balance of components in the baseline context.
Medium	Where the development would appear as a noticeable new component in the townscape and result in a partial loss of or alteration to the existing balance of components in the baseline context.
Low	Where the development would appear as a barely perceptible component in the townscape and result in a slight loss of or alteration to the existing balance of components in the baseline context.

Townscape Significance of Effect Assessment

10.3.22. The evaluation of effects for townscape character will involve consideration of the sensitivity to change, derived during the baseline assessment and the predicted magnitude of change that will occur because of the construction and subsequent operation of the Proposed Scheme. Effects are significant where they are identified as being moderate or greater.

10.3.23. The findings of the assessment will be represented using a descriptive, descending scale ranging from large - moderate – slight - beneficial through neutral to an ascending scale of slight - moderate – large – very large adverse. Explanation of the significance of effect ratings that are proposed is provided below in a descending scale of significance shown in Table 10.3 –Townscape character significance of effect criteria.

Table 10.3 –Townscape character significance of effect criteria

Degree of Significance	Townscape Significance of Effect Criteria
Large Beneficial Effect	The proposals: ▪ Constitute a major restructuring of a degraded townscape or form an essential part of a townscape strategy to redevelop a major area of dereliction, leading to establishment of a new, attractive environment.
Moderate Beneficial Effect	The proposals provide an opportunity to enhance the townscape because: ▪ They fit very well with the scale, built form and pattern of the townscape; ▪ There is potential, through mitigation, to enable the restoration of characteristic features, partially lost or diminished as the result of changes to the baseline context, e.g. from previous inappropriate development; ▪ They will enable a sense of place and scale to be restored through careful design and appropriate mitigation measures, that is, characteristic features are perhaps enhanced through the use of local materials and appropriate scale of the development that fits well into the surrounding townscape; ▪ They enable some sense of quality to be restored or enhanced through design features; and ▪ They further government objectives to regenerate degraded urban areas.
Slight Beneficial Effect	The proposals: ▪ Fit well with the scale, built form and pattern of the townscape; ▪ Incorporate measures for mitigation to ensure they will complement the surrounding townscape structure; ▪ Will enable some sense of place and scale to be restored through careful design and appropriate use of materials as mitigation measures; and ▪ Maintain or enhance existing townscape quality and character.
Neutral Effect	The proposals are well designed to: ▪ Complement the scale, built form and pattern of the townscape; ▪ Incorporate measures for mitigation to ensure that the Proposed Scheme will blend in well with surrounding features and elements; and ▪ Maintain existing townscape quality and character.
Slight Adverse Effect	The proposals: ▪ Do not quite fit the built form and scale of the townscape; ▪ Cannot be completely mitigated for because of the nature of the proposal itself or the character of the townscape in which the development would sit; and ▪ May affect an area of recognised townscape quality.
Moderate Adverse Effect	The proposals: ▪ Are out of scale with, or at odds with, the local townscape pattern and built form; ▪ Are not possible to fully mitigate for, that is, mitigation will not prevent the Proposed Scheme from scarring or detrimentally affecting the townscape in the longer term as some features of interest will be partly destroyed or their setting reduced or removed; and ▪ Will have an adverse effect on a townscape of recognised quality or on vulnerable and important characteristic features or elements.
Large Adverse Effect	The proposals are very damaging to the townscape in that they: ▪ Are at considerable variance with the built form, scale and pattern; ▪ Are likely to degrade, diminish or even destroy the integrity of a range of characteristic features and elements of their setting;

Degree of Significance	Townscape Significance of Effect Criteria
	▪ Will be substantially damaging to a high value or highly vulnerable townscape, resulting in fundamental change and be considerably diminished in quality; and ▪ Cannot be adequately mitigated for.
Very Large Adverse Effect	The proposals would result in exceptionally severe adverse effects on the townscape because they: ▪ Are at complete variance with the built form, scale and pattern; ▪ Would irrevocably damage or degrade, badly diminish or even destroy the integrity of characteristic features and elements and their setting; ▪ Would cause a very high quality or highly vulnerable townscape to be irrevocably changed and its quality very considerably diminished; and ▪ Cannot be mitigated for, that is, there are no measures that would protect or replace the loss of a nationally important townscape.

ASSESSMENT OF VISUAL EFFECTS

10.3.24. The assessment of visual effects will involve the adoption of the four stages of assessment described in Section 10.3.4.

10.3.25. Visual effects may result from the changes in the composition of views or overall visual amenity from the introduction of the Proposed Scheme. The degree to which people will be affected by changes depends on a range of factors, such as:

- The activity of the receptor, such as taking part in leisure, recreational and sporting activities, travelling through the area or working;
- The value of the viewing place or viewpoint, as reflected by designations, inclusion in guidebooks or the facilities provided for visitors, for example;
- Whether receptors are likely to be stationary or moving and how long they will be exposed to views of the Proposed Scheme;
- The extent of the route or area over which the changes would be visible;
- Whether receptors would be exposed to the change daily, frequently, occasionally or rarely; and
- Whether views are oblique or direct.

Zone of Theoretical Visibility (ZTV)

10.3.26. It is widely accepted that the magnitude of change in relation to views tends to decrease with distance. A desktop study together with a ZTV will determine the likely areas where there could be views of the Proposed Scheme. The ZTV will represent the extent of the area within the proposed 3 km study area as defined in Section 2 and within which there would be potential for views of the Proposed Scheme. The analysis will consider three scenarios separately:

- HGV Traffic (4.5m vehicle height) – 4 points at 25m intervals along the bridge deck;
- Bridge Lowered - 2 points to represent the high point of the bridge when lowered; and
- Bridge Raised - 2 points to represent the high point of the deck of the bridge when raised.

10.3.27. The visual analysis will be carried out using the viewshed analysis tool in ArcMap 10.5 and will be based on:

- 2018 OS Terrain 5m contour mapping;
- Lidar Information if available; and
- Observer points using XYZ co-ordinates to replicate the three scenarios.

10.3.28. The Digital Terrain Model (DTM) 5m contour mapping will be used to develop the ZTV. Whilst this is useful in developing the ZTV, it is not always reflected by what is visible on site. The mapping provided illustrates where there is the potential for the tallest aspect of the Proposed Scheme namely the proposed raised bridge structure to be visible, however this is only theoretical and includes all features with a degree of inter-visibility. The ZTV may therefore suggest that the structure would be visible over much broader extents than would be the reality.

10.3.29. If available, 2008-2009 LiDAR Digital Surface Modelling (DSM) at 1m resolution (which includes surface features such as buildings and vegetation) and is accurate to +/-10cm for XY and +/- 5cm for Z will be used to develop the ZTV, it includes all landform, vegetation and built form. It is noted that the ZTV, whilst useful does not always reflect what is visible on site. Whilst all features of the Proposed Scheme, including local road ties in will be assessed the mapping provided illustrates where there is potential for the tallest aspect of the Proposed Scheme to be visible, however this is only theoretical and includes all features with a degree of inter-visibility. The ZTV may therefore suggest that the Proposed Scheme would be visible over much broader extents than in reality.

10.3.30. The results of the analysis will be shown on a plan. Areas will be shaded to indicate locations that are predicted to have direct views of all or part of the bridge structure and represent the worst-case scenario. In areas where the shading is less dense and more sporadically distributed, this will indicate that these views may be highly constrained and/or comprise only the very highest sections of the bridge structure, which are likely to limit the degree to which a significant effect is anticipated to arise.

10.3.31. As a result, the top of the structure may not be visible from all locations suggested by the software or these locations may not be representative of views experienced by the public. The following reasons may include:

- It may be rooflines of buildings or the tops of trees that are registering as having a view (rather than the eye line of a person at that location);
- Intervening buildings and/or vegetation which were not recorded within the baseline data used (e.g. built form and vegetation is not recorded within the mapping data); or
- Upper floor windows from private dwellings or glimpses between buildings will be included which in reality may be heavily constrained or orientated away from the structure.

10.3.32. Therefore, some interpretation of the results is required. The primary objective will be to establish an area within which key receptors or viewpoints, whose views may be influenced by the Proposed Scheme, could be identified to inform the assessment.

10.3.33. Further field surveys will be undertaken to verify the actual extent of views and the likelihood that these will be subject to change. Therefore, inclusion of an area within the ZTV is not an indicator that all potential receptors within the defined area will experience views of the Proposed Scheme.

Representative Viewpoints

10.3.34. The assessment of visual effects is based on the identification of representative viewpoints, which represent a range of receptors within the study area that are likely to experience views of the Proposed Scheme. A total of 12 viewpoints (see Figures 10.1 and 10.2) have been agreed with the landscape officer at NCC, who has been requested to act as consultee on behalf of GYBC. Site surveys will be undertaken to establish the nature, exact location and actual availability of the anticipated view.

Identification of representative viewpoints

The 12 viewpoint locations will be recorded by reviewing the settlement pattern, land use, topography, vegetation, and access and transportation patterns contained within the boundaries of the ZTV. Viewpoints plotted via the desk based review and validated through site survey include the following:

- Residential clusters and individual properties;
- Heritage or cultural locations;
- Main and local roads; and
- Recreational and public access areas including footpaths, cycle routes and public

10.3.35. The viewpoint locations are presented in Figures 10.1 and 10.2.

Field Assessment of viewpoints

10.3.36. The 12 viewpoints will be visited and assessed. Factors considered during the visual assessment will include:

- Associated receptor types and numbers where appropriate (e.g. dwelling / footpath);
- Existing view;
- Distance of view;
- Percentage and elements of the Proposed Scheme likely to be visible;
- Viewpoint position (view up / view down / level view);
- Angle of view (acute / perpendicular / oblique);
- Type of view (foreground / middle ground / background) and position of the Proposed Scheme in the view;
- Analysis of potential impact.

Analysis of Visual Effects

10.3.37. Analysis of the likely visual impacts and evaluation of their associated effects involves consideration of the sensitivity to change and magnitude of impact based upon information gathered through site surveys and analysis of the aesthetics of the Proposed Scheme.

10.3.38. Evaluation of visual effects relates to the potential impacts during:

- The construction phase, which is assumed to be a defined period, during which time cranes and lifting equipment are anticipated to be present on site, and will include the presence of associated plant, construction compounds and local traffic management;
- During operation, at the opening of the Proposed Scheme, the analysis will assume that the visual context applicable would be experienced during winter months and with the bridge in the raised position, when the degree of visual exposure is potentially greatest and represents the worst-case scenario. The assessment also includes an assessment of the potential night time effects of the associated lighting, including additional highway lighting;
- During operation, at year 15 years in summer months and with the bridge in the raised position. The analysis at 15 years into operation demonstrates the effectiveness of any townscape mitigation proposals associated with the Proposed Scheme, allowing for its maturation; and
- Night time effects.

10.3.39. The analysis relates to each representative viewpoint and concludes with an evaluation of the predicted significance of effect.

Visual Sensitivity

10.3.40. Sensitivity to change will consider the nature, location and context of the receptor and is derived from the susceptibility to change of the receptor and the value of the view. Less sensitive receptors are considered, for example, to be people engaged in work whose primary focus would not necessarily be on the surrounding townscape views. Conversely, more emphasis is placed upon receptors whose change in view or visual amenity is either the prime focus, greater in scale, a valued view such as a lookout or potentially covers a wider area.

10.3.41. The degree and importance of the view gained from a receptor also contributes to an understanding of how sensitive a given receptor is towards change. Therefore, value of the view, scenic quality and visual expectations of the receptor are also considered. In this assessment, sensitivity to change is proposed to be ranked as described in Table 10.4 Sensitivity of viewpoints.

Table 10.4 Sensitivity of viewpoints

Sensitivity	Criteria
High	▪ Occupiers of residential properties ▪ Recreational users or tourists whose attention is focussed on the townscape, such as visitors of Registered Parks and Gardens, users of promoted routes/long distance paths/PRoW and canal or river networks ▪ Views that are of high value e.g. lookout points and promoted views.
Medium	▪ People walking or cycling through urban areas where their attention is likely to be focussed to a degree on their surroundings ▪ People staying in hotels, educational and healthcare institutions where the setting and surroundings make a contribution to their experience. ▪ People travelling by vehicle along scenic routes through the townscape where their attention is likely to be focussed to a degree on their surroundings.
Low	▪ People at work and in educational institutions where the setting and surroundings does not contribute to their experience. ▪ People engaged in formal sports activities. ▪ People walking or cycling through urban areas where they are more likely to be preoccupied with getting to their destination than enjoying views and scenery along their route. ▪ People travelling on high speed transport routes through the townscape.

Magnitude of Impact

10.3.42. The magnitude of visual impact resulting from the Proposed Scheme is based on the size or scale of change in the view, the geographical extent of the area influenced and its duration and reversibility. The variables involved are described below:

- The scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition, including the proportion of the view occupied by the Proposed Scheme;
- The degree of contrast or integration of any new features or changes to the form, scale, mass, building line, height, sky-line, background, visual clues, focal points, colour and texture;
- The time over which the Proposed Scheme will be visible and whether views will be full, partial or glimpsed;
- The angle of view in relation to the main activity of the receptor, distance of the viewpoint from the Proposed Scheme and the extent of the area over which the changes would be visible; and
- The duration of the effects (short term, medium term or long term) and the reversibility of the effect (whether it is permanent, temporary or partially reversible).

10.3.43. In this assessment, the magnitude of impact is assessed as high, medium or low considering the criteria set out in Table 10.5 Magnitude of visual impact criteria.

Table 10.5 Magnitude of visual impact criteria

Level of Impact	Magnitude of Impact Criteria
High	Where the Proposed Scheme would cause a substantial change to the existing view, and or become a dominant feature of focal point of the view.
Medium	Where the Proposed Scheme would cause a noticeable change to the existing view, and or which would be a prominent feature readily apparent to the receptor.
Low	Where the Proposed Scheme would cause a slight change to the existing view, and or would not alter the overall balance of feature and elements that comprise the existing view.

Degree of Significance of Visual Effect Criteria

10.3.44. The prime criteria used to evaluate visual effects will relate to the extent to which existing views associated with key viewpoints (such as residents, users of public facilities and visitors to open space and public areas), will change, taking account of embedded mitigation measures. Effects will be significant where they are identified as being moderate or greater.

10.3.45. Other criteria proposed to be used to ascertain visual effect include the size, elevation and proportion of the Proposed Scheme in respect of the receiving environment and the degree to which activity within the receiving environment would alter, both during and post construction, and be visible.

10.3.46. Effects can be detrimental where features or key characteristics such as established planting, old buildings or structures will have to be removed, directly affecting the view. Conversely, effects can prove beneficial where derelict buildings or poorly maintained townscape features are proposed to be restored, replaced or maintained, or where there is the introduction of new tree planting and a townscape structure where none currently exists, constituting an improvement in the current view.

10.3.47. The identification of the resulting effects will be established through an evaluation of the sensitivity of the baseline and the magnitude of the impact likely to occur because of the Proposed Scheme.

10.3.48. The findings are proposed to be represented using a descriptive scale ranging in a descending scale from large - moderate – slight - beneficial and through neutral to an ascending scale of slight - - moderate – large – very large adverse.

10.3.49. Whilst there is a large degree of professional judgement involved in determining the significance of townscape and visual effects, they can broadly be determined by the interaction of the sensitivity of the receptor and magnitude of change, which has been informed by pre-defined criteria as outlined in Table 10.6 – Visual Significance of effect criteria below.

Table 10.6 – Visual Significance of effect criteria

Degree of Significance	Description of visual effect
Large Beneficial Effect	Lead to the removal of a significant eyesore such as a derelict site or buildings and incorporates townscape measures which substantially remodel and enhance the outlook for many people, or where the proposal would cause a substantial improvement in the existing view.
Moderate Beneficial Effect	Visual intrusion associated with the existing view is noticeably relieved, or where the Proposed Scheme would result in a marked improvement. It would also apply where the Proposed Scheme includes provision for townscape proposals which would largely reduce the visual intrusion of the existing outlook.

Degree of Significance	Description of visual effect
Slight Beneficial Effect	Existing visual intrusion associated with the current outlook is slightly relieved, or where the Proposed Scheme would cause a barely perceptible improvement in existing receptor view.
Neutral Effect	Implementation of the Proposed Scheme not leading to a discernible improvement or deterioration in existing receptor view or outlook.
Slight Adverse Effect	The Proposed Scheme is at some distance from the viewpoint, or where the Proposed Scheme would not constitute a new point of principal focus. It would also occur where the Proposed Scheme is closely located to the viewpoint but is seen at an acute angle and at the extremity of the overall available view, or by less sensitive receptor types.
Moderate Adverse Effect	The Proposed Scheme resulting in a noticeable deterioration to the current outlook, involving removal of existing, visually screening elements in the view, exposing the Proposed Scheme. It would also occur where large new structures are introduced as part of the Proposed Scheme which may appear at distance but be positioned as a focal point the field of view, or where the Proposed Scheme can only be partially mitigated.
Large Adverse Effect	The Proposed Scheme would cause a marked deterioration in the current receptor view or outlook, be positioned prominently within an existing view of local interest in a valued townscape, or where only selected elements of the Proposed Scheme can be effectively mitigated.
Very Large Adverse Effect	The Proposed Scheme would cause a high level of deterioration to the current view, and/or be positioned prominently within an existing view of regional or national importance.

NIGHT TIME EFFECTS

10.3.50. Where relevant, night time effects will be considered as part of the assessment where the introduction of new light sources may affect the visual and townscape context. Where available, isolux contour plans will be used to inform this process.

10.3.51. Night time photography is not considered to be required for the Proposed Scheme due to the existing urban context including the port infrastructure and existing lighting along the River Yare.

10.4 BASELINE ENVIRONMENT

TOWNSCAPE

10.4.1. The following data sources have been consulted to inform the baseline data for this report:

- Great Yarmouth Local Plan - Core Strategy, 2015;[99]
- Broads Authority Local Development Framework - Core Strategy, 2007-2021[100];

[99] Great Yarmouth Borough Council (2015) Great Yarmouth Local Plan (Online). (Accessed June 2018). Available at: https://www.great-yarmouth.gov.uk/article/2489/Current-Local-Plan

[100] Broads Authority (2007) Local Development Framework – Core Strategy (Online). (Accessed June 2018). Available at: http://www.broads-authority.gov.uk/planning/planning-policies/development/current-documents/core-strategy-development-plan

- National Character Areas, Natural England;[101]
  - NCA79 – North East Norfolk and Flegg[102]
  - NCA80 – The Broads[103]
  - NCA82 – Suffolk Coast and Heaths[104]
- Broads AuthorityLandscape Character Assessment, 2013;[105]
- Great Yarmouth Borough Council Landscape Character Assessment, 2008;[106]
- MAGIC website[107];
- Google Earth[108]; and
- Bing Maps [109] Including Ordnance Survey mapping

Statutory Landscape Designations

10.4.2. The Broads National Park lies 1 km to the north-west.

Other Designations

10.4.3. The Venetian Waterways, grade II listed registered Park and Garden lies 2.5 km to the north of the Proposed Scheme. There are ten Conservation Areas within the study area, seven to the north and three to the south, however none are located within the Proposed Scheme extents.

TOWNSCAPE CONTEXT

10.4.4. Within the context of a flat terrain, the study area lies within the low-lying town of Great Yarmouth, and is bisected in a north-south orientation by the River Yare.

10.4.5. There are currently many empty properties within this part of the river corridor which give the area a degraded character. There are areas of hard standing on the banks of the river; on the western bank these are a public

[101] Natural England (2013) National Character Area Profiles. (Online). (Accessed June 2018). Available from: http://publications.naturalengland.org.uk/category/587130
[102] Natural England (2013) National Character Area Profile 79 – North East Norfolk and Flegg. (Online). (Accessed June 2018). Available from: http://publications.naturalengland.org.uk/publication/4543880858959872?category=587130
[103] Natural England (2013) National Character Area Profile 80 – The Broads. (Online). (Accessed June 2018). Available from: http://publications.naturalengland.org.uk/publication/11549064?category=587130
[104] Natural England (2013) National Character Area Profile 82 – Suffolk Coast and Heaths. (Online). (Accessed June 2018). Available from: http://publications.naturalengland.org.uk/publication/5626055104659456?category=587130
[105] Broads Authority (2013) The Broads Landscape Character Assessment (Online). (Accessed June 2018). Available at: http://www.broads-authority.gov.uk/news-and-publications/publications-and-reports/planning-publications-and-reports/landscape-character-assessments
[106] Great Yarmouth Borough Council (2008) Landscape Character Assessment (Online). (Accessed June 2018). Available at https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1236&p=0
[107] Department for Environmental and Rural Affairs, Natural England, Environmental Agency, Historic England, Forestry Commission and Marine Management Organisation (2018) – Magic (online). (Accessed: June 2018). Available at http://publications.naturalengland.org.uk/category/587130
[108] Google (2018) Google Earth Aerial Mapping (online). (Accessed June 2018). Available from Google Earth https://earth.google.com/web/
[109] Microsoft (2018) Bing Mapping (online). (Accessed June 2018). Available from https://www.bing.com/maps

space. Building heights are broadly similar throughout the area, typically of no more than three storeys and occasionally, punctuated by taller industrial towers or tanks.

10.4.6. The east bank of the river comprises a mixed pattern of buildings including different sized warehouses, depots and industrial units. Large scale industrial and maritime activities tend to occupy the eastern river bank. Facilities comprising large tanks, storage areas and associated warehouses and offices act to contain views in and out of the river corridor. Some of the older warehouses and buildings have historical and architectural merit but are interspersed by new development and industrial infrastructure of limited architectural value.

10.4.7. The properties overlooking the western bank of the river mainly comprise Victorian red brick terraces in small rows, interspersed with commercial premises, and disused plots of land. To the west of the river the study area consists of a mixed and fragmented urban fringe environment of limited distinctiveness. The residential properties most affected by the Proposed Scheme are situated along Cromwell Road, Queen Anne's Road and Southtown Road.

10.4.8. West of Southtown Road, away from the industrialised waterfront, and approaching the A47 more vegetation becomes apparent where it lines short sections of William Adams Way and Suffolk Road. In places rows of properties fronting the river give some distinctive townscape pattern but this declines beyond to a mix of land uses including scattered commercial buildings. A more distinctive residential pattern can be found to the south of William Adams Way. There is also a prominent belt of conifers to the rear of Queen Anne's Road. Small pockets of green space are interspersed amongst the industrial and domestic land uses either side of William Adams Way and provide a break from the surrounding primarily commercial townscape. A larger green space is Southtown Common Recreation Ground, to the south of William Adams Way and adjacent to the A47. This is bounded by mature deciduous vegetation on its north and east sides, screening it from adjoining busy roads.

10.4.9. There appears to be little pedestrian activity in the study area with some limited use of waterfront spaces, and most movement by motor vehicle.

PUBLISHED NATIONAL CHARACTER AREAS

10.4.10. The Proposed Scheme lies within NCA 79: North East Norfolk and Flegg and NCA 80: The Broads. Due to its proximity, 500m south-west of the Proposed Scheme, NCA 82: Suffolk Coast and Heaths, to the south west has also been included. It should be noted that the published descriptions of these character areas primarily relate to their rural characteristics, and not urban areas lying within or adjoining them. The characteristics of relevance to the study area are listed below.

10.4.11. The key characteristics of relevance NCA 79 are:

- Generally flat, low-lying landscape, compared to adjacent areas, which has limited topographic variation and slopes gently from west to east, becoming flatter as it merges with the Broads.
- Distinctive coastal sand dune system and deposits of marine shingle, with sections of sandy cliffs and long, wide, sandy beaches.
- The River Yare, which provides a distinctive riverine landscape and flows out through the tidal lake of Breydon Water to the North Sea.
- Strong vernacular style of domestic and agricultural buildings, reinforced by use of flint and red brick. Roofs are commonly Norfolk reed thatch or pantiles. Isolated flint churches – either round-towered Saxo-Norman churches or medieval wool churches – are prominent in the open landscape.
- Chalet parks and large caravan sites dominate the settlement structure along parts of the coast.

10.4.12. The key characteristics of NCA 80:

- The landscape is low-lying with some areas below sea level and has characteristic open, extensive views over slow meandering rivers, drained marshland and coastal plain in the lower valley flood plain. Views inland are framed by the tree-lined valley ridge lines.
- The middle, upper and narrow incised side valley tributaries are small scale, low and enclosed, often supporting woodland.
- Rivers dominate the landscape with the middle and Lower River reaches flowing between flood banks, above the level of the surrounding land which is drained by dykes, ditches and pumps.
- The Broads, which are former flooded peat workings, form naturally nutrient-rich shallow lakes of various sizes surrounded by fens, wet woodland and large expanses of reed bed, rich in biodiversity.
- Field patterns are principally defined by drainage over most of the Broads. Regular 18th- and 19th-century enclosure fields (generally marshland) are clearly defined by straight, reed-fringed drainage ditches that form a strongly geometric layout across the lower flood plain. Some earlier curvilinear enclosure of marshland also survives.
- Vertical features are very distinctive in this generally flat landscape and include some very fine medieval churches on the higher ground and several traditional drainage mills located on embankments flanking some of the drainage channels on the marshes and coastal plain.
- Small boatyards and marinas form part of the traditional riverside scenery although, increasingly, extensive modern boatyard/marina developments challenge the traditional character.

10.4.13. The key characteristics of NCA 82 are:

- A predominantly low-lying landscape with some areas along the coastal plain below or at sea level. Changes in relief are slight, but enough to distinguish the Sandlings, sandy rolling ‘upland’ between estuaries.
- A dynamic coast, shaped by long, sweeping bays, cut by the series of more sheltered estuaries. The shoreline is defined by shingle beaches and structures, sea defence features and in places low, soft crumbling cliffs.
- Rivers flow west-east forming intimate, twisting alluvial valleys. Estuaries support internationally important salt marshes and intertidal flats with large numbers of waders and wildfowl, while their open waters are busy with pleasure and commercial craft.
- Expansive coastal level grazing marshes divided by drainage dykes contain internationally important reed beds and fens. Many are managed as nature reserves owing to their rich biodiversity, which includes a nationally important concentration of breeding bittern.
- Large commercial ports (Harwich and Felixstowe), Sizewell nuclear power station, the Cobra Mist transmitting station and the Orwell Bridge all contribute landmark diversity. Major transport infrastructure includes the A14 and A12 and the main East Coast rail line.

Local Landscape Character Areas

10.4.14. Great Yarmouth Borough Landscape Character Assessment, 2008 classifies the area that the Proposed Scheme sits within as Urban. The following landscape character areas are within the study area:

- C1 – Yare Valley – Great Yarmouth Edge
- G4 – Hobland Settled Farmland

10.4.15. The Broads Authority Landscape Character Assessment Supplementary Planning Documents defines an area in the north-west of the study area as Area 20 Yare – Breydon Water; and Area 21 Yare – Burgh Castle Marshes.

TOWNSCAPE CHARACTER

10.4.16. Based on published character studies, mapping, desk studies and fieldwork, townscape character areas will be determined for the assessment within the Environmental Statement.

TOWNSCAPE SENSITIVITY

10.4.17. Sensitivity relates to how much the townscape is valued in combination with the extent to which it is susceptible to the change brought about by the Proposed Scheme. Three orders of sensitivity (high, medium and low) will be adopted and applied to each of the townscape character areas as defined in Section 10.3.

VISUAL AMENITY

10.4.18. Establishment of the visual baseline for the Proposed Scheme will involve the adoption of the four stages of assessment described in Section 10.3.

10.4.19. To establish the distribution and types of visual receptors the following will be undertaken:

- Review of OS 25k mapping, and other published material;
- Review of the ZTV;
- Discussion with the heritage team; and
- Consultation with the local planning authority

10.4.20. Visual receptors will include the following:

- Occupants of residential clusters and individual properties;
- Users on roads with views of the Proposed Scheme; and
- Recreational users of publicly accessible areas including Public Rights of Way, published walking or cycling routes such as national cycling routes and long-distance walking trails, lookout points, and areas of green space.

10.4.21. Until the production of the ZTV and detailed site work all the potential visual receptors cannot be identified, however a preliminary review of baseline information has identified the following receptors likely to experience views of the Proposed Scheme, and form the basis for the selection of 12 representative photographic viewpoints. The list of visual receptors may be adjusted in line with further information and findings as the ES progresses.

Public and cultural visual receptors

10.4.22. Public and cultural receptors include:

- National Cycle Route 517;
- Werrymans' Way;
- Angles Way Long Distance Path;
- England Coast Path;
- Look out point at Nelson Museum;
- Elizabeth House (National Trust);

- Hall Quay / South Quay Conservation Area;
- Public open space adjacent to Hall Quay and Haven Bridge;
- Southtown Common; and
- Footpaths and surrounding roads with potential visibility of the Proposed Scheme.

Residential visual receptors

10.4.23. Properties to the north-west of the Proposed Scheme include:

- Cromwell Road, one property will be demolished as part of the Proposed Scheme;
- Cromwell Court; and
- Southtown Road, nine properties will be demolished as part of the Proposed Scheme.

10.4.24. Properties to the south of the Proposed Scheme include:

- Queen Anne's Road, (ten properties will be demolished as part of the Proposed Scheme);
- Southtown Road (these may be demolished as part of the Proposed Scheme);
- Alpha Road; and
- Ferry Hill.

10.4.25. Properties to the north and east of the Proposed Scheme include:

- Admiralty Road;
- Barrack Road;
- The Steeps; and
- South Quay.

PRELIMINARY REPRESENTATIVE VIEWPOINTS

10.4.26. The following 12 preliminary photographic viewpoints presented in Table 10.7 below have been identified as shown on Figures 10.1 and 10.2; these have been agreed with the landscape officer at NCC who has been requested to act as consultee on behalf of GYBC. The location of the proposed viewpoints will be validated on site and may be relocated following the site visit as required. The locations have been selected to also cover potentially affected heritage locations.

Table 10.7 - Proposed representative viewpoints

Viewpoint Number	Viewpoint Name/Location	Receptors Represented
Viewpoint 1	Southtown Road	Recreational Users on NCN 571 Recreational Users on the East Coast Path Residential Receptors
Viewpoint 2	Queen Anne's Road	Recreational Users NCN 571 Recreational Users East Coast Path Residential Receptors (residential receptors may be demolished as part of the Proposed Scheme)
Viewpoint 3	Southtown Common Recreation Ground	Recreational Users
Viewpoint 4	William Adams Way	Road Receptors
Viewpoint 5	A47 Footbridge	Road Users Recreational Receptors
Viewpoint 6	Bollard Quay	Recreational Users on NCN 571 Recreational Users on the East Coast Path Residential Receptors
Viewpoint 7 (combined heritage viewpoint)	Dolphin Public House	Heritage Asset Recreational Users
Viewpoint 8 (combined heritage viewpoint)	Barrack Road	Heritage Asset Residential Receptors
Viewpoint 9	Admiralty Road	Residential Receptors
Viewpoint 10	Ferryside	Recreational Users on NCN 571 Recreational Users on the East Coast Path Residential Receptors
Viewpoint 11 (combined heritage viewpoint)	South Quay	Heritage Asset Recreational Users
Viewpoint 12	Hall Quay	Recreational Users

PROPOSED PHOTOMONTAGES

10.4.27. Photomontages can be used to demonstrate the appearance and visibility of the Proposed Scheme. Such visualisations will be produced in accordance with Advice Note 01/11110 and the draft LI Advice Note 2018111 published by the Landscape Institute. Where appropriate, mitigation planting can be illustrated at years 0 (completion) and year 15.

10.4.28. The following representative viewpoints are proposed for the creation of verifiable photomontages as they represent highly sensitive receptors who are likely to experience significant effects resulting from the Proposed Scheme.

- Viewpoint 1 – Recreational Users on National Cycle Route 571, East Coast Path and Residential Receptors; and
- Viewpoint 6 – Recreational Users on National Cycle Route 571, East Coast Path and Residential Receptors.

10.5 PREDICTED EFFECTS

CONSTRUCTION

10.5.1. The demolition of buildings will create new views within the townscape. Construction compounds, scaffolding, hoarding, cranes and plant, along with material stockpiles will introduce new prominent visual elements into existing views and alter the balance of townscape components and pattern.

OPERATION

10.5.2. The introduction of the Proposed Scheme will result in a new prominent visual feature of a noticeably different scale and form within the part of the urban fabric of Great Yarmouth. There will be a change to the pattern of townscape and new views resulting from the loss of buildings and introduction of a new public realm, control tower and ancillary highway elements. There will be a change in the setting of River Yare and views along the River Yare. The Proposed Scheme may provide benefits to townscape quality and quality of views.

10.6 PROPOSED MITIGATION

10.6.1. The proposed mitigation is likely to be embedded within the design of the Proposed Scheme, particularly in the bridge structure and placement of associated elements. Due to the scale of the bridge structure it is unlikely that planting will effectively reduce effects at Year 15, however there is scope to screen and filter views of specific receptors along with improving townscape quality through the design of the public open space and planting along the supporting roads and junctions. There is potential to include localised planting to improve specific visual receptors adjacent to the Proposed Scheme where Large Effects have been identified.

[110] Landscape Institute (2011) Advice on photography and photomontage (online) (Accessed June 2018). Available at https://www.landscapeinstitute.org/visualisation/photography-and-photomontage/?utm_source=dotmailer&utm_medium=email&utm_campaign=9545935_20180605%20-%20Photography%20photomontage%20guidance%20update&dm_i=6KZ,5OLOV,4YDDWR,M460P,1

[111] Landscape Institute (2018) Public Consultation Draft (online) (Accessed June 2018). Available at https://www.landscapeinstitute.org/visualisation/photography-and-photomontage/?utm_source=dotmailer&utm_medium=email&utm_campaign=9545935_20180605%20-%20Photography%20photomontage%20guidance%20update&dm_i=6KZ,5OLOV,4YDDWR,M460P,1

CONSTRUCTION

10.6.2. During construction the siting of compounds and boundary treatments such as hoarding of appropriate scale to hide construction activity and storage of materials, particularly around construction compounds will reduce effects on visual receptors.

OPERATION

10.6.3. At operation, mitigation is likely to be embedded within the Proposed Scheme design. Due to the nature and context of townscape, mitigation opportunities such as screening may not be possible or limited to specific receptors, dependant on the chosen final design.

10.7 CONCLUSIONS ON EFFECTS

10.7.1. The bridge structure will be a prominent new feature within the townscape and highly visible.

10.8 ASSESSMENT STILL TO BE UNDERTAKEN

10.8.1. The townscape and visual assessment will be undertaken during the ES in accordance with methodology set out in 1.3.

10.8.2. The following activities are to be undertaken:

- Confirm the design options for the bridge to be taken forward for assessment;
- Define townscape character areas through desk based study and site work within the study area;
- Undertake a ZTV to determine the visual envelope, which will be confirmed or amended through site visits to determine the study area and subsequent amendments if required;
- Undertake the assessment of townscape and visual effects in accordance with the methodology set out in section 1.3
- Prepare photomontages for selected viewpoint locations to be agreed with landscape officer at NCC who has been requested to act as consultee on behalf of GYBC;
- Prepare and agree appropriate mitigation measures, and or design modification where possible aimed at reducing or avoiding significant effects.

11

ROAD DRAINAGE AND THE WATER ENVIRONMENT

11 ROAD DRAINAGE AND THE WATER ENVIRONMENT

11.1 INTRODUCTION

11.1.1. This chapter describes the preliminary assessment of likely significant effects during construction and operation of the Proposed Scheme on the water environment (surface water and groundwater) The assessment is limited to the Proposed Scheme to date and data currently available at this point of the assessment process.

11.1.2. The potential impacts of the Proposed Scheme on other related aspects are addressed in other chapters as follows:

- Flood risk - Chapter 12;
- Nature conservation – Chapter 8; and
- Release of land based contaminants into surface or ground water bodies – Chapter 16

11.1.3. This chapter also addresses the requirements of the Water Framework Directive (WFD). The WFD compliance assessment will be incorporated into the ES for the Proposed Scheme. The WFD assessment will make reference to the findings of the ES in respect of aquatic ecology which will be included in the Nature Conservation Chapter.

11.1.4. The study area has been defined as the area within 1km of the Proposed Scheme Boundary for the assessment of impacts on surface water and 2km for the assessment of impacts on groundwater. Where there is direct hydraulic connectivity, potential impacts on surface water bodies which are outside the defined study area have been considered also. The study area is presented in Figure 11.1. The Proposed Scheme Boundary includes six proposed VMS locations and a large vessel waiting facility. The study area boundaries have been extended to cover these small areas, however at this stage these areas have not been assessed. The work in these areas is limited to erection of VMS or designated vessel waiting facility and therefore no significant effects are currently anticipated. This will be confirmed as part of the ES.

11.2 DIRECTIVES, STATUTES AND RELEVANT POLICES

11.2.1. A summary of the current legislation, policy and guidance documents relevant to the assessment of impacts of the Proposed Scheme on road drainage and the water environment is presented below.

THE WATER FRAMEWORK DIRECTIVE – DIRECTIVE 2000/60/EC

11.2.2. The Water Framework Directive (WFD) makes provision for the maintenance and improvement of the 'ecological and chemical status' of the water environment, which includes rivers, lakes, wetlands, groundwater, estuaries and coastal waters. Chemical status is determined from compliance with environmental standards for chemicals that are classed as 'priority hazardous substances' and 'priority substances'. The ecological status of a surface waterbody is measured through a range of biological quality elements, supported by measurements of physicochemistry, hydromorphology and compliance with environmental standards for chemicals that are classed as 'specific pollutants'. For groundwater the overall status has a quantitative and a chemical component.

11.2.3. The aim is for designated waterbodies to achieve 'good overall status' and prevent deterioration of status of surface waters and groundwater. Certain surface waterbodies may be designated as artificial/heavily modified and will have less stringent targets to meet, however these will still need to demonstrate 'good overall potential'.

11.2.4. Guidance published by the Environment Agency (EA) provides further information on assessing the risk of activities in relation to the River Basin Management Plan (RBMP) objectives.

GROUNDWATER DIRECTIVES

11.2.5. The WFD and the Groundwater Daughter Directive (GDD) (2006/118/EC), which were enacted in 2000 and 2006 respectively, replace the original Groundwater Directive (80/68/EEC) which was repealed in 2013. The GDD introduces procedures for assessing the 'Chemical Status' of groundwater as per the WFD, and protects groundwater by preventing direct discharge of 'hazardous pollutants' and limiting the direct discharge of non-hazardous pollutants.

NATIONAL LEGISLATION

11.2.6. The following legislation is relevant to the objectives of the Directives discussed above and generally to the subject matter of this part of the assessment:

- The Water Resources Act 1991;
- The Water Act 2003;
- The Flood and Water Management Act 2010;
- The Salmon and Freshwater Fisheries Act 1975;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- The Environmental Permitting (England and Wales) Regulations 2016;
- The Control of Pollution (Oil Storage) (England) Regulations 2001; and
- The Environmental Damage (Prevention and Remediation) (England) Regulations 2015.

11.2.7. Consents will be required from the EA for temporary construction and permanent operational discharges as well as any temporary or permanent abstractions, impoundments and in-channel works. Under the Environmental Permitting Regulations, it is an offence to cause or knowingly permit a water discharge activity, including the discharge of polluting materials to freshwater, coastal waters, relevant territorial waters or groundwater, unless complying with an exemption or an environmental permit.

National Planning Policy Framework[56]

11.2.8. The revised National Planning Policy Framework (NPPF) for England was published in July 2018. In particular, Section 15 of the NPPF (Conserving and enhancing the natural environment) is relevant to the assessment of impacts on the water environment from the Proposed Scheme.

11.2.9. Paragraph 170 states that the planning system should contribute to and enhance the natural environment by "*preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability*".

National Policy Statement for National Networks[55]

11.2.10. Specific policies for NSIPs for which particular considerations apply are set out in national policy statements. The key document for the Proposed Schemet is the National Policy Statement for National Networks. It sets out detailed policy on environmental mitigations for development including pollution control, and assessment and management of water quality and resources.

11.3 ASSESSMENT METHODOLOGY

11.3.1. The road drainage and water environment assessment has and will continue to involve the following key tasks:

- Consultations with the relevant statutory and non-statutory bodies to establish the principal water environment issues to be assessed;
- Desk studies and field surveys to ascertain the current baseline conditions on site;
- Assessment of the potential impacts related to the construction and operation of the Proposed Scheme;
- Identification of measures to avoid, minimise or mitigate predicted impacts.

11.3.2. The assessment for the ES will focus upon defining the characteristics and subsequent potential impacts upon the surface water and groundwater receptors, including the wider hydrological catchments as categorised by the EA under the WFD. This hydrological catchment-based approach enables due consideration to be given to both individual locations where interactions occur and any cumulative impacts within larger water body areas.

11.3.3. This assessment provides preliminary information as it relates to the Proposed Scheme to date and data currently available at this point of the assessment process. This preliminary assessment is a qualitative assessment, based largely on existing published datasets and information contained within reports from previous stages of the Proposed Scheme. An initial assessment of the potential impacts of the Proposed Scheme on the water environment has been completed using professional judgment to assess the likely magnitude of impacts where sufficient data is not yet available to quantify these impacts.

11.3.4. A more detailed assessment of potential impacts of the Proposed Scheme on identified receptors will be undertaken for the ES. Gaps in information identified at this PEIR stage will be considered and addressed along with confirmation of the Proposed Scheme design and specific mitigation measures.

SCOPED OUT IMPACTS

11.3.5. The specific characteristics of the Proposed Scheme enable particular impacts to be considered as highly unlikely to occur. Based on professional judgement and taking account of water environment characteristics, Proposed Scheme design and Scoping Opinion, the following items are not intended to be considered further:

- Loss of standing water - scoped out due to the scale of the Proposed Scheme, the urban setting of the study area and the lack of standing water bodies below or adjacent to the Proposed Scheme;
- Loss or change to Groundwater Dependent Terrestrial Ecosystems - scoped out due to the urban setting of the study area and the lack of such ecosystems below or adjacent to the options under development;
- Changes to groundwater level or flows due to cuttings and related dewatering - scoped out as no cuttings are anticipated for the Proposed Scheme.
- Groundwater impacts to Chalk Group aquifer and associated water users as the above lying London Clay Formation will provide a substantially thick low permeable layer to prevent scheme related construction activities impacting upon these receptors.

CONSTRUCTION POLLUTION

11.3.6. Evaluation of the potential for pollution of surface waters as a result of spillage and of the release of sediments into watercourses or water bodies will involve a review of areas where construction would be required within or in proximity (i.e. within 50m) of surface watercourses and water bodies.

11.3.7. Mobilisation of potentially contaminated sediments during construction will also be considered in terms of local receptors with hydraulic connectivity to the Proposed Scheme. For the ES this will be informed by sediment

transport modelling that will be undertaken for the Proposed Scheme and sediment sampling to determine levels of contamination. A qualitative assessment has been completed for the PEIR.

POLLUTION FROM ROUTINE RUN-OFF

11.3.8. DMRB HD 45/09[112] specifies procedures for the assessment of pollution impacts from routine run-off on surface waters, known as 'Method A'.

11.3.9. The Method A assessment comprises two separate elements:

- HAWRAT Assessment: the Highways Agency Water Risk Assessment Tool (HAWRAT) is a Microsoft Excel application designed to assess the short-term risks related to the intermittent nature of road run-off. It assesses the acute and chronic pollution impacts on aquatic ecology associated with soluble and sediment-bound pollutants, respectively; and

- EQS Assessment: EQS are the maximum permissible annual average concentrations of potentially hazardous chemicals, as defined under the WFD. The long-term risks over the period of one year are assessed through comparison of the annual average concentration of pollutants discharged with the published EQS for those pollutants.

11.3.10. To carry out these assessments a variety of baseline and drainage design information is required, including: traffic volumes, areas of impermeable and permeable road surfaces to be drained, proposed treatment train, receiving watercourse dimensions and flow data, water hardness, presence of sensitive sites (considered as international / national designated conservation sites) and in-stream structures or features which may influence the flow.

11.3.11. However, Method A was developed for assessment of discharges into freshwater bodies rather than transitional water such as the River Yare, with such water bodies having different characteristics, receptors and baseline conditions due to tidal influence and dilution factors. Therefore, the appropriate method of assessment for routine run-off will be discussed and agreed with the EA. A qualitative assessment of potential impacts has been completed for the PEIR based on the preliminary drainage strategy for the Proposed Scheme, alongside the hydrological regime of the receiving watercourses.

