
Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 7.4: Design Report

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) (“APFP”)

APFP regulation Number: 5(2)(q)

Planning Inspectorate Reference Number: TR010043

Author: Norfolk County Council

Document Reference: 7.4

Version Number: 0 – Revision for Submission

Date: 30th April 2019

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Foreword

This Design Report accompanies an application (“the Application”) submitted by Norfolk County Council (“the Applicant”) to the Secretary of State for a Development Consent Order (‘DCO’) under the Planning Act 20081.

If made by the Secretary of State, the DCO would grant development consent for the construction, operation and maintenance of a new bascule bridge highway crossing of the River Yare in Great Yarmouth, and which is referred to in the Application as the Great Yarmouth Third River Crossing (“the Scheme”).

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) require that an application for a DCO be accompanied by the documents specified at Regulation 5(2)(a) to (r). This is one of those documents and is specified at Regulation 5(2)(q).

¹ References to legislation in this document are to that legislation as amended at the date of this document.

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Abbreviations

The APFP Regulations	The Infrastructure Planning (Applications - Prescribed Forms and Procedure) Regulations 2009 (SI 2009/2264)
CEEQUAL	Civil Engineering Environmental Quality Assessment and Award Scheme
CftS	Case for the Scheme
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
ES	Environmental Statement
LoD	Limits of Deviation
NIC	The UK National Infrastructure Commission
NPS NN	National Policy Statement for National Networks
NPS for Ports	National Policy Statement for Ports
NSIP	Nationally Significant Infrastructure Project
VMS	Variable Message Sign

Glossary

The Applicant	Norfolk County Council (in its capacity as Highway Authority and promoter of the Scheme).
Application Site	The land bounded by the Order Limits, as shown by a red line on the Land Plans (document reference 2.5) and the Works Plans (document reference 2.6) and being land within which the authorised development may be carried out.
The APFP Regulations	The Infrastructure Planning (Applications - Prescribed Forms and Procedure) Regulations 2009 (SI 2009/2264).
Bridge Lowered	Position of the bascule bridge where it is closed to vessels, and open to vehicular traffic, cyclists and pedestrians.
Bridge Raised	Position of the bascule bridge where it is closed to vehicular traffic, cyclists and pedestrians, and open to vessels.
Crossing	The combined double leaf bascule bridge and the Southtown Road bridge structure (i.e. from it's junction with the new roundabout on William Adams Way to the new junction on South Denes Road).

Double Leaf Bascule Bridge	Opening span and mechanism needed to operate the bridge.
Kingsgate Community Centre	Kingsgate Community Centre is occupied by the Kingsgate Community Church, providing regular community events/activities, and a café.
Knuckles	<p>The areas of the River Yare into which the proposed development extends (from the existing quay walls). These areas consist of the following:</p> <p>Physical protection systems (which are protective structures provided adjacent to the bascule abutments) to fully or partial absorb the design ship collision loads from an aberrant ship or vessel. These protection systems are located on both the south and north of each bascule abutment. They consist of sheet piles driven to dense sands infilled with stone or granular material and capped with a reinforced concrete slab.</p> <p>A bascule abutment which accommodates and allows the movement of the counterweight and houses the mechanical, electrical, instrumentation, control and automation systems. The bascule abutment consists of driven piles and reinforced concrete slabs and walls.</p>

	<p>Plant and control rooms on the western side and plant rooms on the eastern side.</p> <p>Vessel Impact Protection Systems located at the interface between the physical protection systems, the bascule abutments and the River Yare.</p> <p>There are knuckles on both the east and west sides of the River Yare.</p>
MIND Centre and Grounds	Land located to the south of Queen Anne's Road, comprised within Plot Nos. 1-27, 2-03, 2-05, 2-06 and 2-07 on the Land Plans (document reference 2.5), which is currently leased to Great Yarmouth and Waveney Mind for the purposes of its charitable aims and objectives.
NCC	Norfolk County Council (other than in its Highway Authority role as promoter of the Scheme).
New Dual Carriageway Road	Description of road type on the Crossing.
Opening Span	Length of bridge structure that opens.
Order Limits	Limits of land within which the authorised development may be carried out, as shown on