11.3.12. The assessment method for groundwater receptors is known as 'Method C', applied to drainage design features designed to discharge to groundwater specifically. The Method C assessment comprises a risk assessment procedure based on the source-pathway-receptor model, which considers the following parameters: traffic density, rainfall, soakaway design and geometry, depth to groundwater table, groundwater flow type, aquifer grain size and aquifer lithology.

POLLUTION FROM ACCIDENTAL SPILLAGE

11.3.13. The DMRB document HD 45/09[112] specifies procedures for the assessment of pollution impacts from accidental spillage, known as 'Method D'. A summary of the methodology is provided below, with full details provided in HD 45/09[112].

11.3.14. The assessment takes the form of a risk assessment, where the risk is expressed as the annual probability of a serious pollution incident occurring. This risk is the product of two probabilities:

- The probability that an accident will occur, resulting in a serious spillage of a polluting substance on the carriageway; and

[112] Design Manual for Roads and Bridges Volume 11, Section 3, Part 10 (HD 45/09) Road Drainage and the Water Environment, former Highways Agency, November 2009

- The probability that, if such a spillage did occur, the polluting substance would reach the receiving water body and cause a serious pollution incident.

11.3.15. The probability of a serious spillage occurring is dependent on a variety of factors; namely, traffic volumes, percentage of heavy goods vehicles in the traffic volumes, whether the road is a motorway, rural or urban trunk road, the road type categories within the road drainage catchment under assessment (i.e. 'no junction', 'slip road', 'cross road' or 'roundabout'), and the length of each road type within the catchment.

11.3.16. The probability of a serious spillage subsequently causing a serious pollution incident is dependent on the receiving surface water body and the response time of the emergency services; i.e., less than 20 minutes, less than one hour, or greater than one hour.

11.3.17. However, as for Method A, Method D was developed for assessment of discharges into freshwater bodies rather than the transitional water of the River Yare with associated tidal influence and dilution factors. Therefore, the appropriate method of assessment for accidental spillage will be discussed and agreed with the Environment Agency. A qualitative assessment of potential impacts has been completed for the PEIR based on the preliminary drainage strategy for the Proposed Scheme, alongside the hydrological regime of the receiving watercourses.

HYDROMORPHOLOGICAL CHANGES

11.3.18. A hydromorphological assessment will be undertaken which will include sediment transport modelling of the Proposed Scheme to understand the impact of the presence of the bridge infrastructure on the hydromorphology of the River Yare. It will discuss the potential effects on river bed scour/erosion, sediment deposition and any implications for Breydon Water designated site to the north from potential changes to sediment erosion and deposition patterns.

11.3.19. A qualitative assessment of potential impacts has been completed for the PEIR, based on professional judgment as to the likely magnitude of potential impacts on the flow regime of the River Yare due to the proposed bridge structure, physical changes to other surface water bodies and potential changes to the current drainage regime.

GROUNDWATER POLLUTION THROUGH MIGRATION OF CONTAMINATED SEDIMENTS

11.3.20. An assessment of the potential impact of the Proposed Scheme on groundwater quality will be undertaken with respect to potential contamination through migration of contaminated sediments or land-based contaminants entering groundwater through piling or similar activities.

LOSS OR CHANGE TO AQUIFERS AND SUPPORTED WATER SUPPLIES

11.3.21. An assessment of the potential impacts of the Proposed Scheme on groundwater quality and quantity will be undertaken with respect to aquifers and groundwater abstractions within 2km of the Proposed Scheme Boundary. This will include assessment of licensed abstractions and unlicensed private water supplies.

INDIRECT LOSS OR CHANGE TO SURFACE WATER RECEPTORS

11.3.22. Surface water bodies such as streams, lakes and wetlands can receive or recharge groundwater, with movement likely between the two receptors. Any changes to groundwater as a result of groundwater control measures and the emplacement of bridge foundations may indirectly impact surface water bodies and result in changes to surface water flow and quality. The impact on surface water receptors shall be assessed qualitatively.

ATTENUATION POND AND STORM WATER STORAGE FEATURE IMPACT TO GROUNDWATER

11.3.23. The preliminary drainage strategy suggests that a storm water attenuation pond and storage feature will be required for the scheme to operate. An assessment of the potential impacts these will pose on the local aquifers and associated water users will be required.

IMPACT ASSESSMENT CRITERIA

11.3.24. The predicted significance of impacts on surface waters and groundwater will be based on the importance or sensitivity of the relevant waterbody and the magnitude of the impact from the Proposed Scheme, as recommended in DMRB document HD 45/09[112].

11.3.25. The importance or sensitivity of the waterbodies is evaluated taking into account their quality, rarity, scale and substitutability. The criteria used is based on the guidance and examples given in HD 45/09 (Table A4.3) and WebTAG guidance and is provided in Appendix 11A.

11.3.26. The magnitude of the various impacts is evaluated taking into account the extent of loss and effects on integrity of the relevant waterbody attributes. The criteria used is based on the guidance and examples given in HD 45/09 (Table A4.4) and WebTAG guidance and is provided in Appendix 11A.

11.3.27. The estimation of the impact significance is derived by combining the estimated importance of the affected waterbodies and the magnitude of the impacts, taking into account mitigation and the guidance provided in HD 45/09[112], Table A4.5. Details for the methodology and criteria are provided in Chapter 5: Assessment Approach and should be read in conjunction to this chapter.

11.3.28. Where there is more than one option for significance rating, professional judgement is used to determine the significance for the particular impact. Any residual effects assessed as Moderate, Large or Very Large are deemed to be significant.

WATER FRAMEWORK DIRECTIVE ASSESSMENT

11.3.29. A WFD Assessment will be undertaken to assess the Proposed Scheme against the key objectives of the WFD. The approach to the assessment is based on EA guidance available on Gov.UK and will consider the potential impacts of the Proposed Scheme against the quality elements of the WFD waterbodies to determine whether the Proposed Scheme will affect the waterbody status and / or achieving the objectives stated in the RBMP. A preliminary assessment, incorporated into this chapter, has been completed for the PEIR and will be consulted on with the EA.

SOURCES OF INFORMATION

11.3.30. A desk study comprised a review of various information sources in order to obtain information relating to the water environment assembled from other studies and designated and non-designated sites. Information sources which have informed the desk study review include:

- Great Yarmouth Third River Crossing, Stage 2 Environmental Impact Assessment Report 2009 (“the Stage 2 Report”);[113]
- Ordnance Survey Mapping and terrain data;

[113] Mott MacDonald (2009). Great Yarmouth Third River Crossing Simple Environmental Assessment

- Defra's online GIS portal MAGIC[107];
- 1:50,000 Geological map England and Wales Sheet 162, Great Yarmouth, British Geological Survey;
- 1:125,000 Hydrogeological Map of Northern East Anglia, Sheet 1 Regional Hydrological Characteristics and Explanatory Notes, British Geological Survey;
- Datasets available from data.gov.uk, including:
  - LIDAR terrain data;
  - Locations of designated sites;
  - EA Asset Information Management System (AIMS) data;
- FEH web service portal (river catchment boundaries);
- EA Catchment Data Explorer (WFD data)[114]; and
- Groundsure report (2017)[115].

11.4 BASELINE ENVIRONMENT

DESCRIPTION OF THE STUDY AREA

11.4.1. Figure 11.1 shows the study area and key features, which are subject to update when data is received from the EA and local authorities.

11.4.2. The Proposed Scheme is located at and adjacent to the River Yare in Great Yarmouth (NGR 6524 3059). The Proposed Scheme Boundary is approximately 2.5km upstream from the outlet to the North Sea at Gorleston-on Sea. The study area comprises land in the vicinity of the River Yare and is mostly contained within the urban area of Great Yarmouth, although it also encompasses agricultural land to the north and west of the town and the North Sea to the east.

11.4.3. The topography of the area is reasonably flat and low-lying. Land to the south west falls from an elevation of approximately 15 m above Ordnance Datum (AOD) towards the River Yare at Great Yarmouth whilst land to the north and west (near Breydon Water) lies below ordnance datum. The eastern half of Great Yarmouth (east of the River Yare) forms a spit of land with a maximum elevation of around 7 mAOD.

11.4.4. The current land use within the study area is varied. Within the Proposed Scheme Boundary, current uses largely comprise industrial and commercial properties and highway infrastructure. The wider study area includes mainly industrial and commercial properties alongside the River Yare, with infrastructure such as South Denes Power Station and Great Yarmouth Port. Areas of open space for recreation and similar uses are present west of the River Yare, within the urban area. North and west of the town the land use becomes mainly agricultural consisting of marshland surrounding Breydon Water, an area of intertidal mudflats through which the River Yare flows. In addition to the port and harbour, the eastern coastline of Great Yarmouth comprises beaches used for leisure and recreation.

[114] Environment Agency (2018) Catchment Data Explorer. [online] available at http://environment.data.gov.uk/catchment-planning/. Accessed June 2018.
[115] Groundsure Enviro Insight Report Ref: CMAPS-CM-636391-16287-030717EDR, Centre Maps Live, July 2017

SURFACE WATER FEATURES

River Yare

11.4.5. The main surface water feature in the study area is the River Yare which flows north to south through the Application Site and enters the sea through a gap in the spit of land at Gorleston on Sea. The River Yare is a tidal river, according to the Stage 2 report the tidal limit is approximately 15km upstream, with a spring tidal range of approximately 2.2 m. The River Yare is a Main River, under the jurisdiction of the EA.

11.4.6. A confluence between the River Bure (also Main River) and the River Yare is located 2.1 km upstream of the Application Site. The River Waveney also joins the River Yare approximately 8 km upstream. The distance to the River Waveney is considered sufficient such that no impact is likely to result from the Proposed Scheme.

11.4.7. Upstream of the Proposed Scheme Boundary the River Yare passes through Breydon Water, an area of intertidal mudflats with its downstream extent at Breydon Bridge, approximately 2.4km upstream of the Proposed Scheme. Breydon Water covers an area of around 500 ha and is an internationally important RSPB nature reserve, and designated as a Special Protection Area (SPA), Site of Special Scientific Interest (SSSI) and is on the List of Wetlands of International Importance (Ramsar Site).

11.4.8. The River Yare is included in the Outer Thames Estuary SPA which extends from Caister on Sea south to the Thames Estuary.

11.4.9. The River Yare has a large catchment, estimated at around 3,000 km^2. The catchment includes the main tributaries of the River Bure, River Wensum and River Waveney, rising inland, and a significant area of low lying land drained via a network of ditches and channels in the Norfolk Broads.

11.4.10. Through the study area the river is around 80m wide, with banks consisting of engineered quay walls. The EA Asset Information Management System (AIMS) database shows numerous outfalls to the River Yare along both banks as it passes through Great Yarmouth. Several control gates and penstocks are also present near the confluence with the River Bure. The Haven Bridge crosses the River Yare approximately 1500m upstream of the Proposed Scheme, with the Vauxhall Bride crossing a further 800m upstream. Both structures include piers in the channel and associated structures.

11.4.11. Under the WFD, the River Yare is part of the Bure & Waveney & Yare & Lothing waterbody. This is a heavily modified transitional waterbody and is linked with several protected sites. It has an overall status (2016) of Moderate, comprising an ecological status of Moderate and Chemical Status of Good. The objective for the waterbody is to achieve Moderate status by 2027. Details of specific measures to achieve this objective are not known at this stage.

11.4.12. According to the Stage 2 report the normal spring tide discharge is in the region of 400 m^3/s with velocities around 2 m/s. As part of the sediment modelling study in 2008 current velocities were obtained which varied between 0.25 and 2.0 m/s.

11.4.13. The Stage 2 report references water and sediment sampling that was completed in November and December 2007. The sampling locations and details of the methodology are unknown at this stage. The results showed that concentrations of Copper, Biochemical Oxygen demand (BOD) and Total Suspended Solids all exceed their respective quality standard. Sediment samples consisted almost entirely of inorganic material (99%). The results showed that samples exceed probable effect level (PEL) standards (used at the time) for dibenzo(a,h)anthracene and phenanthrene. Sediments exceeding PEL standards suggest that remobilisation of these sediments could cause frequent adverse biological effects. Threshold effect level (TEL) standards were exceeded for the majority of heavy metals and PAHs in the core and grab samples collected in the same area. Exceedance of TEL standards suggests that remobilisation could result in an occasional adverse biological effect. The particle size distribution was determined from sediment samples taken. The majority of sediment grab and core samples had particles with a mean diameter of <1000 µm (ranging from coarse sand to silt). The sediment samples were assessed as being generally poorly sorted. This suggests that sediment at these sites is subject to intermittent disturbances such as storm surges and tidal cycles, during which rapid resuspension and deposition occurs.

River Bure

11.4.14. The River Bure is a tributary of the River Yare with its confluence approximately 2.1 km upstream of the Proposed Scheme Boundary. The River Bure is also a tidal Main River at this location. The River Bure passes through a largely rural catchment, estimated at around 1,000 km^2, in its lower reaches comprising the low-lying land of the Norfolk Broads. The River Bure is also included in the Outer Thames Estuary SPA. The River Bure is part of the Bure & Waveney & Yare & Lothing waterbody.

North Sea

11.4.15. The River Yare discharges to the North Sea at Gorleston-on-Sea. Under the WFD, this is included in the Norfolk East waterbody. This is a heavily modified coastal waterbody and is linked with several protected sites. It has an overall status (2016) of Moderate, comprising an ecological status of Moderate and Chemical Status of Good. The objective for the waterbody is to achieve Moderate status by 2015. Details of specific measures to achieve this objective are not known at this stage.

Other surface water features

11.4.16. Upstream of Great Yarmouth land either side of the main rivers is mainly marshland, drained via a network of ditches and small watercourses. The land generally lies below ordnance datum and land north of Breydon Water is managed by the Broads Internal Drainage Board (IDB). The land to the south is managed by the Waveney, Lower Yare & Lothingland IDB. It is likely these areas ultimately drain to the Breydon water and then the River Yare. The majority of this marshland area lies outside the study area although a small part adjacent to Great Yarmouth is included in the 1km buffer zone for surface water features.

11.4.17. Within the 1km study area there are several small ditches / watercourses and a small pond shown on OS mapping. These are generally located in less densely developed areas, but still within the urban area of Great Yarmouth. These are likely to form part of the surface water drainage infrastructure for the area. Most of the open watercourses are located outside of the Proposed Scheme Boundary although a few are shown within the Proposed Scheme Boundary, around Southtown Common and the A47 roundabout.

11.4.18. These watercourses eventually drain to the marshland west of Great Yarmouth and to the River Yare at Breydon Water via a pumping station.

SURFACE WATER ABSTRACTIONS AND DISCHARGES

11.4.19. There are a number of licensed discharges within the study area to the River Yare. The consents include sewerage, trade effluent, storm overflow discharges and site drainage. Contaminants associated with these processes include faecal material, bleaches and cleaning products.

11.4.20. No active surface water abstraction licenses were identified in the study area.

GEOLOGY

11.4.21. A detailed description of the geology of the study area is available in Chapter 16: Geology and Soils. The associated geological map is presented within the Contaminated Land desk study in Appendix 16A. The main characteristics of the geology of the study area are:

- Blow sand along the shore;
- Quaternary sand and gravel deposits from the North Denes Formation at the East of the Proposed Scheme Boundary;
- Quaternary clay and silt deposits from the Breydon Formation at the West and North West of the Proposed Scheme Boundary;
- Peat, also from the Breydon Formation, at the West and South West of the Proposed Scheme Boundary;

- Quaternary sand and silt deposits from the Lowestoft Till Formation and Happisburgh Glacigenic Formation at the South of the Peat Deposit;
- Underneath the Quaternary deposits, the bedrock consists of sands, gravels, silts and clays from the Crag Group.

11.4.22. The London Clay Formation, Thanet Formation and the Chalk Group underlie the Crag Group. The geological units and their main characteristics in the study area are listed in Table 11.1.

HYDROGEOLOGY

11.4.23. The Hydrogeological Map of North East Anglia 1:125,000 (1976), available on the BGS website[116], gives information about the regional hydrogeological characteristics of the study area. The area consists of three main aquifers: a superficial aquifer in the recent sedimentary deposits and two deeper Principal aquifers.

11.4.24. Including the 2km radius around the Proposed Scheme Boundary, the superficial aquifers comprises of blown sand and shingle, North Denes Formation and Happisburgh Formation. These aquifers are classified by the EA as Secondary A Aquifers, capable of supporting water supplies and/or river base-flow, at a local rather than strategic scale. They directly underlie, or are at shallow depth within the study area and are vulnerable to contamination.

11.4.25. Blown sand and shingle deposits to the east of the Proposed Scheme Boundary where the thickness varies between 9m and 15m. Abstraction yields of up to 15l/s have been proven from these deposits and it should be noted that water in this area is saline.

11.4.26. The North Dene Formation has proven abstraction yields of approximately 25l/s from the gravels. However, this may vary locally.

11.4.27. The Happisburgh Glacigenic Formation has proven abstraction yields of up to approximately 5l/s from the glacial sand and gravels units.

11.4.28. The Crag Group and Chalk Group underlie the superficial deposits (Section 11.4.21 and Section 11.4.24) and are classified by the EA as Principal Aquifers. The EA define these aquifers as having high intergranular and/or fracture permeability and usually provide a high level of water storage, capable of supporting water supplies and/or river base-flow at a regional / strategic scale.

11.4.29. The Crag Group aquifer consists mainly of interbedded sands and gravels. The aquifer dips and thickens eastward and reaches about 60m thick on the east coast. Distinguishing the Crag Group from the overlying superficial aquifers can be difficult where they are in contact due to similarity in composition. The superficial aquifers and Crag Group aquifer are assumed to be hydraulically connected.

11.4.30. The Chalk Group is classified as a Principal Aquifer; with high intergranular and/or fracture permeability and usually providing a high level of water storage.

11.4.31. The hydrogeological map also provides a cross section (Section 1), which is located slightly to the north of the study area but is considered representative of the main hydrogeological characteristics of the area of interest. The cross section gives in depth information on the variation of the hydrogeological units and shows that the Crag Group aquifer and the Chalk Group aquifer are separated by the London Clay Formation, which is assumed to be around 95m thick.

11.4.32. Table 11.1 provides a summary of the hydrogeological units.

[116] http://www.bgs.ac.uk/

Table 11.1 – Main Geological and Hydrogeological units

Geological Time	Geological Formations and Description	Hydrogeological characteristics of the principal formations	Aquifer	EA Aquifer Classification
Quaternary - Holocene	Blown Sand	The blown sand, shingle and valley gravel unit is present locally along the coast. Its thickness varies between 9 and 15m at Great Yarmouth. Water supplies of up to 15l/s have been obtain at this same location, with water being mostly saline.	Superficial Aquifer	Secondary A Aquifer
	North Denes Formation: sand and gravel			
	Breydon Formation: mainly silt and clay	The thickness of this layer varies between 3.5m to 10m. This formation tends to be a low permeability unit.	Non- aquifer	Unproductive Strata
	Breydon Formation: Peat			
Quaternary - Pleistocene	Lowestoft Till Formation: mainly Chalky sandy clay	The chalky boulder clay unit is commonly 30 to 50m thick, where present. This formation limits the infiltration to the underlying aquifers (Crag Group and Chalk Group aquifers) and affects their chemical characteristics.	Non- aquifer	Unproductive Strata
	Happisburgh Glacigenic Formation: mainly sand; some sandy clay; gravel	This formation occurs in mass within and around the chalky boulder clay mentioned above. Water supply up to 5l/s has been obtain where this unit overlays the Crag Group	Superficial Aquifer	Secondary A Aquifer
Quaternary – Pleistocene, Pliocene	Crag Group: Sand, partly shelly, some silt clay	The Crag Group aquifer consists mainly of sand and gravel. The aquifer dips and thickens eastward.	Crag Group Aquifer	Principal Aquifer
Tertiary - Eocene	London Clay Formation: Walton Member: silty mudstone	The London Clay Formation mainly consists of impermeable clays. This layer dips and thickens eastward and has a maximum thickness of around 95m at Great Yarmouth. This unit limits the infiltration to the Chalk Group aquifer below.	Non- aquifer	Unproductive Strata
	London Clay Formation: Harwich Member: sandy siltstone with volcanic ash layers			
	London Clay Formation: Hales Clay: siltstone and mudstone, sand and ash layers			

Geological Time	Geological Formations and Description	Hydrogeological characteristics of the principal formations	Aquifer	EA Aquifer Classification
Tertiary - Palaeocene	Thanet Formation: Ormesby Clay: mudstone mainly some ash layers	The Ormesby Clay have a thickness of around 10m at Great Yarmouth and are mainly non-water bearing. This unit limits the infiltration to the underneath Chalk Group aquifer.	Non- aquifer	Unproductive Strata
Mesozoic - Cretaceous	Chalk Group: white micritic limestone with layers of flint nodule.	This unit represent the principal aquifer. The layer dips eastward and is about 150m deep around the study area. The groundwater flow occurs mainly along the fissure and bedding planes, which are generally more open in the first 30 to 60m of the formation. In the study area the Chalk Group aquifer is confined by the clay layers mentioned above.	Chalk Group Aquifer	Principal Aquifer

GROUNDWATER LEVELS

11.4.33. The Hydrogeological Map of North East Anglia, available on the BGS website, provides a regional piezometric map with 5m interval contours on the estimated minimum level of Crag water table. The water level around the study area is around 0mAOD.

11.4.34. According to the Stage 2 report, groundwater strikes were recorded during the ground investigation drilling works between August and September 2007. Groundwater levels ranged between 0.88 and -1.04 mAOD within shallow deposits of silts and sands (piezometers located between 3 and 5 m below ground level (BGL). Groundwater levels were subsequently monitored at these sites on five occasions by Norfolk Partnership Laboratory. Groundwater levels within the areas of proposed excavation ranged between 0.77 and 2.83 mBGL (between -0.13 and 1.32 mAOD) over the one-month monitoring period.

11.4.35. Table 11.2 below gives water level strikes available on the GeoIndex (Onshore) map of the BGS webpage[117] of boreholes located in the study area. The water depths presented in the table below are consistent with the depths measured during the monitoring campaign of 2008. There are very few boreholes that penetrate the Crag Group and the Chalk Group in the vicinity of the study area, at this stage reliance is placed on the hydrogeological map contours.

[117] http://mapapps2.bgs.ac.uk/geoindex/home.html

Table 11.2 - Groundwater Strikes (BGS GeoIndex)

Borehole name, Reference and position according to the River Yare	Easting	Northing	Length (m)	Groundwater depth (m)	Associated aquifer
ADMIRALTY ROAD GREAT YARMOUTH 210 Ref: TG50NW1057 Drilled in 2003, at the east of the River Yare, in the study area	652668	305865	8.0	1	Superficial Aquifer
BOLLARD QUAY 10 Ref: TG50NW587, Drilled in 1985 at the west of the River Yare, in the study area	652400	305940	11.5	3	Superficial Aquifer
A47 GORLESTON RELIEF ROAD Ref: TG50NW45 Drilled in 1985, further east to the River Yare, on the west boundary of the site boundary	652033	305818	5	1.6	Superficial Aquifer

GROUNDWATER FLOW

11.4.36. Locally groundwater flow direction in the superficial deposits, while generally towards the River Yare will be variable and influenced by local changes in topography as well as the aquifer geometry, e.g. presence of clay layers, tidal fluctuations and rainfall.

11.4.37. The Hydrogeological Map of North East Anglia 1:125,000 (1976), available on the BGS website[116], provides a regional piezometric map with contours showing the estimated minimum level of the Crag Group and Chalk Group water table. This indicates that the regional groundwater flow in both aquifers is generally eastward towards the sea.

11.4.38. The London Clay Formation provides a substantially thick layer of low permeable material between scheme related construction activities and the Chalk Group aquifer. The Chalk will therefore not be impacted upon and is scoped out of this assessment. Where scheme construction details are changed, future assessments may require reconsideration of the impacts to the Chalk Group aquifer.

GROUNDWATER ABSTRACTIONS

11.4.39. There are two groundwater abstractions within study area based on data received from Groundsure in July 2017. A list of licensed groundwater abstractions is provided in Table 11.3. The distance and direction of these abstraction points from the Proposed Scheme Boundary are also provided in Table 11.2 below. Figure 11.1 shows the location of the two abstraction boreholes.

Table 11.3 - Licensed groundwater abstractions within the study area

Licence No.	Name	Estimated distance from the Proposed Scheme Boundary (m)	Easting	Northing	Direct source	Max daily volume (m3)	Version start date
AN/034/0015/020	Camplings Limited	198	651820	306080	Ground Water Source of Supply	210	1/12/2016

Licence No.	Name	Estimated distance from the Proposed Scheme Boundary (m)	Easting	Northing	Direct source	Max daily volume (m3)	Version start date
7/34/15/*G/0220	B & M LEISURE	1200	653140	307460	Ground Water Source of Supply	ND	1/3/1997

11.4.40. Further data regarding abstraction boreholes in the 2-km study area is currently being requested.

GROUNDWATER QUALITY

11.4.41. Under the WFD, the EA has determined the study area lies within the 'Broadland Rivers Chalk & Crag' Groundwater Waterbody (GB40501G400300), classified as holding a 'Poor' status for both quantitative and chemical classifications based on the 2016 dataset. The main pressures are either from agricultural and rural land management or 'no sector responsible'. This waterbody is linked to protected areas under the Drinking Water Directive although the study area does not lie within a drinking water safeguard zone.

11.4.42. The Site Investigation Factual Report (NCC, October 2007) indicates that in 2007 there was groundwater contamination within the study area when compared to drinking water standards, notably arsenic, boron, nickel, selenium, nitrate, sulphate, cyanide and benzo(a)pyrene. Table 11.4 gives more detail about the groundwater quality across the study area. The results shown below are based on a groundwater quality monitoring campaign carried out in nine boreholes in 2007 and represent the latest data available.

Table 11.4 - Groundwater quality results (2007)

Parameter	Minimum	Maximum	Drinking Water Standards	Units
Arsenic Dissolved	2	35	10	µg/l
Barium Dissolved	10	430	-	µg/l
Boron Dissolved	74	3000	1000	µg/l
Cadmium Dissolved	<0.4	0.6	5	µg/l
Chromium Dissolved	3	16	50	µg/l
Copper Dissolved	<1	2	2000	µg/l
Lead Dissolved	<1	1	25	µg/l
Nickel Dissolved	2	47	20	µg/l
Selenium Dissolved	<1	130	10	µg/l
Vanadium Dissolved	<1	25	-	µg/l
Zinc Dissolved	<3	160	50000	µg/l
Mercury Dissolved	<0.05	0	1	µg/l
Nitrate as NO3	<0.3	56	50	mg/l
Sulphate (soluble)	8	1600	250	mg/l
Sulphide	<0.5	<0.5	-	mg/l
Total Cyanide	<0.05	3.5	0.05	mg/l
Free Cyanide	<0.05	0.94	-	mg/l

Parameter	Minimum	Maximum	Drinking Water Standards	Units
pH Value	7.64	8.16	6.5 - 9.5	pH units
EPH (DRO) (C10-C40) Aqueous	<10	4300	-	µg/l
Naphthalene Aqueous	<26	67000	-	ng/l
Phenanthrene Aqueous	<22	13000	-	ng/l
Benzo(a)pyrene Aqueous	<9	34	10	ng/l
PAH 16 Total Aqueous	<27	93000		ng/l
Total PAH*	N/A	63	100*	ng/l

GROUNDWATER VULNERABILITY

11.4.43. The entire study area is designated by the EA as Major Aquifer High. Major aquifers include the Crag Group and Chalk Group aquifers, which are highly permeable formations and able to easily transmit pollution to groundwater.

11.4.44. The soils across the site are classed as having a high leaching potential (U). Soils with a high leaching potential have little ability to attenuate diffuse source pollutants. Non-adsorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater. The 'U' classification indicates an urban setting. The soil information for urban areas is based on fewer observations than elsewhere. Therefore, a worst-case high vulnerability classification is assumed, until proven otherwise.

11.4.45. The Crag Group, comprising silty clayey fine to medium sands, is not as important a source of groundwater as the Chalk Group. The less permeable layers of clay and silt within the Crag Group result in a variability in aquifer properties. Perched groundwater is also present in some horizons. Groundwater from the Crag Group is typified by a high carbonate, chloride, iron and nitrate concentrations, and high salinity overall because of its proximity to the coast. The Happisburgh Glacigenic Formation, comprising glacial tills and sand units, is also highly permeable. However, groundwater is restricted to its sand-rich horizons which are under-bedded with less permeable clay and silt. There are no Source Protection Zones (SPZs) within the study area.

11.4.46. The Crag Group and superficial aquifers of the study area are part of a Groundwater Nitrate Vulnerable Zone.

GROUNDWATER DEPENDENT TERRESTRIAL ECOSYSTEMS (GWDTE)

11.4.47. Based on the GWDTE map of England, no GWDTE has been identified in the 2km study area. The closest GWDTE is located more than 4km up gradient from the western limit of the study boundary and is unlikely to be affected by the Proposed Scheme.

Connections between groundwater and surface water (rivers, drains)

11.4.48. Based on the geology within the Proposed Scheme Boundary and the shallow groundwater, it is likely that there is connectivity between the river level and the surrounding groundwater system.

11.4.49. The groundwater system in the study area is likely to be influenced by tides. High frequency, i.e. 1hr, monitoring of river and groundwater levels is recommended in support of the Environmental Statement.

Future baseline

11.4.50. For the future baseline, the WFD objectives are assumed to be met. The Crag Group aquifer, which is currently designated a 'Poor' WFD status will, therefore, be assessed according to a future 'Good' WFD status. The EA expect the waterbody to achieve 'Good' status of all assessment parameters by 2027. Any potential change in status would not affect the importance of the receptor, which will remain a regionally important aquifer irrespective of designation. Based on the current available information no other changes are expected in baseline conditions.

Sensitive receptors

11.4.51. Based on the review of baseline conditions and current understanding sensitive receptors to the Proposed Scheme have been identified and detailed in Table 11.5 and Table 11.6 below.

Table 11.5 - Sensitive surface water receptors

Receptor	Key features	Current importance / sensitivity Future importance / sensitivity
River Yare	Main River Large tidal watercourse, navigable WFD Moderate status (objective Moderate by 2027) Heavily modified, engineered channel Within Outer Thames SPA Hydraulically linked to Breydon Water (SSSI, Ramsar) Numerous existing discharges No abstractions WFD Waterbody supports aquatic ecology Some contamination but WFD quality status generally good / moderate	Very High (size, linked to international designations) Very High (no change)
River Bure	Main River Large tidal watercourse WFD Moderate status (objective Moderate by 2027) Within Outer Thames SPA Hydraulically linked to Breydon Water (SSSI, Ramsar) No abstractions WFD waterbody supports aquatic ecology Some contamination but WFD water quality generally good / moderate	Very High (size, linked to international designations) Very High (no change)
Breydon Water	SSSI, SPA, Ramsar Intertidal mud-flats, some saltmarsh	Very High (international designations) Very High (no change)
North Sea	Open sea Bathing water protected areas Wild birds and species protected areas WFD Moderate (physico-chemical) Chemical status generally good Within Outer Thames estuary SPA	Very High (international designations, bathing waters) Very High (no change)
Ditches and watercourses within 1km buffer (marshland	Small watercourses Managed watercourses - likely some pumping, sluice gates & modifications WFD Moderate (overall waterbody catchment)	Medium (size, link to international designated sites but not directly

Receptor	Key features	Current importance / sensitivity Future importance / sensitivity
upstream of Great Yarmouth)	Hydraulically linked to Breydon Water (SSSI, Ramsar) Likely some agricultural function	providing key features, WFD status) Medium (no change)
Ditches and watercourses within 1km buffer (within urban area of Great Yarmouth). No direct connectivity to Proposed Scheme	Small watercourses Urban drains Likely engineered watercourses WFD Moderate (overall waterbody catchment), but locations suggest watercourses will receive urban discharges Urban drainage Some local amenity value (parks etc.)	Low (size, potential contamination, likely modification) Low (no change)
Ditches and watercourses in close proximity to Proposed Scheme but not directly affected	Small watercourses Urban drains Likely engineered watercourses WFD Moderate (overall waterbody catchment), but locations suggest watercourses will receive urban discharges Urban drainage	Low (size, potential contamination, likely modification) Low (no change)
Ditches and watercourses at A47 roundabout directly affected by the Proposed Scheme	Small watercourses Urban drains Likely engineered watercourses WFD Moderate (overall waterbody catchment), but locations suggest watercourses will receive urban discharges Urban drainage	Low (size, potential contamination, likely modification) Low (no change)

Table 11.6 - Sensitive groundwater receptors

Receptor	Key Feature	Current importance / sensitivity Future importance / sensitivity
Crag Group Aquifer	Principal Aquifer Shallow groundwater level Hydraulic connectivity with the superficial aquifer Groundwater Vulnerability: Major High aquifer Nitrate Vulnerable Zone WFD Groundwater – Quantitative and Chemical status 'poor'	High (regional aquifer for potable supplies) High (no change)
Blown Sand, North Denes Formation, Happisburgh Glacigenic Formation	Secondary A Aquifers Shallow groundwater level Hydraulic connectivity with the River Yare Poor quality due to saline intrusion and contamination form surface.	Medium (local scale, medium quality) Medium (no change)
Industrial abstraction boreholes	Non-potable, industrial supplies	Medium (local scale, medium quality, industrial uses) Medium (no change)

11.5 PREDICTED EFFECTS

11.5.1. A full description of the Proposed Scheme is included in Chapter 2. With respect to the water environment, key features of the Proposed Scheme are as follows:

- Construction of a new double leaf bascule bridge over the River Yare which will involve the construction of new piers / abutments in the channel, new substructures to support the bridge and temporary or permanent "knuckle walls" or cofferdams in the channel to accommodate their construction. The pier foundations are expected to be piled. A minimum navigable width of 50m will be retained.
- Highway works adjacent to the channel, including a new bridge over Southdown Road, construction of road embankments and construction and reconfiguration of existing at-grade highways;
- Demolition of existing roads, buildings and potentially culverts;
- Realignment and potential culverting of watercourses in the vicinity of the current and new roundabout at Kings Williams Way;
- Changes in traffic flows;
- New highway drainage. The preliminary drainage strategy is described in Chapter 2 and indicates that runoff from the highway west of the crossing will be attenuated and discharged into the existing watercourses at Kings Williams Way. Runoff from the bridge structure and highway east of the river will be discharged into existing Anglian Water combined sewer. The key principles of the preliminary drainage strategy are stated as:
  - Runoff to be attenuated to as close as practical to greenfield rates for the 100-year event, including climate change, and not to exceed existing rates and volumes;
  - Runoff will be adequately treated before discharge; and
  - SuDS will be used where possible.

11.5.2. Details of construction activities and temporary works are not yet available, but it is expected this will involve some in-channel works for the River Yare. A Code of Construction Practice (CoCP) will be developed to mitigate potential impacts during construction.

EFFECTS ON SURFACE WATER RECEPTORS

11.5.3. This topic area covers the assessment of the following potential impacts of the Proposed Scheme on the surface water receptors:

<u>Construction effects</u>

- Pollution to surface water due to increased generation and release of sediments and suspended solids; or dust and debris associated with demolition works.
- Pollution to surface water due to mobilisation of contaminated sediments.
- Pollution to surface water due to increased risk of accidental spillage of pollutants such as oil, fuel and concrete.
- Temporary alterations to the hydromorphological regime, such as changes to erosion, deposition and channel migration processes associated with channel modifications, temporary in-channel structures and drainage outfalls.

- Temporary loss or change to surface water supplies due to degradation of water quality, changes in drainage patterns or disruptions to supply infrastructure.

Operation effects

- Pollution to surface water due to contaminants contained within routine road runoff;
- Pollution to surface water due to accidental spillages and subsequent discharges of contaminants through road drainage systems;
- Alterations to the hydromorphological regime, such as changes to erosion, deposition and channel migration processes associated with channel modifications, in-channel structures and drainage outfalls;
- Loss or change to surface water supplies due to degradation of water quality, changes in drainage patterns or disruptions to supply infrastructure.

11.5.4. Chapter 16: Geology and Soils should be referred to for the assessment of potential effects associated with contaminated land.

11.5.5. Chapter 8: Nature Conservation should be referred to for specific assessment of potential effects on designated sites, habitats and species.

EFFECTS ON GROUNDWATER RECEPTORS

11.5.6. This topic area covers the assessment of the following potential impacts of the Proposed Scheme on the ground water receptors:

Construction effects

- Pollution of superficial aquifers and contamination of groundwater supported supplies as a result of construction activities, such as piling creating preferential pathways for transmission of contaminants; and seepage of spillages;
- Potential for saltwater contamination of the superficial aquifers and groundwater supported supplies as a result of construction activities i.e. dewatering during construction may result in freshwater and saline waters to mix;
- Mobilisation of pre-existing contamination due to invasive works such as temporary excavations and piling;
- Temporary loss of water from storage and the reduction in water levels within superficial aquifers and at groundwater abstractions due groundwater control measures; and
- Temporary change to groundwater discharge pathways affecting surface water receptors as a result of groundwater control measures.

Operation effects

- Pollution of groundwater and aquifers due to contaminants contained within routine road runoff, where infiltration is proposed as part of the drainage strategy.
- Pollution of groundwater and aquifers due to accidental spillage, and subsequent release of contaminants to groundwater through infiltration.
- Changes to groundwater flow paths due deep foundations; and
- Change to groundwater discharge pathways affecting surface water receptors as a result of deep foundations.

11.5.7. Changes in groundwater level, flows and groundwater quality in the Chalk Group aquifer have not been assessed in detail at this stage as effects on this aquifer are unlikely due the vertical separation between the aquifer and the study area (the Chalk is at considerable depth, 150m below the land within the Proposed Scheme Boundary, and separated by the London Clay Formation (95m thick) and Thanet Formation, approximately 10m thick). This will be confirmed in the next stage.

11.6 PROPOSED MITIGATION

EMBEDDED MITIGATION

11.6.1. At this stage of the development of the Proposed Scheme some embedded mitigation is already available for assessment. This includes the principle of provision of appropriate treatment of runoff and SuDS to be incorporated into the highway drainage. These remove hydrocarbons, soluble metals, sediment and sediment bound pollutants from road drainage discharges, and other flow attenuation systems. Full details will be provided in the ES once the design has been progressed and assessment has been completed. Mitigation will be incorporated to reduce pollution from routine run-off to acceptable levels as defined within DMRB.

ADDITIONAL MITIGATION

11.6.2. Mitigation beyond the commitments described in the drainage strategy has still to be determined however it is expected that further mitigation as necessary will be incorporated into the design of the Proposed Scheme and that a Code of Construction Practice will be developed for the Proposed Scheme to mitigate risks associated with construction activities.

Construction Mitigation

11.6.3. More detail of proposed measures will be incorporated into the ES once these have been defined however examples of appropriate measures are as follows. These will be implemented through the Code of Construction Practice (CoCP) which it is expected will also include appropriate training and monitoring procedures:

- Oil absorbent booms will be installed, as appropriate, on the surface watercourses immediately downstream of the works area, and will be regularly inspected and maintained;
- Temporary cut-off drains will be used uphill and downhill of the working areas to prevent clean runoff entering and dirty water leaving the working area without appropriate treatment;
- Vegetated buffer strips will be maintained adjacent to all watercourses where possible;
- Sediment laden water generated on site will be appropriately treated before discharge. This may be through the use of silt fences, silt traps, filter bunds, settlement ponds and/or proprietary units such as a ‘siltbuster’;
- Potential future sampling & removal of contaminated sediment if deposited in a sensitive area;
- Control and treatment measures will be regularly inspected to ensure they are working effectively;
- Local weather forecasts will be monitored and works scheduled accordingly. In particular, earthworks and in-stream works will be stopped during storm events;
- Emergency response plans will be developed and spill kits made available on site;
- Stockpiling areas will be located at least 50m from sensitive watercourses;
- Fuels and potentially hazardous construction materials will be stored in bunds that have areas with external cut-off drainage; fuel will be stored in double skinned tanks with 110% capacity;

- Fuelling and lubrication of construction vehicles and plant will generally be on hardstandings, where reasonably practical, with appropriate cut-off drainage and located away from watercourses. In the event of plant breakdown drip trays will be used during any emergency maintenance and spill kits will be available on site;

- Construction plant will be checked regularly for oil and fuel leaks, particularly when construction works are undertaken in or near the existing site waterbodies;

- Waste fuels and other fluid contaminants will be collected in leak-proof containers prior to removal from construction site to an approved recycling processing facility;

- Sewage generated from site welfare facilities will be disposed of appropriately. This may be by discharge to the foul sewer or by collection in septic tank for disposal off site;

- Temporary arrangements for diversion, culverting or pumping of existing watercourses to be made prior to blocking watercourses;

- Specific mitigation associated with the works within the River Yare is anticipated as follows:

  - Use of coffer dams to exclude works areas from the main waterbody, thus reducing the risk of increased sediment loads or hazardous substances being directly released into the waterbody; and

  - Dredged material to be disposed of appropriately (e.g. to sea subject to appropriate licensing and contamination testing) or to a licensed facility where contamination threshold levels are exceeded.

11.6.4. In relation to potential effects from piling activities, ground investigation and a Piling Risk Assessment will be undertaken as detailed in Chapter 16: Geology, Soils and Contamination.

11.6.5. It is anticipated that a piling method which does not allow the “dragging down” of contaminants and does not create pathways from the near-surface soils to the aquifers shall be adopted where required depending on site conditions. The precise solution will be discussed in the ES once the piling risk assessment has been completed.

11.6.6. There is potential for the piling construction exercise to introduce saltwater to the upper freshwater aquifers i.e. the superficial aquifers and the Crag Group aquifer. To our knowledge there is no low permeable geological barrier between the two aquifer units and therefore these aquifers are considered within hydraulic connectivity with each other. The hydraulic connectivity of the two aquifers will need to be proven prior to construction to ensure no contamination of freshwater aquifers occurs during construction, as per the WFD (. To determine if these aquifers are mutually exclusive or hydraulically connected a site-specific ground investigation will be required whereby multiple observation wells will be installed in the superficial and Crag Group aquifers and subsequently monitored. Monitoring should include for both groundwater level and groundwater quality data. The results of the monitoring exercise will define the hydraulic relationship of the aquifer units.

11.6.7. If the aquifers are not in hydraulic connectivity then mitigations such as clean drilling techniques into the superficial and Crag Group aquifers will be required to avoid cross contamination and aquifer deterioration. Discussions with the EA and other relevant statutory bodies will be required if the aquifers are deemed to be hydraulically connected to ensure the Regulator is satisfied with the assessment and proposed construction methodology.

11.6.8. A programme of water quality monitoring on the relevant watercourses, upstream and downstream of the working corridor will be implemented throughout the construction phase period. The monitoring parameters and frequency will be agreed with the EA prior to construction works commencing.

Operational Mitigation

11.6.9. Further mitigation that will be considered for inclusion in the design and operation of the Proposed Scheme includes:

- Design of crossing piers (if required) to reduce localised turbulence and scour effects;
- Inclusion of appropriate measures for spillage containment within the road drainage;
- Design of culverts to reduce effects on channel morphology and aquatic ecology where deemed necessary; such as oversizing of culverts and provision of natural bed; and
- Lining of drainage features where there is an unacceptable risk of migration of contaminated runoff to underlying groundwater.

11.7 CONCLUSIONS AND EFFECTS

11.7.1. Tables 11.8 to 11.11 summarise the findings of the preliminary assessment of potential impacts and resulting significance of effects from the construction and operation of the Proposed Scheme on the identified surface water and groundwater receptors. The estimation of the impact significance has been derived by combining the estimated importance of the affected waterbodies and the magnitude of the impacts, taking into account mitigation in line with the guidance provided in HD 45/09 Table A4.5. The full assessment, including assessment of impacts prior to additional mitigation, is provided in Appendix 11B.

Table 11.8 - Summary of potential effects during construction to surface water bodies

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
River Yare (Very High)	Increased sediment loads	CoCP; coffer dams	Minor adverse (temporary)	Moderate adverse (temporary)
	Disturbance of contaminated sediments	CoCP; coffer dams; suitable disposal of dredged material	Minor adverse (temporary)	Moderate adverse (temporary)
	Dust and debris pollution	CoCP	Minor adverse (temporary)	Moderate adverse (temporary)
	Pollution due to spillage or hazardous substances	CoCP; coffer dams	Minor adverse (temporary)	Moderate adverse (temporary)
	Changes to hydromorphological regime	CoCP; design of coffer dams etc	Minor adverse (temporary)	Moderate adverse (temporary)
	Loss or change to surface water supplies due to degradation of water quality	CoCP; coffer dams; suitable disposal of dredged material	Negligible adverse (temporary)	Slight adverse (temporary)
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	None identified	No change	Neutral
River Bure (Very High)	Increased sediment loads	CoCP; coffer dams; silt barriers	Negligible adverse (temporary)	Slight adverse (temporary)
	Disturbance of contaminated sediments	CoCP; coffer dams; suitable disposal of dredged material; silt barriers	Negligible adverse (temporary)	Slight adverse (temporary)
	Dust and debris pollution	CoCP	Negligible adverse (temporary)	Slight adverse (temporary)
	Pollution due to spillage or hazardous substances	CoCP; coffer dams	Negligible adverse (temporary)	Slight adverse (temporary)
	Changes to hydromorphological regime	CoCP; design of coffer dams etc	No change	Neutral

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
	Loss or change to surface water supplies due to degradation of water quality	CoCP; coffer dams; suitable disposal of dredged material	No change	Neutral
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	None identified	No change	Neutral
Breydon Water (Very High)	Increased sediment loads & deposition	CoCP; coffer dams; silt barriers	Negligible adverse (temporary)	Slight adverse (temporary)
	Disturbance of contaminated sediments	CoCP; coffer dams; suitable disposal of dredged material; silt barriers	Negligible adverse (temporary)	Slight adverse (temporary)
	Dust and debris pollution	CoCP	Negligible adverse (temporary)	Slight adverse (temporary)
	Pollution due to spillage or hazardous substances	CoCP; coffer dams	Negligible adverse (temporary)	Slight adverse (temporary)
	Changes to hydromorphological regime	CoCP; design of coffer dams etc	No change	Neutral
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		
North Sea (Very High)	Increased sediment loads & deposition	CoCP; coffer dams; silt barriers	Negligible adverse (temporary)	Slight adverse (temporary)

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
	Disturbance of contaminated sediments	CoCP; coffer dams; suitable disposal of dredged material; silt barriers	Minor adverse (temporary)	Moderate adverse (temporary)
	Dust and debris pollution	CoCP	No change	Neutral
	Pollution due to spillage or hazardous substances	CoCP; coffer dams	Minor adverse (temporary)	Moderate adverse (temporary)
	Changes to hydromorphological regime	N/A		
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		
Ditches and watercourses within 1km buffer (marshland upstream of Great Yarmouth) (Medium)	Increased sediment loads & deposition	CoCP; coffer dams; silt barriers	No change	Neutral
	Disturbance of contaminated sediments	CoCP; coffer dams; suitable disposal of dredged material; silt barriers	No change	Neutral
	Dust and debris pollution	CoCP	No change	Neutral
	Pollution due to spillage or hazardous substances	CoCP; coffer dams	No change	Neutral
	Changes to hydromorphological regime	CoCP; design of coffer dams etc	No change	Neutral

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
	Loss or change to surface water supplies due to degradation of water quality	CoCP; coffer dams; suitable disposal of dredged material	No change	Neutral
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	None identified	No change	Neutral
Ditches and watercourses within 1km buffer (within urban area of Great Yarmouth) (Low)	Increased sediment loads & deposition	CoCP; coffer dams; silt barriers	No change	Neutral
	Disturbance of contaminated sediments	CoCP; coffer dams; suitable disposal of dredged material; silt barriers	No change	Neutral
	Dust and debris pollution	CoCP	No change	Neutral
	Pollution due to spillage or hazardous substances	CoCP; coffer dams	No change	Neutral
	Changes to hydromorphological regime	CoCP; design of coffer dams etc	No change	Neutral
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		
Ditches and watercourses in	Increased sediment loads & deposition	CoCP; coffer dams; silt barriers	Negligible adverse (temporary)	Neutral

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
proximity of the Proposed Scheme - but not directly affected	Disturbance of contaminated sediments	CoCP; coffer dams; suitable disposal of dredged material; silt barriers	No change	Neutral
	Dust and debris pollution	CoCP	No change	Neutral
	Pollution due to spillage or hazardous substances	CoCP; coffer dams	Negligible adverse (temporary)	Neutral
	Changes to hydromorphological regime	CoCP; design of coffer dams etc	No change	Neutral
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		
Ditches and watercourses at A47 roundabout directly affected by the Proposed Scheme (Low)	Increased sediment loads & deposition	CoCP; silt barriers	Moderate adverse (temporary)	Slight adverse (temporary)
	Disturbance of contaminated sediments	CoCP; coffer dams; suitable disposal of dredged material; silt barriers	No change	Neutral
	Dust and debris pollution	CoCP	Moderate adverse (temporary)	Slight adverse (temporary)
	Pollution due to spillage or hazardous substances	CoCP;	Minor adverse (temporary)	Neutral
	Changes to hydromorphological regime	CoCP – maintain drainage routes	Moderate adverse (temporary)	Slight adverse (temporary)

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		

Table 11.9 - Summary of potential effects during operation to surface water bodies

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
River Yare (Very High)	Pollution to surface water due to contaminants contained in routine road runoff	Runoff treatment in drainage	Negligible adverse	Slight adverse
	Pollution to surface water due to spillage	Runoff treatment in drainage; spillage containment	Negligible adverse	Slight adverse
	Changes to hydromorphological regime	Bridge pier design to reduce turbulence	Minor adverse	Moderate adverse
	Loss or change to surface water supplies due to degradation of water quality	Runoff treatment in drainage spillage containment	Negligible adverse	Slight adverse
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	Drainage routes maintained	No change	Neutral
River Bure (Very High)	Pollution to surface water due to contaminants contained in routine road runoff	Runoff treatment in drainage	No change	Neutral
	Pollution to surface water due to spillage	Runoff treatment in drainage; spillage containment	Negligible adverse	Slight adverse

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
	Changes to hydromorphological regime	Bridge pier design to reduce turbulence	No change	Neutral
	Loss or change to surface water supplies due to degradation of water quality	Runoff treatment in drainage spillage containment	No change	Neutral
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	Drainage routes maintained	No change	Neutral
Breydon Water (Very High)	Pollution to surface water due to contaminants contained in routine road runoff	Runoff treatment in drainage	No change	Neutral
	Pollution to surface water due to spillage	Runoff treatment in drainage; spillage containment	Negligible adverse	Slight adverse
	Changes to hydromorphological regime	Bridge pier design to reduce turbulence	No change	Neutral
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		
North Sea (Very High)	Pollution to surface water due to contaminants contained in routine road runoff	Runoff treatment in drainage	No change	Neutral
	Pollution to surface water due to spillage	Runoff treatment in drainage; spillage containment	No change	Neutral
	Changes to hydromorphological regime	N/A		
	Loss or change to surface water supplies due to degradation of water quality	N/A		

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		
Ditches and watercourses within 1km buffer (marshland upstream of Great Yarmouth) (Medium)	Pollution to surface water due to contaminants contained in routine road runoff	Runoff treatment in drainage	No change	Neutral
	Pollution to surface water due to spillage	Runoff treatment in drainage; spillage containment	Negligible adverse	Neutral
	Changes to hydromorphological regime	Bridge pier design to reduce turbulence	No change	Neutral
	Loss or change to surface water supplies due to degradation of water quality	Runoff treatment in drainage spillage containment	No change	Neutral
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	Drainage routes maintained	No change	Neutral
Ditches and watercourses within 1km buffer (within urban area of Great Yarmouth) (Low)	Pollution to surface water due to contaminants contained in routine road runoff	Runoff treatment in drainage	No change	Neutral
	Pollution to surface water due to spillage	Runoff treatment in drainage; spillage containment	Negligible adverse	Neutral
	Changes to hydromorphological regime	Bridge pier design to reduce turbulence	No change	Neutral
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
Ditches and watercourses in proximity of the proposed Scheme - but not directly affected (Low)	Pollution to surface water due to contaminants contained in routine road runoff	Runoff treatment in drainage	No change	Neutral
	Pollution to surface water due to spillage	Runoff treatment in drainage; spillage containment	Negligible adverse	Neutral
	Changes to hydromorphological regime	Bridge pier design to reduce turbulence	No change	Neutral
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		
Ditches and watercourses at A47 roundabout directly affected by the Scheme (Low)	Pollution to surface water due to contaminants contained in routine road runoff	Runoff treatment in drainage	Minor adverse	Neutral
	Pollution to surface water due to spillage	Runoff treatment in drainage; spillage containment	Minor adverse	Neutral
	Changes to hydromorphological regime	Design of channels and culverts to reduce impacts	Moderate adverse	Slight adverse
	Loss or change to surface water supplies due to degradation of water quality	N/A		
	Loss or change to surface water supplies due to change in drainage patterns or infrastructure	N/A		

Table 11.10 - Summary of potential effects during construction to groundwater bodies

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
Crag Group (High)	Decrease in groundwater level due to use of groundwater control measures	CoCP; Exclude groundwater flow into excavations using sheet piling or similar techniques rather than dewatering wherever possible.	Negligible adverse (temporary)	Slight (temporary)
	Disruption of groundwater flow due to use of groundwater control measures or due to construction process	CoCP; Exclude groundwater flow into excavations using sheet piling or similar techniques rather than dewatering wherever possible	Negligible adverse (temporary)	Slight (temporary)
	Degradation of groundwater quality due to spillage or hazardous substances	CoCP; coffer dams	Minor adverse	Slight
	Mobilisation and / or drawdown of pre-existing contamination	CoCP;	Minor adverse	Slight
Blown Sand, North Denes Formation, Happisburgh Glacigenic Formation (Medium)	Decrease in groundwater level due to use of groundwater control measures	CoCP; Exclude groundwater flow into excavations using sheet piling or similar techniques rather than dewatering wherever possible.	Negligible adverse (temporary)	Neutral (temporary)
	Disruption of groundwater flow due to use of groundwater control measures or due to construction process	CoCP; Exclude groundwater flow into excavations using sheet piling or similar techniques rather than dewatering wherever possible	Negligible adverse (temporary)	Neutral (temporary)
	Degradation of groundwater quality due to spillage or hazardous substances	CoCP; coffer dams	Minor adverse	Slight
	Mobilisation and / or drawdown of pre-existing contamination	CoCP;	Minor adverse	Slight
Industrial abstraction boreholes (Medium)	Decrease in groundwater level due to use of groundwater control measures	CoCP; Exclude groundwater flow into excavations using sheet piling or similar techniques rather than dewatering wherever possible.	Negligible adverse (temporary)	Neutral (temporary)

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
	Disruption of groundwater flow due to use of groundwater control measures or due to construction process	CoCP; Exclude groundwater flow into excavations using sheet piling or similar techniques rather than dewatering wherever possible	Negligible adverse (temporary)	Neutral (temporary)
	Degradation of groundwater quality due to spillage or hazardous substances	CoCP; coffer dams	Minor adverse	Slight
	Mobilisation and / or drawdown of pre-existing contamination	CoCP;	Minor adverse	Slight

Table 11.11 - Summary of potential effects during operation to groundwater bodies

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
Crag Group (High)	Local decrease in groundwater level due to a decrease in recharge caused by the impermeable construction	-	Negligible adverse	Slight adverse
	Local disruption of groundwater flow due to a decrease in recharge caused by the impermeable construction	-	Negligible adverse	Slight adverse
	Local disruption of groundwater flow due to piles	-	Negligible adverse	Slight adverse
	Degradation of groundwater quality due to spillage or hazardous substances	Runoff treatment in drainage; spillage containment	Negligible adverse	Slight adverse
	Degradation of groundwater quality due to contaminants contained in routine road runoff that infiltrate to the aquifer	Runoff treatment in drainage	Negligible adverse	Slight adverse
Blown Sand, North Denes Formation, Happisburgh Glacigenic Formation (Medium)	Local decrease in groundwater level due to a decrease in recharge caused by the impermeable construction	-	Negligible adverse	Neutral
	Local disruption of groundwater flow due to a decrease in recharge caused by the impermeable construction	-	Negligible adverse	Neutral
	Local disruption of groundwater flow due to piles	-	Negligible adverse	Neutral

Receptor and importance	Impact	Assumed mitigation	Residual impact magnitude	Residual significance
	Degradation of groundwater quality due to spillage or hazardous substances	Runoff treatment in drainage; spillage containment	Negligible adverse	Neutral
	Degradation of groundwater quality due to contaminants contained in routine road runoff that infiltrate to the aquifer	Runoff treatment in drainage	Negligible adverse	Neutral
Industrial abstraction boreholes (Medium)	Degradation of groundwater quality due to spillage or hazardous substances	Runoff treatment in drainage; spillage containment	Negligible adverse	Neutral
	Degradation of groundwater quality due to contaminants contained in routine road runoff that infiltrate to the aquifer	Runoff treatment in drainage	Negligible adverse	Neutral

11.7.2. Where the preliminary assessment has derived a level of significance, the majority of the operational effects are not considered to be significant at this PEIR stage. The exception is potential localised changes to the hydromorphological regime at the new crossing of the River Yare (currently assessed as Moderate adverse), associated with disrupted flows. This will be further assessed through the sediment transport modelling. During construction, some effects are considered to be Moderate adverse, and therefore deemed significant, where works are taking place within watercourses. However, the effects will be temporary with improvement in conditions over time as pollutants are treated and dispersed and disturbed sediment and silt settles out of the water column.

11.7.3. A preliminary review of the potential effects of the Proposed Scheme against the objectives of the WFD has been completed, as summarised in Table 11.12. At this stage it is considered the Proposed Scheme will be compliant with the requirements of the WFD.

Table 11.12 - Preliminary WFD review

Waterbody & type	Current status	Current objective	Scheme element	Comment
Bure & Waveney & Yare & Lothing Transitional water	Moderate	Moderate by 2027	New crossing of River Yare	No change to status or objectives - some potential temporary effects due to mobilised contaminated sediments (chemical status) and longer-term effects on flow characteristics but localised. Not sufficient to change ecological status
			Runoff discharges	No change – runoff will be treated and is expected to meet HAWRAT & EQS
Norfolk East (coastal)	Moderate	Moderate by 2015	New crossing of River Yare	No change to status or objectives - some potential temporary effects due to mobilised contaminated sediments (chemical status) and longer-term effects on flow characteristics but localised. Not sufficient to change ecological status
			Runoff discharges	No change – runoff will be treated and is expected to meet HAWRAT & EQS
Broadland Rivers Chalk & Crag Groundwater Waterbody (GB40501G400300)	Poor	Good by 2027	Runoff discharges	No change – runoff will be treated and is expected to meet HAWRAT & EQS. Infiltration not proposed
			Piling / foundations	No change to status or objectives – some potential for contamination during construction but insufficient to change overall chemical status. No significant change expected to groundwater flow regime – controlled by natural conditions.

11.8 ASSESSMENTS STILL TO BE COMPLETED

11.8.1. The following will be undertaken and presented in the ES:

- Further consultation to identify local abstractions in the study area;
- Groundwater monitoring;
- A dewatering impact assessment, subject to confirmation that dewatering will potentially be required;
- Detailed assessment on the water environment once the design has been further progressed;
- Sediment transport modelling and assessment of impacts on hydromorphological and regime;
- Sediment sampling and identification of mitigation measures as necessary to manage potential mobilisation of contaminated sediments during construction;
- DMRB HAWRAT calculations for routine run-off pollution impacts to surface waters (Methods A and B) and accidental spillages (Method D)
- The preliminary drainage strategy suggests that a storm water attenuation pond and storage feature will be required for the scheme to operate. An assessment of the potential impacts these will pose on the local aquifers and associated water users will be required once the design has been further progressed;
- Detailed assessment of potential impacts on groundwater aquifers from piling operations and the presence of piles, once the design has been further progressed and the piling risk assessment has been completed; and
- Water Framework Directive Assessment against the Anglian River Basin Management Plan.

12

FLOOD RISK

12 FLOOD RISK

12.1 INTRODUCTION

12.1.1. This chapter provides preliminary information with regard to cultural heritage as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process. This Chapter supported by a hydraulic assessment technical note (Appendix 12A) and Figure 12.1.

12.1.2. A full Flood Risk Assessment (FRA) will be carried out upon confirmation of the design of the Proposed Scheme that will be presented at the application for the DCO. The FRA will include an assessment of flood risk to the Proposed Scheme from all sources as well as an assessment of the impact of the Proposed Scheme on flood risk elsewhere for both the construction and post-construction phases.

12.1.3. A number of comments were made at scoping stage by NCC and the Environment Agency (EA), these are discussed in this chapter and will also inform the FRA and Environmental Statement that will support the DCO.

12.1.4. The design of the Proposed Scheme will need to take into account the fact that works are planned to upgrade the quay walls through Great Yarmouth in the future to improve the standard of flood protection afforded by these. In addition, if deemed necessary following risk assessment, provision of a large vessel waiting facility at a remote location south of the crossing (including any dredging, quay strengthening, fendering and mooring alterations) will be required. If this is deemed necessary, its impact on flood risk will be assessed within the FRA.

STUDY AREA

12.1.5. The study area for the proposed assessment encompasses a large part of Great Yarmouth and is centred on the River Yare (see Figure 12.1). The Norfolk Broads are at the western extent of the study area, the eastern extent is the North Sea immediately where the River Yare meets the sea at Gorleston-on-sea. The study area extends as far as Caister-on-Sea in the north and Gorleston-on-Sea in the south.

LIMITATIONS

12.1.6. This chapter of the PEIR provides preliminary information as it relates to the Proposed Scheme to date and to data currently available and gathered at this point of the assessment process.

12.1.7. To date, the impact of the Proposed Scheme on fluvial and tidal flood risk post-construction has not been considered. The risk of flooding to the Proposed Scheme from all sources has not yet been assessed and will be in the full FRA submitted with the DCO application and appended to the ES. Similarly, the impact of the Proposed Scheme on surface water runoff will be assessed as part of the full FRA. The FRA will also consider the risk of flooding to the Proposed Scheme and impacts on flooding elsewhere during the construction phase.

12.1.8. At this stage, the modelling is in the early stages where a single tidal event (2013) has been simulated to understand how well the model represents flooding in Great Yarmouth.

12.1.9. The information contained herein is intended to inform consultation responses at this stage. Any gaps in information identified at this PEIR stage will be considered and addressed along with specific mitigation measures as part of the assessment for the production of the ES.

12.2 DIRECTIVES, STATUTES AND RELEVANT POLICES

DIRECTIVES

12.2.1. The Floods Directive (2007/60/EC) makes provision for the assessment of flood risk, mapping its potential impact and planning measures to reduce potential and significant flood risk.

REGULATIONS

12.2.2. The objectives of the Floods Directive discussed above that are relevant to this assessment are met through the following UK legislation:

- Highways Act 1980;
- The Water Resources Act 1991;
- Land Drainage Act 1991;
- Environment Act 1995;
- The Water Act 2003;
- Flood Risk Regulations (2009); and
- The Flood and Water Management Act 2010.

12.2.3. Under the various acts and regulations listed above, consent will be required from the Environment Agency for temporary construction and permanent operational discharges as well as any temporary abstractions, impoundments and in-channel works related to construction activities.

NATIONAL POLICY

12.2.4. The Proposed Scheme has been determined by Direction of the SoS to be nationally significant and to be development requiring development consent under the Planning Act and it has been agreed with the EA that it is “safety critical infrastructure” for the purposes of paragraph 4.41 of the NPS NN.

12.2.5. The NPS recognises that as a result of climate change, the risk of flooding will increase within the lifetime of NSIPs. The NPS NN states that the FRA should be carried out with reference to the guidance from the NPPF and accompanying National Planning Practice Guidance (NPPG) document.

12.2.6. Paragraphs 155 to 165 of the NPPF outline national planning policy in terms of flood risk. Supporting guidance is provided by the Planning Practice Guidance. The section of the PPG dealing with Flood Risk and Coastal Change provides additional guidance in the implementation of the NPPF in relation to development and flood risk.

12.2.7. The NPPF requires developments to address flood risk, requiring the provision of Flood Risk Assessments and the application of the Sequential and Exception Tests where appropriate Priority is given to the use of Sustainable Drainage Systems (SuDS) within the NPPF. The FRA for the Proposed Scheme will address the second part of the Exception Test as set out in the NPSNN and NPPF (paragraph 157) as the Sequential Test and first part of the Exception Test have already been completed.

GUIDANCE

12.2.8. The following guidance documents have also been taken into account:

- Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 HD 45/09[112]; and

- CIRIA Report 753 SuDS Manual[118].

12.3 ASSESSMENT METHODOLOGY

12.3.1. Baseline data relating to flooding has involved collation of the following:

- Collation and analysis of available data on flood risk;
- OS Mastermap covering Great Yarmouth;
- Bathymetric survey of the River Yare through Great Yarmouth (collected August 2017);
- 0.5m resolution LiDAR flown in 2015;
- Environment Agency Extreme Sea Levels;
- Daily average water level data recorded at the Haven Bridge and Great Yarmouth gauges; and
- Environment Agency defence levels through Great Yarmouth.

12.3.2. The objectives of the FRA presented in the ES will be to:

- Assess the risk to the Proposed Scheme from all potential sources of flooding (both during construction and operation);
- Establish the existing and future flood risk to the Proposed Scheme.
- Assess the potential impacts of the Proposed Scheme on flood risk elsewhere (both during construction and operation);
- Determine appropriate mitigation measures to manage flooding issues during operation in a sustainable way; and
- Link to the drainage strategy for the Proposed Scheme that will address how any additional surface water runoff generated by the Proposed Scheme will be managed.

12.3.3. The main source of flooding to the Proposed Scheme is tidal. The Great Yarmouth Strategic Flood Risk Assessment (SFRA)[119] identified that 'tidal-locking' may occur further up the Yare catchment, increasing the flood risk over a broad area. An existing 1D-2D hydraulic model of the River Yare and the wider Broadlands river network was obtained for use in this assessment. The existing model was reviewed and it was deemed appropriate to develop a new 2D only model of the River Yare through Great Yarmouth for the purposes of the FRA.

12.3.4. The focus of this assessment is the local hydraulic effects of the Proposed Scheme, therefore there is a need to use the most recent and accurate data, particularly within the Proposed Scheme boundary. The existing model was developed for a different purpose and is still valid but it has been necessary to refine and incorporate more detail into the model to determine the impacts of the Proposed Scheme on the hydraulics within the River Yare.

12.3.5. Wave overtopping from the open coast has been considered but it was judged not to be critical in this assessment as the main flood risk to Great Yarmouth is tidal inundation. The Proposed Scheme is approximately 2.6km from the coastal boundary, therefore wave overtopping will not have an impact on the Proposed Scheme because at water levels below the coastal defences, the arrangement of various defences at the River Yare

[118] CIRIA (2015). 753 SUDs Manual. [online] Available at http://www.scotsnet.org.uk/documents/NRDG/CIRIA-report-C753-the-SuDS-manual-v6.pdf . Accessed June 2018
[119] JBA Consulting. (2017) Great Yarmouth Strategic Flood Risk Assessment Final Report

entrance prevents significant transmission of waves into Great Yarmouth. Should the defences be overtopped, wave action would have less of an impact and wave overtopping has been judged as a small residual uncertainty. Sensitivity testing of the tidal boundary has shown that the peak tidal level has the greatest impact on the maximum flood levels predicted for each return period event.

12.3.6. A suite of sensitivity tests will be undertaken to determine the impact of a variety of parameters on the model results, including the roughness values representing land use within the model, fluvial inflows and tidal levels.

12.3.7. The model will be used to investigate three scenarios:

- Baseline – to establish the existing flood risk to the existing area of the Proposed Scheme and Great Yarmouth as a whole;
- Construction phase – to establish the impact of temporary works within the river channel on flood risk; and
- Proposed Scheme – to establish the impact of the Proposed Scheme on flooding elsewhere.

12.3.8. Model development is ongoing at this stage and it may be that the baseline flood risk predicted by the model is refined going forward. Once the baseline model is finalised, the results of the construction and post-scheme runs will be compared to the baseline results to determine their impacts on flood risk within Great Yarmouth.

12.3.9. Three flood return periods will be investigated using the flood model developed for the Proposed Scheme; these are:

- the 5% Annual Exceedance Probability (AEP) event;
- the 0.5% AEP event (tidal Flood Zone 3); and
- the 0.1% AEP event (tidal Flood Zone 2).

12.3.10. Model runs are to be undertaken for each return period with and without climate change allowances applied to determine the present day (2018) flood risk in Great Yarmouth and predicted future flood risk. The impact of, and resilience to, future flooding will be considered and mitigation against future flood risk elsewhere will be recommended as necessary. Climate Change allowances will be applied based on the NPSNN. As the Proposed Scheme is safety-critical, the UK Climate Projections (UKCP09) high emissions scenario for the 2080s at the 50% probability level will be used to inform the design and mitigation of the Proposed Scheme as agreed with the EA.

12.3.11. The design will be assessed against the H++ estimates (high risk, low probability) for sea level rise to assess a credible maximum scenario. The EA have agreed that they do not expect the design or mitigation to be provided to this level but the Proposed Scheme should be assessed against this scenario to understand the full picture of risk.

12.3.12. The need for flood mitigation is dependent on the magnitude of impact and the vulnerability of the receptor(s) that are affected by any increase in flood depth. Table 12.1 shows how a given increase in flood depth from the baseline scenario to the Proposed Scheme scenario will be classified in terms of impact.

12.3.13. Table 12.2 compares the magnitude of impact with the flood risk vulnerability of receptors (taken from Table 2 within the PPG for flood risk and coastal change) to demonstrate when mitigation may be required. The tables are valid up to and including the 0.5% AEP plus climate change event as the Proposed Scheme has to be designed and mitigated up to this level in line with current guidance[120]. The 0.1% AEP event will be considered separately in this assessment to provide a picture of the range of flood risk to Great Yarmouth, with the Proposed Scheme in place. Although Table 12-2 is used as a guide to determine when mitigation is required; the need for

[120] Flood Risk Assessment: standing advice, https://www.gov.uk/guidance/flood-risk-assessment-standing-advice, 2017.

mitigation is also determined using professional judgement based on the practicalities of what can be provided and how much benefit this will provide alongside discussions with the EA.

Table 12.1– Classification of magnitude of Flooding Impact

Magnitude of Impact	Change in depth (m)
No change	0
Negligible	>0.0 – <=0.02
Moderate	>0.02 – <=0.3
Major	0.3+ **OR** *Flooding in areas that were previously not flooding.*

Table 12.2 – Significance of flood impact

Magnitude of Impact	Receptor Sensitivity				
	Water Compatible	Less Vulnerable	More Vulnerable	Highly Vulnerable	Essential infrastructure
No change	No Mitigation required	No Mitigation required	No Mitigation required	No Mitigation required	No Mitigation required
Negligible	No Mitigation required	No Mitigation required	No Mitigation required	Mitigation	Mitigation
Moderate	No Mitigation required	Mitigation	Mitigation	Mitigation	Mitigation
Major	No Mitigation required	Mitigation	Mitigation	Mitigation	Mitigation

12.4 BASELINE ENVIRONMENT

12.4.1. The Proposed Scheme lies predominantly within floodplain cited as Flood Zone 3 (defined as land having a 1 in 100 or greater annual probability of river flooding (1%) or land having a 1 in 200 or greater annual probability of sea flooding (0.5%)), with this typically adjacent and relatively close to the banks of the River Yare and Norfolk Broads, plus where the tributary River Bure is situated. Flood Zone 3 is the highest risk zone defined by the EA.

12.4.2. Additional areas of land classified as being within Flood Zone 2 are also within the study area (defined as land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%)), primarily the east side of the Proposed Scheme at Middle Road West.

12.4.3. Figure 12.2 shows the areas of Flood Zone 3 and 2 relative to the Proposed Scheme location.

12.4.4. The EA Flood Map for planning[121] only shows minimal lengths of flood defences in Great Yarmouth, however the River Yare quay walls are classified as formal defences and are generally at the same level as the ground behind them. Information regarding the levels of the quay walls was obtained from the EA for use in this assessment. The Broadlands Rivers Catchment Flood Management Plan aims to reduce flood risk within Great Yarmouth by continuing with improvement works to the existing defences. It is understood that the existing defences are to be patched using innovative techniques to identify defects reinstating the tidal flood protection.

[121] http://apps.environment-agency.gov.uk/wiyby/37837.aspx

It may be that in future, the overall flood risk to Great Yarmouth is reduced based on the works undertaken as part of the Broadlands Rivers Catchment Flood Management Plan.

12.4.5. The Proposed Scheme is not at flood risk from artificial sources, as the Great Yarmouth Third River Crossing design is not located within the maximum extent area of any nearby reservoirs or canals. However, there is a sewage and surface water pumping station in Great Yarmouth referred to as North Quay pumping station (Grid Reference: TG 5223 0831). It is unknown whether this particular pumping station has an impact on the Proposed Scheme area. This will be assessed as part of the full FRA.

12.4.6. Groundwater flooding is prominent in Great Yarmouth. The NCC Preliminary Flood Risk Assessment Report identified that approximately 1,000 to 10,000 properties in Great Yarmouth are susceptible to groundwater flooding. The locations of the properties at risk are currently unknown. Therefore, the risk of groundwater flooding to the Proposed Scheme will be assessed fully in the FRA.

12.5 PREDICTED EFFECTS

12.5.1. At this stage, a full modelling assessment has not been undertaken. Modelling has been undertaken to determine the predicted flooding by the model during an historic flood event (see Appendix 12A for further information) during which water overtopped the River Yare causing flooding to parts of great Yarmouth. The tidal profile for the high tidal event of 2013 has been simulated by forcing water levels at the two gauge locations in the domain (Haven Bridge and Great Yarmouth) and allowing the model to predict the water level, velocities and flooding within Great Yarmouth.

12.5.2. It should be noted that further refinement of the baseline hydraulic model is likely as the assessment progresses and the EA are further consulted regarding the modelling. The EA will review the hydraulic model developed for this assessment. A full FRA and modelling report will be produced for the ES.

12.5.3. The preliminary model results show significant flooding to Great Yarmouth for the simulated 2013 event. This is due to the tidal peak exceeding the defences in the harbour. See Appendix 12A for more information.

12.5.4. The model will be refined and calibrated using event data. It will then be submitted to the EA as part of the FRA assessment. The model is not yet developed enough to undertake the full assessment required for the FRA.

12.6 MITIGATION

12.6.1. At this stage, a worst-case scenario being considered and there is likely to be an impact on water levels in the channel and flood depths on the floodplain. Given that flood risk in the area is tidal, it is likely that any increases in water levels will be relatively small. EIA is an iterative process and the ongoing assessment of flood risk will inform the design of the Proposed scheme to minimise the impact on flooding as much as possible. As flood risk to Great Yarmouth is tidal, compensatory storage will not work as flood mitigation. It is therefore envisaged that any small increases in water levels will have to be managed by ensuring that an emergency plan is in place for flooding in Great Yarmouth and identifying safe access and egress from the Proposed Scheme during a flood event if possible. The EA will continue to be consulted to ensure that appropriate management measures are in place for any increase in water levels as a result of the Proposed Scheme.

12.7 CONCLUSIONS AND EFFECTS

12.7.1. There is existing flood risk to Great Yarmouth and the Proposed Scheme site from the sea. Flood risk to the Proposed Scheme and its impact on flood risk elsewhere will be quantified using the hydraulic model developed.

12.7.2. The Proposed Scheme lies predominantly within floodplain cited as Flood Zone 3 (defined as land having a 1 in 100 or greater annual probability of river flooding (1%) or land having a 1 in 200 or greater annual probability of sea flooding (0.5%)), with this typically adjacent and relatively close to the banks of the River Yare and Norfolk Broads, plus where the tributary River Bure is situated.

12.7.3. The Proposed Scheme is not at flood risk from artificial sources, as the Great Yarmouth Third River Crossing design is not located within the maximum extent area of any nearby reservoirs or canals.

12.7.4. Groundwater flooding is prominent in Great Yarmouth. Therefore, the risk of groundwater flooding to the Proposed Scheme will be assessed fully in the FRA.

12.7.5. Given that main flood risk in the area is tidal, it is likely that any increases in water levels will be relatively small. The EIA is an iterative process and the ongoing assessment of flood risk will inform the design of the Proposed scheme to minimise the impact on flooding as much as possible. As flood risk to Great Yarmouth is tidal, compensatory storage will not work as flood mitigation. It is therefore envisaged that any small increases in water levels will have to be managed by ensuring that an emergency plan is in place for flooding in Great Yarmouth and identifying safe access and egress from the Proposed Scheme during a flood event if possible.

12.8 ASSESSMENTS STILL TO BE COMPLETED

12.8.1. Further work is required to develop the model to make it robust for use in the flooding assessment. This will include engagement with the EA to ensure the model is acceptable for use in the assessment.

12.8.2. Further discussions with EA will determine whether any increase in flood depth and extent is acceptable as part of the Proposed Scheme. The EA discussions will inform any design decisions to minimise the impact of the Proposed Scheme on flood risk within Great Yarmouth.

12.8.3. When the design of the Proposed Scheme has been finalised, a full FRA will be carried out with reference to the NPPF and PPG to not only assess the impact of the Proposed Scheme elsewhere but to assess flood risk to the Proposed Scheme itself. All sources of flooding will be considered as part of the FRA and the surface water drainage required on the site will be determined. The FRA will also include a specific receptor assessment and discussion to assess the impact of flooding on Great Yarmouth.

12.8.4. The findings of the FRA will be presented within a Chapter of the ES.

13

CLIMATE CHANGE

13 CLIMATE CHANGE

13.1 INTRODUCTION

13.1.1. This chapter provides preliminary information with regard to climate change as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process. This chapter considers the effects of the Proposed Scheme in terms of:

- The contribution to climate change: the greenhouse gas (GHG) emissions assessment under Section 13.2; and
- The assessment of the vulnerability of the Proposed Scheme to climate change (climate change resilience and adaptation) under Section 13.3.

13.1.2. The two distinct parts of the climate assessment are presented together in this chapter however, the presentation may be different in the subsequent ES.

13.2 GREENHOUSE GASSES

STUDY AREA

13.2.1. The assessment of vulnerability of the Proposed Scheme to the impacts of climate change is informed by regional scale information on historic and projected change in climate variables. The UK Climate Projections 2009 (UKCP09)[122] provide data on projected change in climate variables for each of the administrative regions of the UK. The Proposed Scheme falls within the East of England region so this will form the study area for the vulnerability assessment.

LIMITATIONS

13.2.2. The PEIR has been completed based on the currently available information regarding the scale and nature of the Proposed Scheme. Data to fully consider construction emissions, embodied carbon and operational end user emissions is not currently at a sufficient level to allow the assessment to take place. Data to be assessed will include:

- The type and volume of materials required for the Proposed Scheme (to consider construction emissions);
- The quantities of materials in construction elements such as major structures (e.g. roundabouts and bridges) (to assess the embodied carbon associated with the Proposed Scheme); and
- Emissions from the construction process (e.g. from vehicles and construction plant).

13.2.3. No modelling of regional traffic emissions was available at the time of writing and therefore it is not possible to determine the scale of any potential increase or reduction.

[122] DEFRA (2009) Adapting to Climate Change, UK Climate Predictions. [online] Available at https://www.gov.uk/government/publications/adapting-to-climate-change-uk-climate-projections-2009 . Last accessed June 2018

United Nations Framework Convention on Climate Change

13.2.4. The UK is a member of the United Nations Framework Convention on Climate Change (UNFCCC) which drives international action on climate change. The UK has pledged to reduce emissions under the Paris Agreement, as a part of a joint pledge by members of the European Union (EU). This provides an overarching commitment by the UK.

UK Climate Change Act

13.2.5. The Climate Change Act (2008) established a legal requirement for an 80% reduction in the GHG emissions of the UK economy by 2050 in comparison to the 1990 baseline. The Climate Change Act also created the Committee on Climate Change, with responsibility for:

- Setting 5-year Carbon Budgets covering successive periods of emissions reduction to 2050;
- Advising and scrutinising the UK Government's associated climate change adaptation programmes; and
- Producing a National Adaptation Plan for the UK Government to implement.

13.2.6. In 2011, the Highways Agency was required to complete a climate change adaptation report and submit it to UK government to inform the National Adaptation Plan. In 2015, Highways England submitted a voluntary report on progress following the climate change adaptation report.

Infrastructure Carbon Review

13.2.7. In 2013, the UK government published the Infrastructure Carbon Review[123], aiming to "release the value of lower carbon solutions and to make carbon reduction part of the DNA of infrastructure in the UK". Major infrastructure owners, operators and developers were invited to endorse, become signatories and make commitments under the review. Highways England was one of these organisations.

13.2.8. The review provided increased emphasis on 'capital carbon' (GHG emissions associated with raw materials, activities and transport for construction, repairs, replacement, refurbishment and de-construction of infrastructure) while acknowledging that 'operational carbon' (associated with energy consumption for the operation and use of infrastructure) will continue to dominate overall emission to 2050 and beyond.

13.2.9. The Infrastructure Carbon Review highlighted the need to assess GHG emissions early in the lifecycle of an infrastructure project when there is the greatest carbon reduction potential. It also led to the publication of a Publicly Available Specification on infrastructure carbon management; PAS2080:2016.

National Planning Policy Framework

13.2.10. The revised NPPF (2018)[124] includes in the definition of the environmental objective '*mitigating and adapting to climate change, including moving to a low carbon economy*' (paragraph 8).

- Chapter 9: Promoting Sustainable Transport encourages the provision of a choice of genuine transportation modes, the use of single private vehicles, the latter being understood to contribute to a significant proportion

[123] HM Treasury (2013). Infrastructure Climate Review. [online] Available at https://www.gov.uk/government/publications/infrastructure-carbon-review. Last Accessed June 2018

[124] Ministry of Housing, Communities and Local Government (July 2018) National Planning Policy Framework. Available here:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/728643/Revised_NPPF_2018.pdf

of total UK carbon emissions. For example, between 1990 and 2007, domestic transport comprised 24% of total UK emissions; the largest share was from road passenger cars at 86%[125]. In 2013, domestic and international transport accounted for 26% of all UK greenhouse gas emissions[126]; and

- Chapter 14: Meeting the Challenge of Climate Change, Flooding and Coastal Change, establishes that Local Planning Authorities should "*should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure*".

National Policy Framework for National Networks

13.2.11. The NPS NN chapters relevant to climate change mitigation and adaptation for the Proposed Scheme are shown in Table 13.1 – National Policy Statement for National Networks (2015) below:

Table 13.1 – National Policy Statement for National Networks (2015)

Chapter 3: Wider Government policy on national networks	
Emissions	Identifies that the transport sector will play an important part in meeting the Government's carbon targets. It is acknowledged that technologies, fuels, and promoting lower carbon transport choices will make the biggest reductions and that (comparatively) the likely impact from road development is "very small".
Technology	Sets out how the use of innovative technologies has the potential to improve the way we travel while "reducing costs and environmental impacts".
Sustainable transport	Describes how carbon impacts can be reduced by promoting *"sustainable modes of transport and high-quality cycling and walking environments*" which are "essential to reducing carbon emissions from transport".
Chapter 4: Assessment principles	
Environment impact assessment	This section sets out the fact that all proposals are subject to the EIA Directive (2011/92/EU) which requires "*an environmental impact assessment to identify, describe and assess effects on…air, climate…and the interactions between them*".
Climate change adaptation	Sets out the how the NPS shall put policy into practice with regards to climate change mitigation and adaptation when developing and consenting infrastructure.
Chapter 5: Generic impacts	
Carbon emissions	Sets out Government policy on climate change and outlines the importance of reducing carbon emissions, stating that the Government has a legally binding commitment to reduce greenhouse gas emissions by "at least 80% by 2050" and to conform to carbon budgets outlined in the "Carbon Plan 2011". The policy states that *"Carbon impacts will be considered as part of the appraisal of scheme options (in the business case), prior to the submission of an application for DCO*"

[125] Joseph Rowntree Foundation, Distribution of Carbon Emissions in the UK: Implications for Domestic Energy Policy, page 20 https://www.jrf.org.uk/sites/default/files/jrf/migrated/files/carbon-emissions-energy-policy-full.pdf
[126] Department for Transport, Cars and carbon dioxide: http://www.dft.gov.uk/vca/fcb/cars-and-carbon-dioxide.asp

	and that "*any Environmental Statement will need to describe an assessment of any likely significant climate factors in accordance with the requirements in the EIA Directive*". However, it goes on to say that "*It is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets. However, road projects applicants should provide evidence of the carbon impact of the project and an assessment against the Government's carbon budgets*". The policy also states that "*an increase in carbon emissions is not a reason to refuse development consent, unless the increase in carbon emissions resulting from the proposed Project are so significant that it would have a material impact on the ability of Government to meet its carbon reduction targets*".
Biodiversity & Conservation	The Biodiversity 2020 Strategy's aims need to be "*viewed in the context of the challenge of climate change: failure to address this challenge will result in significant impacts on biodiversity*".
Coastal change	Sets out the key considerations for infrastructure projects that are proposed on or near the coast. Developments in these areas are required to "*undertake an assessment of the vulnerability of the proposed development to coastal change, taking account of climate change, during the project's operational life*". With regards to the decision-making process, the policy states that "*the applicant must demonstrate that a full account has been taken of the policy on assessment and mitigation…taking account of the potential effects of climate change on these risks*".
Flood risk	Acknowledges the fact that climate change will likely lead to an "*increased flood risk in areas susceptible to flooding, and to an increased risk of flooding in some areas which are not currently thought of as being at risk*". It also states that an applicant's assessment should "*identify and assess the risks of all forms of flooding to and from the Proposed Scheme and demonstrate how these flood risks will be managed, taking climate change into account*" by taking *"the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made*" when preparing the Flood Risk Assessment.

Regional Policy

Great Yarmouth Borough Council Local Plan: Core Strategy 2013-2030[127]

13.2.12. The Core Strategy[75] contains a number of core policies which make reference to climate change. Policy CS1: Focusing on a Sustainable Future recognises that climate change is one of the greatest future challenges, but planning can support the transition of a low carbon economy and provide resilience to climate change impacts. If also states that policies in the Core Strategy will focus on ways to minimise greenhouse gas emissions, the risk of flooding and encourage the use of renewable energy.

13.2.13. Policy CS12: Utilising Natural Resources identifies an aim, where feasible, to reduce carbon dioxide emissions (over the requirements set by Building Regulations) by 10% through enhanced energy efficiency measures or the installation of renewable or low carbon sources in all major development.

[127] Great Yarmouth Borough Council (2013), Local Plan: Core Strategy: https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1213&p=0

13.2.14. CS14: Securing essential new infrastructure makes reference to having positive impacts on climate changes as the effect of the policy is to reduce reliance upon car use and therefore GHG emissions, by creating improvements to public transport, highways, footpaths and cycleways. The policy does note that positive impacts are reliant upon individual travel choices which are difficult to change.

ASSESSMENT METHODOLOGY

13.2.15. The Greenhouse Gas (GHG) assessment will be based on the following guidance:

- IEMA's EIA guide to Assessing GHG emissions and evaluating their significance[128]
- TAG Unit A3 Environmental Impact Appraisal (DfT, 2015). Chapter 4 Greenhouse Gases[129]; and
- PAS 2080:2016 Carbon management in infrastructure[130].

13.2.16. The assessment approach considers the likely magnitude of GHG emissions (or avoided emissions) in comparison to the baseline scenario with no Proposed Scheme. It considers emissions throughout the lifecycle of the Proposed Scheme including:

- Construction stage e.g. embodied emissions associated with materials, transportation of materials to site and waste arisings from site, and the construction process;
- Operation e.g. operation of lighting and controls, maintenance and replacement of original materials, as well as emissions (or avoided emissions) from end-user vehicles; and
- End of life (decommissioning) stage e.g. deconstruction and management of materials, arisings and waste.

13.2.17. There are no specific criteria for assessing the significance of GHG emissions of highways schemes. In line with the NPS NN, significance of GHG impacts is assessed by comparing estimated GHG emissions arising from the Proposed Scheme with the respective UK carbon budgets (see Table 13.2) which have been set by the UK government covering 2018 to 2032.

13.2.18. The NPS NN also sets out *that "it is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets."*

13.2.19. There are currently no agreed thresholds for what level of greenhouse gas emissions is considered significant in an EIA context. A judgement is however made regarding the likely magnitude of emissions and the need for further assessment.