	the Land Plans (document reference 2.5) and the Works Plans (document reference 2.6).
The Outer Harbour	Part of the Port of Great Yarmouth, the deep water Outer Harbour (completed in 2010) is situated at the southern end of the South Denes peninsula and offers direct access to the North Sea.
The Planning Act	The Planning Act 2008.
The Port	The Port of Great Yarmouth, comprising both commercial quays on both sides of the River Yare and Outer Harbour and within the jurisdiction of the Great Yarmouth Port Authority.
Principal Application Site	The land comprised in the Application Site but excluding the Satellite Application Sites.
Proposed Scheme	Great Yarmouth Third River Crossing project at the time of statutory pre-application consultation.
Proposed Scheme Boundary	The boundary of the land within which the Proposed Scheme was proposed to be carried out, as delineated by a red line on Figure 2.3 of the PEIR.

Reinforced Earth Embankment	A reinforced earth or reinforced soil embankment is a general term which refers to the use of placed or in situ soil or other material in which tensile reinforcements act through interface friction, bearing or other means to improve stability. The reinforced earth embankment is supported by driven piles and pilecaps.
Satellite Application Sites	The parts of the Application Site within which Work Number 13 may be carried out, as shown on the Works Plans (document reference 2.6) and described in Schedule 1 to the draft DCO (document reference 3.1).
Scheme	The Great Yarmouth Third River Crossing project for which the Applicant seeks development consent.
Southtown Road Bridge	Bridge structure over Southtown Road.
Study Area	The boundary/extents of a specific assessment.
Underpass	The underpass beneath the Crossing, located on the east side of the River Yare, to be constructed to provide a new private means of access for the benefit of owners and occupiers of adjoining land.

Vessel Waiting Facilities	Provision of 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.