Table 13.2 - National Carbon Budgets set by the Government

Carbon budget period	UK carbon budget
Third: 2018 - 2022	2,544 $MtCO_2e$
Fourth: 2023 - 2027	1,950 $MtCO_2e$
Fifth: 2028 - 2032	1,725 $MtCO_2e$

[128] IEMA (2017) *EIA guide to Assessing GHG emissions and evaluating their significance*: https://www.iaia.org/pdf/wab/EIA%20Guide_GHG%20Assessment%20and%20Significance_IEMA_16May17.pdf

[129] Department for Transport (2015). TAG Unit A3 Environment Impact Appraisal Chapters 4 Greenhouse Gases. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/638648/TAG_unit_a3_envir_imp_app_dec_15.pdf

[130] BSI (2016) *PAS 2080:2016 Carbon management in infrastructure:* https://shop.bsigroup.com/ProductDetail?pid=000000000030323493

13.2.20. There are multiple GHG emission sources associated with each lifecycle stage of the Proposed Scheme. At this stage, limited information is available to assess GHGs during construction and operation. For example, a materials bill of quantities and traffic modelling data is not yet available.

13.2.21. Table 13.3, therefore, presents the key emissions sources associated with each lifecycle stage of the Proposed Scheme and the corresponding conclusion of the scoping assessment.

Table 13.3 - Lifecycle stages and key emissions sources

Lifestyle stage		Key GHG source	Conclusion of scoping assessment
Construction	Product stage (manufacture and transport of raw materials to suppliers)	Manufacture and supply of materials (e.g. aggregate and asphalt) for: New dual carriageway and flyover across Southtown Road New roundabout Realignment of William Adams Way New cycleway and footway on bridge. New signal controlled junction Manufacture and supply of materials (e.g. steel, reinforced concrete) for, 55m for single span lifting bridge; including steel deck, 3 longitudinal steel box beams per leaf (x2), Piers (reinforced concrete box structures on reinforced concrete piles), control tower, approach embankments and retaining walls. Manufacturing and supply of drainage, barriers, signs, lighting.	Scope in
	Construction process stage (transport of materials and arisings to/from site; construction process, earth movements)	Emissions from construction activity including: Constructing bridge superstructure Delivery and laying of materials for dual carriageway, roundabout, cycleway and footway. Export and disposal of site excavations Delivery and installation of drainage, barriers, signs and lighting.	Scope in
	Land use, land use change and forestry	No significant land take or emissions.	Scope out
Operation	End-user emissions (regional traffic flows)	Vehicles using highways infrastructure. Change in end-user emissions expected from the surrounding network	Scoped in
	Operation and maintenance	Lighting expected to be efficient LED units providing some reduction in emissions compared to the baseline.	Scope out
	Repair, replacement, refurbishment	There will be an increase in emissions from road and bridge maintenance and refurbishment requirements proportional to the increase in the carriageway pavement area.	Scope out

13.2.22. The end of life stage has been scoped out as the expected timescales for decommissioning are so far into the future that there is insufficient certainty about the likelihood, type or scale of emissions activity. This scoping decision was agreed by the Planning Inspectorate in their Scoping Opinion issues May 2018, Case Reference TR010043.

Emissions Calculation

13.2.23. Emissions calculations for the construction stage will be completed within an industry recognised carbon calculation tool which focuses on emissions throughout the project lifecycle. For this particular assessment, Highways England's carbon tool will be used which multiplies emissions activity (e.g. quantities of material consumed, transport distances, fuel, power) by the relevant emissions factors expressed in carbon dioxide equivalents. Values will be reported as tonnes of carbon dioxide equivalents (tCO_2e).

13.2.24. The total operational stage end-user greenhouse gas emissions from traffic, will be modelled in accordance with the Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 Air Quality; HA 207/07[131]. The modelling will include the total greenhouse gas emissions for all vehicles covered by the traffic model covering the strategic and local road network in the area of the Proposed Scheme and its surrounding region.

Significance of Effects

13.2.25. At this stage, there is not enough information available to determine the level of magnitude or significance of emissions of the Proposed Scheme and, therefore, an assessment will be presented in the Environmental Statement.

13.2.26. Significance will be determined using professional judgement in line with the criteria outlined in paragraphs 13.2.16 to 13.2.19.

BASELINE ENVIRONMENT

13.2.27. The greenhouse gas (GHG) assessment is not restricted by geographical area but instead includes any increase or decrease in emissions as a result of the Proposed Scheme. This includes:

- Construction and decommissioning emissions in the area of the Proposed Scheme footprint but also related to the transport of materials to and from the construction site, their manufacturing and disposal (this may be far from the scheme location e.g. emissions for manufacture of concrete and steel); and

- Operational emissions resulting from the Proposed Scheme infrastructure but also emissions, or any reduction in emissions, which result from the end-use of the Proposed Scheme (vehicle movements) and any consequent shifts in transport modes/patterns which may occur. Such emissions include those for traffic using the Proposed Scheme as well as the surrounding regional road network. Electricity consumption (e.g. for lighting) will typically result in emissions at power generation stations throughout the national electricity grid.

13.2.28. In the baseline (do nothing) scenario, GHG emissions occur constantly and widely as a result of human and natural activity including energy consumption (fuel, power), industrial processes, land use and land use change – both in the area of the Proposed Scheme but also more widely. The GHG assessment will only consider where the Proposed Scheme results in additional or avoided emissions in comparison to the baseline scenario and its assumed evolution. The baseline conditions therefore focus on those emissions sources subject to change between the baseline scenario and the Proposed Scheme.

[131] Design Manual for Roads and Bridges (2007), Volume 11, Section 3, Part 1 Air Quality (HA 207/07), former Highways Agency, May 2007.

PREDICTED EFFECTS

13.2.29. The impacts of GHGs relate to their contribution to global warming and climate change. These impacts are global and cumulative in nature, with every tonne of GHG contributing to climate change impacts upon natural and human systems. GHG emissions result in the same global effects wherever and whenever they occur and, therefore, the sensitivity of different human and natural receptors is not considered.

13.2.30. GHGs are natural and man-made gases occurring in the atmosphere, which absorb and emit infrared radiation thereby maintaining the Sun's energy within the Earth's atmosphere. There is an overwhelming scientific consensus that the major increase in the concentration of GHGs from man-made sources is contributing to global warming and climate change.

13.2.31. The seven main GHGs defined by the Kyoto Protocol are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride. In combination, these GHG emissions are commonly expressed in terms of carbon dioxide equivalents according to their relative global warming potential. For this reason, the shorthand 'carbon' may be used to refer to GHGs.

PROPOSED MITIGATION

13.2.32. A range of design, mitigation and enhancement measures may be available as the Proposed Scheme progresses through detailed design and into construction and operation. These include:

- Design optimisation to reduce the requirement for construction materials, substitute construction elements for lower-carbon alternatives (e.g. changing the design and materials for a bridge) and reduce the requirement for earth movements to/from and within the construction site;
- Specification of materials and products with reduced embodied GHG emissions including through material substitution, recycled or secondary content and from renewable sources;
- Recovery and re-use / recycling of site arisings (ideally, on-site);
- Selection and engagement of materials suppliers and construction contractors taking into account their policies and commitments to reduction of GHG emissions, including embodied emission in materials; and
- Through design, providing the conditions for efficient low-carbon vehicles and driving practices, such as increasing capacity, which would potentially result in a reduction in emissions per vehicle where congestion is relieved;

CONCLUSIONS AND EFFECTS

13.2.33. At this stage, there is not enough information available to determine the level of magnitude or significance of emissions of the Proposed Scheme and, therefore an assessment will be presented in the Environmental Statement.

13.2.34. Given the design, mitigation and enhancement measures available, it is not expected that there will be significant residual effects in terms of GHG emissions. This assertion will be confirmed in the Environmental Statement. It should also be noted that the NPS NN also set out that "*it is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets.*"

ASSESSMENTS STILL TO BE COMPLETED

13.2.35. GHG sources associated with the construction phase of the Proposed Scheme using available quantitative data such as a bill of quantities.

13.2.36. GHG emissions (baseline and total end user) during operational phase using traffic flow modelled in accordance with the Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 Air Quality; HA 207/07[41].

13.2.37. Total estimated GHG emissions arising from the Proposed Scheme to assess the significance of the Proposed Scheme.

13.3 CLIMATE RESILIENCE

INTRODUCTION

13.3.1. To mainstream the consideration of climate risk and vulnerability, a proportionate assessment should be undertaken at an early stage of project development, including as part of the EIA process. This will ensure that projects achieve an appropriate level of resilience in a cost-effective manner.

13.3.2. This document presents an assessment of the vulnerability of the Proposed Scheme to the impacts of climate change. Details of the proposed scheme are presented in Chapter 2. It should be noted that the assessment here is limited to providing preliminary information as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process.

STUDY AREA

13.3.3. The assessment of vulnerability of the Proposed Scheme to the impacts of climate change will be informed by regional scale information on historic and projected change in climate variables. The UK Climate Projections 2009 (UKCP09) provide data on projected change in climate variables for each of the administrative regions of the UK. The Proposed Scheme falls within the East of England region so this will form the study area for the vulnerability assessment.

ASSESSMENT APPROACH

13.3.4. This section outlines the full approach to assessment of climate vulnerability and risk in the EIA process. This approach aligns with the following UK and international guidance:

- IEMA (2015) Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation[132];
- European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment[133];
- European Commission (2016) Climate change and major projects[134]; and
- European Commission Non-Paper Guidelines for Project Managers: Making vulnerable investments climate resilient[135].

[132] IEMA (2015) Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation. Available at: https://www.iema.net/assets/templates/documents/iema_guidance_documents_eia_climate_change_resilience_and_adaptation%20(1).pdf.

[133] European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment. http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf

[134] European Commission (2016) Climate Change and Major Projects. : https://ec.europa.eu/clima/sites/clima/files/docs/major_projects_en.pdf

[135] European Commission (undated) Non-paper Guidelines for Project Managers: Making vulnerable investments climate resilient. Available at: http://climate-adapt.eea.europa.eu/metadata/guidances/non-paper-guidelines-for-project-managers-making-vulnerable-investments-climate-resilient/guidelines-for-project-managers.pdf

13.3.5. The full approach consists of 4 steps:

- Step 1: Identify receptors and analyse policy context;
- Step 2: Climate vulnerability assessment;
- Step 3: Risk assessment; and
- Step 4: Adaptation measures.

13.3.6. In this PEIR, the results of Steps 1 and 2 will be presented in order to describe the level of vulnerability of the Proposed Scheme to the impacts of climate change and determine which vulnerabilities should be assessed further (following Steps 3 and 4) at the next stage of the EIA process.

Step 1: Identify receptors and analyse policy context

13.3.7. During this stage, relevant receptors which may be affected by climate change are identified with consideration given to the impact of extreme weather and changes in climate on the Proposed Scheme over its lifetime. These receptors may comprise both known (i.e. receptors affected by historic weather events) and unknown (new) receptors. This stage includes a definition of the policy context.

Step 2: Climate vulnerability assessment

13.3.8. This stage comprises an assessment of the vulnerability of the receptors identified in step 1 to projected climate change and extreme weather variables. The vulnerability of a receptor to extreme weather and climate change is a function of:

- The typical sensitivity of the receptor to climate variables – based on literature review and expert judgement.
- The exposure of the receptor to projected change in climate variables – based on information on observed climate and projected climate (from UKCP09).

13.3.9. For each element of the vulnerability assessment (i.e. sensitivity and exposure), a vulnerability categorisation is assigned to each climate variable in relation to each receptor based on the following scale:

- High: High climate sensitivity or exposure.
- Moderate: Moderate climate sensitivity or exposure.
- Low: No significant climate sensitivity or exposure.

13.3.10. This is a qualitative assessment informed by expert opinion and supporting literature.

13.3.11. The vulnerability of receptors to climate variables is determined from the combination of the sensitivity and exposure categorisation, using the matrix shown in Table 13.4. At this point ‘Low’ vulnerabilities are not taken forward for further assessment, whilst ‘High’ and selected ‘Moderate’ vulnerabilities are assessed further, following Steps 3 and 4.

Table 13.4 - Vulnerability rating matrix

Sensitivity	Exposure		
	Low	**Medium**	**High**
Low	Low vulnerability	Low vulnerability	Low vulnerability
Moderate	Low vulnerability	Medium vulnerability	Medium vulnerability
High	Low vulnerability	Medium vulnerability	High vulnerability

Step 3: Risk assessment

13.3.12. Firstly, hazards related to the 'Medium' and 'High' vulnerabilities are identified. Typical hazards are shown in Table 13.5.

Table 13.5 - Typical hazards associated with climate variables

Climate variable	Associated hazards
Average air temperature change (annual, seasonal, monthly)	High temperatures, longer growing season
Extreme air temperature (frequency and magnitude)	Heatwaves
Average precipitation (annual, seasonal, monthly)	Flooding (fluvial, pluvial), ground stability, soil moisture deficit, snow, ice and hail
Extreme rainfall (frequency and magnitude)	Flooding, ground stability
Average wind speed change (annual, seasonal, monthly)	Wind loading
Gales and extreme winds (frequency and magnitude)	Storms (tracks and intensity), including storm surge
Humidity	Fog
Solar radiation	High temperatures, storms and lightning
Sea level	Coastal flooding

13.3.13. The risk assessment is undertaken by considering the consequence and the likelihood of climate hazards to the Proposed Scheme elements. These determinants are then combined to develop a climate risk rating for each element of the Proposed Scheme in respect to specific climate hazards. The risk assessment is a qualitative assessment based on expert judgment, engagement with the project team and a review of relevant literature. This process is supplemented with quantitative data and information where available.

Table 13.6 - Risk rating matrix

Likelihood of hazard occurring	Consequence of hazard occurring				
	Negligible	Minor adverse	Moderate adverse	Large adverse	Very large adverse
Very high	Low	Medium	High	Extreme	Extreme
High	Low	Medium	Medium	High	Extreme
Medium	Low	Low	Medium	High	Extreme
Low	Low	Low	Medium	Medium	High
Very low	Low	Low	Low	Medium	Medium

Step 4: Adaptation measures

13.3.14. In the final step, adaptation measures for the Extreme, High and Medium risks are identified through consultation with the project team and expert opinion. Taking account of the contribution of incorporated adaptation measures, a summary of the level of climate resilience of the Proposed Scheme elements to climate change is applied:

- High - a strong degree of climate resilience, remedial action or adaptation may be required but is not a priority.
- Moderate - a moderate degree of climate resilience, remedial action or adaptation is suggested.
- Low – a low level of climate resilience, remedial action or adaptation is required as a priority.

13.3.15. Recommendations for supplementary climate change adaptation measures are then identified where necessary.

VULNERABILITY ASSESSMENT

13.3.16. This section presents the findings of the assessment of steps 1 and 2 in order to determine if there are significant vulnerabilities to climate change which need to be further assessed (through steps 3 and 4) in the next stage of the EIA process.

STEP 1: IDENTIFY RECEPTORS AND POLICY CONTEXT

13.3.17. Receptors associated with the Proposed Scheme are as follows:

- Dual carriageway road
- Double lead bascule bridge and supporting structures (design life 120 years)
- Roundabout
- Single span bridge
- Embankments and earth walls

- ‘Knuckle’ walls in the waterway
- New junction
- Cycle and pedestrian provision
- Parking
- Signage

13.3.18. The policy context for this assessment is set out in Table13.7.

Table 13.7 - Policy context

Document	Summary
National Planning Policy Framework (NPPF)	The revised National Planning Policy Framework (NPPF) was published on 24 July 2018. The Climate Change Act (2008) strengthened the institutional framework in respect of planning policy and managing the impact of climate change. In line with the objectives and provisions of the Climate Change Act (2008), the NPPF states that local authorities should adopt proactive strategies to mitigate and adapt to climate change (paragraph 149)
UK Climate Change Act (2008)	The Climate Change Act (2008) created a new approach to managing and responding to climate change in the UK, by: • Setting ambitious, legally binding reduction targets. • Taking powers to help meet those targets. • Strengthening the institutional framework. • Enhancing the UK’s ability to adapt to the impacts of climate change. • Establishing clear and regular accountability to the UK Parliament and to the developed legislatures. Key provisions of the Act in respect of climate change adaptation includes a requirement for Government to report, at least every five years, on the risks to the UK of climate change, and to publish a programme setting out how these will be addressed. The Act also introduced powers for Government to require public bodies and statutory undertakers to carry out their own risk assessment and make plans to address those risks.
Amendment to the EIA Directive (2014/52)	The requirement to consider a project’s (or Proposed Scheme’s) vulnerability to climate change results from the 2014 amendment to the EIA Directive (2014/52). The Directive requires: “A description of the likely significant effects of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change.”
Tomorrow’s Norfolk, Today’s Challenge – Summary of the County Climate Change Strategy	‘Tomorrow’s Norfolk, Today’s Challenge’ is the climate change strategy for Norfolk, produced and endorsed by the county’s eight local authorities. It is a key element of Norfolk’s Sustainable Communities Strategy. It recognises the need for climate change adaptation and states that an adaptation plan will be developed following a comprehensive risk assessment.

STEP 2: CLIMATE VULNERABILITY ASSESSMENT

Sensitivity

13.3.19. Based on relevant guidance[136], the climate variables which the Proposed Scheme elements are typically vulnerable to are shown in Table 13.8. Cells in white in the table indicate where the climate variable or climate-related hazard is not relevant to the Proposed Scheme elements; these climate variables and climate-related hazards have then been omitted from the forthcoming analyses.

[136] Standards Australia (2013) Climate Change Adaptation for settlements and infrastructure – a risk based approach. SAI Global Limited

Table 13.8 - Climate variables and climate related hazards: Transport

Proposed Scheme element	Variable																	
	Sea				Precipitation			Temperature			Wind		Relative humidity		Soils			
	Sea level rise	Storm surge and storm tide	Surface temperature	Currents and waves	Change in annual average	Drought	Extreme precipitation events (flooding)	Changes in annual average	Extreme temperature events	Solar radiation	Gales and extreme wind events	Storms (snow, lightning, hail)	Changes in annual average	Evaporation	Soil moisture	Salinity/pH	Runoff	Soil stability
Roads	■	■			■	■	■		■	■	■	■			■	■		■
Bridges	■	■				■			■	■	■	■						■
Pedestrian and cycle	■	■			■	■	■		■	■	■	■			■	■		■

13.3.20. **Sea** – transport infrastructure located near the coast or in estuarine locations is sensitive to changes in sea level and storm surges. An increase in sea level or increased storm surges could lead to coastal flooding which could cause damage to roads, bridges and associated structures (e.g. earthworks, control buildings and equipment). Coastal flooding could lead to temporary closure of roads and bridges as well as deterioration of materials.

13.3.21. **Precipitation** – roads and bridges are sensitive to high rainfall. An average increase in winter rainfall may cause roads and footways to become flooded due to flooding of local watercourses (fluvial flooding) or surface water flooding (pluvial flooding). Flooding may mean that roads and footways are impassable and cause loss of amenity. Flooding may also cause damage to paved surfaces (leading to increased maintenance requirements). Roads, bridges and footways are also sensitive to extreme rainfall events which, in addition to flooding, may also lead to destabilisation of soils and earthworks, potentially leading to temporary or permanent loss of amenity. Any electronic control equipment associated with the bridge will also be sensitive to flooding.

13.3.22. Roads and footways are also sensitive to low rainfall or drought. Prolonged dry periods may lead to drying out and cracking of earthworks and soils.

13.3.23. **Temperature** – roads, bridges and footways are sensitive to extreme temperatures. High temperatures may cause damage to paved surfaces, including potential melting and deformation. An increase in solar radiation can also cause more rapid deterioration of materials and associated infrastructure such as signage. Bridges are sensitive to high temperatures which affect thermal expansion joints and increase earth pressures.

13.3.24. **Wind** – bridges are sensitive to high winds which increase wind loading on the structure. High winds and storms can affect the stability of above-ground infrastructure and hasten material degradation. High winds can also cause wind-driven rain infiltration into building materials and surfaces which can increase maintenance costs and operational disruption. High winds also increase risk to bridge users (particularly high sided vehicles) and may lead to temporary closure. Road and footway users may also be sensitive to high winds. Associated infrastructure such as signage or signals could also be damaged by high winds.

13.3.25. Bridges are also sensitive to storms, particularly the risk of lightning strike. Electronic control equipment associated with bridges is likely to be highly sensitive to lightning strike.

13.3.26. **Soils** – roads, bridges and footways are all sensitive to soil stability. Soil stability can be reduced as a result of extreme rainfall or prolonged periods of rainfall which can lead to waterlogging, as well as extreme temperatures and drought which can causes soils to dry out and crack. Earthworks and embankments associated with roads, bridges and footways are particularly sensitive to changes in soil stability.

13.3.27. Water availability can cause a number of impacts to water quality and soils. For example, greater water volumes can increase the mobilisation of pollutants in soils whilst water scarcity can increase the accumulation of chemicals and pollutants which may cause increased salinity and acidification. Sea level rise could also lead to increasing soil salinity. More acidic soils and/or water will increase the deterioration of building materials.

13.3.28. Based on the information described above, literature review and expert opinion, Table 13.9 outlines the climate sensitivity of the Proposed Scheme.

Table 13.9 - Sensitivity rating

Climate variable		Scheme element		
		Road	Bridge	Cycle and footway
Sea	Sea level rise	Medium	Medium	Medium
	Storm surge and storm tide	High	High	Medium
Precipitation	Changes in annual average	Medium		Low
	Drought	Medium		Medium
	Extreme precipitation events	High	High	Medium

Climate variable		Scheme element		
		Road	Bridge	Cycle and footway
Temperature	Extreme temperature events	High	High	Medium
	Solar radiation	Medium	Low	Low
Wind	Gales and high winds	Medium	High	Low
	Storms	Low	High	Low
Soils	Soil moisture	Medium		Medium
	Soil salinity	Low		Low
	Soil stability	Medium	High	Medium

EXPOSURE

13.3.29. This section considers the exposure of the Proposed Scheme to current climate and climate change/changes in extreme weather.

Current climate

13.3.30. The Proposed Scheme is located in the East of England which has a warm, dry climate, compared to UK average. Information long term average observed climate variables over the period 1980 – 2010 is presented below. This information is taken from the UKCP09 report, The Climate of the United Kingdom and Observed Trends[137] and Met Office regional climate profile for Eastern England[138].

Temperature

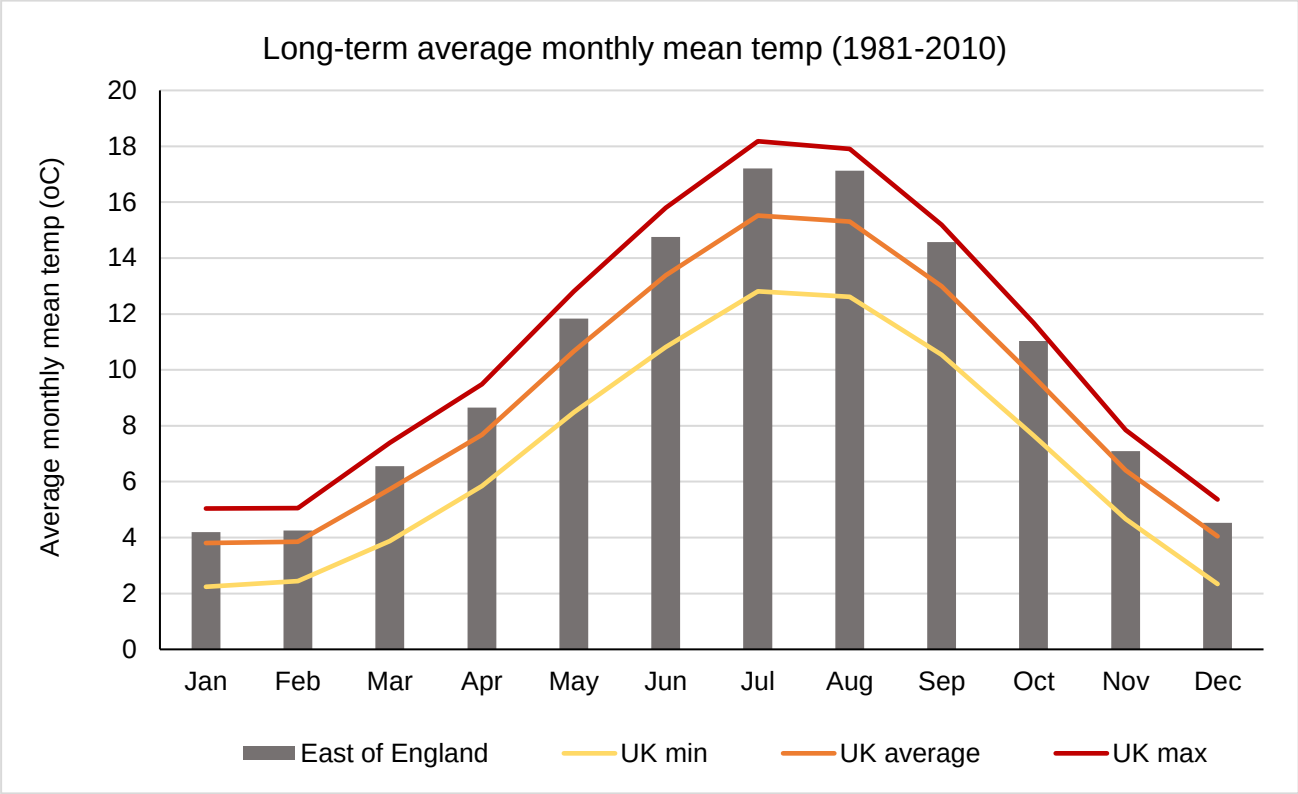
13.3.31. Figure 13.1 shows the long-term average mean monthly temperature for the East of England region between 1980 and 2010. The mean annual temperature over the region varies from around 9.5 °C to just over 10.5 °C[138].

13.3.32. Many of the UK maximum temperature records are held by stations in Eastern England. The highest known temperature recorded in the region was 37.3 °C at Cavendish on 10 August 2003[138].

13.3.33. Sea temperatures off the coast of eastern England vary from 5-6 °C in February and early March to 15-16 °C in August[139]. The temperature is governed by the influx of warm water associated with the Gulf Stream.

[137] Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK.
[138] Eastern England Climate, Met Office. https://www.metoffice.gov.uk/climate/uk/regional-climates/ee
[139] Eastern England Climate, Met Office. https://www.metoffice.gov.uk/climate/uk/regional-climates/ee

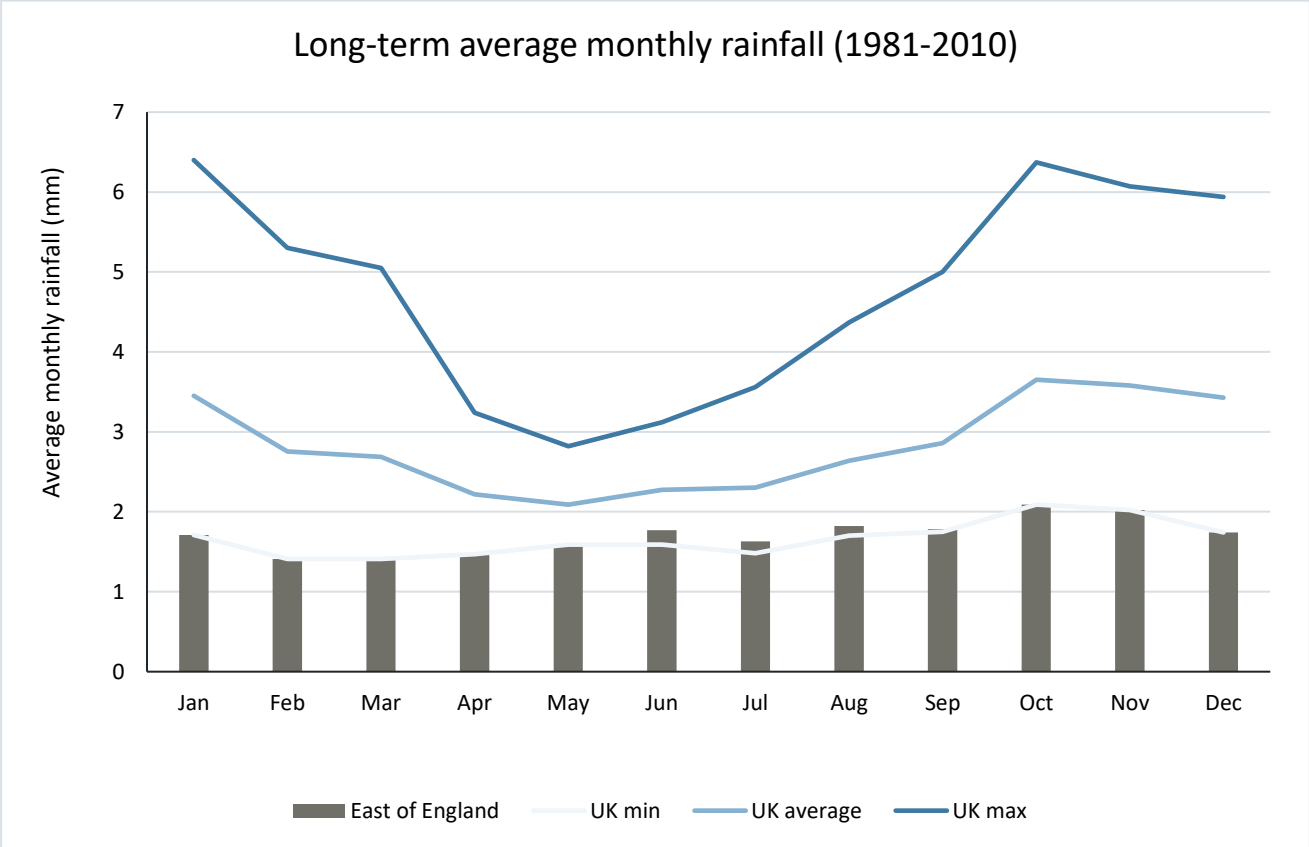
Figure 13.1 – Long term average mean monthly temperature



Precipitation

13.3.34. Figure 13.2 shows the long-term average monthly rainfall for the East of England region between 1981 and 2010. Across most of the region there are, on average, about 30 rain days (rainfall greater than 1 mm) in winter (December to February) and less than 25 days in summer (June to August) with the highest averages being at the higher altitude of the Lincolnshire Wolds.[139]

Figure 13.2 – Long term average mean monthly rainfall



13.3.35. Although rainfall is generally low in the East of England, there have been some noteworthy severe storms. These include[140]:

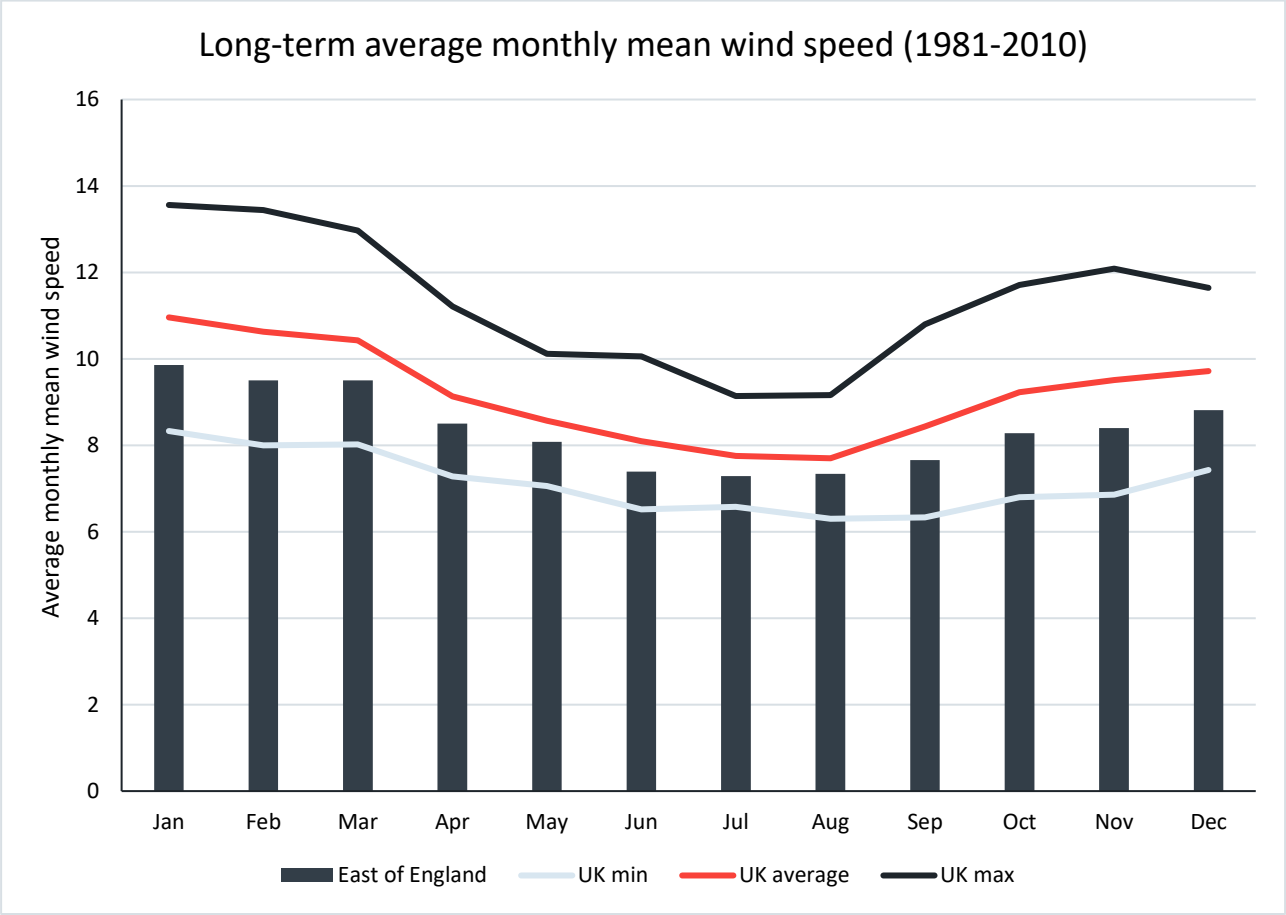
- 25 to 26 August 1912 - over 100 mm was recorded in Norfolk causing damage to roads and bridges
- 1 September 1994 - 147 mm was recorded in only a few hours at Ditchingham near Bungay in Suffolk, causing transport disruption and significant flooding

Wind

13.3.36. Figure 13.3 shows the long-term average monthly mean wind speed in the East of England region between 1981 and 2010. Eastern England is one of the more sheltered parts of the UK and the strongest winds are associated with the passage of deep depressions across or close to the UK[140].In coastal areas sea breezes are an important feature of the weather in late spring and summer when the land is warming up and the sea still relatively cool.[140]

[140] Eastern England Climate, Met Office. https://www.metoffice.gov.uk/climate/uk/regional-climates/ee

Figure 13.3 – Long term average monthly mean wind speed



13.3.37. A day of gale is defined as a day on which the wind speed attains a mean value of 34 knots or more over any period of 10 minutes.[140] Much of East Anglia and Lincolnshire has no more than 2 days of gale each year, but exposed coasts average about 5 gales each year. Two particularly noteworthy gale events have occurred in the region:[140]

- 2 January 1976 - a depression moved across Scotland to the North Sea causing storm force winds that particularly affected the north, east and Midland areas of England. Gusts exceeding 90 knots were reported in East Anglia and sea walls were breached at Walcott in Norfolk and Cleethorpes on Humberside causing extensive damage.

- The 'Great Storm' of 15-16 October 1987 caused widespread damage across south-east England. The strongest gust recorded in Eastern England was 87 knots at Shoeburyness (Landwick) in Essex.

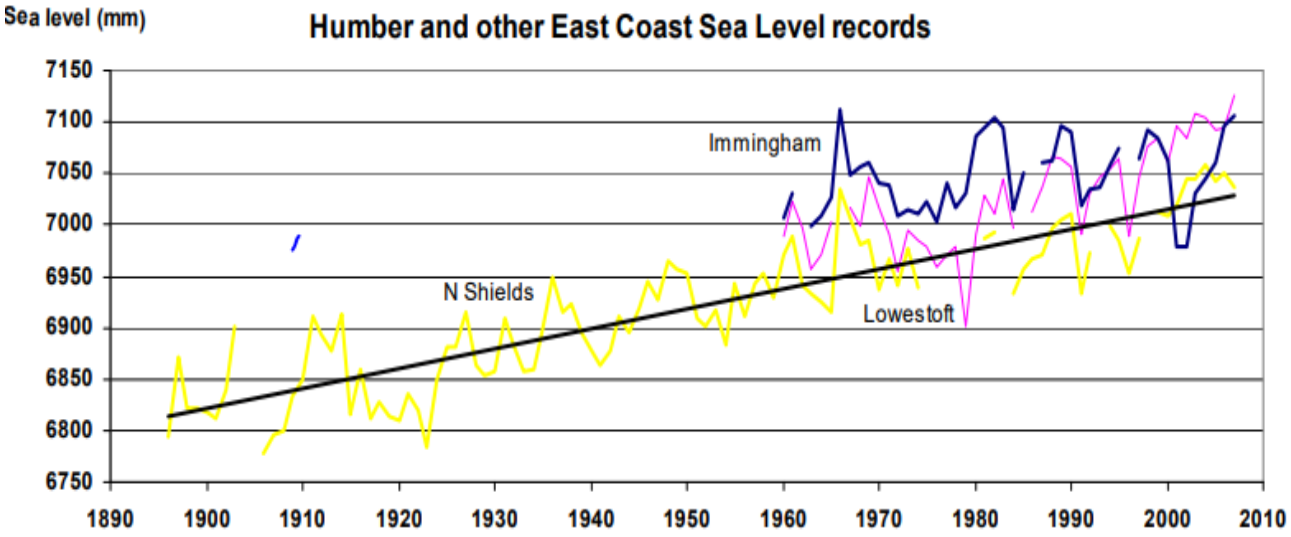
Sea level

13.3.38. Sea level change is controlled by two main factors: eustatic (changes related to the expansion and contraction of sea water plus changes in the volume of water stored on land as ice sheets/glaciers) and isostatic (changes related to movement of the land in responses to the effect of glaciers on the Earth's crust). Recent and future sea level change in the region is dominated by the eustatic component resulting from global warming. Local changes (i.e. in geomorphology), modify these broader changes and can have a significant effect on the actual sea level rise experienced along the region's coastline.

13.3.39. Sea level around the UK rose by about 1mm/yr in the 20th century, corrected for land movement[141]. At Lowestoft (the nearest tide gauge site to the Proposed Scheme), mean sea level increased by 2.01 (+/- 0.42) mm per year over the period 1960-1996[142].

13.3.40. Figure 13.4 shows sea level records on the east coast. Lowestoft is the nearest recording station to the Proposed Scheme.

Figure 13.4 – East coast sea level records



Projected climate

13.3.41. Information on projected climate is taken from the UK Climate Projections 2009. The UK Climate Projections 2009 (UKCP09) are the most up-to-date projections of climate change for the UK. Probabilistic projections of a range of climate variables are presented for different emissions scenarios[143] and for a range of timeslices[144] to the end of the 21st Century. The projections are provided at a resolution of 25 km over land, and as averages for administrative and river basin regions.

Precipitation

13.3.42. Climate change is projected to lead to wetter winters and drier summers, with more extreme rainfall events. UKCP09 suggests that by the 2050s in the East of England region, mean winter precipitation is expected to increase by 16% (50th percentile) and by the 2080s, increase by 26% (50th percentile) under the High emissions scenario. For the summer, by the 2050s, mean summer precipitation is expected to decrease by 18% (50th percentile) and by the 2080s, decrease by 27% (50th percentile), under the High emissions scenario. Table 13.10 summarises changes in mean winter and summer precipitation in the East of England region for the 2050s and 2080s under the Low, Medium and High emissions scenarios.

[141] Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK.
[142] Review of UK climate indicators, Defra. http://www.ecn.ac.uk/iccuk/indicators/9.htm
[143] UKCP09 shows data for 3 possible emissions scenarios: low, medium and high. These are the Intergovernmental Panel on Climate Change (IPCC) scenarios B1, A1B and A1FI respectively. More information on the nature of these emissions scenarios can be found in the IPCC's SRES report.
[144] UKCP09 projections are given for seven overlapping 30-year time periods. Each period steps forward by a decade, with the first time period being 2010-2039. For simplicity, these time periods are referred to by the middle decade, starting with the 2020s (2010-2039) and ending with the 2080s (2070-2099).

Table 13.10 - Projected change in mean summer and winter precipitation (mm) for the 2050s and 2080s under Low, Medium and High emissions scenario

Period		Emissions scenario								
		Low			Medium			High		
		10th	50th	90th	10th	50th	90th	10th	50th	90th
Summer	2050s	-34	-13	+14	-38	-17	+6	-40	-18	+8
	2080s	-36	-14	+11	-45	-21	+6	-53	-27	+4
Winter	2050s	+1	+12	+26	+3	+14	+31	+3	+16	+35
	2080s	+4	+16	+34	+4	+20	+44	+7	+26	+57

13.3.43. In addition to changes in seasonal average precipitation, it is likely that there will be more extreme rainfall events. By the 2050s, projections for the wettest day in summer for the East of England region suggest a decrease of up to 10% under both the low and high emissions scenario (central estimate). By the 2080s, projections for the wettest day in summer suggest decrease of between 10 and 20%, depending on emissions scenario (central estimate).

13.3.44. Snowfall is closely linked with temperature, with falls rarely occurring if the temperature is higher than 4 °C. For snow to lie for any length of time, the temperature normally has to be lower than this. With regards to future changes, rising winter temperatures are likely to reduce the amount of precipitation that falls as snow in winter. UKCP09 projects a reduction of mean snowfall, the number of days when snow falls and heavy snow events by the end of the 21st century. UKCP09 does not provide projections for the nearer-term for snow.

Temperature

13.3.45. Climate change is projected to lead to hotter summers and warmer winters. UKCP09 suggests that by the 2050s, mean winter temperature in the East of England region is expected to increase by 2.5ºC (50th percentile) and by the 2080s, increase by 3.7 ºC (50th percentile), under the High emissions scenario. For the summer, by the 2050s, mean summer temperature is expected to increase by 2.9 ºC (50th percentile) and by the 2080s, increase by 4.5 ºC (50th percentile), under the High emissions scenario. Table 13.11 summarises changes in mean winter and summer precipitation for the 2020s, 2050s and 2080s under the Low, Medium and High emission scenarios.

Table 13.11 - Projected change in mean summer and winter temperature (°C) for the 2050s and 2080s under Low, Medium and High emissions scenario

Period		Emissions scenario								
		Low			Medium			High		
		10th	50th	90th	10th	50th	90th	10th	50th	90th
Summer	2050s	1.0	2.4	4.0	1.2	2.5	4.3	1.3	2.9	4.8
	2080s	1.3	2.7	4.7	1.9	3.6	5.9	2.4	4.5	7.5
Winter	2050s	0.9	2.0	3.1	1.1	2.2	3.4	1.4	2.5	3.8
	2080s	1.4	2.6	4.0	1.6	3.0	4.7	2.0	3.7	5.7

13.3.46. In addition to changes in seasonal average temperatures, it is likely that there will be more extreme temperature events. By the 2050s, projections for daily maximum summer temperature for the East of England region suggest increases of between 2 and 4ºC, depending on emissions scenario (central estimate). By the 2080s, projections for daily maximum summer temperature suggest increases of between 3 and 6ºC, depending on emissions scenario (central estimate).

13.3.47. With regard to heat waves, research published by the Met Office Hadley Centre suggests the European summer heat wave in 2003 could become a normal event by the 2040s. By the 2060s, such a summer would be considered cool according to some climate models (Ref. 1.20). It is very likely (confidence level >90%) that human influence has at least doubled the risk of a heatwave exceeding mean summer temperatures experienced in 2003.[145]

Solar radiation

13.3.48. A recent (regional) study suggests that the England South region (including the UKCP09 East of England administrative region), is likely to see an increase in annual solar radiation by the 2050s of 5.6Wm-2 (Low), 5.3Wm-2 (Medium) or 6.2Wm-2 (High) under the central (50th percentile) estimate. By the 2080s, increases of 6.2 Wm-2 (Low), 6.8 Wm-2 (Medium) or 8.0 Wm-2 (High) under the central (50th percentile) estimate are projected[145]. All regions of the UK are likely to have increased cloud cover (although there is large uncertainty around future projections of cloud cover) and therefore slightly less solar radiation during the winter.

Wind

13.3.49. The UKCP09 projections depict a wide spread of future changes in mean surface wind speed, however, there is large uncertainty in projected changes in circulation over the UK and natural climate variability contributes much of this uncertainty[146]. It is therefore difficult to represent regional wind extreme winds and gusts within regional climate models[147].

13.3.50. Central estimates of change in mean wind speed for the 2050s are small in all ensemble runs (<0.2ms-1). A wind speed of 0.2 ms−1 (~0.4 knots) is small compared with the typical magnitude of summer mean wind speed of about 3.6–5.1 ms-1 (7–10 knots) over much of England[148]. Seasonal changes at individual locations across the UK lie within the range of –15% to +10%. Results suggest that there could be a future reduction in the summer westerly wind flows over the southern half of the UK. There may be an increase in westerly flows in the north during summer and also an increase in southerly flows over the UK in winter.

Relative humidity

13.3.51. Relative Humidity is the most common measure of humidity. It measures how close the air is to being saturated. By the 2050s, projections for winter mean relative humidity in the East of England region suggest a decrease of up to 5% under the high emissions scenario (central estimate). By the 2080s, winter mean relative humidity could increase by up to 5% (high emissions scenario, central estimate. The projection for summer mean humidity in the 2050s under the high emissions scenario is a decrease of up to 5% (central estimate). By the 2080s the decrease could be as much as 10% (high emissions scenario, central estimate).

Extreme climate change scenarios

13.3.52. A range of 'extreme' climate change scenarios (produced by Wade et al., 2015 have also been reviewed. Wade et al., (2015) considered a range of climate variables including heatwaves, cold snaps, low and high rainfall, droughts, floods and windstorms. The H++ scenarios represent the margins or beyond the 10th to 90th percentile

[145] Burnett, D., Barbour, E. and Harrison, G.P. (2014) The UK solar energy resource and the impact of climate change. Renewable Energy, 71, 333-343.

[146] Brown, S., Boorman, P., McDonald, R., and Murphy. J. (2012) Interpretation for use of surface wind speed projections from the 11-member Met Office Regional Climate Model ensemble. Post-launch technical documentation for UKCP09. Met Office Hadley Centre, Exeter, UK. Crown copyright.

[147] Brown, S., Boorman, P., Buonomo, E., Burke, E., Caesar, J., Clark, R., McDonald, R. and Perry, M. (2008) A climatology of extremes for the UK: A baseline for UKCP09. Met Office Hadley Centre, Exeter

[148] Jenkins, G. J., Perry, M. C. and Prior, M. J. (2008) The Climate of the United Kingdom and Recent Trends, Met Office Hadley Centre, Exeter, UK. Crown copyright.

range of the 2080s UKCP09 High emissions scenario as presented in the UKCP09 projections and reported here. These scenarios provide a high-impact, low-likelihood event to compare against more likely outcomes.

13.3.53. The H++ scenarios suggest that average summer maximum temperatures will exceed 30°C across most of the UK, with temperatures of the hottest days are also likely to exceed 40°C[149]. The H++ scenarios for heavy daily and sub-daily rainfall suggest that, for the same period, there is a 60% to 80% increase in rainfall for summer or winter events based on a consideration of new high-resolution modelling and physical processes. This is within the UKCP09 distribution range for the 2080s High emissions "wettest day of the winter" variable but higher than uplifts previously considered for summer.

Sea level

13.3.54. With regard to future changes in sea level, the UKCP09 projections provide predictions for four cities across the UK of which London is the most applicable here. Table 13.12 presents future projections of sea level (with respect to 1990 levels) to the end of the century.

Table 13.12 - Sea level rise projections (in cm) for London (relative to 1990 levels)

Year	Scenario		
	Low	Medium	High
2050	25.8	21.8	18.4
2060	31.4	26.3	22.2
2070	37.2	31.2	26.3
2080	43.3	36.3	30.5
2090	49.7	41.6	35
2095	53.1	44.4	37.3
2050	25.8	21.8	18.4
2060	31.4	26.3	22.2
2070	37.2	31.2	26.3

EXPOSURE RATING

13.3.55. Based on the climate change projections for the East of England region, Table 13.13 indicates the level of exposure of the Proposed Scheme to changes in climate variables.

[149] Wade, S., Sanderson, M., Golding, N., Lowe, J., Betts, R., Reynard, N., Kay, A., Stewart, L., Prudhomme, C., Shaffrey, L., Lloyd-Hughes, B., Harvey, B. (2015). Developing H++ climate change scenarios for heat waves, droughts, floods, windstorms and cold snaps. Met Office Hadley Centre, Exeter, UK. Crown copyright

Table 13.13 – Exposure assessment

Climate variable		Scheme element		
		Road	Bridge	Cycle and footway
Sea	Sea level rise	High		
	Storm surge and storm tide	High		
Precipitation	Changes in annual average	Medium		
	Drought	High		
	Extreme precipitation events	High		
Temperature	Extreme temperature events	High		
	Solar radiation	Medium		
Wind	Gales and high winds	Medium		
	Storms	Medium		
Soils	Soil moisture	High		
	Soil salinity	High		
	Soil stability	High		

VULNERABILITY RATING

13.3.56. The sensitivity and exposure analyses are combined to provide an overall assessment of vulnerability of the Proposed Scheme. Table 13.14, Table 13.15 and Table 13.16 present the overall assessment of vulnerability for the road, bridge and cycle and footway elements of the Proposed Scheme respectively.

Table 13.14 – Vulnerability rating assessment for road elements of the Proposed Scheme

Climate variable		Sensitivity	Exposure	Vulnerability
Sea	Sea level rise	Medium	High	**Medium**
	Storm surge	High	High	**High**
Precipitation	Changes in annual average	Medium	Medium	**Medium**
	Drought	Medium	High	**Medium**
	Extreme events	High	High	**High**
Temperature	Extreme temperature events	High	High	**High**
	Solar radiation	Medium	Medium	**Medium**
Wind	Gales and high winds	Medium	Medium	**Medium**
	Storms	Low	Medium	**Low**
Soils	Soil moisture	Medium	High	**Medium**
	Soil salinity	Low	High	**Low**
	Soil stability	Medium	High	**Medium**

Table 13.15 - Vulnerability rating assessment for bridge elements of the Proposed Scheme

Climate variable		Sensitivity	Exposure	Vulnerability
Sea	Sea level rise	Medium	High	**Medium**
	Storm surge	High	High	**High**
Precipitation	Extreme events	High	High	**High**
Temperature	Extreme temperature events	High	High	**High**
	Solar radiation	Low	Medium	**Low**
Wind	Gales and high winds	High	Medium	**Medium**
	Storms	High	Medium	**Medium**
Soils	Soil stability	High	High	**High**

Table 13.16 - Vulnerability rating assessment for cycle and footway elements of the Proposed Scheme

Climate variable		Sensitivity	Exposure	Vulnerability
Sea	Sea level rise	Medium	High	**Medium**
	Storm surge	Medium	High	**Medium**
Precipitation	Changes in annual average	Low	Medium	**Low**
	Drought	Medium	High	**Medium**
	Extreme events	Medium	High	**Medium**
Temperature	Extreme temperature events	Medium	High	**Medium**
	Solar radiation	Low	Medium	**Low**
Wind	Gales and high winds	Low	Medium	**Low**
	Storms	Low	Medium	**Low**
Soils	Soil moisture	Medium	High	**Medium**
	Soil salinity	Low	High	**Low**
	Soil stability	Medium	High	**Medium**

CONCLUSION

13.3.57. Based on the assessment provided above, the following variables with High and Medium Vulnerability ratings have been identified. Note, those with an asterisk indicate vulnerabilities common across all Proposed Scheme elements.

Table 13.17: High and Medium Climate Vulnerability ratings identified

Roads	
Sea	Sea level rise* Storm surge and storm tide*
Precipitation	Changes in annual average precipitation Drought Extreme precipitation events (including flooding)*
Temperature	Extreme temperature events* Solar radiation
Wind	Gales and high wind
Soils	Soil moisture Soil stability*
Bridges	
Sea	Sea level rise* Storm surge and storm tide*
Precipitation	Extreme precipitation events (including flooding)*
Temperature	Extreme temperature events*
Wind	Gales and extreme wind events Storms (lightning, hail)
Soils	Soil moisture Soil stability*
Cycle and footways	
Sea	Sea level rise* Storm surge and storm tide*
Precipitation	Drought Extreme precipitation events (including flooding)*
Temperature	Extreme temperature events*
Soils	Soil moisture Soil stability*

ASSESSMENTS STILL TO BE COMPLETED

13.3.58. The risks associated with the High and Medium vulnerabilities identified and required adaptation measures will be further assessed in the ES, following the methodology set out in paragraphs 13.3.12 to 13.3.15.

14

PEOPLE AND COMMUNITIES

14 PEOPLE AND COMMUNITIES

14.1 INTRODUCTION

14.1.1. This chapter provides preliminary information with regard to People and Communities as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process. In particular, it considers the generation of direct, indirect and induced employment opportunities and increases in economic activity, increase in demand for accommodation, local services (including education and healthcare) and recreational / open space due to an influx of construction workers, land-take, severance and disruption to terrestrial and marine businesses and associated activities, change to access and amenity value of public routes and resources both on-site and off-site, land-take from public land and private holdings as well as change in driver stress and delay.

14.1.2. The Chapter also identifies, where appropriate, proposed mitigation measures to prevent, minimise or control likely adverse effects arising from the Proposed Scheme and the subsequent anticipated residual effects.

STUDY AREA

Generation of direct, indirect and induced employment opportunities

14.1.3. As the Proposed Scheme is located within Great Yarmouth, the 'local level' comprises Great Yarmouth Borough as noted in the EIA Scoping Report[5].

14.1.4. Given the scale of the Proposed Scheme, strong transport connections, economic linkages and travel to work patterns, the employment effects of the Proposed Scheme are considered to extend beyond Great Yarmouth. Based on the travel to work information identified in the Census 2011, a larger number of workers travel throughout Norfolk. As such, the 'regional level' has been set as Norfolk as a whole.

14.1.5. Statistics for East of England region / England / Great Britain / UK have been provided within the baseline for context, but are not utilised within the Chapter.

Increase in demand for accommodation, local services (including education and healthcare) and recreational / open space due to an influx of construction workers

14.1.6. The construction contracts for the Proposed Scheme have not been confirmed, meaning a proportion of the construction workers could be from beyond the local (Great Yarmouth Borough) and regional (East of England) areas and need to relocate to an area local to the Proposed Scheme for the duration of the construction phase. At this stage, it is not known where the construction workers moving to the area will be living; however, for the purposes of the assessment, it is assumed that they will be based within Great Yarmouth Borough. Therefore, the study area is the administrative area within Great Yarmouth Borough Council.

Land-take, severance and disruption to terrestrial and marine businesses and associated activities

14.1.7. The study area used for effects in relation to terrestrial and marine businesses will focus on the River Yare and Great Yarmouth port; the extent of the study area will be confirmed following discussions with relevant stakeholders and completion of the traffic modelling.

Change to access and amenity value of public routes and recreational resources both on-site and off-site

14.1.8. The study area that will be used for the assessment will include all public routes that are potentially affected by the Proposed Scheme. An initial study area of 2km around the Application Site has been used to identify key community receptors and the routes between them / residential areas; however, the focus is likely to be on those within 500m of the Application Site (given the potential for these to be significantly affected). The study area for the recreational resources will be confirmed following the completion of the traffic modelling and the hydromorphological analysis.

Land-take from public and private land holdings

14.1.9. The study area that will be used for the assessment includes the land within and immediately adjacent to the Application Site; however, consideration is given to the wider housing market and existing demand across the Great Yarmouth Borough.

Change in Driver Stress and Delay

14.1.10. The study area that will be used for the assessment will include all roads where a significant change in traffic is anticipated (e.g. greater than 10%) change. As such, the study area will include all the links in the SATURN traffic modelling (see Figure 17.1).

LIMITATIONS

14.1.11. The assessment reported within this Chapter is based on the information available at the time of writing. Therefore, the assessment has not taken consideration of:

- Construction information including construction contracts and Traffic Management systems;
- Vessel simulation model;
- Navigational Risk Assessment;
- Transport model and hydromorphological assessment;
- Traffic data;
- Economic Impact Assessment;
- Pedestrian and cyclist survey count data; and
- Walkers, Cyclists Horse-riding Assessment Report.

14.1.12. Where information is not available, the assessment has identified whether the Proposed Scheme is likely to have an ‘adverse’ or ‘beneficial’ effect. However, these should be treated as preliminary results as a more detailed assessment will be undertaken as part of the Environmental Impact Assessment.

14.1.13. The assessment is based on the use of secondary data that is publicly available. As such, there are limitations associated with the secondary data applied in each case.

14.2 DIRECTIVES, STATUTES AND RELEVANT POLICES

LEGISLATION

The Countryside and Rights of Way Act 2000

14.2.1. The Countryside and Rights of Way Act 2000[150] regulates Public Rights of Way and access to them. It requires local highway authorities to publish a 'rights of way improvement plan', which should be reviewed every 10 years. The Act also obliges the highway authority to recognise the needs of the mobility impaired when undertaking improvements.

[150] Countryside and Rights of Way Act 2000

Highways Act 1980

14.2.2. Footpaths, footways, bridleways and carriageways are all 'highways' and thus regulated under the Highways Act. The Act covers the following of relevance to people and communities:

- The creation of highways.
- Maintenance of publicly maintainable highways and maintenance of privately maintainable footpaths and bridleways.
- Stopping up and diversion of footpaths and bridleways.
- Protection of public rights and damage, obstruction to highways. For example, maintenance and erection of stiles and cutting or felling of foliage overhanging footpaths / bridleways.

Road Traffic Regulation Act 1984

14.2.3. Confers broad powers on Traffic Authorities to prohibit or restrict traffic (including pedestrians) on highways and other roads to which the public has access.

PLANNING POLICY

National Networks National Policy Statement

14.2.4. The Government's vision and strategic objectives for national networks includes '*supporting a prosperous and competitive economy and improving overall quality of life'* and specifically:

- Networks with the capacity and connectivity to support national, regional and local economic activity and facilitate growth whilst creating jobs; and
- Networks which sustain cohesion and decreases severance of communities and effectively providing linkages to each other.

14.2.5. Paragraph 2.27 of the NPS NN states that "*in some cases….it will not be sufficient to simply expand capacity on the existing network. In those circumstances new road alignments and corresponding links, including alignments which cross a river or estuary, may be needed to support increased capacity and connectivity*."

14.2.6. Paragraph 3.3 requires that in delivering new schemes, "*reasonable opportunities to deliver environmental and social benefits as part of the schemes*" should be considered and that environmental and social impacts should be mitigated in line with the principles set out in the National Planning Policy Framework (NPPF) and the Government's planning guidance.

14.2.7. It also states that "*Applicants should identify existing and proposed land uses near the project, any effects of replacing an existing development or use of the Application Site with the proposed project or preventing a development or use on a neighbouring site from continuing. Applicants should also assess any effects of precluding a new development or use proposed in the development plan*".

National Policy Statement for Ports

14.2.8. The NPS for Ports provides a framework for decisions on proposals for new port development to provide port capacity, as well as associated road and rail links for which consent is sought alongside the principal development.

14.2.9. Paragraph 3.3.5 of the NPS for Ports states that the Government sees port development as an engine for economic growth that supports sustainable transport and supports sustainable development.

National Planning Policy Framework[56]

14.2.10. Within the revised NPPF, there is an overarching presumption in favour of sustainable development, so that "*sustainable development is pursued in a positive way*".. The NPPF notes in paragraph 8 that there are three dimensions to sustainable development; economic, social and environmental. Planning's role is to contribute to building a strong, responsive and competitive economy and by identifying and coordinating development requirements, including the provision of infrastructure.

14.2.11. Section 9 of the NPPF sets out how transport should be considered within the context of planning decisions and sustainable development..

14.2.12. The NPPF also encourages development that exploits opportunities for sustainable transport. Particularly by giving priority "*first to pedestrian and cycle movements, both within the scheme and with neighbouring areas; and second – so far as possible – to facilitating access to high quality public transport, with layouts that maximise the catchment area for bus or other public transport services, and appropriate facilities that encourage public transport use*" (paragraph 110).

14.2.13. Paragraph 80 states "*Significant weight should be placed on the need to support economic growth and productivity, taking into account both local business needs and wider opportunities for development".*

14.2.14. Paragraph 81 states that planning policies should *"set out a clear economic vision and strategy which positively and proactively encourages sustainable economic growth, having regard to Local Industrial Strategies and other local policies for economic development and regeneration".*

14.2.15. Paragraph 102 states that transport issues should be considered from the earliest stages of development proposals, so that (amongst other things) '*the environmental impacts of traffic and transport infrastructure can be identified, assessed and taken into account – including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains*;

Great Yarmouth Local Plan: Core Strategy (2013-2030)

14.2.16. The following policies within the Great Yarmouth Local Plan: Core Strategy[75] are of relevance to people and communities:

- Policy CS3 Addressing the Borough's Housing Need: To ensure that new residential development in the borough meets the housing needs of local people, the Council and its partners will seek to make provision for at least 7,140 new homes over the plan period (2013-2030). The Council also encourages the effective use of the existing housing stock.

- Policy CS4 Delivering Affordable Housing: To ensure that an appropriate amount and mix of affordable housing is delivered throughout the borough, the Council and its partners will seek to maximise the provision of additional affordable housing within the overall provision of new residential developments. The Council will also ensure that affordable housing is provided either 'on-site' or via an 'off-site' financial contribution, in exceptional circumstances.

- Policy CS6 Supporting the Local Economy: To ensure that the conditions are right for new and existing businesses to thrive and grow, there is a need to continue to strengthen the local economy and make it less seasonally dependent.

- Policy CS15 Providing and Protecting Community Assets and Green Infrastructure: The Council will resist the loss of important community facilities and/or green assets unless appropriate alternative provision of equivalent or better-quality facilities is made in a location accessible to current and potential users or a detailed assessment clearly demonstrates there is no longer a need for the provision of the facility in the area. Ensure that all new developments contribute to the provision of recreational green space and incorporate improvements to the quality of, and access to, existing green infrastructure in accordance with local circumstances. The Council will also safeguard the natural beauty, openness and recreational value of the borough's beaches and coastal hinterland.

- Policy CS16 Improving Accessibility and Transport: The Council and its partners will work together to make the best use of, and improve, existing transport infrastructure within and connecting to the Borough.

GUIDANCE

14.2.17. In August 2012, Highways England produced the 'People and Communities Clarification Note'[151], which recommends combining the Interim Advice Note (IAN) assessments of 'Community and Private Assets' and 'Effects on all Travellers' into a single topic entitled 'People and Communities'. This Clarification Note will be adhered to within this assessment, and has therefore been considered within this Chapter of the PEIR.

14.2.18. The scope adopted for this assessment is also based on relevant parts of existing DMRB guidance (Volume 11, Section 3):

- Part 6: Land Use[152];
- Part 8: Pedestrians, Equestrians, Cyclists and Community Effects[153]; and
- Part 9: Vehicle Travellers[154].

14.2.19. In addition, guidance document IAN 195/16 'Cycle Traffic and the Strategic Road Network'[155]. has been used to inform this assessment

14.3 ASSESSMENT METHODOLOGY

OVERVIEW

14.3.1. The assessment methodology adopted is based on the principles set out in within DMRB guidance:

- Volume 11, Section 3, Part 8 Pedestrians, Cyclists, Equestrians and Community Effects[153];
- Volume 11, Section 3, Part 6 Land Use[152];
- Volume 11, Section 3, Part 9 Vehicle Travellers[154]; and
- Interim Advice Note 125/09 Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment[156].'

COLLECTION OF BASELINE DATA

14.3.2. A desktop study has been undertaken to gather all the relevant information. The following data sources have been consulted to inform the baseline conditions reported within this Chapter:

- MAGIC Interactive Map[107];
- Office of National Statistics (ONS) Census 2011[157];

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[151] Interim Advice Note 125/15 Supplementary guidance for users of Design Manual for Roads and Bridges Volume 11 'Environmental Assessment', Highways England, October 2015
[152] Design Manual for Roads and Bridges Volume 11, Section 3, Part 6 (Land Use), former Highways Agency, August 2001
[153] Design Manual for Roads and Bridges Volume 11, Section 3, Part 8 (Pedestrians, Cyclists, Equestrians and Community Effects), former Highways Agency, June 1993.
[154] Design Manual for Roads and Bridges Volume 11, Section 3, Part 9 (Vehicle Travellers), former Highways Agency, June 1993.
[155] Highways England (2016) Interim Advice Note 195/16: 'Cycle Traffic and the Strategic Road Network'
[156] Highways England (2009) Interim Advice Note 125 /09: Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment'
[157] https://www.ons.gov.uk/

- ONS Labour Market Statistics Report (NOMIS)[158];
- Office of National Statistics English Indices of Multiple Deprivation (2015)[159];
- Great Yarmouth Borough Council Local Plan: Core Strategy (2013-2030)[75];
- Great Yarmouth Borough Council Local Plan Policies Map (2015)[160];
- Great Yarmouth Open Space Study (2013)[161]; and
- Webtris (Highways England's online traffic database)[162].

14.3.3. No site visits have been undertaken at this stage; however, a site visit will be undertaken to inform the Environmental Statement (ES).

ASSESSMENT METHODOLOGY

Generation of direct, indirect and induced employment opportunities

14.3.4. The key assumptions used during the assessment of effects related to employment are as follows:

- For the purposes of this assessment, it is assumed that there is no employment on-site at present;
- For the purposes of this assessment, it is assumed that one job is equal to one Full-Time Equivalent (FTE); and
- For the purposes of the assessment, the evaluation for the local and regional levels is not mutually exclusive i.e. the number of FTE / jobs is considered in relation to the total employees at both the local and regional levels.

Construction Phase

14.3.5. Generation of direct, indirect, and induced employment opportunities during construction of the Proposed Scheme will be assessed, including consideration of existing on-site employment displacement.

14.3.6. Calculations relating to employment generation will be undertaken using Excel-based analysis. All the modelling data sources used will be publicly available. Employment generation during the construction phase will be based on the construction duration and cost as shown in Table 14.1. The number of Full Time Equivalents (FTE) / jobs will be estimated by applying an average gross output per construction industry employee to the estimated total construction cost to determine gross and net construction employment generation per annum.

Table 14.1: Direct FTE / job calculation factors during the construction stage

Factor	Description
Anticipated total construction cost	£60,000,000
Construction period	2 years and 4 months

[158] Office of National Statistics. Available at https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/previousReleases
[159] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015
[160] Great Yarmouth Borough Council 2015. Local Plan Policies Map. Available at https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1583&p=0 . Last accessed June 2018
[161] Great Yarmouth Borough Council 2013. Open Space Study.
[162] http://webtris.highwaysengland.co.uk/

14.3.7. Leakage rates will be applied to the construction employment calculations. Leakage effects are the benefits to those outside the effect area.

14.3.8. A multiplier will be applied in relation to the generation of indirect and induced employment opportunities. Multiplier effects describe the economic activity (jobs, expenditure or income) associated with additional local income and local supplier purchases. A multiplier of 1.5 will be applied on the basis that there are supply linkages associated with the Proposed Scheme, based on its location within Great Yarmouth.

Operational Phase

14.3.9. Once operational, the Proposed Scheme is anticipated to lead to an increase in economic activity due to greater connectivity afforded by the Proposed Scheme. The assessment will consider the potential effects on enhanced access for local businesses and industrial estates (e.g. Harfrey's Industrial Estate) and reduction in journey times / delay.

14.3.10. An economic appraisal was undertaken for the Proposed Scheme at Outline Business Case. The economic appraisal estimates that the Proposed Scheme would save £122,632 for business users and providers (£23,762 for business car journeys and £98,870 for freight journeys). The cost savings will be due to improved journey times and the associated cost of operating business vehicles. This information will be further refined and developed through the Economic Impact Report, which will be used to inform the assessment within the ES but is not available at the time of writing.

<u>Increase in demand for accommodation, local services (education and healthcare) and recreational / open space due to an influx of construction workers</u>

14.3.11. The construction contracts for the Proposed Scheme have not been confirmed, meaning a proportion of the construction workers could be from beyond Great Yarmouth and relocate to an area local to the Proposed Scheme for the duration of the construction phase. This could increase demand on accommodation, local services (e.g. education and healthcare facilities) and recreational / open space.

14.3.12. A qualitative assessment of effects relating to increase in accommodation, local services and recreational / open space induced by the newly created jobs will be undertaken by evaluating the likely number of additional individuals coming to live in the study area. It is anticipated that the Proposed Scheme would generate 18 gross direct jobs outside of Great Yarmouth (see Table 14.14). The influx of these construction workers will be used to estimate the magnitude of change on accommodation, local services and recreational / open space in context of existing demand within Great Yarmouth.

<u>Land-take, severance and disruption to terrestrial and marine businesses and associated activities</u>

14.3.13. During the construction of the Proposed Scheme, there is anticipated to be land-take from existing business premises. In addition, it is anticipated that during the construction phase, the roads within and in the vicinity of the Proposed Scheme Boundary will be subject to temporary closure and / or diversion to facilitate the Proposed Scheme. This may cause severance and / or disruption of accesses to these businesses. However, the Traffic Management systems that will be implemented during the construction phase are unknown at this stage of the Proposed Scheme. Once complete (i.e. during operation), the Proposed Scheme may enhance access for businesses and / or cause disruption to marine commercial activities.

14.3.14. A qualitative assessment will be undertaken to determine the land-take of private land, considering the importance of the land (i.e. whether it is imperative to a business operation), the availability of alternative land within the vicinity and proportion of the land-take as an overall of each land holding. The impact of land take is assessed during the construction phase as this is when the land will be taken and is the point of impact. The assessment will however consider whether the land take is permanent or temporary in nature.

14.3.15. The level of severance and disruption will also be considered qualitatively in terms of a reduction in footfall for businesses, for example off Queen Anne's Road and including increases in journey length for non-motorised and motorised users to reach the businesses. In accordance with DMRB, the average journey speeds for users will be assumed to be 5km/hr for non-vulnerable pedestrians (i.e. able-bodied adults), 3km/hr for vulnerable

pedestrians (i.e. elderly, disabled persons and children), 20km/hr for cyclists (assuming these are non-vulnerable) and 50km/hr for vehicle travellers. These speeds will be considered within the context of the length of the journey in terms of an increase / decrease to determine whether there is a significant change.

14.3.16. The assessment of effects on marine commercial businesses and activities will focus on land-take, severance and disruption to operations within the River Yare and Port operations. Vessel Simulation Modelling that allows a virtual navigation of a vessel through the River Yare to test how the Proposed Scheme interacts with Port operations is being ongoing, although it is not available at the time of writing. In addition, a Navigational Risk Assessment will also be prepared and used to inform the ES; however, this document was not available at the time of writing.

14.3.17. For the purposes of the assessment, land-take, severance and disruption will be considered as a single effect on the sensitive receptors identified.

Changes to access and amenity value of public routes and recreational resources both on-site and off-site

14.3.18. During construction, the Proposed Scheme will require changes to access and amenity value of public routes (including Public Rights of Way and non-designated public routes) and recreational resources[163] both on-site (i.e. within the Application Site and immediately vicinity) and off-site (i.e. within the wider area and along the Norfolk coast).

14.3.19. A qualitative assessment of changes to accessibility will consider disruption to routes due to construction activities / vehicles and increases in journey length / decrease of the route /recreational resource (e.g. recreational grounds).

14.3.20. The DMRB defines amenity value as the relative 'pleasantness' of an experience and notes a number of factors which contribute to this, including receptor's exposure to traffic - noise, dirt and air quality - and the effect of the Proposed Scheme itself. Noise, dirt and air quality will be dealt with elsewhere, and therefore will not be considered as part of this assessment.

14.3.21. The qualitative assessment of amenity value focuses on changes to fear / safety associated within the below:

- The current condition of the route / recreational resource (e.g. width of route etc.);
- Distance of the route / recreational resource from the works / the Proposed Scheme; and
- The presence of any barriers between the users of the route / recreational resource and associated plant / traffic.

14.3.22. During the operational phase, the assessment will consider the changes to the availability of routes and access to the recreational resource within the immediate area of the Application Site. For the wider resources which may be affected, the outputs of the hydromorphological analysis will be used to qualitatively determine what the change / impact may be at the off-site recreational resources (e.g. reduction in sand deposition at beaches and associated loss of recreational resources).

Land-take from public land

14.3.23. The assessment of loss of public land will consider the importance of the land (i.e. whether it is imperative to a community and residential receptor or business operation), the availability of alternative land / facilities within the vicinity and proportion of the land-take as an overall of each land holding.

[163] Open space, sport and recreational facilities

Change in driver delay and stress

14.3.24. The changes in driver delay and stress will be considered for both the construction and operational phases of the Proposed Scheme. The quantitative assessment will be based on the traffic and road conditions likely to be encountered and will consider the average hourly peak flow per lane, average journey speed, the location of the road (e.g. urban or rural) and the road of road (e.g. motorway, dual carriageway or single carriageway). The assessment will consider both the anticipated delay (in terms of time) for vehicle receptors to travel and driver stress, which is defined as the adverse mental and physiological effects experienced by a vehicle traveller traversing a road network.

ASSESSMENT CRITERIA

14.3.25. The assessment of potential effects as a result of the Proposed Scheme has taken into account both the construction and operation phase. Where possible, a significance level has been attributed to an effect based on the impact magnitude due to the Proposed Scheme and the sensitivity of the affected receptor/receiving environment due to change, as well as a number of other factors outlined in more detail in Chapter 5 Assessment Approach. Impact magnitude and the sensitivity of the affected receptor/receiving environment are both assessed on a scale of high, medium low and negligible (as shown in Chapter 5 Assessment Approach).

14.3.26. Determining the sensitivity of receptor is based upon the baseline conditions. The criteria for sensitivity of community receptors are outlined in Table 14.2 - Criteria for Sensitivity.

Table 14.2 - Criteria for Sensitivity

Sensitivity	Criteria
High	A vulnerable receptor with little capacity to absorb change, such as: ▪ Areas with levels of considerable unemployment well in excess of the national / regional averages and level of relative deprivation (top 10%). ▪ Community facilities that are used by a very high number of individuals / limited in number within the area. ▪ Limited local services and recreational / open space available / that have the capability to cope with a limited increased demand. ▪ Businesses that depend on a high level of footfall. ▪ Residential properties / private land / access needed for ongoing business operations. ▪ PRoW frequently used by non-motorised users (NMU) (including pedestrians and cyclists) for commuting, recreational and leisure purposes (e.g. National Trails). Also for use by vulnerable travellers (e.g. elderly, school children and people with disabilities). Frequently used recreational areas. ▪ Routes of high driver stress (defined as a route with 1600+ average peak hourly flow per lane in flow units / 1 hour at any speed).
Medium	A non-vulnerable receptor with limited capacity to absorb change, such as: ▪ Areas with levels of unemployment above the national / regional averages and level of relative deprivation (top 50%). ▪ Community facilities that are used by a moderate number of individuals / several present within the area. ▪ Several local services and recreational / open space available / that have the capability to cope with some increased demand. ▪ Businesses that depend on a medium level of footfall. ▪ Private land / access that is not crucial for ongoing business operations.

Sensitivity	Criteria
	▪ PRoW moderately used by NMU for commuting, recreational and leisure purposes (e.g. regional trails). Moderately used recreational areas. ▪ Routes of medium driver stress (defined as a route with under 1,200 average peak hourly flow per lane in flow unit / 1 hour with average speed of 60-80 or 1200 - 1600 average peak hourly flow per lane in flow units / 1 hour with average journey speed of 60+km/hr).
Low	A non-vulnerable receptor with capacity to absorb change, such as: ▪ Areas with levels of unemployment in line with national / regional averages and level of relative deprivation (bottom 50%). ▪ Community facilities that are used by a limited number of individuals / a number are present within the area. ▪ A number of local services and recreational / open space available / that have the capability to cope with increased demand. ▪ Businesses that depend on a low level of footfall. ▪ Private land / access that is only required occasionally for ongoing business operations or where an alternative access is available. ▪ PRoW sometimes used by NMU for recreational / leisure purposes (e.g. local routes). Recreational areas with limited use by the general public. ▪ Routes of low driver stress (defined as a route with under 1,200 average peak hourly flow per lane in flow units / 1 hour with average journey speed of 80+km/hr).
Negligible	A non-vulnerable receptor with ability to absorb changes, such as: ▪ Areas of very limited unemployment (well below the national / regional averages) and level of relative deprivation (bottom 50%). ▪ Community facilities that are used by infrequently by individuals / a large number are present within the area. ▪ Large number of local services and recreational / open space available / that have the capability to cope with increased demand. ▪ Businesses that do not depend on a footfall / where customers are prepared to travel to the business operations. ▪ Private land / access that is not required for ongoing business operations ▪ PRoW not / infrequently used by NMU for recreational purposes. Recreational areas not / minimally used by the general public. ▪ Routes with very limited driver stress due to infrequent use.

14.3.27. Determining the impact magnitude relates to whether the Proposed Scheme will result in changes to the receptor and the scale of these effects. The criteria for impact magnitude are outlined in Table 14.3 - Criteria for Impact Magnitude.

Table 14.3 - Criteria for Impact Magnitude

Impact magnitude	Criteria
High	▪ Greater than 5% increase / decrease on existing baseline levels of employment. ▪ Where there will be a major impact on an asset used by the community due to disturbance (e.g. the asset could no longer fulfil its function). ▪ Where there will be a major impact on land holdings / access to landholdings (e.g. permanent loss of land / access to landholdings with no alternative access available). ▪ Permanent loss / severance of an existing recreational route / resource used by NMU / considerable change in amenity value. ▪ Where there will be a major increase / reduction in in driver stress resulting from the Proposed Scheme compared to the do minimum.
Medium	▪ 1% - 5% increase / decrease on baseline levels of employment. ▪ Where there will be a medium change on an asset used by the community due to disturbance (e.g. temporary impact on the ability to asset to fulfil its function). ▪ Where there will temporary land take / reduction in accessibility of private land ▪ Disruption of a recreational route / resource used by NMU with significant increase / decrease in journey length / time / or moderate change in amenity value. ▪ Where there will be a moderate increase / reduction in in driver stress resulting from the Proposed Scheme compared to the do minimum.
Low	▪ 0.01 – 0.9 % increase / decrease on existing baseline levels of employment. ▪ Where there will be a small change on an asset used by the community due to disturbance (e.g. limited impact on the ability to asset to fulfil its function). ▪ Where there will limited land take / reduction in accessibility of private land. ▪ Alteration of a recreational route / resource used by NMU but with no significant increase in journey or minor change in amenity value. ▪ Limited increase in driver stress above baseline levels.
Negligible	▪ Less than 0.01% increase / decrease on existing baseline levels of employment. ▪ Limited disturbance to assets used by community receptors. ▪ No change to recreational route / resource used by NMU or change in amenity value. ▪ No change to levels of driver stress above baseline levels.

EFFECT SIGNIFICANCE

14.3.28. The following terms have been used to define the significance of the effects identified; however, it is not prescriptive and professional judgement has been applied where appropriate:

- Large effect: where the Proposed Scheme could be expected to have a considerable effect (either beneficial or adverse) on people and communities receptors;
- Moderate effect: where the Proposed Scheme could be expected to have a noticeable effect (either beneficial or adverse) on people and communities receptors;
- Minor effect: where the Proposed Scheme could be expected to result in a small, barely noticeable effect (either beneficial or adverse) on peoples and communities receptors; and
- Neutral: where no discernible effect is expected as a result of the Proposed Scheme on people and community receptors.

14.3.29. Where the magnitude of change has not been assessed due to a lack of information at this stage of the Proposed Scheme the potential effect has been assigned an 'adverse' or 'beneficial' level of significance.

14.4 BASELINE ENVIRONMENT

POPULATION

14.4.1. The Proposed Scheme is located within Great Yarmouth, within Norfolk. The resident population in Great Yarmouth was estimated to be 99,200 (totalling 49,000 males and 50,200 females) in 2016 based on the Office of National Statistics (ONS) NOMIS report[158]. There are a lower proportion of individuals aged 16-64 in Great Yarmouth (58.7%), compared with the averages across the East of England region (61.5%) and Great Britain (63.1%).

DEPRIVATION

14.4.2. The Index of Multiple Deprivation (IMD) is the official measure of relative deprivation for small areas in England and ranks every small area in England from 1 (most deprived area) to 32,844 (least deprived area).

14.4.3. The IMD combines information from seven domains to produce an overall relative measure of deprivation. The domains are combined using the following weights:

- Income Deprivation (22.5%);
- Employment Deprivation (22.5%);
- Education, Skills and Training Deprivation (13.5%);
- Health Deprivation and Disability (13.5%);
- Crime (9.3%);
- Barriers to Housing and Services (9.3%); and
- Living Environment Deprivation (9.3%).

14.4.4. In the IMD 2015, Great Yarmouth was ranked 29 in England out of 326 local authorities and, as such, is in the 10% most deprived Local Authority areas in England. The Proposed Scheme is located within two Lower Layer Super Output Areas (LSOAs): Great Yarmouth 006A and Great Yarmouth 007B. The eastern extent of the Proposed Scheme is located in Great Yarmouth 006A LSOA, which is in the top 10% most deprived areas in the UK. The western extent of the Proposed Scheme is located in the Great Yarmouth 007B LSOA and is amongst the 20% most deprived neighbourhoods in England.

14.4.5. There are a number of local businesses located within the Application Site and surrounding area. Local businesses, including Kings Centre and Simpsons New and Used Motorhomes, are located off Queen Anne's Road and Suffolk Road. Businesses are also located off Suffolk Road, including, but not limited to, Space 4 U Storage Ltd and Great Yarmouth Day Services. Harfrey's Industrial Estate is situated immediately west of the A47 / Williams Adam Way roundabout. To the east of the River Yare, an industrial area including UKPN, Asco, Perenco is located adjacent to the river. A summary of the land holdings within the vicinity of the Scheme is provided in Table 14.5.

14.4.6. In Great Yarmouth, the proportion of individuals aged 16-64 who were estimated to be economically active in 2016 was 77.9% (47,300 people), compared with an average of 79.1% (437, 600 people) in Norfolk, 80.2% in the East of England and 78% across Great Britain. In 2015, there was an estimated 38,000 jobs in Great Yarmouth, with 60.5% full time and 42.1% part time.

14.4.7. In 2015, the job density levels (i.e. the ratio of total jobs to the population aged 16-64) was 0.71 in Great Yarmouth and 0.8 in Norfolk. This is lower than the averages across the East of England region (0.81) and Great Britain (0.83) and indicates less availability of employment opportunities within Great Yarmouth.

14.4.8. The Borough of Great Yarmouth has a diverse local economy. According to the Great Yarmouth Local Plan, it is the main service base in England for the offshore energy industry and has a thriving seasonal visitor economy[164].

14.4.9. Table 14.4 details the estimated employee jobs by industry sector in 2016. In Great Yarmouth, the highest proportion of employee jobs were in the Human Health and Social Work Activities (Sector Q) at 21.1%. This is a greater proportion than the average across Norfolk (15%), the East of England region (11.8%) and Great Britain (13.3%). The construction industry (Sector F) constituted 3.9% of the workforce (approximately 1,500 jobs) in Great Yarmouth, which is slightly lower than the regional average (5.3%) and national average (4.6%).

Table 14.4 - Overview of estimated employee by jobs by industry sector (2016)

Industry sector	Great Yarmouth	Norfolk	East of England	Great Britain
B: Mining and quarrying	0.9	0.2	0.1	0.2
C: Manufacturing	7.9	9.5	8.0	8.1
D: Electricity, gas, steam and air conditioning supply	0.2	0.1	0.2	0.4
E: Water supply; sewerage, waste management and remediation activities	1.2	0.8	0.7	0.7
F: Construction	3.9	5.3	5.5	4.6
G: Wholesale and retail trade; repair of motor vehicles and motorcycles	15.8	17.3	16.8	15.3
H: Transportation and storage	3.9	3.9	5.1	4.9
I: Accommodation and food service activities	15.8	8.1	6.6	7.5
J: Information and communication	0.8	1.9	3.9	4.2
K: Financial and insurance activities	0.7	3.6	2.4	3.6
L: Real estate activities	0.5	1.3	1.4	1.6

[164] Great Yarmouth Borough Council (2015) Great Yarmouth Local Plan: Core Strategy 2013 - 2030

M: Professional, scientific and technical activities	7.9	5.6	8.7	8.6
N: Administrative and support service activities	5.3	8.6	11.3	9.0
O: Public administration and defence; compulsory social security	2.4	4.5	3.5	4.3
P: Education	7.9	8.9	9.1	8.9
Q: Human health and social work activities	21.1	15.0	11.8	13.3
R: Arts, entertainment and recreation	4.6	3.1	2.7	2.5
S: Other service activities	1.3	1.9	2.0	2.1

Source: NOMIS, ONS

LAND USES

14.4.10. Land within the Proposed Scheme Boundary and surrounding areas is in a mixture of private and public ownership. Private landholdings are owned by a mixture of companies as outlined in Table 14.5. The public-sector land holdings, including residential properties, are owned by Highways England, NCC and Great Yarmouth Borough Council.

14.4.11. The Proposed Scheme Boundary also includes a section of the River Yare used for berthing and as a navigation channel for commercial and for leisure vessels. The channel is maintained by the port operator Peel Ports and includes a large vessel waiting facility.

14.4.12. Table 14.5 provides a summary of the land holdings in the vicinity of the Proposed Scheme.

Table 14.5 – Land holdings within the vicinity of the Proposed Scheme

Landowner	Lessees or reputed lessees / Occupiers	Description
Highways England	N/A	Various
Transmit Containers Limited	N/A	Units 1A and 1B Boundary Road, Harfrey's Industrial Estate
SLA Property Company Limited	East Coast Waste Limited	Land lying to the east of Harfrey's Road, Great Yarmouth
Hope (Borough of Great Yarmouth)	Renfree Energy Limited	Land on the south west side of Queen Anne's Road, Great Yarmouth
Simpsons Garage (Great Yarmouth) Limited	N/A	Land on the west side of Suffolk Road, Gorleston, Great Yarmouth Land on the north-east side of Queen Anne's Road, Great Yarmouth and Land on the west side of Suffolk Road, Great Yarmouth
Great Yarmouth Borough Council	Asco UK Limited	Land at Queen Anne's Road, Great Yarmouth
Regaland Limited	N/A	Various
The Great Yarmouth and Gorleston Allotment Association Limited	N/A	Allotment Sites at Great Yarmouth, Gorleston and Bradwell

Landowner	Lessees or reputed lessees / Occupiers	Description
The Norfolk County Council	Saffron Housing Trust Limited / Eastern Power Networks Plc	Various
Private Residential Properties	N/A	Various
National Grid Property Holdings Limited	Great Yarmouth Port Company Ltd / Asco UK Limited	Various
Swift Taxis and Private Hire Ltd	N/A	173 Southtown Road, Great Yarmouth (NR31 0LA)
Fitzmaurice Holdings Limited	Stapleton's (Tyre Services) Limited	Land adjoining Units 1 and 2 Southtown Road, Great Yarmouth Units 1 and 2 Southtown Road, Great Yarmouth
Norwich Diocesan Board of Finance Limited	Private	Various
Great Yarmouth Port Authority / National Grid Property Holdings Limited / Private	Great Yarmouth Port Company Ltd	Various
Great Yarmouth Borough Council / National Grid Property Holdings Limited / Great Yarmouth Port Authority	Asco UK Limited	Various
Great Yarmouth Port Authority	Various (Perenco UK Limited, Asco UK Limited, Great Yarmouth Port Company Ltd, E.On Climate & Renewables UK Offshore Wind Ltd, Great Yarmouth Port Authority)	Land at Atlas Terminal, Southgates Road, Great Yarmouth
Yarmouth Stores Limited	Score (Europe) Limited	Various
Steel Services Holding Company Limited	N/A	Various
H S Fishing 2000 Limited	N/A	Various
Abbey Waste Control Limited	N/A	Land and buildings on the east side of South Denes Road, Great Yarmouth
Simpsons Garage (Great Yarmouth) Limited	N/A	land on the north side of Queen Anne's Road, Great Yarmouth
N/A	R & S Impex Ltd	The Dolphin Public House, Fish Wharf, Great Yarmouth, NR30 3LP
Quay Developers Ltd	N/A	land on the east side of Southgates Road, Great Yarmouth
A Fordable Car Sales Ltd	Private	Various
Unknown	Internet Workwear Ltd	Land and property to east of South Denes Road
Unknown	Yare Accountancy Services	37 Southgates Road

Landowner	Lessees or reputed lessees / Occupiers	Description
Unknown	221 (Great Yarmouth) Squadron Air Training	Land to the south of William Adams Way

14.4.13. Located to the west of the Proposed Scheme (west of Great Yarmouth) is Grade 3 agricultural land and further north there is Grade 4 agricultural land. Local businesses and community facilities are also situated within the Proposed Scheme Boundary and surrounding area (see below sections for further detail).