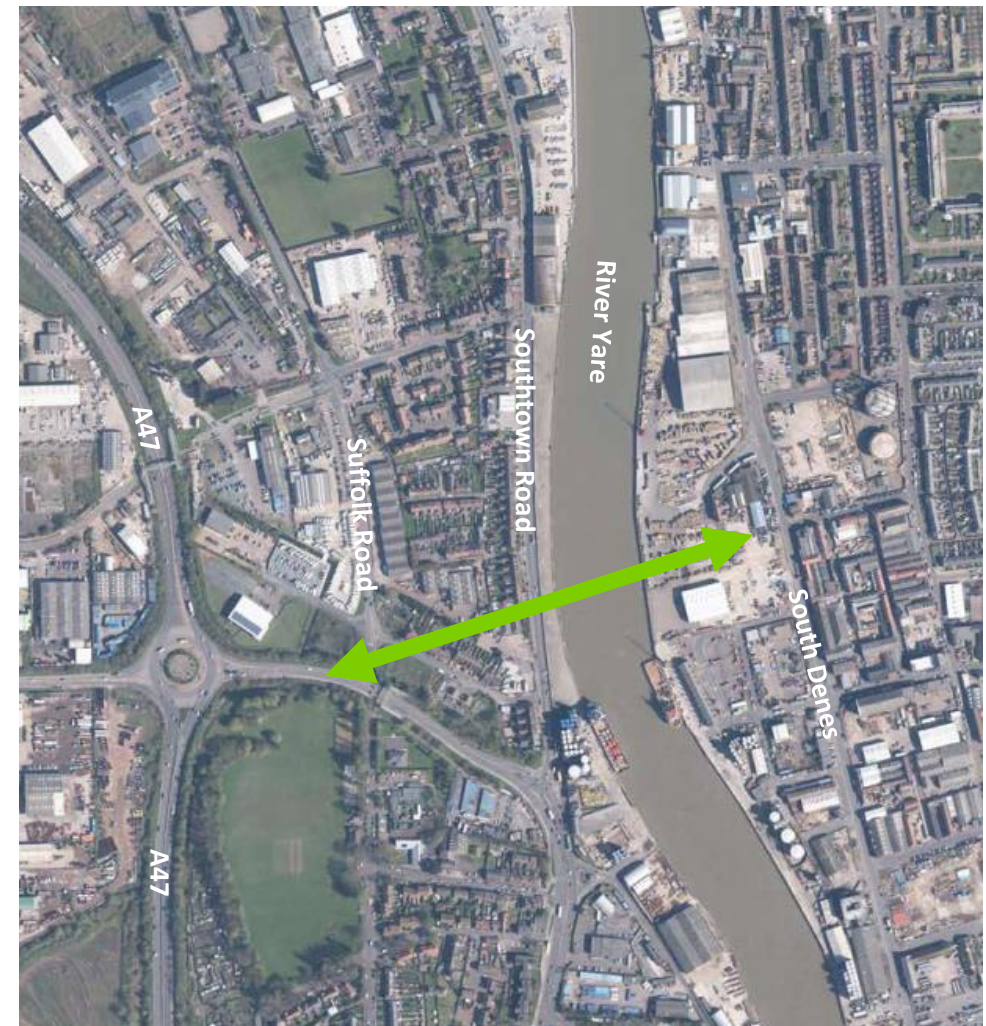
1 Introduction and summary

1.1 Purpose of this report

- 1.1.1 This Design Report is a supporting document submitted as part of the application for a Development Consent Order (DCO) for the Great Yarmouth Third River Crossing, the “Scheme” under the Planning Act 2008.
- 1.1.2 This report describes the design for which consent is sought, and how the application of ‘good design’ has been incorporated within the constraints of the Scheme. It provides evidence to address the policy concerned with design in the National Policy Statement for National Networks (NPS NN).
- 1.1.3 There is no statutory requirement for a Design Report, or a ‘Design and Access Statement’ to be submitted in an application for DCO, as would usually be submitted with a planning application under other planning procedures. However, the Applicant acknowledges the benefit of a supplementary document within the Application to deal with design matters and describe the Scheme in straightforward terms.
- 1.1.5 This report demonstrates how the need for good design has been considered, to ensure a Scheme that contributes to Great Yarmouth beyond the strategic network objectives described in the Case for the Scheme (CfS) (document reference 7.1).
- 1.1.6 This report also explains, in Appendix A ‘Approach to detailed design’ how the design will later be taken forward to detailed design should development consent be granted for the Scheme.
- 1.1.4 This report should be read in conjunction with the drawings and documents contained within the Application, particularly the

Works Plans (document reference 2.6), Engineering Plans, Drawings and Sections (document reference 2.10), General Arrangement Plans (document reference 2.2).

Figure 1-1: Location of the Scheme (the Principal Application Site)



1.1.5 The Application Site is made up of the Principal Application Site (within which the main structure and highway design of the crossing and its connections to the existing highway network would be located) and a number of Satellite Application Sites (in which other associated works required for the Scheme would be situated) as shown in Figure 1-2.

1.1.6 For the purpose of explaining the Scheme design, the descriptions provided within this report and the areas shown in the figures and images are limited to the Principal Application Site.

1.2 Structure of this report

1.2.1 The structure of the Design Report is as follows:

Section 1 – Introduction

This section explains the purpose of the report as a supporting document to the Application explaining the design of the Scheme for which the Applicant seeks development consent.

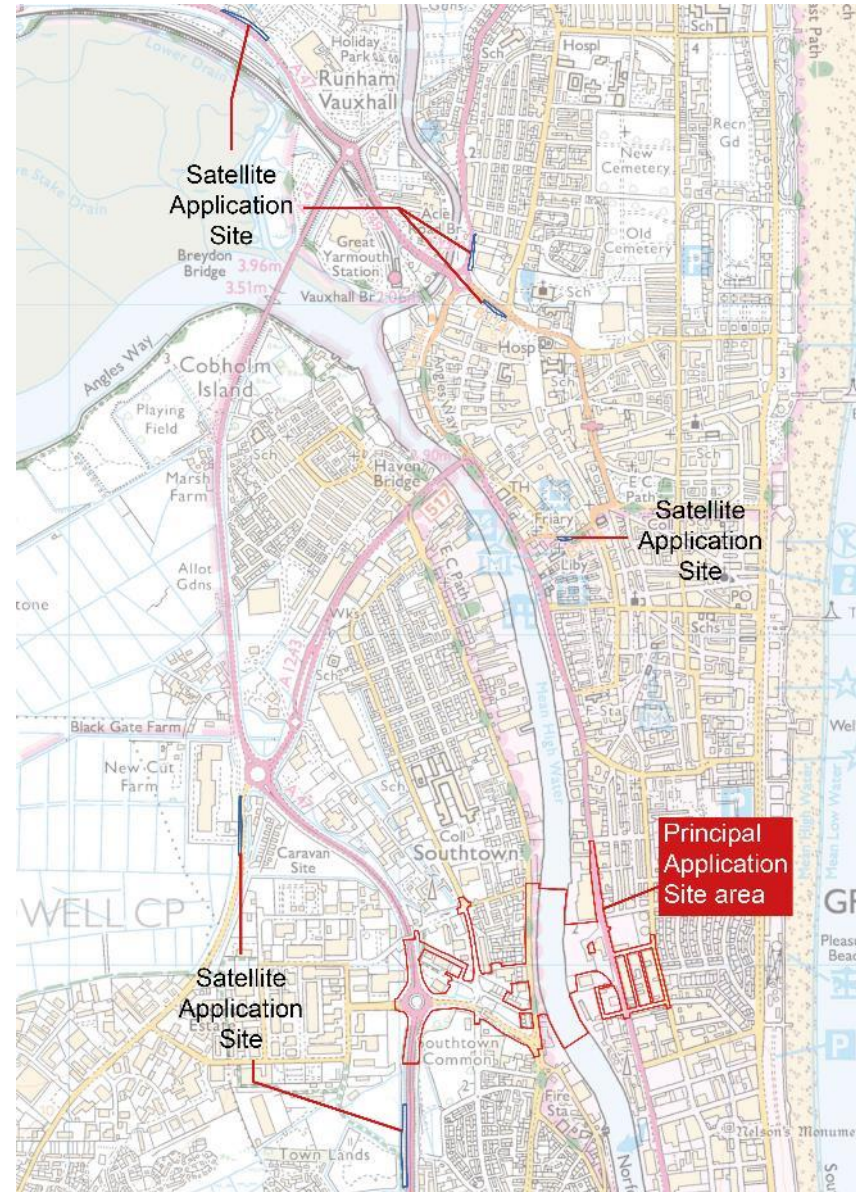
Section 2 – Project context

This section sets the scene by explaining the background to the Scheme and its setting in Great Yarmouth. It also provides a summary of the proposed solution (the Scheme) to support the growth of the renewable energy sector and Port industries, and offer wider benefits to the community.

Section 3 – Planning context

This section provides a summary of the design related policy and guidance relevant to the Scheme.

Figure 1-2: The Application Site areas of the Scheme



Section 4 – The approach to good design

This section explains the Applicant's understanding of the need for good design and the approach taken to achieving this for the Scheme.

Section 5 – Site context

This section introduces the site within which the Scheme is proposed, and the constraints and considerations acting upon the development of the design.

Section 6 - The design

This section divides the Scheme geographically to provide explanation of the components comprising the design and alternative ideas that were explored during its development.

Section 7 – Review of the design

This section reviews the Scheme design against relevant sections of the National Policy Statement for National Networks (NPS NN), described in Section 3 of this report, to consider its adherence to the design-related parts of this policy.