14.4.14. The area between William Adams Way and Queen Anne's Road is allocated as an Open Amenity Space (Saved Policy REC11) in the Great Yarmouth Core Strategy Proposals Map. The Proposed Scheme also includes a part of a Safeguarded Employment Area (CS6) to the north of Queen's Anne Road and a Safeguarded Employment Area (CS6) to the east of River Yare. A further Safeguarded Employment Area (CS6) is located to the south of Southtown Road, albeit this falls outside of the Application Site[160].

COMMUNITY FACILITIES

14.4.15. The only community receptors located within the Application Site itself are two allotment gardens, situated immediately north-east of the Queen's Anne Road and Suffolk Road junction, and Community Roots Mind Allotments. Community receptors located outside the Application Site include Southtown Common Recreation Ground, which is a key community receptor; it is located to the south of William Adams Way. Allotment gardens are located to the south-west of this recreation ground. Kingsgate Community Church is situated approximately 30m north of William Adams Way at its closest point. Harfrey's Industrial Estate is located directly west of the A47 / Williams Adam Way roundabout, offering a range of shops and also a gym.

14.4.16. As shown in Table 14.6 there are a number of other community facilities within 500m of the Application Site. Appendix 14A details all the currently identified community facilities within 2km of the Application Site.

14.4.17. **Table 14.6 – Community facilities within 500m of the Application Site**

Name	Type of facility	Direction from the Proposed Scheme	Distance from the Proposed Scheme
St James Church	Church	200 m	NE
Great Yarmouth Primary Academy	Primary School	243 m	NE
Trafalgar College	Secondary School	258 m	N
Edward Worlledge Ormiston Academy	Primary School	474 m	N
King Street	High Street	500 m	N

RECREATIONAL RESOURCES

14.4.18. The only recreational resources located within the Application Site itself are two allotment gardens, situated immediately north-east of the Queen's Anne Road and Suffolk Road junction, and Community Roots Mind Allotments. The recreational resources located outside of the Application Site include Southdown Common Recreation Ground and the allotment gardens to the south-west of the recreation ground. There are no water activity centres within the immediate vicinity of the Proposed Scheme; however, the potential for water sports (including canoeing, rowing and kayaking) along the River Yare will be identified through consultation with local groups and regional bodies such as the Great Yarmouth and Gorleston Sailing Club, Royal Yachting Association and The Broads Authority.

14.4.19. The Great Yarmouth sea front is located approximately 510m to the east of the Proposed Scheme Boundary at its closest point. There are numerous recreational attractions along the beach, including Pleasure Beach, a

scenic railway and Pleasure Beach Gardens. Pleasure Beach offers family rides and attractions and is located approximately 460m east of the most eastern extent of the Proposed Scheme Boundary.

14.4.20. The area to the east of Southtown Road, and east of the River Yare, is within the England Coast Path Coastal Margin and therefore has the potential to be open space**.**

14.4.21. There are also a number of additional open / recreation spaces within 500m of the Application Site, as outlined in Table 14.7 – Recreational facilities within 500m of the Application Site. The currently identified open / recreational spaces within 2km of the Application Site are shown in Appendix 14B.

Table 14.7 – Recreational facilities within 500m of the Application Site

Name	Description	Direction from the Proposed Scheme	Distance from the Proposed Scheme
Playground East Community Centre	Play Area	30 m	E
Peggotty Road	Play Area	30 m	E
Suffolk Road Recreation Ground	Play Area	95 m	E
Admirals Quay Playground	Play Area	300 m	W
Admirals Quay	Play Area	300 m	NW
Anchor Court Play area	Play Area	330 m	NW
Anchor Court	Play Area	330 m	NW
Louise Close Playground	Play Area	360 m	NE
Louise Close	Play Area	360 m	N
St Nicholas Recreation Ground	Sports pitches	380 m	E
Sidney Close	Play Area	500 m	N

14.4.22. The Great Yarmouth Open Space Study (Open Space Audits and Local Standards)[161] identified that there is 5.63ha of open space per 1,000 people in the Southtown and Cobholm ward and 4.38ha per 1,000 people in the Nelson ward. Across all wards, the total area of open space per ward ranges from 2.77ha to 77.93ha.

14.4.23. In general, the quality of open space in the Borough is very high. The average quality of outdoor sports facilities meets the proposed standard and for most types of sport there is sufficient supply. However, there are local variations and deficiencies in rural areas which were identified in the study. The average amenity greenspace is considered sufficient for the Borough. Sports facilities are considered to be well maintained across the Borough, but issues were identified with the ancillary facilities which require improvements (e.g. changing rooms and floodlighting). Outdoor sports facilities are considered to be accessible with most of the facilities catchment population within 0.5-mile radius, and many are accessible by public transport.

PUBLIC RIGHTS OF WAY AND NON-DESIGNATED PUBLIC ROUTES

14.4.24. Sustrans Cycle Route 517 is located within the Proposed Scheme and runs along Southtown Road and Malthouse Lane, which both join with William Adams Way. Hopton-on-Sea to Sea Palling is also a national trail with the trail forming part of the England Coast Path. It is located within the Proposed Scheme and also runs along Southtown Road and Malthouse Lane. It should be noted that NCC are currently in the process of progressing a separate scheme to improve cycle facilities along Southtown Road. This scheme includes widening the footway into the carriageway to provide a shared use facility for pedestrians and cyclists, between Queen Anne's Road and to the north of Waveney Road. Construction of this scheme has commenced with completion programmed in early August.

14.4.25. On a local level, a pedestrian footbridge is currently located along William Adams Way and a footbridge over this road providing access to Southtown Common Recreation Ground, although this will be demolished as

described Section 2.4 NMU Crossings. There are also a number of Public Rights of Way (PRoW) located within 2km of the Application Site, mainly located to the west of the Proposed Scheme Boundary, around Harfrey's Industrial Estate

14.4.26. A pedestrian and cyclist survey was undertaken for the existing Haven Bridge in June 2016[165]. The survey counted the number of pedestrians and / or cyclists observed crossing at this location during a 12-hour (7am – 7pm) period. Surveys taken at the A47 Breydon Bridge were not assessed due to the nature of the road (50mph) with no facilities for walking or cycling. Table 14.8 provides an overview of the survey count data for June 2016.

Table 14.8 – Summary of pedestrian and cyclist survey count (June 2016)

Date	Location	Pedestrian Count	Cyclist Count
30/06/2016	Haven Bridge	5,453	1,214

14.4.27. Additional surveys were undertaken in February 2017 at four locations, listed in Table 14.9 - Summary of pedestrian and cyclist survey count (February 2017). This survey data was used to supplement the June 2016 count data, mainly for assessing the impact of replacing the footbridge on William Adams Way with a toucan crossing.

Table 14.9 - Summary of pedestrian and cyclist survey count (February 2017)

Date	Location	Pedestrian Count	Cyclist Count
21/02/2017	Suffolk Road / Queen Anne's Road / William Adams Way	466	159
21/02/2017	William Adams Way Footbridge	386	79
21/02/2017	South Denes Road	45	59
21/02/2017	William Adams Way / Beccles	527	258

HIGHWAY NETWORK

14.4.28. The main roads in the vicinity of the Application Site include the A47 which is located immediately west of the Proposed Scheme. The A47 is a key road in Great Yarmouth and connects the area to Norwich, links south to Lowestoft and other areas to the west. To the south, the A12 provides links to Ipswich, while the A143 links Great Yarmouth with areas in the south-west such as Bury St Edmunds.

14.4.29. Table 14.10 – Average Annual Daily Traffic between 01/01/2017 and 01/01/2018 outlines the average volume of traffic (measured in Annual Average Daily Traffic) for the A47 northbound and southbound carriageways[166].

Table 14.10 – Average Annual Daily Traffic between 01/01/2017 and 01/01/2018

		Average Annual Daily Traffic			
Site Ref.	Direction	24hr	18hr	16hr	12hr
30360732	A47 northbound between A143 and A1243	16,894	16,324	15,934	13,812
6337/2	A47 southbound between A149 and A1243	17,634	17,182	16,623	14,439

Source: Webtris

[165] Mouchel (2017) Great Yarmouth Third River Crossing: Outline Business Case
[166] Highways England (2018) Webtris [online] Available at: http://webtris.highwaysengland.co.uk/ (Accessed May 2018)

14.4.30. A review of Collison Map167 (based on Government data) indicates that a number of slight accidents and one serious accident have recently occurred along the A47 / Williams Adam Way roundabout and approaches to the roundabouts (see Table 14.11 – Accidents within the vicinity of the Proposed Scheme between 31/12/13 and 31/12/16).

Table 14.11 – Accidents within the vicinity of the Proposed Scheme between 31/12/13 and 31/12/16

Location	Date	Severity	No casualties
A47 / Williams Adam Way roundabout	February 2015	Slight	4
A47 / Williams Adam Way roundabout	August 2016	Slight	2
A47 / Williams Adam Way roundabout	November 2015	Slight	1
A47 / Williams Adam Way roundabout	November 2014	Slight	1
Approx. 70m north of roundabout	November 2016	Serious	3
Approx. 140m north of roundabout	August 2014	Slight	1
Approx. 170m north of roundabout	April 2015	Slight	3
Approx. 210m north of roundabout	November 2014	Slight	1
Approx. 200m south of roundabout	October 2015	Slight	1

Source: Collison Map

Sensitive Receptors

14.4.31. The following sensitive receptors could be affected by the Proposed Scheme:

- Economic receptors, e.g. individuals of working age and businesses, terrestrial and marine commercial businesses;
- Community receptors e.g.. Kingsgate Community Church;
- Recreational receptors, including terrestrial (e.g. users / visitors to the Southtown Common Recreational Ground) and marine activities (e.g. users of the River Yare);
- Public landholdings;
- Non-motorised user receptors, including pedestrian and cyclist users of the local PRoW and non-designated public routes; and
- Vehicle user receptors, including drivers along the highway network.

[167] Buchanan Computing (2017) Collison Map [online] Available at: http://www.collisionmap.uk/ (Accessed May 2018)

14.5 PREDICTED EFFECTS

INSIGNIFICANT EFFECTS

14.5.1. It is considered that site security arrangements for the Proposed Scheme will be in line with the requirements set out within the Construction (Design and Management) Regulations 2015, and appropriate security (CCTV / security personnel including existing port security) will be provided on-site. Therefore, in accordance with the Scoping Opinion effects in relation to crime and perception of crime will not be considered further within this PEIR and the ES.

14.5.2. Once operational, the Proposed Scheme will not involve further changes in land use, in terms of demolition or refurbishment. Therefore, changes in private and public landholdings during the operational phase will not be considered in this PEIR and the ES.

14.5.3. Given the nature of the Proposed Scheme (i.e. highways infrastructure), there are unlikely to be any significant changes to demands for local services, accommodation and recreational open space during the operation phase. Therefore, this will not be considered further within this PEIR and the ES.

14.5.4. It is anticipated that the Proposed Scheme would generate 18 gross direct jobs outside of Great Yarmouth (see Table 14.14). It is anticipated that the effect of the influx of construction workers on the capacity of local services (e.g. education, healthcare or community facilities) and recreational / open space would be negligible and of neutral significance.

POTENTIAL EFFECTS

14.5.5. The Proposed Scheme could have the following potential effects on people and communities:

Construction Phase

- Generation of direct, indirect and induced employment opportunities;
- Land-take, severance and disruption to terrestrial and marine businesses and associated activities;
- Change to access and amenity value of public routes and resources both on-site and off-site;
- Land-take from public and private land holdings; and
- Changes in driver stress and delay.

Operational Effects

- Increase in economic activity due to improved connectivity;
- Severance and disruption to terrestrial and marine businesses and associated activities;
- Change to access and amenity value of public routes and resources both on-site and off-site; and
- Change in driver stress and delay.

14.5.6. Table 14.12 details the effects covered elsewhere within this PEIR. Table 14.15 at the end of the chapter provides an overview of the assessments that were able to be undertaken at this stage of the Proposed Scheme.

Table 14.12 – Summary of topics covered within this PEIR

Topic	Chapters
Effects in relation to quality of surroundings and sense of place	Cultural Heritage Chapter and Landscape and Visual Chapter
Effects in relation to health	Acoustics, Air Quality, Water Environment and Geology and Soils

Potential for disturbance, disruption and reduction in amenity of residents	Acoustics, Air Quality and Landscape and Visual Amenity

CONSTRUCTION PHASE

Generation of direct, indirect and induced employment opportunities

14.5.7. Construction employment represents a positive economic effect that can be estimated as a function of the scale and type of construction (e.g. infrastructure). The following sections estimate gross employment arising from the Proposed Scheme during the construction phase and then take into account leakage, displacement and multiplier effects in order to assess the net effects on local and regional economies.

Gross Direct Construction Employment

14.5.8. The estimated construction period is approximately two years and four months. The construction work is not permanent and therefore the effect will be temporary in nature. The capital and revenue expenditure involved in the construction period will lead to increased output in Great Yarmouth and the wider regional economy.

14.5.9. The employment resulting from the temporary construction phase can be estimated by applying an average gross output per construction industry employee to the estimated total construction cost. It is therefore estimated that there are likely to be 176 FTE construction workers per annum on the Site during the construction phase.

Leakage

14.5.10. Leakage effects are the benefits to those outside the effect area. Analysis carried out on Census 2011 data indicates that approximately 9,274 people working in Great Yarmouth live outside the area[168]. This corresponds to a low leakage rate as set out by HCA Additionality Guidance[169] and implies that the majority of employment opportunities will go to people living within the effect area. An adjustment of 10% has been applied to the estimated 176 gross construction jobs. It is therefore estimated that 158 employees from within Great Yarmouth and 18 employees from outside of Great Yarmouth will be working per annum at the Proposed Scheme during the construction period.

Displacement

14.5.11. Displacement measures the extent to which the benefits of a project are offset by reduction of output or employment elsewhere. An additional demand for labour cannot simply be treated as a net benefit – it has the potential to remove workers from other positions and the net benefit is reduced by the extent that this occurs.

14.5.12. Construction workers typically move between construction projects when delays occur or to help the workforce meet particular construction deadlines. Overall it is assumed that, due to the flexibility of the labour market and the fact that construction workers at the Proposed Scheme represent such a small proportion of the Great Yarmouth construction labour force, displacement of the direct construction employment will be low.

14.5.13. The HCA Additionality Guidance[169]**Error! Bookmark not defined.** provides 'ready reckoners' for displacement. Within the c ontext of Great Yarmouth, a low displacement of 25% is considered appropriate. This is considered to be a best practice approach in the absence of specific local information that might provide a defensible justification for another level of displacement being used, either above or below 25%. Applying this level of displacement to the

[168] Office for National Statistics (2018) Location of usual residence and place of work by method of travel to work [online]. Available at: https://www.nomisweb.co.uk/census/2011/WU03UK/chart/1132462257

[169] Homes & Communities Agency (2014) Additionally Guide: Fourth Edition

total gross direct employment figure results in a net direct employment figure of 132 jobs per annum during the construction period.

Multiplier Effect

14.5.14. In addition to the direct employment generated by the Proposed Scheme itself, there will be an increase in local employment arising from indirect and induced effects of the construction activity. Employment growth will arise locally through manufacturing services and suppliers to the construction process (indirect or supply linkage multipliers). Additionally, part of the income of the construction workers and suppliers will be spent in Great Yarmouth, generating further employment (in terms of induced or income multipliers).

14.5.15. The effects of the multiplier depend on the size of the geographical area that is being considered, the local supply linkages and income leakage from the area. The HCA Additionality Guidance[169]**Error! Bookmark not defined.** p rovides a 'ready reckoner' of composite multipliers – the combined effect of indirect and induced multiplier effects. This is considered to be a best practice approach in the absence of specific information that might provide a defensible justification for another multiplier effect level being used, appropriate to the sectors concerned. Applying the 1.5 multiplier to the figure for total net direct employment of 132 results in a net indirect employment of 66 during the construction period.

Net Additional Construction Employment

14.5.16. Table 14.13 presents the temporary employment generated by the Proposed Scheme taking leakage, displacement and multiplier effects into account. For the Proposed Scheme, the total net additional employment created within Great Yarmouth is estimated to be 178 whilst 20 jobs will be created outside of Great Yarmouth, supporting a total of 198 net jobs on average per year during the construction period.

Table 14.13 – Net Additional Construction Employment Per Year

FTE Employment	Total Great Yarmouth	Outside Great Yarmouth	Total
Gross direct employment	158	18	176
Displacement	-39	-4	-44
Net direct employment	118	13	132
Indirect & induced employment	59	7	66
Total net employment	**178**	**20**	**198**

14.5.17. In the context of the labour pool of construction workers in Great Yarmouth, the direct, indirect and induced employment, expenditure and upskilling created by the construction phase of the Proposed Scheme is likely to have a direct moderate beneficial, temporary effect on the Great Yarmouth economy (local study area) and minor beneficial effects on Norfolk's economy (regional study area).

Land-take, severance and disruption to terrestrial and marine businesses and associated activities

14.5.18. It is anticipated that there will be temporary and / or partial closures of the roads surrounding the Proposed Scheme during the construction phase. These temporary / partial closures could have **adverse** effects on the local businesses surrounding the Proposed Scheme. The Traffic Management systems that will be implemented during the construction phase are unknown at this stage of the Proposed Scheme meaning a full assessment cannot be undertaken. In addition, further detail on the types of businesses and footfall required by these businesses (e.g. specialised businesses will require less footfall as customers are prepared to travel for these services) will be sought to inform the ES.

14.5.19. In addition, construction activities within the River Yare, associated with piers (if required) and the placement of the bridge, have the potential to affect vessel transport and Port operations. Construction of the new crossing

will introduce a new structure within the River Yare which will reduce the width of the existing navigation channel. The Proposed Scheme will also result in the loss of quay spaces. The Proposed Scheme is likely to result in additional delays to recreational vessels wishing to navigate the River Yare.

14.5.20. It is therefore anticipated that the Proposed Scheme will have an adverse effect on commercial marine activities during construction. However, at the time of writing detailed information on the construction programme and activities was not available and therefore a full assessment could not be undertaken

Changes to access and amenity value of public routes and recreational resources both on-site and off-site

14.5.21. It is anticipated that the Proposed Scheme will cause temporary disruption and change in accessibility for public routes and recreational resources (both terrestrial and marine). The Proposed Scheme is also likely to result in additional delays to recreational vessels that want to navigate the River Yare.

14.5.22. At the time of writing, information on the construction diversion routes and recreational resources was not available and therefore a full assessment could not be undertaken. However, it is anticipated that there will be an **adverse** effect on accessibility for public routes and recreational resources during construction.

Land-take from public and private land holdings

14.5.23. Land-take from a number of public landholdings will be required to deliver the Proposed Scheme. The areas of land-take that will be required to deliver the Proposed Scheme, including NCC owned residential properties, warehouses and allotment land to the west of the River Yare. To the east of River Yare, the Proposed Scheme will require South Denes Car centre to be demolished as well as an industrial storage area.

14.5.24. Table 14.14 provides more detail on the residential, commercial and industrial properties that will be demolished to accommodate the Proposed Scheme.

Table 14.14 – Residential, commercial and industrial properties for demolition

Location	Description
Queen Anne's Road	Block of ten terraced properties (13 to 22 Queen Anne's Road)
South of Cromwell Road	Warehouses (including MMC Performance Ltd)
Cromwell Road	Residential property (11 Cromwell Road)
Southtown Road	Block of nine terraced houses (148 to 156 Southtown Road)
South Denes Road	Warehouse (including South Deans Car Centre

14.5.25. It is anticipated that the loss of the residential properties, warehouse and commercial spaces will have an adverse effect on the local community and businesses. However, a new allotment location, north of Queen Anne's Road, has been identified.

Changes in driver stress and delay

14.5.26. It is anticipated that temporary road blockades / partial closures and diversions will be required during the construction of the Proposed Scheme. It is anticipated that these diversions could, temporarily, increase driver stress delay and stress for vehicle receptors. At the time of writing, information on the construction diversion routes was not available and therefore a full assessment could not be undertaken at this stage of the Proposed Scheme. However, it is anticipated that there will be an **adverse** effect on driver stress during construction

OPERATIONAL PHASE

Increase in economic activity due to improved connectivity

14.5.27. During operation, the Proposed Scheme will provide a vehicular link across the River Yare, with the current crossing located approximately 1.5 km north of the Proposed Scheme Boundary. Therefore, the Proposed Scheme will link the communities to the west and east of River Yare, which could increase footfall for businesses and generate **beneficial** effects on local businesses and the economy. The Economic Impact Report was not available at the time of writing meaning a detailed assessment could not be undertaken at this stage of the Proposed Scheme.

Severance and disruption to terrestrial and marine businesses and associated activities

14.5.28. Once complete, the piers and the placement of the bridge have the potential to affect vessel transport and port operations. It is anticipated that the Proposed Scheme will have an **adverse** effect on accessibility for commercial marine activities. However, at the time of writing information the vessel simulation model and Navigational Risk Assessment was not available and therefore a full assessment could not be undertaken

Changes to access and amenity value of public routes and recreational resources both on-site and off-site

14.5.29. The Proposed Scheme will enhance connectivity for public routes and recreational resources as it will provide a link across the River Yare. The Proposed Scheme also includes non-motorised users' facilities across the River Yare (see Chapter 3 for more detail), resulting in a beneficial effect. However, as part of the Proposed Scheme the footbridge will be lost and replaced by controlled toucan crossings across Adam William's Way southeast and the bridge approaches to the western roundabout. Both will be signalised and staggered with a waiting area in the central reservation. The Proposed Scheme includes an uncontrolled crossing at Southtown Road and a new signalised crossing at Suffolk Road. Further non-motorised facilities would be provided at the eastern junction as described in Chapter 3. A more detailed assessment of the effects of the Proposed Scheme on NMU facilities will be undertaken as part of the Environmental Impact Assessment when the NMU survey count data and the NMU Context Report will be available.

14.5.30. In addition, it is anticipated that changes in traffic and the introduction of infrastructure associated with the Proposed Scheme could reduce amenity of both terrestrial and marine recreational resources (e.g. Southdown Common Recreation Ground, two replacement allotment gardens and River Yare), including the allotment gardens, resulting in an adverse effect.

14.5.31. During operation, the Proposed Scheme could cause sediment and hydromorphological changes to the River Yare and the wider Norfolk coast, which could have an **adverse** effect off-site recreational resources (e.g. beaches). Further details are presented within Chapter 11, which relates to Road Drainage and the Water environment. Sediment transport and hydromorphological assessments will be progressed as part of the Environmental Impact Assessment.

Changes in driver stress and delay

14.5.32. During the operational phase, the vehicle travellers are anticipated to experience a **beneficial** effect on driver delay as the Proposed Scheme will improve connectivity across the River Yare, and take traffic off local roads that currently allow access across the River Yare**.**

14.5.33. It is anticipated that vehicle travellers using the Proposed Scheme will also experience a reduction in driver stress as the Proposed Scheme will improve connectivity, journey times and reliability. However, as the traffic data is not available at the time of writing a detailed driver stress and delay assessment could not be undertaken at this stage

14.6 PROPOSED MITIGATION

14.6.1. At this stage, the following mitigation is considered relevant. However, further work in preparing the ES may determine that further mitigation will be required.

CONSTRUCTION

- The Applicant will work proactively with contractors and suppliers to provide employment opportunities and to enable access to training. The processes used to recruit and manage employees working to build the Proposed Scheme will be demonstrably fair and offer equal opportunities to all. There will also be one-to-many briefing for the local Jobcentre Plus and other local training providers.
- There may be scope for additional measures to optimise the spending by contractors in the local economy during the construction phase by voluntary measures to place contracts with local firms and purchase from local suppliers.
- The public will be informed of the nature, timing and duration of particular construction activities and the duration of the construction works by newsletters and liaison with the Applicant.
- Adherence to measures set out in the Construction Environmental Management Plan to reduce noise, air quality and lighting impacts, where practicable.
- Management / layout of construction compounds to reduce impacts on access to / from private landholdings.
- Construction plant that is not in use will be separated from public access points. Where practicable, NMU movements will be separated from construction activity and vehicle/machinery movements.
- The provision of appropriate and quality diversions which are established prior to construction and clear directions for any alternative routes and appropriate alternative diversions will be clearly publicised to maintain public access.

OPERATION

- Provision of off-site housing or financial contributions to mitigate the loss of private residential properties.
- Proposed road layout, road markings and traffic signs are clear and transparent to avoid confusion by all road users, including cyclists.

14.7 CONCLUSIONS AND EFFECTS

14.7.1. Interim conclusions drawn from the preliminary assessments carried out to date are that:

- The construction of the Proposed Scheme will have beneficial effects associated with the generation of direct, indirect and induced employment opportunities.
- During the construction phase, the Proposed Scheme could have adverse effects due to land-take, severance and disruption to terrestrial and marine businesses and associated activities, changes to access and amenity value of public routes and recreational resources both on-site and off-site, land-take from public and private land holdings as well as changes in driver stress and delay.
- The operation of the Proposed Scheme will have beneficial effects on economic activity due to improved connectivity, driver stress and delay as well as NMU connectivity across the River Yare.
- It is anticipated that the Proposed Scheme will have an adverse effect due to severance and disruption to terrestrial and marine businesses and associated activities as well as changes to access and amenity value of public routes and recreational resources both on-site and off-site.

Table 14.15 - Assessment of Effects

Environmental aspect	Sensitivity	Type of impact	Nature of impact	Magnitude of impact (Adverse and Beneficial)	Significance of effect
Generation of direct, indirect and induced employment opportunities	Local study area (Great Yarmouth): High	Construction	The construction of the Proposed Scheme is likely to generate direct, indirect and induced employment opportunities.	Moderate	Beneficial
	Regional study area (Norfolk): Medium			Minor	Beneficial
Increased demand for local services and recreational / open space	Local services and recreational / open space: Medium	Construction	An influx of construction workers could increase demand on local services (e.g. education, healthcare or community facilities) and recreational / open space.	Negligible	Neutral

14.8 ASSESSMENTS STILL TO BE COMPLETED

14.8.1. The following assessment will be included as part of the ES:

- A revised quantitative assessment of the direct on-site and indirect and induced employment opportunities that will be generated as a result of the Proposed Scheme will be undertaken based on more detailed information.
- A detailed assessment of:
  - Changes to access and amenity value of public routes and recreational resources both on-site and off-site;
  - Land-take from public and private land holdings;
  - Changes in driver stress and delay;
  - Increase in economic activity due to improved connectivity; and
  - Severance and disruption to terrestrial and marine businesses and associated activities.

15

MATERIALS

15 MATERIALS

15.1 INTRODUCTION

15.1.1. This chapter provides preliminary information with regard to materials as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process. This section considers the implications of the Proposed Scheme on the consumption of material resources (which includes recovered site arisings), and the generation and disposal of waste. It sets out the proposed methodology and identifies those impacts that can be scoped out of the EIA.

15.1.2. The assessment methodology proposed in this assessment is based on guidance set out in IAN 153/11 (Highways Agency, 2011) Environmental Assessment of Material Resources[170]. IAN153/11[171] sets out the process and information required for the assessment of significant effects from material resources and waste.

15.1.3. Materials resources are defined in IAN 153/11 as "the materials and construction products required for the construction, improvement and maintenance of the road network. Materials resources include primary raw materials such as aggregates and minerals, and manufactured construction products. Many material resources will originate off site, purchased as construction products, and some will arise on site such as excavated soils or recycled road planning".

15.1.4. IAN 153/11 does not include a definition of waste, however the EU Waste Framework Directive[172] defines it as "*any substance or object that the holder discards or intends or is required to discard*".

STUDY AREA

15.1.5. The primary study area comprises the Proposed Scheme Boundary presented in Figure 2.3

15.1.6. The secondary study area extends to the availability of construction and recovered material resources within the East of England (Hertfordshire, Bedfordshire, Cambridgeshire, Essex, Norfolk and Suffolk) and the UK, and the capacity of waste management facilities in the East of England.

15.2 DIRECTIVES, STATUTES AND RELEVANT POLICES

LEGISLATIVE FRAMEWORK

15.2.1. The legislative framework applicable to Material Resources is summarised as follows:

Waste Framework Directive (2008/98/EC)[173].

15.2.2. The Directive provides a comprehensive foundation for the management of waste across the European Community and provides a common definition of waste. A definition of waste is provided in Article 3 of the Directive which defines waste as:

- *"any substance or object that the holder discards or intends or is required to discard".*

170 Highways Agency (2011) Interim Advice Note (IAN) 153/11 – Guidance on the Environmental Assessment of Material Resources [

171 Interim Advice Note (IAN) 153/11 (2011) Guidance on the Environmental Assessment of Material Resources, Volume 11 [online] available at: http://www.standardsforhighways.co.uk/ians/pdfs/ian153.pdf (Accessed November 2017).

172 The EU Waste Framework Directive, European Directive 2006/12/EC, as amended by Directive 2008/98/EC.

173 European Commission (2014)The Environmental Impact Assessment Directive (2014/52/EU)

15.2.3. It is important to note that the definition of 'discard' set out in the Waste Framework Directive is different to its dictionary definition: the Directive definition includes any substance or object that is discarded for disposal or that has not been subject to acceptable recovery (including recycling).

15.2.4. In accordance with the Waste Framework Directive, Member States are obligated to give due consideration to waste prevention mechanisms and where possible recover, reuse or recycle waste. Specifically, explicit targets are laid out for construction, demolition and excavation wastes: 70% of non-hazardous construction and demolition waste must be recovered, reused or recycled by 2020.

15.2.5. The Waste Framework Directive sets out the Waste Hierarchy (Figure 15.1) against which action to reduce the production and disposal of waste shall be taken.

Figure 15.1 – Waste Hierarchy

15.2.6. The main principles of the Waste Hierarchy[174] are:

- Prevention - using less material in design and manufacture; keeping products for longer; re use; using less hazardous materials;
- Preparing for reuse - checking, cleaning, repairing, refurbishing, whole items or spare parts;
- Recycling - turning waste into a new substance or product; includes composting if it meets quality protocols;
- (other types of) Recovery - anaerobic digestion; incineration with energy recovery; gasification and pyrolysis which produce energy (fuels, heat and power); recovering materials from waste; some backfilling; and
- Disposal - landfill and incineration without energy recovery.

[174] Defra (2011) Guidance on the Waste Hierarchy

UK Legislation

15.2.7. The following legislations set out the principal requirements relevant to the control of the storage, collection, treatment and disposal of waste in England:

The Controlled Waste (England and Wales) Regulations 2012[175]*.*

15.2.8. The Regulations provide a definition of controlled waste and classifies waste as household, industrial or commercial waste. It allows Local Authorities to implement charges for the collection of waste from non-domestic properties.

The Waste (England and Wales) Regulations 2011[176]*.*

15.2.9. The legislative requirements of the EU Directive are transposed into UK law via these regulations. They stipulate the requirement for industry and businesses to implement the Waste Hierarchy.

Clean Neighbourhoods and Environment Act 2005[177]*.*

15.2.10. States that it is the responsibility of construction workers on site to guarantee that waste is disposed in the appropriate manner. In accordance with this, employees must undertake waste disposal activities as outlined in national law.

Hazardous Waste (England and Wales) Regulation's 2005[178]*.*

15.2.11. Introduce measures to control the storage, transport and disposal of hazardous waste. It provides a means to ensure that hazardous waste and any associated risks are appropriately managed.

Waste Minimisation Act 1998[179]*.*

15.2.12. Enables Local Authorities to take the appropriate steps to reduce and minimise the generation of household, commercial or industrial waste within their area.

Environmental Protection Act 1990[180]*.*

15.2.13. Outlines the requirement of the manager of a development to ensure that any excess materials or waste as a result of construction activities are recovered or disposed of without any subsequent adverse effects upon the surrounding environment.

The Control of Pollution Act 1974[181]*.*

15.2.14. Makes provisions with respect to the generation and revision of 'waste disposal plans' and prohibits the unlicensed disposal of waste.

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[175] HM Government (2012) The Controlled Waste (England and Wales) Regulations 2012
[176] HM Government (2011) The Waste (England and Wales) Regulations 2011
[177] HM Government (2005) The Clean Neighbourhoods and Environment Act 2005
[178] HM Government (2005) Hazardous Waste (England and Wales) Regulations 2005
[179] HM Government (1998) Waste Minimisation Act 1998

[180] HM Government (1990) The Environmental Protection Act 1990
[181] HM Government (1974) The Control of Pollution Act 1974

NATIONAL POLICY

15.2.15. The following policy documents set out the vision, goals and ambitions for waste in England.

The NPS for National Networks (NPS NN)

15.2.16. NPS NN re-iterates the waste hierarchy as a method of achieving sustainable waste management. It also states that an applicant should provide "*Evidence of appropriate mitigation measures (incorporating …. use of materials) in both design and construction….*"

National Policy Statement for Ports (NPSP)

15.2.17. NPSP also mentions the use of the waste hierarchy in order to attain sustainable waste management as well as providing information on dredging and disposal of waste at sea.

Waste Management Plan for England, 2013[182].

15.2.18. The Waste Management Plan for England provides a detailed analysis of the present state of waste management at a national level, and assesses how the objectives of the Waste Framework Directive will be effectively supported. It states that excavation, construction and demolition waste is the largest contributor to total waste generation in the UK (Waste Management Plan for England, 2013).

15.2.19. The Waste Management Plan for England also outlines the waste hierarchy, which gives top priority to waste prevention, followed by preparing for reuse, the recycling, other types of recovery and finally disposal (e.g. landfill).

National Planning Policy for Waste, 2014[183].

15.2.20. The National Planning Policy for Waste outlines the ambition to promote a sustainable approach to resource use and management. It sets out waste planning policies, and should be read alongside: the recently revised National Planning Policy Framework; the National Waste Management Plan for England and any relevant successor policies, guidance or documents. Policies include:

- Delivery of sustainable development and resource efficiency, including provision of modern infrastructure, local employment opportunities and wider climate change benefits, by driving waste management up the waste hierarchy;
- Ensuring that waste management is considered alongside other spatial planning concerns, such as housing and transport, recognising the positive contribution that waste management can make to the development of sustainable communities;
- Helping to secure the reuse, recovery or disposal of waste without endangering human health and without harming the environment; and
- Ensuring the design and layout of new residential and commercial development and other infrastructure (such as safe and reliable transport links) complements sustainable waste management, including the provision of appropriate storage and segregation facilities to facilitate high quality collections of waste.

15.2.21. The National Planning Policy for Waste also states that when determining planning applications for non-waste development, local planning authorities should, to the extent appropriate to their responsibilities, ensure that:

[182] Defra (2013) Waste Management Plan for England
[183] DCLG (2014) National Planning Policy for Waste

- The likely impact of proposed, non-waste related development on existing waste management facilities is acceptable and does not prejudice the implementation of the waste hierarchy and/or the efficient operation of such facilities;

- New, non-waste development makes sufficient provision for waste management and promotes good design to secure the integration of waste management facilities with the rest of the development and, in less developed areas, with the local landscape; and

- The handling of waste arising from the construction and operation of development maximises reuse/recovery opportunities, and minimises off-site disposal.

National Policy Statement for Hazardous Waste 2013[184].

15.2.22. This policy statement outlines the main objectives on Government Policy for hazardous waste, including:

- To protect human health and the environment: there are stringent legislative controls in place to control the management of waste with hazardous properties;

- Implementation of the waste hierarchy: This aids the production of less hazardous waste, promoting its reuse as a resource (where possible). Disposal of the waste is noted as a last resort;

- Self-sufficiency and proximity: This ensures that sufficient disposal facilities are provided across country to match expected arisings of all hazardous wastes, except those produced in very small quantities, and to enable hazardous waste to be disposed of in one of the nearest appropriate installations; and

- Climate change: To minimise greenhouse gas emissions and maximise opportunities for climate change adaptation and resilience.

15.2.23. The policy additionally outlines the key principles for the management of hazardous waste, as follows:

- Principle 1: Hazardous waste should be managed as to provide the best possible environmental outcome. This is expected to be in line with the waste hierarchy, with the exception of when life cycle analysis suggests that the best overall environmental option would require a departure from that hierarchy.

- Principle 2: Requires a reduction in reliance upon landfill, with landfill only being used where there is no alternative recovery or disposal option available.

- Principle 3: This principle requires that hazardous waste is not mixed with different categories of hazardous waste or with other waste substances or materials (although co-disposal of some wastes in landfill is allowed).

- Principle 4: Stipulates that organic hazardous wastes that cannot be reused, recycled or recovered should be subject to destruction using best available techniques, with energy recovery for all appropriate treatments. No hazardous organic waste should be landfilled unless the requirements of the Landfill Directive are met.

- Principle 5: The practice of relying on higher Landfill Directive waste acceptance criteria to enable some hazardous waste to continue to be landfilled must end.

[184] Defra (2013) National Policy Statement for Hazardous Waste

LOCAL POLICY

15.2.24. The Norfolk Mineral and Waste Local Development Framework[185] is published by NCC within the Core Strategy and Waste Management Policies Development Plan Document (DPD) 2010-2026 and adopted in September 2011. The strategy document is central to NCCl's Development Plan and contains the Minerals and Waste Policies. The purpose of the Minerals and Waste Development Framework is to plan for mineral extraction and associated development and waste management facilities in the most sustainable way that minimises adverse impacts on amenity and the environment. The principal aims of the Minerals Policy (CS1 & CS2) are to:

- Manage and safeguard mineral resources to meet current and future needs through the development of Mineral Safeguarding Areas. This includes protecting minerals of economic importance from unnecessary sterilisation by non-mineral development, and considering the feasibility of mineral extraction proper to non-mineral development (subject to certain assessment criteria).
- Assess proposals for non-energy mineral extraction both individually and cumulatively in terms of their contribution to national and regional guidelines and social, environmental and economic impacts.
- Impose high standards of restoration and aftercare to worked land to ensure it is returned to the most appropriate and beneficial use.

15.2.25. The principal aims of the Waste Policy (CS3 – CS16) are to encourage action in the highest tiers of the Waste Hierarchy. This will be achieved through:

- Assessing proposals for waste management facilities in regard to location criteria, such as achieving on-site waste management, expansion of existing facilities, co-location of waste facilities, situated within employment areas and using previously developed land.
- Ensuring the development would not have an adverse impact on the environment and human health.
- Only permitting development that would result in the loss of a waste management facility where it can be demonstrated that there is no longer a need for that facility, or the capacity can be met elsewhere.

GUIDANCE

15.2.26. IAN 153/11 Guidance on the Environmental Assessment of Material Resources[186] provides guidance for the assessment of the impacts and effects associated with the use of materials in new construction, improvement and maintenance projects. The document outlines the consideration of material resource use and waste as part of an EIA process. The document provides a definition of materials resources:

15.2.27. *"The materials and construction products required for the construction, improvement and maintenance of the road network. Materials resources include primary raw materials such as aggregates and minerals, and manufactured construction products. Many material resources will originate off site, purchased as construction products, and some will arise on site such as excavated soils or recycled road planings".*

[185] Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026 (adopted September 2011)
[186] Highways England (2011) IAN 153/11 Environmental Assessment of Materials & Resources

15.3 ASSESSMENT METHODOLOGY

15.3.1. The primary guidance that will be used to inform the assessment process is IAN153/11 Environmental Assessment of Material Resources

15.3.2. As the proposed works comprise demolition works, highway alterations and the generation of a new river crossing with associated infrastructure, the Proposed Scheme is classed as a ‘large local major scheme’; this aligns with the IAN153/11 guidance definition of 'complex improvement and large new construction works'. In accordance with the requirements for complex works set out in the guidance, a detailed assessment of material resources shall be undertaken.

15.3.3. The consumption of material resources and production / disposal of waste beyond the first year of Proposed Scheme operation has been scoped out, because forecasts anticipate negligible impacts and effects. This scoping method has been agreed by the Planning Inspectorate in their Scoping Opinion dated May 2018, Case Reference TR010043.

15.3.4. As part of the EIA, the following tasks will be carried out:

- Relevant waste legislation, policies and guidance will be reviewed to identify material use and waste management objectives, commitments and targets;
- The likely types of material resources (including site arisings) and waste will be identified, and quantities estimated for the Proposed Scheme; for waste, inert and non-inert forecasts will be made;
- Impacts will be evaluated against the regional and national materials markets and the capacity of regional (or if appropriate, national) waste infrastructure;
- Opportunities to eliminate, reduce, re-use, recycle or recover material resources, site arisings and (potential) waste, will be identified through a review of the Proposed Scheme (including proposed building materials, construction methods and design, where available) and in accordance with industry best practice; and
- Identification of viable circular economy opportunities in design and construction will be made.

15.3.5. The ES will take into account the nature of impacts (adverse/beneficial, permanent/temporary, direct/indirect) from material resources and waste. Significance of effects will be determined using Table 2.4 in DMRB Volume 11 Section 2 Part 5 HA 205/08[187], whilst also taking into account the requirements of the national and local policy documents.

15.3.6. The main outputs from the detailed assessment will be:

- Resources (including site arisings) and waste; and
- The measures which will be implemented to eliminate or mitigate impacts, and to fulfil resource efficiency and circular economy opportunities.

[187] Design Manual for Roads and Bridges Volume 11, Section 2, Part 5: H205/08, former Highways Agency, August 2008

15.4 BASELINE ENVIRONMENT

15.4.1. The following sections describe baseline material consumption and waste disposal for these current assets, and provide a regional / national information and data in the context of which subsequent environmental impact assessment will be undertaken.

MATERIAL RESOURCES

Materials Currently Required:

15.4.2. The operation and maintenance of the current infrastructural assets within the Proposed Scheme boundary are likely to require a small number of specialist components (for example, light bulbs, signage steelwork, kerbstones) as well as some bulk products (asphalt for minor re-surfacing) for routine works and repairs.

15.4.3. The current consumption of construction and other material resources within the Proposed Scheme boundary is, however, deemed negligible.

15.4.4. The do-minimum option (no scheme pursued) is not expected to change the current consumption of material resources within the Proposed Scheme Boundary.

UK and regional perspective: availability of construction materials

15.4.5. Table 15.1 provides a summary of the availability of the main construction materials in the East of England and the UK, as required to deliver typical highways and bridge schemes. The overview provides a context in which the assessment of impacts and significant effects from material consumption on the Proposed Scheme can be undertaken.

Table 15.1: Construction materials available in the East of England and the UK

Material type		Availability (2015 data unless otherwise stated)	
		East of England	UK
Aggregate	Sand and gravel *	11.6Mt	58.1Mt (to Q3 2015)
	Permitted crushed rock *	456,000t (2016)	98.5Mt
Recycled and secondary aggregate (as part of 'Aggregate', above) *		(not available)	63Mt
Ready-mix concrete +		1.4Mm3	25.2Mm3
Asphalt *		2.3Mt	26.3Mt
Concrete blocks #		(confidential)	72.9Mm3
Steel +		(not available)	11Mt
# stocks + production * sales			

15.4.6. Currently, data for the East of England regarding materials typically required for highways and bridge construction, are incomplete; accordingly, a full picture of resource availability in the region cannot be obtained.

15.4.7. However, the availability of all construction materials in the UK indicates that stocks / production / sales remain buoyant. Using UK data as a proxy, in combination with information that is available for the East of England, the sensitivity of materials availability for the Proposed Scheme is assessed to be low.

SITE ARISINGS

Site Arisings Currently Generated

15.4.8. Current routine operation and maintenance works on current infrastructural assets within the Proposed Scheme boundary (roads, roundabouts, junctions) are likely to generate negligible volumes of site arisings.

15.4.9. The do-minimum option (no scheme pursued) is not expected to change the volume or type of site arisings generated within the footprint of the Proposed Scheme.

National and Regional Perspective: Transfer, Recovery and Recycling

15.4.10. Defra data (Table 15.2) shows that within England, the recovery rate for non-hazardous construction and demolition arisings has remained above 90% since 2010. This exceeds the EU target of 70%, which the UK must meet by 2020.

15.4.11. Defra confirmed that it does not publish construction, demolition and excavation figures at a regional level, and only national (England) data are accessible through the publicly available Waste Data Interrogator Database; the database is held and operated by the Environment Agency. It was quoted that:

15.4.12. *"The methodology used to generate these figures is complex, in order to take into account the inherent double-counting and data gaps that are present within waste system data, and it would not be feasible to reproduce these on a regional basis."*

15.4.13. Until such a time that construction, demolition and excavation generation and recovery rates by region are made available by Defra, transfer (non-civic), recovery and metal recycling data (available through the Waste Data Interrogator Database) will be used as the closest possible proxy.