Section 8 – Next steps

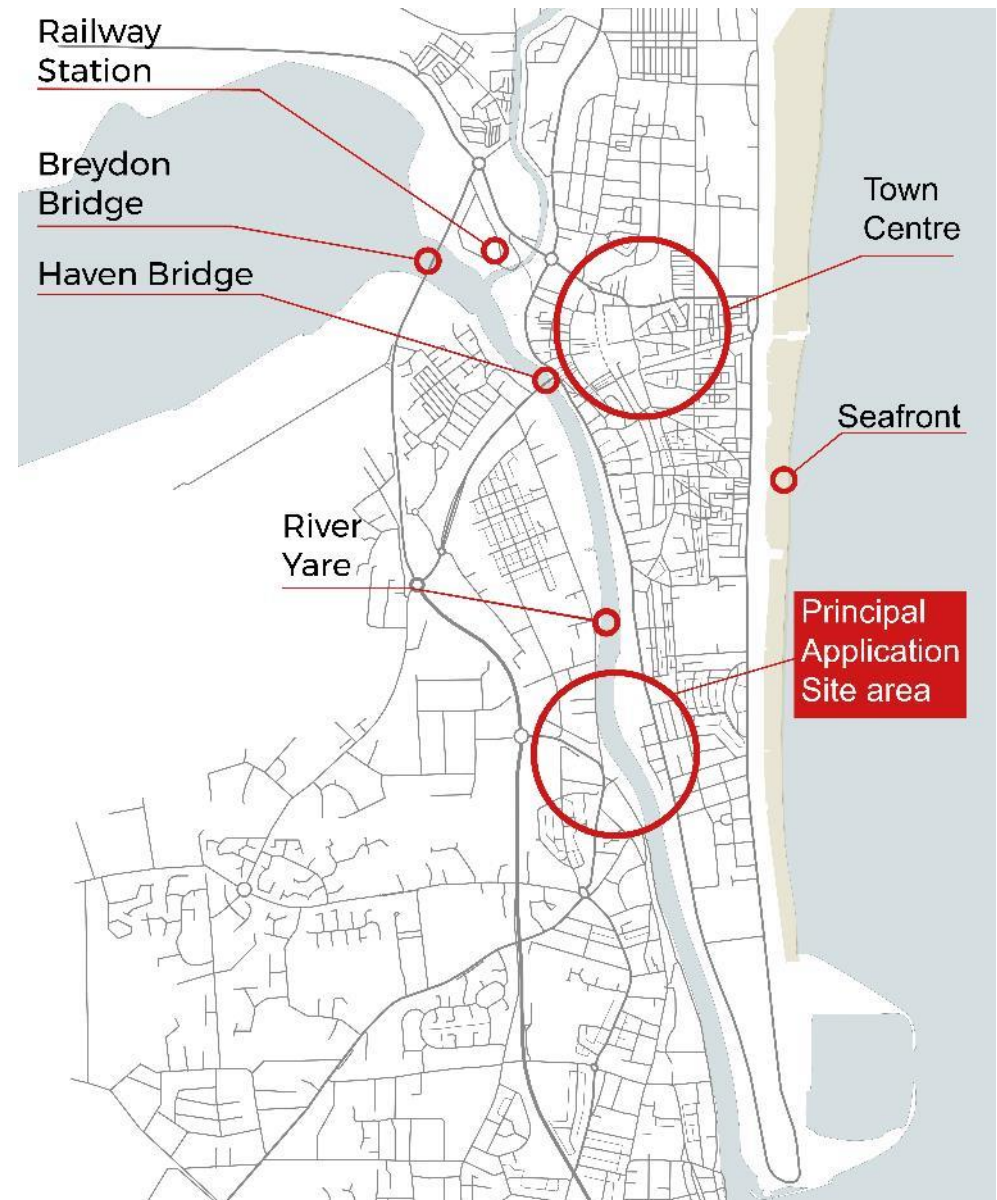
This section introduces Appendix A 'Approach to detailed design', which informs the detailed design to ensure it is in line with the design principles and aspirations for the Scheme, and continues the approach to good design.

2 Scheme context and description

2.1 The Scheme context

- 2.1.1** Great Yarmouth is a coastal town, known for its seafront and sandy beaches popular with tourists, and its port related industries. Geographically the town is split in a north to south direction by the River Yare, separating communities, employment areas, and transport links in the town.
- 2.1.2** Currently there are two bridges in the town crossing the River Yare; Breydon Bridge and Haven Bridge (as shown in Figure 2-1). These bridges are located near the town centre, and necessitate any traffic (including industrial and some port related traffic) accessing the peninsula from the South via the A47 to be funnelled through the town centre. The absence of a crossing located along the peninsula currently can cause congestion and delays to residents, businesses, and visitors to the town. This is explained further in the Transport Assessment (document reference 7.2).
- 2.1.3** In a Direction made under Section 35 of the Planning Act dated 26th February 2018 ('the s35 Direction', the Secretary of State confirmed that he was satisfied that the Scheme is nationally significant (i.e. a Nationally Significant Infrastructure Project (NSIP)) and directed that the Scheme, together with any matters associated with it, was to be treated as development for which development consent is required.
- 2.1.4** In summary, the Scheme is an NSIP due to its potential to support Port industries and the renewable energy sector in Great Yarmouth.