Table 15.2: Non-hazardous construction and demolition arisings and recovery in England

Year	Generation (Mt)	Recovery (Mt)	Recovery rate (%)
2010	43.9	39.7	90.5%
2011	44.1	39.9	90.6%
2012	45.3	41.3	91.1%
2013	46.3	42.1	91.1%
2014	49.1	44.9	91.4%

15.4.14. Figure 15.2 shows that rates of material transfer (non-civic), recovery and metal recycling within the East of England continue to rise steadily. Since 2011, rates for material recovery have increased notably. Data provided include all waste types in the region and hence will include, but are not specific to, construction, demolition and excavation arisings.

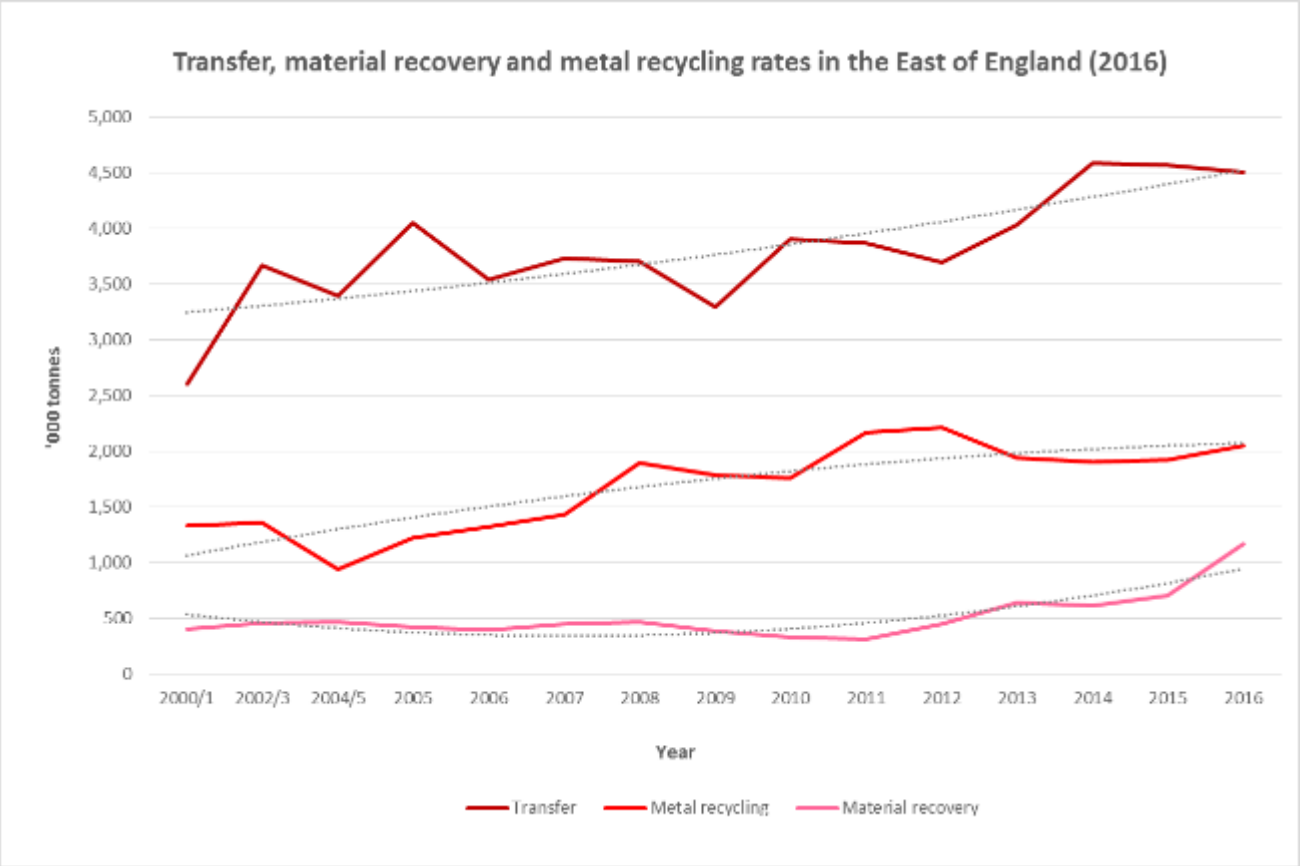


Figure 15.2 – Transfer, material recovery and metal recycling in the East of England

15.4.15. Available data demonstrate that the upward trends for transfer, recovery and metal recycling within the East of England remain consistent. Data indicate that there is likely to be regional infrastructure and capacity for the transfer and recovery for construction, demolition and excavation arisings from the Proposed Scheme. Construction and demolition recovery trends across England (Table 15.3) demonstrate further capacity in this context.

15.4.16. The availability of materials recovery infrastructure in the East, and across England, suggests that there is strong potential to divert from landfill site arisings generated by the Proposed Scheme. Both the importance (positive value) of this infrastructure, and (hence) the potential to maximise the re-use / recycling value of site arisings, are assessed to be high.

WASTE GENERATION AND DISPOSAL

Waste currently generated and disposed of

15.4.17. The operation and maintenance of the infrastructural assets currently within the Proposed Scheme Boundary are likely to generate small volumes of waste from routine highway maintenance, in combination with littering, light replacement, signage replacement, and replacement of reflective road studs (cats' eyes). The anticipated effects of disposing of this waste are deemed negligible in the context of available regional capacity.

Regional perspective: remaining landfill capacity

15.4.18. At the end of 2016, the East of England had 45 active landfill sites with 58.2Mm^3 of remaining capacity. Table 15.3 summarises the Environment Agency data relating to these landfill types.

Table 15.3 - Landfill capacity in the East of England (2016)

Landfill type		Number of sites	Remaining capacity (M m3, end of 2016)
Inert		22	36.0
Non-hazardous	Non-Hazardous	19	28.6
	Non-Hazardous with Stable Non-Reactive Hazardous Waste Cell	4	6.5
Hazardous		0	0.0
Total remaining capacity		45	71.1

15.4.19. Environment Agency data confirm that at the end of 2016, remaining landfill capacity in the East of England was: 36.0Mm^3 for inert (up 16.4Mt from 2015) and 35.1Mm^3 for non-hazardous (3Mt down from 2015). No regional remaining capacity for hazardous waste was recorded.

15.4.20. Using the most up to date information available, trends for baseline regional landfill capacity are detailed in Figure 15.3 overleaf.

15.4.21. Due to the fact that a significant increase in inert landfill site capacity was recorded in 2016 for the East of England region (16.4Mt or 84%), incorporating forecasting data and trend lines for remaining void space to the first year of operation, has not been possible for this waste type.

15.4.22. Simple forecasting calculations (using the MS Excel forecast function) shows that non-hazardous landfill capacity may (in the absence of future provision) decrease as much as 49% by 2023 (the first year of scheme operation). Forecasting for inert and total landfill capacity trends has not been undertaken due to the recent increase in landfill capacity.

15.4.23. No new capacity for hazardous waste (currently absent) is expected in the region.

15.4.24. Individually, the sensitivity of different landfill capacity types is assessed to be inert (negligible), non-hazardous (high) and total (low). On average, the sensitivity of landfill capacity is assessed to be medium.

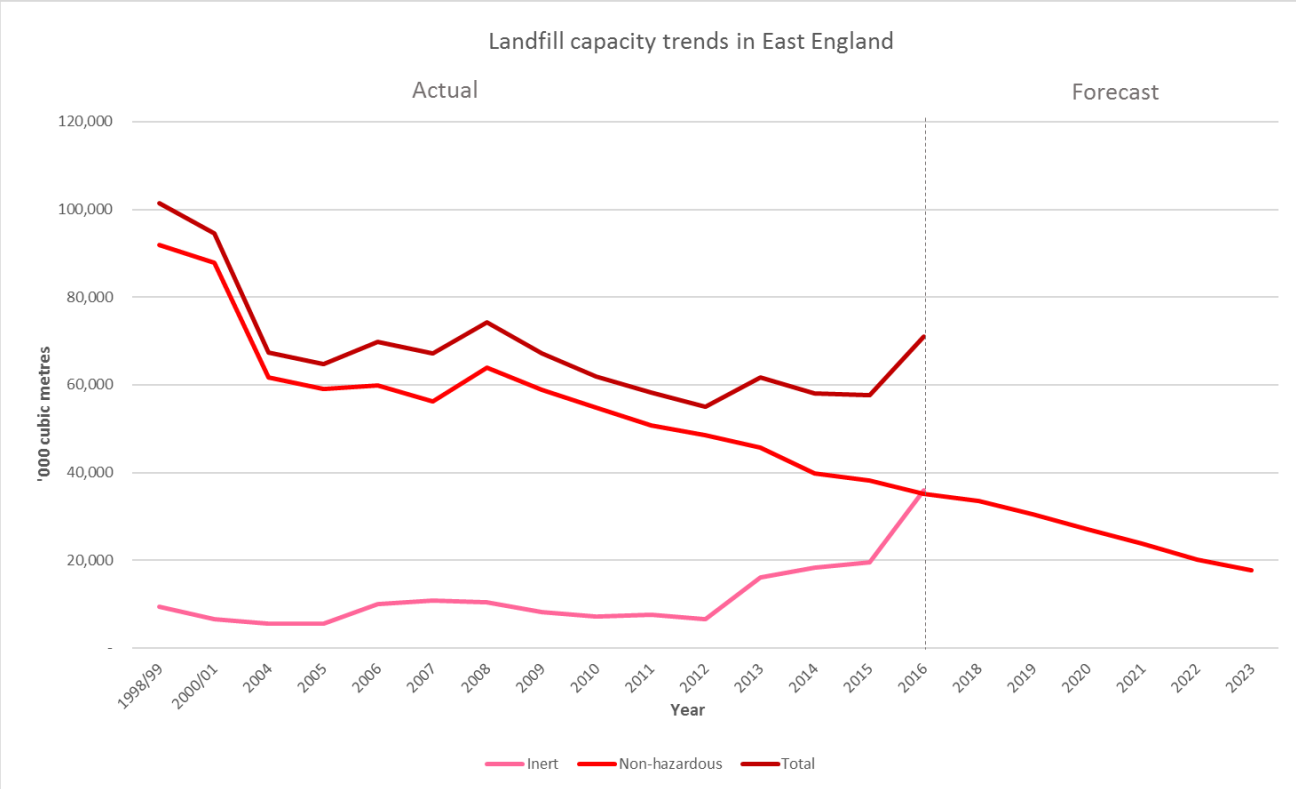


Figure 15.3 - East of England Remaining Landfill Capacity (2000/1-2016) and Non-hazardous Landfill Capacity Forecast (2023)

15.5 PREDICTED EFFECTS

15.5.1. The Proposed Scheme has the potential to consume material resources (including those recovered from site arisings), and produce and dispose of waste, during the demolition, site preparation and construction phases of delivery.

15.5.2. The associated potential environmental impacts (both direct and indirect) will occur during these lifecycle phases. Impacts arising further into the operational lifecycle are expected to be negligible, and hence (as described in Table 15.4) have been scoped out of this assessment.

15.5.3. The effects associated with the described impacts include those associated with the production, processing, consumption and disposal of material resources. These effects are likely to occur on-site, off-site within the UK and, potentially, internationally.

15.5.4. It is important to note that direct and indirect impacts and effects as a result of the transportation of material resources and waste to and from site, will not be assessed within the Material Resources chapter. Instead, they will be considered in the Air Quality, People and Communities, Noise, Water & Drainage, and Climate chapters, as appropriate to these specialist topics. Similarly, issues concerning land contamination and resource sterilisation will be assessed within the Geology & Soils chapter.

15.5.5. In response to the requirements set out in IAN 153/11 (paragraph 3.2.1 of the guidance), a summary of the potential for material resource consumption and waste generation and disposal to generate significant environmental effects, is provided in Table 15.4. Where appropriate, the potential influence of recovering and reusing/recycling site arisings is also included within Table 15.4 - Potential impacts and significant effects of consuming material resources and disposing of waste.

Table 15.4 - Potential impacts and significant effects of consuming material resources and disposing of waste

Element	Use of materials resources	Production and disposal of waste
Demolition	No potential significant effects identified with regards to the consumption of material resources during demolition.	▪ Waste in this phase of the works would be produced during the demolition (on the west side of the River Yare) of residential buildings and associated assets on Queen Anne's Road and Southtown Road; during the demolition of a large non-residential building (warehouse) adjacent to Cromwell Court; and demolition of an existing pedestrian bridge of William Adams Way. ▪ Demolition waste would also be generated in the breaking out of highways and junctions on (particularly) Queen Anne's Road and Suffolk Road to the west of the River Yare; in works required on the east of the river to a non-residential property (a warehouse and concreted external area); and to residential properties on Queen Anne's Road, Cromwell Road and Southtown Road. Wastes generated during demolition are likely to include: ▪ brick, mortar, concrete, steel, timber, tiles and glass; ▪ broken out concrete, cut steel and road surface planings; ▪ hazardous or contaminated material found on or beneath the Proposed Scheme; and ▪ other demolition wastes. ▪ As far as possible, it would be expected that arisings from demolition would be reused and / or recycled on or off site, with beneficial effect. Where diverting site arisings from landfill is not possible, the impacts associated with disposing of waste would be adverse, permanent and direct. ▪ The potential for significant effects from waste disposal is associated with the commensurate reduction in landfill capacity, and any indirect effects that result (greenhouse gas emissions, water consumption, water pollution – among others). Landfill capacity is increasingly considered a sensitive receptor in the UK.

Element	Use of materials resources	Production and disposal of waste
		▪ The demolition of buildings, highways and associated assets is likely to result in a considerable volume of arisings, a proportion of which (after the potential for reuse and recycling has been maximised) may need to be disposed of. ▪ Where demolition waste needs to be disposed of, and in combination with other the on-site phases, there is potential for significant adverse effects.
Site remediation and preparation	▪ Timber and steel products will be required for the erection of perimeter fencing and temporary barriers as part of the construction site preparation phase. ▪ It is also expected that material resources (concrete, steel, formwork, other) will be required during the stabilisation, laying out and making safe of areas adjacent to the River Yare, ready for construction of the new river embankments, retaining walls and bridge. ▪ Temporary stockpile and construction areas may also be required, and could necessitate the consumption of aggregate and stone for ground improvements prior to use by heavy plant and equipment. ▪ Impacts associated with material resource consumption at this stage are likely to be adverse, permanent and direct. ▪ In combination with other lifecycle stages (particularly construction of the Proposed Scheme), there is potential to generate significant adverse effects from material resource consumption during site remediation and preparation.	Wastes likely to be generated during site preparation include: ▪ vegetation and other above ground materials produced by site clearance; ▪ paving, kerbing, bitumen and sub-base material; ▪ surplus non-highway subsoil material; ▪ hazardous or contaminated material found on or beneath the Proposed Scheme. ▪ The presence or extent of any hazardous or contaminated substances is currently unknown, but will be informed by Ground Investigation. ▪ There is potential for considerable waste to be produced and disposed of during site preparation works; associated impacts would be adverse, permanent and direct. Some impacts could be precluded where arisings e.g. subsoil and kerbing, can be diverted from landfill. ▪ Where waste from site remediation and preparation does need to be disposed of, there is potential for significant adverse effects.
Proposed Scheme construction	▪ Material resources will be required for the construction of the Proposed Scheme, including (but not limited to): local road realignment and development, alterations to roundabouts and junctions, the construction of the new embankments and retaining walls (7m) on either side of the River Yare, and the construction of the double leaf bascule bridge and control tower. Construction materials required are anticipated to include:	▪ Waste is anticipated to be generated during the construction of the Proposed Scheme, particularly during the construction of new roads, roundabouts and junctions, and in the digging out and construction of the new river embankments. It is anticipated that the following wastes would be generated: ▪ Timber and steel from formwork and fencing;

Element	Use of materials resources	Production and disposal of waste
	▪ Bulk materials for earthworks and landscaping (volumes will be dependent on the cut and fill balance); ▪ Road and pedestrian paving and kerbing materials, including sub-base and bituminous materials; ▪ Steel for bridge structures and sheet piling; ▪ Concrete including for pre-cast and prefabricated elements, especially for the new embankments, retaining walls, bridge structure and drainage arrangements; ▪ Bricks, sand and aggregate; ▪ Timber and steel for fencing and formwork; ▪ New street furniture, signage and lighting; ▪ Cabling; ▪ Specialist mechanical and engineering (M&E) components / technologies; and ▪ Other general construction materials. ▪ The volumes of material resources required for the Proposed Scheme will be ascertained during environmental impact assessment. Volumes of bulk earthworks, road paving, steel, concrete and aggregate are expected to be significant. The main impacts as a result of the use of materials are the consumption of natural resources. Impacts would be considered adverse, direct and permanent, and would result in the following effects: ▪ depletion of natural resources and local / regional stocks; and ▪ degradation of the natural environment. ▪ Based on the scale and nature of the works it is anticipated that the consumption of material resources has the potential to have significant adverse effects.	▪ Concrete, bricks, aggregate and steel waste; ▪ Road paving materials including sub-base and bituminous materials; ▪ Hazardous or contaminated material found or generated on site; ▪ Surplus cabling; ▪ Redundant street furniture, signage and lighting; ▪ General construction waste e.g. packaging, ducting, damaged goods. ▪ The volumes of waste likely to be generated and disposed of as result of the Proposed Scheme will be identified and assessed during environmental impact assessment. ▪ Impacts as a result of waste generation would be adverse and direct, and are generally accepted to be permanent in nature. The resultant adverse effects would be a reduction in landfill void capacity, and any indirect effects that result (greenhouse gas emissions, water consumption, water pollution – among others). ▪ It is expected that a programme commitment to reuse or recycle site arisings will be established – making use of these resources either within, or outside, the Proposed Scheme boundary. Where this is not possible, disposal is likely to be required. ▪ Based on the scale and nature of the works, it is anticipated that there is potential for significance adverse effects from the generation and disposal of waste.

Element	Use of materials resources	Production and disposal of waste
Operation and maintenance of asset	In the first year of operation, minor amendments and changes to the Proposed Scheme assets may be required. Depending on the extent of these changes, the potential to consume material resources (including recovered site arisings), and produce and dispose of waste may be required. The extent of changes within the first year of operation are unlikely to have significant effects. Similarly, and beyond the first year of operation, it is predicted that there will no significant effects. These elements have therefore been scoped out of the assessment, as agreed in the Planning Inspectorate Scoping Opinion dated May 2018, Case Reference TR010043.	

15.6 PROPOSED MITIGATION

15.6.1. Specific design, mitigation and enhancement measures to avoid and mitigate adverse impacts from materials consumption and the generation and disposal of waste, and to encourage beneficial outcomes from the recovery and reuse of site arisings, may include those set out in Table 15.5 - Potential design, mitigation and enhancement measures

Table 15.5 - Potential design, mitigation and enhancement measures

Element	Enhancement and mitigation measures	Application lifecycle stage	Monitoring
Material resources	Identification and specification of materials that can be acquired responsibly, in accordance with BES 6001 Responsible Sourcing of Construction Products.[188]	Design, construction	Incorporate on engineering plans configurations and layouts that show how the most effective use of materials can be achieved. Maintain records of materials that were acquired in accordance with BES 6001 Responsible Sourcing of Construction Products.
	Design for resource optimisation: simplifying layout and form, using standard sizes, balancing cut and fill, maximising the use of renewable materials, and materials with recycled or secondary content, and setting net importation as a Proposed Scheme goal.	Design	
	Design for off-site construction: maximising the use of pre-fabricated structures and components, encouraging a process of assembly rather than construction	Design	
	Design for the future: considering how materials can be designed to be more easily adapted over an asset lifetime, and how deconstructability and demountability of elements can be maximised decommissioning/ at end-of-first-life.	Design	
Site arisings	Design for recovery and reuse: identifying, securing and using materials at their highest value, whether they already exist on site, or are sourced from other schemes.	Design	Incorporate on engineering plans configurations and layouts that show how the

[188] British Research Establishment (BRE) BES 6001 The Framework Standard for Responsible Sourcing of Construction Products (Version 3.1 2014) [link]

Element	Enhancement and mitigation measures	Application lifecycle stage	Monitoring
	Identify opportunities to minimise the export and import of materials.	Design, construction	most effective use of site arisings can be achieved. Implement a regime of comparing and contrasting data on site arisings in a Design Site Waste Management Plan (forecast), with construction data (actuals)
	Working to a proximity principle, ensuring arisings generated are handled, stored, managed and re-used or recycled as close as possible to the point of origin.	Design, construction	
	Identify areas for stockpiling and storing arisings that will minimise quality degradation and leachate, and will minimise damage and loss.	Design, construction	
	Ensure potential arisings and waste are properly characterised before or during design, to maximise the potential for highest value reuse.	Design	
	Capture information and data on site arisings recovered and diverted from landfill, by developing a Design Site Waste Management Plan once a preferred option has been selected.	Design	
	Implement a Materials Management Plan in accordance with the CL:AIRE 189 Definition of Waste: Code of Practice.	Construction	
Waste to landfill	Engage early with contractors to identify possible enhancement and mitigation measures, and to identify opportunities to reduce waste through collaboration and regional synergies.	Design, Procurement	Implement a regime of comparing and contrasting data on waste in a Design Site Waste Management Plan (forecast), with construction data (actuals) Ensure all legal documentation (waste carrier registration, landfill licence, waste transfer documentation) associated with the management of construction and operational materials, site arisings and waste is recorded and retained.
	Capture information and data on waste sent to landfill, by developing a Design Site Waste Management Plan once a preferred option has been selected.	Design	

[189] CL:AIRE is the acronym for 'Contaminated Land: Applications in Real Environments'

15.7 CONCLUSIONS AND EFFECTS

15.7.1. It is anticipated that, with the implementation of effective mitigation measures, including designing out waste, and implementing a Construction Environmental Management Plan (CEMP) including a Site Waste Management Plan (SWMP) and Materials Management Plan (MMP) on site, that there would be no significant residual effects associated with material resources. This assertion will be tested fully as part of the Proposed Scheme environmental impact assessment.

15.7.2. The consumption of construction materials is likely to have an adverse impact on the regional and national market resources. Primary materials required for the Proposed Scheme are a finite resource and whilst they are generally available through local and regional supply, some national or wider sourcing may be required.

15.7.3. It has not been possible to quantify the amount of materials needed for the Proposed Scheme as the design is not yet been finalised.

15.7.4. During demolition, site remediation and preparation, and construction, it is expected that a proportion of the waste generated will be suitable for recovery (processing / reuse / recycling) at an off-site facility, in line with Norfolk Waste Strategies. Excavated and other materials that comply with an appropriate waste exemption, or reuse criteria set out in the CL:AIRE Definition of Waste Code of Practice[190] are expected to be reused on the scheme.

15.7.5. Any waste which cannot be diverted from landfill is likely to have an adverse impact on (the reducing) landfill capacity in the region.

15.7.6. During the first year of operation and beyond, minor amendments, changes and maintenance of the Proposed Scheme assets may be required.

15.8 ASSESSMENTS STILL TO BE COMPLETED

15.8.1. Due to the absence of robust material resource information at this stage of the design, a detailed assessment of material resources will be undertaken and reported in the ES.

[190] CL:AIRE Definition of Waste - Development Industry Code of Practice [link]

16

GEOLOGY AND SOILS

16 GEOLOGY AND SOILS

16.1 INTRODUCTION

16.1.1. This chapter describes the preliminary assessment of the likely significant effects of the Proposed Scheme on geology, soils and contamination during the construction and operational phases of the Proposed Scheme. It is supported by a Contaminated Land Desk Study, which is presented in Appendix 16A.

16.1.2. The assessment of this topic area considers potential impacts relating to the following aspects:

- The potential for disturbance of existing contaminated land (including river sediments);
- The potential that construction could establish pathways between pollutants and receptors;
- Effects on users/adjacent users of the Proposed Scheme;
- Effects on buried infrastructure (including buried services and foundations);
- Effects on controlled waters (from the mobilisation of contaminants). The water environment is specifically dealt with in Chapter 11 Road Drainage and the Water Environment.

16.1.3. The impact on ecological receptors are assessed in Chapter 8: Nature Conservation and sediment modelling is addressed in Chapter 12: Flood Risk. The comments received through the Scoping Opinion have been addressed in this chapter.

STUDY AREA

16.1.4. The study area for this PEIR is the Proposed Scheme Boundary presented in Figure 2.3. It is anticipated that any impacts to geology and soils are not likely to extend beyond this boundary.

16.1.5. The study area covers an area of approximately 43ha, centred at National Grid Reference 652320, 306005.

LIMITATIONS

16.1.6. This chapter of the PEIR provides preliminary information as it relates to the Proposed Scheme to date and to data currently available and gathered at this point of the assessment processes.

16.1.7. The information contained herein is intended to inform consultation responses at this stage. A more detailed assessment of potential impacts as a result of the Proposed Scheme on individual sensitive receptors will be undertaken at subsequent stages to inform the ES.

16.1.8. Any gaps in information identified at this PEIR stage will be considered and addressed along with specific mitigation measures as part of the assessments for the production of the ES.

16.2 DIRECTIVES, STATUTES AND RELEVANT POLICES

16.2.1. The assessment has been undertaken in accordance with and in reference to legislation specific to geology, hydrogeology and human health as follows:

NATIONAL LEGISLATION

- The Environmental Protection Act 1990;
- Water Resources Act 2003; and
- Water Act 2003.

NATIONAL POLICY

- National Planning Policy Framework 2018[56]; and
- National Policy Statement for National Networks 2015.
- National Policy Statement for Ports 2012

16.2.2. Further information on these is provided in Table 16.1 - Relevant Legislation to the Assessment of Geology and Soils:

Table 16.1 - Relevant Legislation to the Assessment of Geology and Soils

Legislation	Summary
The Environmental Protection Act 1990	The Environmental Protection Act 1990 defines, within England, Wales and Scotland, the fundamental structure and authority for waste management and control of emissions into the environment. The Act was intended to strengthen pollution controls and support enforcement with heavier penalties. Part 2A of the Environmental Protection Act 1990 was inserted into that Act by section 57 of the Environment Act 1995 and contains a regulatory regime for the identification and remediation of contaminated land. In addition to the requirements contained in the primary legislation, operation of the regime is subject to regulations and statutory guidance. The main objective underlying the introduction of the Part 2A contaminated land regime was to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health or the wider environment, assessed in the context of the current use and circumstances of the land. It provides a means of identifying and remediating land that poses a significant risk to health or environment, where there is no alternative solution. It also works alongside planning rules to help ensure that this land is made suitable for use following development. Development of land will have to take into account Part 2A because a change in the use of the land may bring the development inside the statutory definition of contaminated land by creating a pollutant linkage.
Water Resources Act 2003	The Water Resources Act 1991 replaced the corresponding sections of the Water Act 1989. The Act sets out the responsibilities of the Environment Agency in relation to water pollution, resource management, flood defence, fisheries, and in some areas, navigation. The Act regulates discharges to controlled waters, namely rivers, estuaries, coastal waters, lakes and groundwaters. To prevent pollution of controlled waters, planning policies and decisions should ensure that new development is appropriate for its location. The risks at site need to be adequately characterised. The Water Resources Act 2003 amends the Water Resources Act 1991 to improve long-term water resource management by: ■ creating two new forms of abstraction licence – the transfer licence and the temporary licence; ■ widening the control over impoundments so that licences are required for the whole duration of impoundment works; ■ replacing licensing exemptions based on water use with a new exemption threshold of less than 20 cubic metres of water per day; ■ ending the current exemption for irrigation (other than spray irrigation) and dewatering from the abstraction licensing regime; ■ requiring all new abstraction licences to be time-limited;

Legislation	Summary
	▪ empowering the Environment Agency to revoke or vary an abstraction licence without compensation if it has not been used for four years; and ▪ removing the entitlement to compensation if the SoS (or the Assembly) directs that a licence without a time limit should be curtailed, on or after 15 July 2012, on the grounds of serious environmental damage.
Water Act 2003	Under the Water Act it is an offence to cause or knowingly permit a discharge of poisonous, noxious or polluting matter into any Controlled Waters without the proper authority.
National Planning Policy Framework 2018	NPPF (paragraphs 178--183) provides guidance on land contamination issues. These include local policies and decisions that ensure development sites are suitable for use, taking account of ground conditions and pollution arising from previous uses, as well as any proposals for land remediation. Paragraph 180 of the NPPF states that: *"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development".*
National Policy Statement for National Networks 2015	NPS NN provides some guidance on assessing geology, soils and contamination in relation to biodiversity and ecological conservation, coastal change, noise and vibration, water quality and resources, land use and sets out how the impacts should be considered.
National Policy Statement for Ports (2012)	PNPS, in Paragraph 5.13.8, likewise advises that developments on "*previously developed land……should ensure that they have considered the risk posed by land contamination*".

16.3 ASSESSMENT METHODOLOGY

16.3.1. An Environmental Desk Based Study (Appendix 16A) has been prepared, using information from historical Ordnance Survey maps, environmental data reports, together with published and internet based information sources.

16.3.2. An understanding of the likely existing environmental setting in terms of geology, soils and contamination has been established with reference to the following sources of information:

- British Geological Survey[191];
- Environment Agency[192]; and
- Historical Ordnance Survey maps and environmental data reports obtained from GroundSure.

[191] www.bgs.ac.uk
[192] https://www.gov.uk/government/organisations/environment-agency

16.3.3. The assessment will be based upon the guidance presented in DMRB Volume 11 Section 3 Part 11 Geology and Soils[193] and be supplemented by the assessment procedures contained within BS10175:2011[194] and CLR11[195]. The assessment of significance will take into account the procedures contained within BS10175 and CLR11 as well as professional judgement.

GROUND INVESTIGATION

16.3.4. A land based ground investigation was completed in March 2018 and comprised:

- 25 onshore cable percussion boreholes;
- 9 window samples;
- 1 machine excavated trial pit;
- Soil sampling and associated chemical testing;
- Gas and groundwater monitoring wells constructed in selected boreholes; and
- Gas and groundwater monitoring.

16.3.5. A marine ground investigation is being undertaken and comprises;

- 10 marine cable percussion boreholes;
- Soil sampling and associated chemical testing;

16.3.6. An Interpretative Environmental Ground Investigation Report will be prepared and included with the ES. This will include a risk assessment of human health and controlled waters undertaken in accordance with:-

- CLR and SR (SC050021 series) (DEFRA) guidance as well as CL:AIRE guidance on Comparing Soil Contamination Data with a Critical Concentration, May 2008[196]; and
- Environment Agency Remedial Targets Methodology, Hydrogeological Risk Assessment for Land Contamination, 2006[197].

16.3.7. These two risk assessments will assess the potential contaminant linkages identified in the Contaminated Land Desk Study Report (presented in Appendix 16A) and will allow the development of an updated site conceptual model to clarify potential source-pathway-receptor linkages, and assist with the assessment of potential impacts on human health and controlled waters.

16.3.8. The Interpretative Environmental Ground Investigation Report will also include a waste assessment and material re-use assessment to determine likely waste disposal routes for excavated soils and to determine if excavated

[193] The Highways Agency et al, (1993), Design Manual for Roads and Bridges, Volume 11, Section 3, Part 11, Geology and Soils.
[194] British Standards Institution (2011). BS 10175:2011 Code of Practice for the Investigation of Contaminated Land.
[195] The Environment Agency (2004). Model Procedures for the Management of Land Contamination. Contaminated Land Report.
[196] The Chartered Institute of Environmental Health (2008). Guidance on Comparing Soil Contamination Data with Critical Concentration
[197] Environment Agency 2006. Remedial Targets methodology, Hydrogeological Risk Assessment for Land Contamination. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/314317/geho0706bleq-e-e.pdf

soils are suitable for re-use within the Proposed Scheme. Chapter 15: Materials provides further detail on the materials aspect of the Proposed Scheme.

16.3.9. Outline remedial measures will be reported if remediation is considered necessary and these measures will inform the mitigation assessment with the Environmental Statement.

SIGNIFICANCE CRITERIA

16.3.10. In terms of geological and geomorphological resources as well as contaminated land, DMRB does not provide any specific methods of assessment or scales of measurement for either the value / sensitivity of the receptor or the magnitude of the impact. Assessment will therefore be based on professional judgement, using a phased approach, taking into account the assessment procedures detailed in CLR11 to inform a quantitative risk assessment using the source-pathway-receptor protocol. Determination of significance will be carried out using the principals detailed in CIRIA C552[198] and professional judgement.

16.4 BASELINE ENVIRONMENT

Designated Sites

16.4.1. No geologically designated sites exist within 500m of the Proposed Scheme.

Bedrock Geology

16.4.2. As indicated on the British Geological Survey (BGS) website[199] the bedrock geology across the study area comprises sand and gravel of the Crag Group.

Superficial Geology

16.4.3. The BGS website indicates that the Application Site is underlain by the following superficial deposits:-

- South west - peat of the Breydon Formation;
- North – clay and silt of the Breydon Formation;
- Eastern part beyond the River Yare – sand and gravel of the North Denes Formation; and
- Within the River Yare - Clay and silt tidal river or creek deposits.

Soils and Sediment

16.4.4. The Soilscapes website[200] indicates the soils at the Application Site comprise loamy and clayey soils of coastal flats with naturally high groundwater, freely draining slightly acid sandy soils and sand dune soils.

16.4.5. However, due to previous development across the Application Site, it is unlikely that significant amounts of naturally occurring soils are present and made ground is more likely to be prevalent in most areas.

16.4.6. The nature of onsite soils and sediments determined during the ground investigation is discussed in the Ground Investigation Information sub-section below.

[198] CIRIA (2001). Contaminated Land Risk Assessment. A Guide to Good Practice.
[199] www.bgs.ac.uk/geologyofbritain /home.html
[200] http://landis.org.uk

Potentially Contaminated Sites

16.4.7. The Interpretive Environmental Desk Study Report presented in Appendix 16A includes a review of information from a GroundSure report (reference CMAPS-CM-636391-16287-030717). This records that no locations within the study area are determined as contaminated land under Part 2A legislation, but does record a number of historical ground workings, as well as industrial uses; all of which may have introduced contaminated material onto the study area. On the eastern side of the study area, these included a gasworks, boat building yard, an icehouse, fish canning, oilskin production, chemical factory and unspecified depots, factories and warehouses. On the western side of the study area, historical industrial uses include an iron works, rope walk, gas works, malthouses, a railway, shoe factory and a printing works. A quayside / dock area was present on both sides of the river.

16.4.8. There are records relating to an historic Environment Agency landfill 450m to the west, an Environment Agency licensed waste site located onsite and eight records within 250m of the study area although both have multiple entries in the GroundSure report (see Appendix 16A).

Existing Ground Investigation / Remediation Information

16.4.9. Other than the ground investigations carried out by NCC and detailed below, no other ground investigation or remediation information has been provided to WSP for review.

Ground Investigation Information

16.4.10. A land based ground investigation was undertaken between September 2017 and March 2018 by Ground Technology Services for NCCl. A copy of the Interpretative Environmental Ground Investigation report will be provided as an Appendix to the Environmental Statement once the report has been completed.

16.4.11. Superficial and bedrock geology ground conditions encountered during the ground investigation were generally sand or sand and gravel with some clay, silt and peat layers – North Denes Formation overlying the Crag Formation. These strata were generally overlain by made ground of varying thickness although at a few locations at the western end of the study area, made ground was absent and thin topsoil was present overlying the superficial deposits.

16.4.12. Made ground was recorded at most locations and varied in thickness up to 11.6m (BH12B located on the east side of the River Yare, close to the quayside. Made ground was generally thickest close to the quayside and thinnest at the western and eastern ends of the study area. Made ground was absent from some of the window sample locations in the west of the Application Site where drilling occurred through landscaped areas.

16.4.13. From the Engineers logs provided by the Ground Investigation Contractor, the made ground appeared to be reworked natural soils with brick or concrete content. Other detritus including metal, glass, wood, slate, cloth, slag, ash and plastic was also recorded.

16.4.14. Olfactory evidence of contamination described as diesel fuel odour was recorded at 2.6 and 7.6m depth in BH14 located on the eastern side of the River Yare, close to the edge of the quayside. No other visual or olfactory evidence of contamination was recorded.

16.4.15. A marine ground investigation is currently being undertaken and the findings will also inform the Environmental Statement.

16.5 PREDICTED EFFECTS

16.5.1. At this stage, until the interpretation of the ground investigation chemical test data is complete it is not possible to assess the likely significance of the predicted effects.

Construction Impacts

16.5.2. This section assesses the potential effects, using the information that is available at the PEIR stage, of the construction phase on the receptors identified in the Environmental Desk Study (Appendix 16A) and on the underlying and surrounding geology and soils. Construction work is likely to cause adverse disturbance to the geology and soils and this includes potentially contaminated ground which could then impact upon identified receptors.

Geology and Soils

16.5.3. Contamination is anticipated to be site wide associated with the differing historic site uses and may be present either within natural soils or made ground. During construction, contaminants could be mobilised resulting in an adverse effect of cross contamination of uncontaminated ground or controlled waters. Controlled waters are discussed in Chapter 11: Road Drainage and the Water Environment.

Water Environment

16.5.4. Impacts to the water environment are discussed in detail in Chapter 11: Road Drainage and the Water Environment. The ground investigation reporting will include an assessment of the potential risks to the water environment from soil and water based contaminants.

Site Users and Adjacent Site Users including Construction Workers

16.5.5. Site users, adjacent site users and construction workers could be adversely impacted during construction through direct contact, ingestion and inhalation of contaminated soils and possibly also contaminated ground water.

On-Site Infrastructure

16.5.6. The works will include the construction of below ground structures that will interact with the geology and soils and potentially contaminated ground which has the potential to adversely impact the integrity of buried structures.

Operational Impacts

Geology and Soils

16.5.7. All necessary remediation will be undertaken during the construction phase. It is therefore considered that operation of the Proposed Scheme within the existing urban environment will not impact Geology and Soils or adversely affect the baseline environment.

Water Environment

16.5.8. Impacts to the water environment are discussed in detail in Chapter 11: Road Drainage and the Water Environment.

16.5.9. Remedial mitigation measures will have been completed during the construction phase. Therefore no additional soil or geology mitigation measures will be required as part of the operational phase of the Proposed Scheme.

Site Users and Adjacent Site Users including Construction Workers

16.5.10. In areas such as landscaping where humans could interact with the geology and soils, adverse operational impacts could arise through direct contact, ingestion or inhalation of contaminated soils.

On-Site Infrastructure

16.5.11. Onsite infrastructure could be adversely impacted through direct contact with geology, soils and contamination and onsite infrastructure could also impact geology and soils through the creation of new pathways for migration of contamination.

16.6 PROPOSED MITIGATION

Construction Impact Mitigation

16.6.1. This section summarises the proposed mitigation for the above predicted impacts, using the information that is available at the PEIR stage.

16.6.2. The Proposed Scheme will adhere to pollution prevention guidance and best practice during the construction works which will be incorporated into and managed via the full CEMP. A CoCP will be prepared for submission with the ES and subsequently a full CEMP will be prepared by the Contractor.

Geology and Soils

16.6.3. Good working practices and housekeeping during construction such as sealing or covering stockpiles of contaminated soils and treating water removed from excavations prior to discharge are considered likely to reduce the risks.

16.6.4. A piling risk assessment will be prepared once the findings of the ground investigation are known and will assess the potential risks to the Study Area and surrounding geology and soils from piling activities during construction.

Water Environment

16.6.5. Controlled waters are further discussed in Chapter 11: Road Drainage and the Water Environment.

16.6.6. Where contaminated soils / waters are identified as posing unacceptable risks to controlled waters, consideration will be given to remediation in those areas to minimise the risks.

16.6.7. As indicated in 16.6.2 above, the Proposed Scheme will adhere to pollution prevention guidance and best practice during the construction works which will be incorporated into and managed via the full CEMP.

16.6.8. Silt pollution caused by working within the River Yare will be minimised by keeping water out of the works area using appropriate isolation techniques, such as coffer dams, pile jackets, by-pass channels, silt curtains or the use of special excavation plant.

16.6.9. Water removed from any excavations will be disposed of in accordance with Environment Agency requirements.

16.6.10. During construction, any soil stockpiles will be located away from the quayside and River Yare and will be sealed and if necessary covered to minimise runoff during heavy rainfall.

16.6.11. A piling risk assessment will be prepared once the findings of the ground investigation are known and will assess the potential risks to the water environment from piling activities during construction.

Site Users and Adjacent Site Users including Construction Workers

16.6.12. Potential risks to construction workers during the construction phase will be managed through the CDM Regulations by the Contractor using developed Method Statements, Risk Assessments and the use of good construction practices. These practices will be included within the interim CEMP and will include:-

- Use of appropriate PPE for construction workers;
- Good hygiene practice including wearing gloves and washing hands before eating, drinking or smoking when working with potentially contaminated soils or water; and
- Damping down during periods of dry weather to reduce dust generation.

On Site Infrastructure

16.6.13. Assessment of the ground conditions during the ground investigation and at detailed design stage together with the implementation of appropriate remediation measures and design specifications such as clean inert trench fill and sulphate resistant concrete are likely to minimise the risk to onsite infrastructure.

Operational Impact Mitigation

Water Environment

16.6.14. Mitigation for the water environment is discussed in detail in Chapter 11: Road Drainage and the Water Environment.

16.6.15. A suitable drainage system will be incorporated into the Proposed Scheme to mitigate to acceptable levels the risk of contamination that could arise from traffic emissions entering the water environment.

Site Users and Adjacent Site Users including Construction Workers

16.6.16. Appropriate remedial measures, informed from the results of the ground investigation, will be undertaken where required in areas such as landscaping where humans could interact with the geology and soils. The remedial measures will be designed to break the contaminant linkage by treating or removing the contamination source or pathway thereby reducing the potential risks to receptors to appropriate levels.

On Site Infrastructure

16.6.17. The findings of the ground investigation will inform detailed structural bridge design and structures such as concrete foundations will be designed accordingly so that onsite infrastructure will not be impacted by the geology and soils during the operational phase. The findings of the ground investigation will also inform the detailed design of structures to ensure they do not impact geology and soils such as introducing new contamination pathways through piled foundations.

16.7 CONCLUSIONS AND EFFECTS

16.7.1. A preliminary assessment has been undertaken of the predicted impacts of the Proposed Scheme on the geology and soils, including potentially contaminated soils and the subsequent impacts on human health, controlled waters and the environment.

16.7.2. At the submission of this PEIR, only desk based assessments have been undertaken which have identified the potential for contamination to be present across the Application Site. If present, this contamination could be mobilised during and after construction, leading to potentially unacceptable impacts on geology and soils, controlled waters, human health and the environment.

16.7.3. Intrusive ground investigation undertaken between September 2017 and March 2018 and the marine ground investigation being undertaken have gathered information on the ground conditions and will allow a quantitative

assessment of the potential contamination risks to be undertaken and to identify likely remedial measures to be required.

16.7.4. Impacts upon human receptors are considered likely during the construction phase without appropriate mitigation and management of potential risks through the Construction (Design and Management) Regulations 2015, the development of Method Statements and Risk Assessments and the use of good construction practices.

16.7.5. On completion of the contamination risk assessments, the potential construction and operational impacts will be further assessed and appropriate mitigation developed to minimise the potential impacts. It is not considered at this time that residual significant effects upon geology, soils and contamination will occur.

16.8 ASSESSMENTS STILL TO BE COMPLETED

16.8.1. Following the completion of the land and marine based ground investigation works, an Interpretative Environmental Ground Investigation Report will be prepared and will include human health and controlled waters risk assessments. This will culminate in a revision of the preliminary conceptual site model presented in the Environmental Desk Study report (Appendix 16A). An assessment of the potential contaminant linkages that can be discounted and those that are considered to pose an unacceptable risk will be included.

16.8.2. Outline remedial measures for mitigation of any identified contamination risks will be included within the Interpretative Environmental Ground Investigation Report.

17

TRAFFIC AND TRANSPORT

17 TRAFFIC AND TRANSPORT

17.1 INTRODUCTION

17.1.1. This chapter of the PEIR describes the preliminary assessment of the likely significant effects of the Proposed Scheme with respect to traffic and transport. This includes a consideration of the effects of the re-distributed traffic associated with the Proposed Scheme, identifying areas where there are expected changes in traffic on the existing highway network during the weekday AM and PM peak hours.

17.1.2. This chapter also describes the methods used to assess the effects and the baseline conditions currently existing in the study area. It also identifies the studies and assessments that are yet to be undertaken which will be presented in the ES. This chapter is supported by figures 17.1 and 17.2 and the Preliminary Transport Assessment which is included in Appendix 17A.

17.1.3. This chapter incorporates an assessment of the Effects on All Travellers, as set out in Chapter 11 of DMRB and considers the impacts of the Proposed Scheme against the following criteria, in accordance with IEMA and DMRB Guidelines:

- Effects on Public Transport Users;
- Driver delay;
- Pedestrian and cyclist amenity, journey times and delay;
- Collisions and safety;
- Fear and intimidation; and
- Hazardous Loads.

STUDY AREA

17.1.4. The study area has been informed by those junctions where traffic is expected to change significantly. This could be by way of an increase in traffic flow, decrease in traffic flow, or changes to the direction of flow of traffic. The study area is shown on Figure 17.1.

LIMITATIONS

17.1.5. This chapter of the PEIR provides preliminary information as it relates to the Proposed Scheme and data currently available and collated at this point of the assessment process. The information contained herein is intended to inform consultation responses at this stage. A more detailed assessment of potential impacts as a result of the Proposed Scheme on identified sensitive receptors will be undertaken at subsequent stages to inform the ES.

17.1.6. Any gaps in information identified at this PEIR stage will be considered and addressed along with specific mitigation measures as part of the assessments for the production of the ES.

17.2 DIRECTIVES, STATUTES AND RELEVANT POLICES

17.2.1. The following legislation and planning policy will inform the ES.

LEGISLATION

Countryside and Rights of Way Act (2000)

17.2.2. The CRoW Act (2000) amongst other ecological matters provides for public access on foot to certain types of land and amends the law relating to public rights of way (PRoW).

The Wildlife and Countryside Act (1980)

17.2.3. Part III of the Wildlife and Countryside Act 1980 requires Local Authorities to produce a Definitive Map showing all PRoW within their jurisdiction. The map has been used to identify PRoW within the study area to be considered within the assessment.

The Highways Act (1980)

17.2.4. The Highways Act 1980 gives Highway Authorities powers (subject to exceptions and controls) to divert or stop up public footpaths or bridleways.

The Road Traffic Regulation Act (1984)

17.2.5. Confers broad powers on Traffic Authorities to prohibit or restrict traffic (including pedestrians) on highways and other roads to which the public has access.

PLANNING POLICY

National Planning Policy Framework (July 2018)[56]

17.2.6. The revised NPPF states that the planning system should help to shape places in ways that contribute to radical reductions in greenhouse gas emissions (paragraph 148). The Proposed Scheme has a primary aim of reducing congestion, and will thereby support reduced greenhouse gases and pollutants.

17.2.7. With particular reference to transport, paragraph 111 of the NPPF states that:

"All developments that will generate significant amounts of movement should be required to provide a travel plan, and the application should be supported by a transport statement or transport assessment so that the likely impacts of the proposal can be assessed".

17.2.8. Whilst the Proposed Scheme is not 'development' which itself generates trips, it will cause traffic reassignment around the town which requires assessment.

National Policy Statement for National Networks

17.2.9. The NPS NN, January 2015, sets out the need for the development of NSIPs on the national road networks in England and the Government's policies to deliver these. The NPS works to complement the overall strategic aims of the NPPF.

17.2.10. The Government, therefore, sets out its vision and strategic objectives for the national road network in the NPS, which are as follows:

"The Government will deliver national networks that meet the country's long-term needs; supporting a prosperous and competitive economy and improving overall quality of life, as part of a wider transport system. This means:

- *Networks with the capacity and connectivity and resilience to support national and local economic activity and facilitate growth and create jobs;*
- *Networks which support and improve journey quality, reliability and safety;*
- *Networks which support the delivery of environmental goals and the move to a low carbon economy; and*
- *Networks which join up our communities and link effectively to each other*".

17.2.11. The NPS highlights the need for development of the national road network and delivers the above aims in the context of Government policy for economic performance, environment, safety, technology, sustainable transport,

accessibility and journey reliability. The national road network connects towns, cities and regions and there is a critical need to address congestion issues to provide safe and resilient networks. The pressure on this network is predicted to increase as the long-term drivers for demand to travel, GDP and population, are also forecast to increase.

The National Infrastructure Plan[201]

17.2.12. The National Infrastructure Plan (NIP) was published in 2014 and is based on the principle that high quality infrastructure boosts productivity and competitiveness, allowing businesses to grow and enabling them to reach suppliers, deepen labour and product markets, collaborate and innovate, and attract inward investment.

17.2.13. Hence, the NIP recognises the role of Government in funding improvements to the Strategic Road Network (SRN) and aims to transform the nation's road network over the next 25 years. Furthermore, local roads which are not a component of the SRN, are also crucial to the successful operation of the transport system. Local authorities are responsible for managing, maintaining and improving the overall local road network. The Government provides financial support for road maintenance and renewal schemes, and supports investment in new local transport schemes through Growth Deals, allocating Local Growth Fund through Local Enterprise Partnerships.

17.2.14. This support was fulfilled in Autumn 2017, when the Chancellor, pledged £98m of funding towards the construction of the Proposed Scheme

17.3 ASSESSMENT METHODOLOGY

17.3.1. A Transport Assessment (TA) will be prepared to assess the impact of the Proposed Scheme on the capacity of highway infrastructure. This will be scoped with NCC (as Highway Authority) and key stakeholders, and submitted in support of the DCO. The ES will summarise the findings of the TA and will focus on likely significant environmental effects upon the local community during construction and operation of the Proposed Scheme, such as severance, driver delay or an increased collision rate. The ES will:

- Address changes to local traffic flows during the construction phase and once the Proposed Scheme is completed and operational;
- Address potential disruption to local pedestrians, cyclists and road vehicle users during the construction phase; and
- Provide information on transport conditions both before and after the Proposed Scheme is built, including changes in relative accessibility of the local area by foot, bicycle, and public transport.

17.3.2. DMRB Volume 11 Section 3 Part 8[153] provides additional guidelines for the assessment of effects on pedestrians, cyclists, equestrians and community. It suggests where relevant, it should include the key facilities and their catchment area. DMRB guidelines also states that in addition to the above, other factors such as level of use, use by vulnerable users and availability of alternative facilities should be taken into account.

17.3.3. The ES will take account of paragraphs 108 to 111 of the updated NPPF and also consider the IEMA Guidelines for the Environmental Assessment of Road Traffic (1993)[202], which whilst no longer in publication contains additional relevant detail. Close consultation will be undertaken with key stakeholders, including Highways England, NCC and GYBC.

[201] Infrastructure and Projects Authority 2013. National Infrastructure Delivery Plan 2016-2021.
[202] Institute of Management and Environmental Assessment (1993) Guidelines for the environmental assessment of road traffic.

17.3.4. Further desk studies and site visits will be undertaken to identify key features of the existing road and pedestrian/cycle networks in the vicinity of the Proposed Scheme and to obtain data on existing collision rates and identify existing public transport services.

17.3.5. The proposed methodology to assess the significance of transport effects of the Proposed Scheme during construction and operation on receptors is detailed below. This sets out the criteria for identifying links that require assessment as a part of the ES, the sensitivity of different receptors to environmental change, the methodology for determining the magnitude of a transport impact and sets out a matrix for determining the significance of an environmental effect.

ASSESSMENT CRITERIA

17.3.6. The Institute of Environmental Management and Assessment (IEMA) 'Guidelines for the Environmental Assessment of Road Traffic[202]' and Design Manual for Roads and Bridges (DMRB) Volume 11 have been used to ensure that the environmental effects arising due to predicted changes in traffic levels are properly and comprehensively addressed.

17.3.7. The following types of effects will be considered as a part of the ES.

- Effects on Public Transport Users;
- Driver delay;
- Pedestrian and cyclist amenity and delay;
- Collisions and safety;
- Fear and intimidation; and
- Hazardous Loads.

17.3.8. The following impacts will inform this assessment; however, they are not assessed directly as a part of this chapter:

- Severance (including new pedestrian severance from community facilities and relief from severance for pedestrians);
- Driver Stress;
- Noise;
- Vibration; and
- Population and Human Health.

17.3.9. The IEMA Guidelines[202] provide two 'rules of thumb' as a screening process to delimit the scale and extent of the assessment of traffic impacts and the determination of which traffic links require assessment. The rules are as follows:

- Rule 1: Include highway links where traffic flows will increase by more than 30% (or the number of heavy goods vehicles will increase by more than 30%); and
- Rule 2: Include any other specifically sensitive areas where traffic flows have increased by 10% or more.

17.3.10. DMRB Volume 11 Section 3 Part 8[153] provides additional guidelines for the assessment of effects on pedestrians, cyclists, equestrians and community. It suggests where relevant, it should include the key facilities and their catchment area. DMRB guidelines also states that in addition to the above, other factors such as level of use, use by vulnerable users and availability of alternative facilities should be taken into account.

SENSITIVITY OF RECEPTORS

17.3.11. The sensitivity of a receptor to environmental change varies depending upon a combination of its value and susceptibility. The sensitivity of different receptors is outlined in Table 5.1.

MAGNITUDE OF PREDICTED CHANGE

17.3.12. To assist with identifying the magnitude of predicted change, the IEMA Guidelines sets out considerations, and in some cases thresholds, in respect to changes in the volume and composition of traffic to facilitate judgement on the significance of traffic impacts. Where no guidelines are available, commonly agreed thresholds for judging the significance of an impact on sensitive receptors and professional judgement have been applied. Dependent on whether magnitude of impact is positive or negative, the impact on receptors can be adverse or beneficial.

Public Transport Network

17.3.13. There is no formal or published guidelines for the assessment of impacts on the public transport network. Accordingly, professional judgement has been applied to determine the magnitude of impact of on the public transport network. For this purpose of this assessment, the following factors have been taken into consideration:

- Changes in bus and rail capacity;
- Enhancements to existing routes / services;
- New routes / services; and
- Changes to the connectivity / waiting facilities of public transport interchanges (e.g. bus stops).

Pedestrian and Cyclist Delay

17.3.14. There are no formal or published guidelines for the assessment of pedestrian or cyclist delay. However, the IEMA Guidelines recommend assessors use their professional judgement to determine the significance of impacts. For the purpose of this assessment changes in traffic flows of 30%, 60% and 90% are considered to represent a low, medium and high magnitude impact on pedestrian delay.

Pedestrian and Cyclist Amenity

17.3.15. The IEMA Guidelines suggest a screening threshold for judging the significance of changes in pedestrian amenity would be where the traffic flow is halved or doubled. In the absence of other criteria, this threshold has been used in this assessment for assessing pedestrian and cyclist amenity.

Fear and Cyclist Intimidation

17.3.16. In the absence of commonly agreed thresholds for judging the significance of likely fear and intimidation impacts, IEMA Guidelines suggest the thresholds outlined in Table 17.2 are used as an option to assess the magnitude of impact on fear and intimidation.

Table 17.2- Example of Fear and Intimidation. Source: IEMA 'Guidelines for the Environmental Assessment of Road Traffic' (1993)[202]

Degree of hazard	Average traffic flow over 18 hr day (veh/hr)	Total 18 hr HGV vehicle flow	Average speed over 18 hr day (mph)
Extreme	1,800 +	3,000 +	20 +
Great	1,200 – 1,800	2,000 – 3,000	15 – 20
Moderate	600 – 1,200	1,000 – 2,000	10 - 15

17.3.17. Considerations key to assessing the impact on fear and intimation include: volume of traffic, percentage of HGVs and the proximity of pedestrians to traffic. In addition, the speed of traffic, the number of turning movements, the proximity of schools and the level of vulnerable groups should be considered.

Driver Delay

17.3.18. A Paramics Discovery model will be used to quantify the operational impact of the Proposed Scheme on junctions and links within the Study Area. The Paramics Discovery model previously submitted in support of the OBC will be updated in line with the SATURN model.

17.3.19. Traffic surveys have recently been undertaken at key junctions and links surrounding the Proposed Scheme, and the SATURN model previously submitted in support of the OBC is currently being updated to produce a 2018 base year, taking account of this data and recently completed local infrastructure schemes.

17.3.20. The 2023 and 2038 forecast year models will also be updated to reflect the latest design of the Proposed Scheme and will include future schemes on the A47 SRN and the local network. Forecast traffic flows from the updated SATURN model will be used in the quantified assessments of air quality and noise in the ES and to generate an updated BCR for the Proposed Scheme.

17.3.21. The magnitude of impact on driver delay will be quantified based on the absolute and percentage change in driver delay at key junctions and links surrounding the Proposed Scheme. The threshold for defining the magnitude of impact will be based on professional judgement.

Accidents and Safety

17.3.22. An estimate can be made of potential changes to global accident statistics relative to change in traffic flows, using COBALT software. However, in the case of change to the character of traffic or the road and transport network professional judgement will be used to assess the implications.

Hazardous Loads

17.3.23. If the number of hazardous load movements is expected to be significant, a risk or catastrophe analysis will be required to illustrate the potential for an accident to happen and the likely impact of such an accident.

SIGNIFICANCE OF EFFECT

17.3.24. As set out in Regulation 14(2) of the EIA Regulations, it is the effects, not the impacts, of a development which are to be reported in its environmental statement.

17.3.25. The significance of the traffic and transport effect is a product of the receptors sensitivity and magnitude of impact. A matrix for determining the significance of effects is provided in Table 5.3.

17.3.26. The potential effects will be considered to determine the level of significance, either: major, moderate, minor or of negligible significance. Effects of major and moderate significance are considered to be significant in EIA terms.

17.3.27. The following terms have been used to define the significance of the effects identified:

- Major effect: where the Proposed Scheme could be expected to have a very significant effect (either positive or negative) on users of the local transport network;
- Moderate effect: where the Proposed Scheme could be expected to have a noticeable effect (either positive or negative) on users of the local transport network;
- Minor effect: where the Proposed Scheme could be expected to result in a small, barely noticeable effect (either positive or negative) on users of the local transport network; and

- Negligible: where no discernible effect is expected as a result of the Proposed Scheme on users of the local transport network.

17.3.28. Following the classification of an effect as detailed in Table 5.3, a clear statement will be 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.

17.4 BASELINE CONDITIONS

17.4.1. This section examines the existing transport conditions within the vicinity of the Proposed Scheme. The study area is shown in Figure 17.1.

17.4.2. STRATEGIC ROAD NETWORK

17.4.3. The SRN in England is managed by Highways England and within the study area includes the A47. Key junctions and infrastructure on this route in the study area include:

- Vauxhall Roundabout;
- Breydon Bridge (Bascule Bridge);
- Gapton Hall Roundabout; and
- Harfrey's Roundabout.

17.4.4. The closest access to the SRN from the Proposed Scheme is via the A47 Harfrey's roundabout, which lies at the western end of the red line boundary approximately 0.4km west of the river.

Local Highway Network

17.4.5. On the western side of the river, a new five-arm roundabout will connect the new crossing with Suffolk Road, William Adams Way and the western end of Queen Anne's Road; A single span bridge over Southtown Road, will join the bridge to the new roundabout at William Adams Way;

17.4.6. The Queen Anne's Road junction with Suffolk Road will be closed, and a new priority junction onto Southtown Road created, providing access to the Queen Anne's Road residential area;

17.4.7. The scheme will incorporate revised access arrangements for existing businesses onto the local highway network including, potentially, a new structure to allow vehicular access under the proposed crossing on the eastern bank subject to agreement with affected businesses and landowner;

17.4.8. It includes dedicated provision for cyclists and pedestrians which tie into existing networks and the demolition of an existing pedestrian bridge on William Adams Way;

17.4.9. A control tower structure will be located adjacent to the crossing on the western side of the river. The control tower will facilitate the 24/7 operation of the opening span of the new double leaf bascule bridge;

17.4.10. The scheme incorporates additional signage to assist the movement of traffic in response to network conditions and the openings / closings of the double leaf bascule bridge;

17.4.11. The scheme may also include associated changes, modifications and/or improvements to the existing local highway network as informed by traffic modelling. This could include improvements within the existing highway boundary to some existing junctions within the red line boundary, in addition to amended parking arrangements.

17.4.12. On the eastern section of the road crossing, the proposed link over the River Yare links into a new signalised junction with South Denes Road. The direction of operation of Sutton Road and Swanston's Road will be

reversed to ensure efficient operation. Controlled crossing facilities will be incorporated to assist the movement of pedestrians and cyclists.

Baseline Traffic Data

17.4.13. A summary of the existing, and historic, two-way traffic flows from DfT data sources in the study area is shown in the table below:

Table 17.3 -Summary of traffic flow data

Source	Type Count	Date	Number Sites
TRADS	ATC	Permanent	4
DfT	ATC	Permanent	6
NCC	MCC	October 2015	9
AECOM	MCC	June 2015	8
	ATC	April 2016	38
	MCC		8
	ANPR		36
WSP (Mouchel)	RSIs	November 2016	9
	MCC		41
	ATC		3
WSP	MCC	March 2018	15
	ATC		20

Public Transport Network

17.4.14. Bus services cover the main corridors through the town, with all routes from outlying areas serving the town centre and Market Gates bus station. The majority of bus services in Great Yarmouth are operated by First in Norfolk and Suffolk, with a small number operated by other local bus operators.

17.4.15. The majority of bus services in the town run in north / south direction connecting Great Yarmouth with the Caister-on-Sea to the north and / or Gorleston-on-Sea to the south. Notable exceptions to this this are bus service 2, a circular route serving the town centre and Denes Peninsula only, and bus service 74 between Great Yarmouth Town Centre and Little Plumstead to the west.

17.4.16. Great Yarmouth Market Gates bus station is located in the town centre, 2 km north of the scheme, and is approximately 550m from the sea front, or a 5- to 7=minute walk. Public realm improvements are currently being undertaken at Market Hill Bus Station, this includes new Real Time Passenger Information (RTPI) displays along, new lighting and new railings.

17.4.17. The nearest bus stop to the Proposed Scheme is located on Southtown Road on the western bank of the River Yare. The majority of bus services in stop at bus stops along this road as it connects with Bridge Road and Haven Bridge. The most central bus stop to the location of the Proposed Scheme is Waveney Road bus stop. This is comprised of a flag and pole only; no other waiting facilities or passenger information is provided.

17.4.18. The highest frequency service operating along Southtown Road is bus route 8 operated by First in Norfolk and Suffolk. This operates between James Paget Hospital in Gorleston and Caister-on-Sea on a 15-minute frequency Monday to Saturday, reducing to a 30-minute frequency on Sundays. In addition to this service, eleven other bus services operate along Southtown Road, the majority of these operate on a half hourly or hourly frequency.

17.4.19. To the east of the River Yare there are no bus stops within the immediate vicinity of the Proposed Scheme. The closest bus stop on the east side of the River Yare is Battery Road bus stop on Admiralty Road. This is the southernmost bus stop on the peninsula and is severed by service 2 only. This is a circular route that connects the peninsula with Great Yarmouth town Centre. There are no bus stops along the A1243 South Denes Road.

17.4.20. Great Yarmouth Station is one of two stations on the Wherry Line railway from Norwich. The station is located approximately 1.5 miles, or a 30-minute walk, from the Proposed Scheme. No bus services currently serve Great Yarmouth station forecourt bus stop. However, it is approximately 1km from the town centre, or a 10-to-15-minute walk via Vauxhall Bridge where a number of bus services can be accessed.

17.4.21. All train services from Great Yarmouth Station are operated by Abellio Greater Anglia. According to the Office of Rail Regulation usage figures for 2016-2017, Great Yarmouth was the fifth-busiest railway station in Norfolk, after Norwich, King's Lynn, Diss and Downham Market.

17.4.22. The majority of services from Great Yarmouth run direct to Norwich via Acle, however two trains per day run direct to Norwich via Berney Arms. On both routes, the majority of services call at all stations. The approximate journey time between Great Yarmouth and Norwich is 35 minutes.

17.4.23. During the AM peak period (07:00-10:00), four services depart from Great Yarmouth to Norwich. In the PM peak period (16:00-19:00), there are five services to Norwich. Off-peak there is typically 1 departure per hour to Norwich, however between 20 May and 9 September four additional direct non-stopping services operate between Great Yarmouth and Norwich. At weekends, the Saturday timetables to Norwich operate similarly to weekdays. However, there are a reduced number of Sunday services, whereby services operate only every other hour to Norwich.

Pedestrian Network

17.4.24. The River Yare divides the western side of Great Yarmouth from the town centre, sea front, harbour and other destinations on the South Denes peninsula. To access these facilities, all pedestrian and cycle journeys between east and west have to cross the existing bridges. For pedestrians this means using Haven Bridge, as the Breydon Bridge has no footways. As a result of this, the time and distance involved for many trips is significant when compared with the equivalent "crow fly" distance.

17.4.25. The pedestrian network along the eastern bank of the River Yare is adequate, with footways generally provided on both sides of the A1243. Along South Quays Road the footways are generally between 1.5m and 2.0m in width, however as you travel further south these become very narrow, with footways of between 1.0 and 1.5m in width on both sides of Southgates Road and South Denes Road. South of Hartman Road there is also large stretches South Denes with no footway provision.

17.4.26. On the western side of the river, the pedestrian network is less comprehensive with no public realm space or footway directly alongside the river due to the existing industrial units that occupy this space.

17.4.27. On Southtown Road, which runs parallel to the River Yare, there are footways of between 1.2 to 1.5m on both sides the carriageway and at the signalised junction of William Adams Way / Beccles Road / Southtown Road there are pedestrian crossing facilities. To the south of Southtown Road there is limited footway provision along Malthouse Lane and Riverside Road.

17.4.28. Footways of about 2m in width are provided along the south side of William Adams Way, however at the A47 / William Adams Way roundabout, only informal pedestrian crossing facilities are provided. There is a ramped pedestrian and cycle bridge on William Adams Way which provides access to Suffolk Road and Queen Anne's Road.

17.4.29. Haven Bridge is the main crossing for pedestrians travelling between Gorleston and Great Yarmouth. Footways of approximately 2m in width are provided on Bridge Road on approach and across the River Yare on both sides of the carriageway. Breydon Bridge to the north has no footways and is not considered suitable for use by non-motorised users due to the 50mph speed limit.

Cycle Network

17.4.30. Great Yarmouth's cycle network, comprises sections of National Cycle Network (Routes 30 and 517) and the Regional Cycle Network, as well as other signposted on-road cycle routes (referred to as pedalways), advisory cycling routes and some traffic free cycle routes.

17.4.31. Existing opportunities for cyclists to cross the River Yare are limited. The Breydon Bridge has designated cycle lanes on either side of the carriageway, however, these are unsegregated and pose a risk to cycle users due to the nature of the road (50mph speed limit). The Haven Bridge has a shared use path leading up to it on either side of the river as part of the National Cycle Network Route 517, however, there is no provision on the crossing itself and cycle users have to dismount.

17.4.32. Along the east bank of the River Yare, there is a wide segregated footway/cycleway along the western side of A13243 South Quay between Haven Bridge and Nottingham Way. South of Nottingham Way and towards the location of the Proposed Scheme there is no designed cycle route or infrastructure along the A1243. Pedalway Route 1 runs parallel to the A1243 along Blackfriars Road, Camden Road and Admiralty Road and connects with Pedalway Route 2 which runs along the beach front. This route is principally on-street along quieter residential with limited provision for cyclists.

17.4.33. Opposite the Haven Bridge, there is a dedicated cycle lane on Regent Street (Pedalway Route 7) which provides cycle access to the town centre. To the north of Haven Bridge, an on-road cycle route starts at Stonecutters Way and runs through to George Street, and The Conge, before linking in with National Cycle Route 30 at the North Quay junction.

17.4.34. On the western side of the River Yare, Southtown Road is designated as National Cycle Network Route 517, it is non-segregated apart from a section close to the Pasteur Road junction. The route continues on to Malthouse Lane and Riverside Road before reaching Gorleston. Pedalway Routes 5 and 6 follow the same route before turning on to Ferry Hill at the Riverside Road junction towards Bradwell and Gorleston respectively. Pedalways Routes 3 and 4 follow Pasteur Road on an off-carriageway footway/cycleway from Haven Bridge before continuing on to Gapton Hall Road towards Burgh Castle and Belton.

Community facilities

17.4.35. The movement of vehicles and NMUs to community facilities is presently severed by the River Yare, particularly in relation to destinations on the peninsula. Volume II shows community facilities in the area, which include religious buildings, medical and educational facilities.

Personal Injury Collisions

17.4.36. For the OBC submission, personal injury collisions (PIC) data for the Great Yarmouth area was obtained from STATS19 Road Safety Data from the five year period between 2012 and 2016. In total, there were 115 injury collisions across the junctions assessed within the Preliminary Transport Assessment in Appendix 17A. There were no fatal collisions, 20 severe PICs and 95 slight PICs during the five year period. More detailed accident analysis can be found within the Preliminary Transport Assessment. This analysis will be updated using newer data as part of the final Transport Assessment.

17.5 POTENTIAL SIGNIFICANT EFFECTS

17.5.1. The introduction of the Proposed Scheme will not in itself generate any additional traffic although providing the bridge as an alternative route to the current crossing options, will result in a reassignment of traffic and these impacts will be assessed in the Transport Assessment.

17.5.2. The potential impacts of the Proposed Scheme with regards to traffic are likely to be predominantly positive, with journey time savings, vehicle operating cost savings, reduced congestion, enhanced journey time reliability, collision and casualty savings, and an increase in the use of more active modes of travel.

17.5.3. As noted in the limitations statement above (paragraphs 17.1.5 and 17.1.6, the Preliminary Transport Assessment has been based on information available at the time of writing, and thus relies upon the work undertaken at OBC stage. Further assessment will be carried out in order to produce the final Transport Assessment and ES. The following paragraphs summarise the aspects which will be considered.

CONSTRUCTION PHASE

Pedestrian and cyclist amenity and delay

17.5.4. The construction phase of the Proposed Scheme will lead to an increase in traffic flows on local roads in the immediate vicinity. This will include a temporary increase in HGV movements. Prior to mitigation this is likely to result in a worsening of amenity for pedestrians and cyclists travelling along effected links.

Collisions and safety

17.5.5. The construction phase of the Proposed Scheme will increase traffic flows on the local and strategic road network, including a temporary increase in the number of HGVs. Detailed consideration will be given to impacts during construction and how these can be mitigated in the CoCP.

Fear and intimidation

17.5.6. The construction phase of the Proposed Scheme will lead to an increase in traffic flows on local road. This will include a temporary increase in HGV movements. Prior to mitigation this is likely to result in a worsening of fear and intimidation of pedestrians and cyclists along affected links. Detailed consideration will be given to impacts during construction and how these can be mitigated in the CoCP.

OPERATION PHASE

Effects on Public Transport Users

17.5.7. The operation of the Proposed Scheme will enable existing bus services to be rerouted across the Third River Crossing. This is likely to result in improved public transport accessibility for people living and working on the South Denes Peninsula. This is also likely to result in wider public transport journey time improvements across Great Yarmouth as a result of a reduction in traffic congestion at and around Haven Bridge.

Pedestrian and cyclist amenity and delay

17.5.8. Operation of the Proposed Scheme will lead to a reassignment of traffic on the local and strategic road network. Prior to mitigation, on links where there is an increase in traffic flows there is likely to be a deterioration in the amenity for pedestrian and cyclists. On links where there will be a reduction in traffic flows there is likely to be an improvement in the amenity for pedestrians and cyclists.

Collisions and safety

17.5.9. Once the Proposed Scheme is operational, the forecast changes in traffic assignment across the network will lead to a change in likely accident rates and locations. This will be quantified using COBALT software, which

based on the evidence from the OBC, is anticipated to show an overall reduction in the costs of accidents across the study area.

Fear and intimidation

17.5.10. Operation of the Proposed Scheme will lead to a reassignment of traffic on the local and strategic road network. Prior to mitigation, on links where there is an increase in traffic flows there is likely to an increase in fear and intimidation for pedestrian and cyclists. On links where there will be a reduction in traffic flows there is likely to be a reduction in fear and intimidation for pedestrians and cyclists.

Hazardous Loads

17.5.11. The construction phase of the Proposed Scheme is likely to involve the transportation of hazardous (oversize loads). Prior to mitigation this is likely to result in disruption to users and present increased risk to users of the local and strategic road network.

17.6 MITIGATION

17.6.1. As described previously in Chapter 3 and section 17.4, the Proposed Scheme includes new highway infrastructure on either side of the crossing to enable its efficient operation. This will be supplemented with advance variable message signage (VMS) to enable drivers to divert if required when the Proposed Scheme is closed to road traffic. It is anticipated that local signage will also be required within the red line boundary to direct drivers and non-motorised users to the most appropriate routes depending on their destination.

17.6.2. Proposed mitigation works will be detailed in the final Transport Assessment and summarised in the ES once all modelling work has been completed.

17.7 CONCLUSIONS AND EFFECTS

17.7.1. It is likely that the Proposed Scheme will result in adverse effects during the construction phases of the Proposed Scheme. These are expected to be temporary in nature, being restricted to the construction phase only.

17.7.2. Findings from the Preliminary Transport Assessment indicate the Proposed Scheme is expected to make a positive contribution to the delivery of the scheme objectives, in some cases with very large positive effects. This is expected to result in long tern beneficial effects during the operation phase of the Proposed Scheme, particularly in relation to access and connectivity for all modes, increased resilience of local road network, reduced congestion and improved journey time reliability.

17.7.3. The significance of such effects has yet to be fully determined, and will be assessed once transport modelling data is available. This be presented within the Environmental Statement.

17.8 ASSESSMENTS STILL TO BE COMPLETED

17.8.1. The Preliminary Transport Assessment in Appendix 17A details the assessments which will be completed for inclusion in the final Transport Assessment.

18

CUMULATIVE EFFECTS

18 CUMULATIVE EFFECTS

18.1 INTRODUCTION

18.1.1. This chapter presents the preliminary assessment of Cumulative Effects (CEA) as it relates to (i) the Proposed Scheme to date; and (ii) data currently available and gathered at this point of the assessment process. The focus of a CEA is to assess the potential cumulative effects of the Proposed Scheme interacting with other developments as a result of multiple actions on receptors and resources over time which are generally additive or interactive.

18.1.2. This assessment is emerging and will be based upon Advice Note 17: Cumulative Effects Assessment203. Cumulative effects These generally fall into three categories:

- Cumulative effects arising from the combination of the different environmental topics as outlined in the PEIR;
- Cumulative effects arising from a range of developments (projects), occurring at different locations or over a period of time. Separately, such individual projects may not create an unacceptable degree of adverse impact but collectively the results may be potentially significant; and
- Cumulative effects caused by the project in conjunction with other developments that occurred in the past, present or are likely to occur in the foreseeable future.

18.1.3. As identified in the second point above, cumulative or combined effects are those that are likely to arise when the Proposed Scheme is considered in relation to other foreseeable developments (projects) either located in the immediate vicinity or that have a relationship with similar environmental resources. Individually, the impact of the Proposed Development may be of minor magnitude but when combined with the impact from other projects could increase the overall significance of an effect on an individual resource. The results of this process enable the determining authority to ensure that this and any future developments are mutually compatible and remain within the environmental capacity of the area considered.

STUDY AREA

18.1.4. The study area for the assessment has been determined following consideration of the likely significant effects that could reasonably arise from the projects that have been considered alongside the Proposed Scheme. At present this is still being developed in line with (i) advice provided by the Planning Inspectorate within the Scoping Opinion and (ii) the scoping response received from GYBC[6] on the 8th June 2018.

LIMITATIONS

18.1.5. This chapter of the PEIR provides preliminary information as it relates to the Proposed Scheme to date and to data currently available and gathered at this point of the assessment process.

[203] The Planning Inspectorate. Advice Note 17: Cumulative effects assessment relevant to nationally significant infrastructure projects. Available here. Last accessed May 2018

18.2 DIRECTIVES, REGULATIONS AND RELEVANT POLICIES

EIA Regulations

18.2.1. Schedule 4 of the EIA Regulations state that a description of likely significant effects on the environment resulting from the following is required:

"the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;"

National Policy Statement for National Networks

18.2.2. The NPS NN states that the SoS should take into account "*potential adverse impacts, including any longer term and cumulative adverse impacts, as well as any measures to avoid, reduce of compensate for any adverse impacts*". The Examining Authority should consider how significant cumulative effects and the interrelationships between effects might as a whole affect the environment, even though they may be considered on an individual basis with mitigation measures in place.

National Policy Statement for Ports

18.2.3. The NPSP provides a framework for the decisions on proposals for new port development. It applies, wherever relevant, to associated development, such as road and rail links, for which consent is sought alongside that for the principal development.

18.2.4. The NPSP specifically identifies adverse cumulative impacts upon health as a topic for consideration with an ES, as well as the cumulative effects from flooding and the potential shortage of construction workers.

Planning Inspectorate Advice Note 17

18.2.5. This Advice Note identifies the nature of projects (referred to as 'other developments' in the Advice Note) that should be within a CEA.

18.3 ASSESSMENT METHODOLOGY

18.3.1. The Assessment will be undertaken in accordance with the advice presented in Advice Note 17[203]. Guidance within Advice Note 17 identifies a four-stage process to the CEA process and the ES will include a CEA that follows the same approach. Table 18.1 - CEA Main Stages and Activities outlines this process.

18.3.2. Rejected planning applications that are not subject to appeal will not be considered as their implementation is not considered to be reasonably foreseeable.

18.3.3. The assessment will consider the capacity of environmental resource and receptors to accommodate changes that are likely to occur. This includes the duration, extent, type (additive or synergistic), frequency, value and resilience of the receptor and likely mitigation.

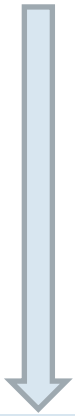
18.3.4. When considered in isolation environmental effects of a single resource or receptor may not be significant. However, when individual effects are considered in combination the resulting cumulative effect may be significant.

Table 18.1 - CEA Main Stages and Activities

CEA Stage	Main Activities
Stage 1 Establishing a zone of influence for the Proposed Scheme and identifying a long list of 'other developments'	Identifying a long list of 'other development' that is proposed in the vicinity of the Proposed Scheme. The applicant undertakes a desk study of planning documents, development plan documents, and relevant development frameworks within the Zone of Influence. The applicant will consult with the relevant planning authority and statutory consultees regarding the list
Stage 2 Identify a shortlist of 'other developments'	Identifying the nature of the 'other development; and assessing whether there is the potential for significant cumulative effects The applicant will consult with the relevant planning authority and statutory consultees regarding the list Documented information can be high level, identifying the key issues to be taken forward to stage 2 and 3
Stage 3 Information gathering	Collation of information on the 'other development identified at Stage 2
Stage 4 Assessment	Assessing Applicant reviews each of the 'other development' in turn to assess weather cumulative effects may arise and documents this Mitigation measures should be identified in relation to adverse cumulative effects The applicant may wish to consult with applicants/developers of 'other development' to identify means to jointly address the mitigation of significant adverse cumulative effect and the means to ensure delivery.

18.3.5. A list of 'other developments' for inclusion with the CEA is to be determined using the tiered selection projects, an approach that is published within Advice Note 17[203] and reproduced in Table 18.2 – 'Other Development' for Inclusion in CEA below.

Table 18.2 – 'Other Development' for Inclusion in CEA

Tier 1	Under construction	Decreasing level of detail likely to be available 
	permitted application(s), whether under the PA2008 or other regimes, but not yet implemented;	
	submitted application(s) whether under the PA2008 or other regimes but not yet determined;	
Tier 2	projects on the Planning Inspectorate's Programme of Projects where a scoping report has been submitted.	
Tier 3	projects on the Planning Inspectorate's Programme of Projects where a scoping report has not been submitted.	
	identified in the relevant Development Plan (and emerging Development Plans - with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited;	
	identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward.	

DETERMINING STUDY AREA

18.3.6. Advice Note 17[203] states that the *'scale and nature of NSIPs will typically dictate a broad and temporal zone of influence (ZOI) for an NSIP'*. For individual environmental topics, the ZOI is defined by the relevant institutional guidelines which are discussed within each respective chapter. However, in determining a ZOI for 'other developments' that could give rise to cumulative effects when interacting with the Proposed Scheme it will be necessary to consider each development on a case by case basis. A desk study was completed to examine and record permitted developments that, as a result of scope and nature or temporal scope, may cause a cumulative effect.

18.3.7. The scale and nature of developments identified within the ZOI is included if it is considered that interactions between developments and the Proposed Scheme could result in cumulative effect.

SIGNIFICANCE OF EFFECTS

18.3.8. The significance of the effect is formulated as a function of the receptors or a resources' environmental value (or sensitivity) and the magnitude of the project impact. Advice Note 17[203] states "*The significance criteria used to assess likely cumulative effects should consider the capacity of environmental resources and receptors to accommodate changes that are likely to occur. The terminology used to determine significance should be explicit and ensure a clear understanding of the outcome of the CEA*."

18.3.9. The significance of effect will be determined using the significance criteria for cumulative effects, published within Volume 11, Section 2, Part 5 of the DMRB (HA 205/08)[31] This has been reproduced in Table 18.3 – Determining Significance of Cumulative Effects below.

Table 18.3 – Determining Significance of Cumulative Effects

Significance	Definition Effect
Severe	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised.
Major	Effects that may become key decision-making issue.
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.
Minor	Effects that are locally significant.
Not Significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

18.3.10. In line with the DMRB, the following have been considered in determining the significance of cumulative effects;

- Which receptors/resources are affected;
- How will the activity or activities affect the condition of the receptor/resource;
- What are the probabilities of such effects occurring; and
- What ability does the receptor/resource have to absorb further effects before change becomes irreversible?

18.4 BASELINE ENVIRONMENT

18.4.1. At this stage of the Proposed Scheme the CEA is at Stage 1, wherein the zone of influence for the Proposed Scheme is being established.

18.4.2. The EIA Scoping Report[5], presented the following developments as having the potential to result in a cumulative impact in combination with the Proposed Scheme:

- Great Yarmouth and Lowestoft Enterprise Zone;
- Lake Lothing Third River Crossing;
- Great Yarmouth Tidal Barrier;
- East Anglia Array Windfarm;
- Beacon Park Enterprise Zone;
- Great Yarmouth Waterfront Area;
- South Denes Enterprise Zone and Energy Park; and
- A27 Great Yarmouth Vauxhall, Harfrey's and Gapton Junctions.

18.4.3. In response to this list of projects, the Panning Inspectorate, within the Scoping Opinion[6], noted that the inclusion of the East Anglia Array Windfarm, and requested that the ES clearly define which NSIP(s) this relates to, as several windfarms have been proposed or consented.

18.4.4. The East Anglia Array is a wind farm development that consists of four phases, although it is noteworthy that two of these phases are proposed to be combined into a single DCO submission.

18.4.5. East Anglia ONE received development consent in August 2017. It is understood that construction of the onshore elements commenced in May 2017, the offshore works are due to commence in August 2018, first power achieved in 2019 and full operation during 2020. This the construction phased of this development is unlikely to significantly overlap with that of the Proposed Scheme.

18.4.6. East Anglia THREE received development consent in August 2017. The Environmental Statement[204] submitted with the application states that "*Construction of the proposed East Anglia THREE project…would commence between 2020 and 2025*. This will overlap with the construction phase of the Proposed Scheme.

18.4.7. A scoping opinion for East Anglia TWO[205] and East Anglia ONE NORTH[206] was issued by the SoS in December 2017. The scoping opinion for both projects notes that "*Onshore construction works are anticipated to take approximately 18 to 24 months*". However, no details on the dates of the construction programme for either project are yet available although a combined PEIR for both East Anglia TWO and East Anglia ONE North is proposed for late 2018 with submission of the East Anglia TWO DCO in 2019 and East Anglia ONE NORTH DCO in 2020. It is possible likely that these developments will overlap with the construction phase of the Proposed Scheme.

18.4.8. On this basis it is likely that East Anglia ONE will be excluded from the assessment. East Anglia ONE NORTH, East Anglia TWO and East Anglia TWO are likely to be included, subject to further assessment.

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[204] Royal Haskoning 2015. East Anglia Three Environmental Statements. [online] .Available here. Last accessed June 2018

[205] The Planning Inspectorate 2017. Scoping Opinion: Proposed East Anglia Two Offshore Windfarm. [online] Available here. Lat Accessed June 2018

[206] The Planning Inspectorate 2017. Scoping Opinion: Proposed East Anglia One North Offshore Windfarm. [online] Available here. Last Accessed June 2018

18.4.9. In the Scoping Opinion[6], the Planning Inspectorate stated that cumulative effects assessment should clearly state the other developments that have been included within the traffic data, and provide appropriate cross-reference to other aspect chapters, as applicable. As stated in chapter 17, whilst the additional trips from new developments are not directly related to the Proposed Scheme, they are a consequence of the new crossing therefore the anticipated impact should be assessed within the ES. It is anticipated that the Proposed Development and associated infrastructure improvements will meet the demand for the additional trips by all modes without putting additional pressure on the existing transport networks. Although it is not covered within this PEIR, the ES will consider the cumulative effects that may arise from the Proposed Scheme in conjunction with other existing and / or approved projects. Details of committed schemes which have been included in the SATURN modelling work are contained in the preliminary Transport Assessment, presented in Appendix 17A.

18.4.10. Early consultation with the Environment Agency identified the potential for a Tidal Barrier scheme for Great Yarmouth. It is understood that this project is at the early concept stage and the funding has not yet been applied for. Information relating to this project is expected to be limited and it is anticipated that it will form a Teir 3 development in accordance with the advice given in Advice Note 17.

18.4.11. The GYBC scoping response also provides additional advice on other schemes for inclusion within the assessment of cumulative effects. Including the following:

- "*Great Yarmouth Local Development Orders Great Yarmouth currently Local Development Orders (LDO) in place, which relate to (i) the South Denes LDO; and (ii) the Beacon Park LDO. The GYBC scoping response identifies that these LDOs broadly cover the same areas as the two Enterprise Zones and notes that the LDOs can allow some potentially significant developments to take place without express planning permission needing to be granted;*

- *Epoch 2 of the Great Yarmouth Flood Defence Improvements, which is being led by the Environment Agency;*

- *Various proposed junction improvements to the A47 being progressed by Highways England – Gapton Hall, Harfrey's and Vauxhall (all in Yarmouth), with other A47 improvements further west (Burlingham-Blofield dualling, Thickthorn junction improvements and Easton-North Tuddenham dualling). These developments are being considered within the transport modelling assessment;*

- *Consent for roughly 1,000 residential dwellings at Beacon Park, which are under construction;*

- *The proposed North Lowestoft Garden Village (Draft Allocation in the Waveney Local Plan, c. 1,300 dwellings, 8ha employment land, anticipated delivery 2026-2044); and*

- *Proposed leisure developments south of Pleasure Beach, Great Yarmouth, which include a new hotel, restaurant and car parking (under construction), and an outline permission for a proposed casino plus cinema, bars & restaurants etc*".

18.4.12. The next step of the assessment, to be presented within the ES, will be to identify a shortlist of developments and obtain information about those developments, in accordance with CEA Stage 2. This will be presented within Matrix 1, published in Appendix 1 for Advice Note 17.

18.5 POTENTIAL SIGNIFICANT EFFECTS

18.5.1. An assessment of the potential significant cumulative effects has yet to be undertaken. This forms CEA stages 3 and 4 as defined in Advice Note 17. The findings of the impact assessment will be presented in an assessment Matrix consistent with Appendix 2 of Advice Note 17.

18.6 MITIGATION

18.6.1. The mitigation requirements for the Proposed Scheme cannot currently be determined. This will be provided within the ES as part of the Stage 4 assessment.

18.7 CONCLUSIONS AND EFFECTS

18.7.1. At this stage of the assessment a number of projects have been identified within the vicinity of the Proposed Scheme, which could result in cumulative effects in combination with the Proposed Scheme.

18.7.2. It has been determined that a number of nearby NSIPs have construction phases that overlap with that of the Proposed Scheme. The significance of these cumulative effects will be assessed as the potential effects of the Proposed Scheme emerge.

18.7.3. As this stage of the Proposed Scheme it is not possible to reach a conclusion about the combined effects arising from environmental topics as assessments are in at the preliminary stages.

18.8 ASSESSMENTS STILL TO BE COMPLETED

18.8.1. At this stage of the Proposed Scheme, the CEA is at Stage 1, wherein the zone of influence for the Proposed Scheme is being established. Stages 3 – 4 of the assessment are to be progressed based upon the combined feedback presented within the Scoping Opinion[6] and the Scoping response from GYBC.

The Forum
Barnfield Road
Exeter, Devon
EX1 1QR

wsp.com