Figure 2-1: The Scheme location in Great Yarmouth



2.2 The proposed solution – the Scheme

- 2.2.1 The Great Yarmouth Third River Crossing (the Scheme) is a new dual carriageway road proposed to cross the River Yare in an east to west orientation, with appropriate connections to the surrounding highway networks. The Crossing would provide a direct connection from the Strategic road network to South Denes on the coastal peninsula of Great Yarmouth on which the seafront, key renewable energy industries, and some of the Port operations are located.
- 2.2.2 The Applicant is the highway authority for highways in the county of Norfolk (except the strategic highways for which Highways England is the highway authority). It is in this capacity that the Applicant has made the application for the DCO, and it will be the highway authority for the new highways comprised in the project.

- 2.2.3 The new crossing of the River Yare would be located centrally (about halfway) along the coastal peninsula of Great Yarmouth, and would accommodate vehicles, pedestrians and cyclists.
- 2.2.4 The Scheme would connect with the A47 Harfrey's Roundabout to the west, oversail Southtown Road, the River Yare and join South Denes Road to the east. A new roundabout would be required on the western side of the Scheme to connect with the existing road network.
- 2.2.5 The Scheme would include a bridge with an opening span to allow vessel movement with a double leaf bascule mechanism. This would be operated from a Control Tower building which is also included in the Scheme.

Figure 2-2: Photograph taken from Bollard Quay looking North towards Principal Application Site



2.2.6 A design solution prepared as part of an application for DCO must be to a level of detail appropriate for assessment of impacts, setting Limits of Deviation (LoD) within which the Scheme must be constructed, operated and maintained, and to ensure overall constructability. The LoD are explained further in 4.5 of this report.

2.2.7 A detailed explanation of the design for the Scheme and its various structural components, is set out in Section 6 of this report.

2.2.8 Chapter 2 of Volume I of the Environmental Statement (ES) (DCO Document 6.1) provides a full description of the Scheme, and is accompanied by the General Arrangement Plan (DCO Document 2.2).

2.2.9 Section 2.3 of this report provides the Scheme Description as it is used throughout the other Application documents.

2.3 Scheme Description

2.3.1 The Scheme involves the construction, operation and maintenance of a new crossing of the River Yare in Great Yarmouth. The Scheme consists of a new dual carriageway road, including a road bridge across the river, linking the A47 at Harfrey's Roundabout on the western side of the river to the A1243 South Denes Road on the eastern side. The Scheme would feature an opening span double leaf bascule (lifting) bridge across the river, involving the construction of two new 'knuckles' extending the quay wall into the river to support the bridge. The Scheme would include a bridge span over the existing Southtown Road on the western side of the river, and a bridge span on the eastern side of the river to provide an underpass for existing businesses, enabling the new dual carriageway road to rise westwards towards the crest of the

new crossing.

2.3.2 If constructed, the Scheme would comprise the following principal elements:

- a new dual carriageway road, crossing the River Yare in an east-west orientation, comprising of:

- A new double-leaf bascule bridge providing an opening span to facilitate vessel movement within the river. This would include structures to support and accommodate the operational requirements of the bridge-opening mechanism, including counterweights below the level of the bridge deck. The bridge would be supported on driven piles;
- New substructures, supported by driven piles, to support the double leaf bascule bridge within the existing quays either side of the river and within the river itself, requiring new permanent "knuckle" walls, creating cofferdams in the waterway to accommodate their construction;
- A new five-arm roundabout connecting the new dual carriageway road with Suffolk Road, William Adams Way and the western end of Queen Anne's Road. Sections of the new five arm roundabout would be supported on driven piles where deep soft ground is encountered;
- A single-span bridge over Southtown Road, with reinforced earth embankments joining that bridge to the new roundabout at William Adams Way. Southtown Road bridge and the reinforced earth embankments would be supported on driven piles;
- A single-span bridge to provide an underpass on the eastern side of the river, with reinforced earth

embankments joining that single span bridge to South Denes Road. The underpass and reinforced earth embankments would be supported on driven piles; and

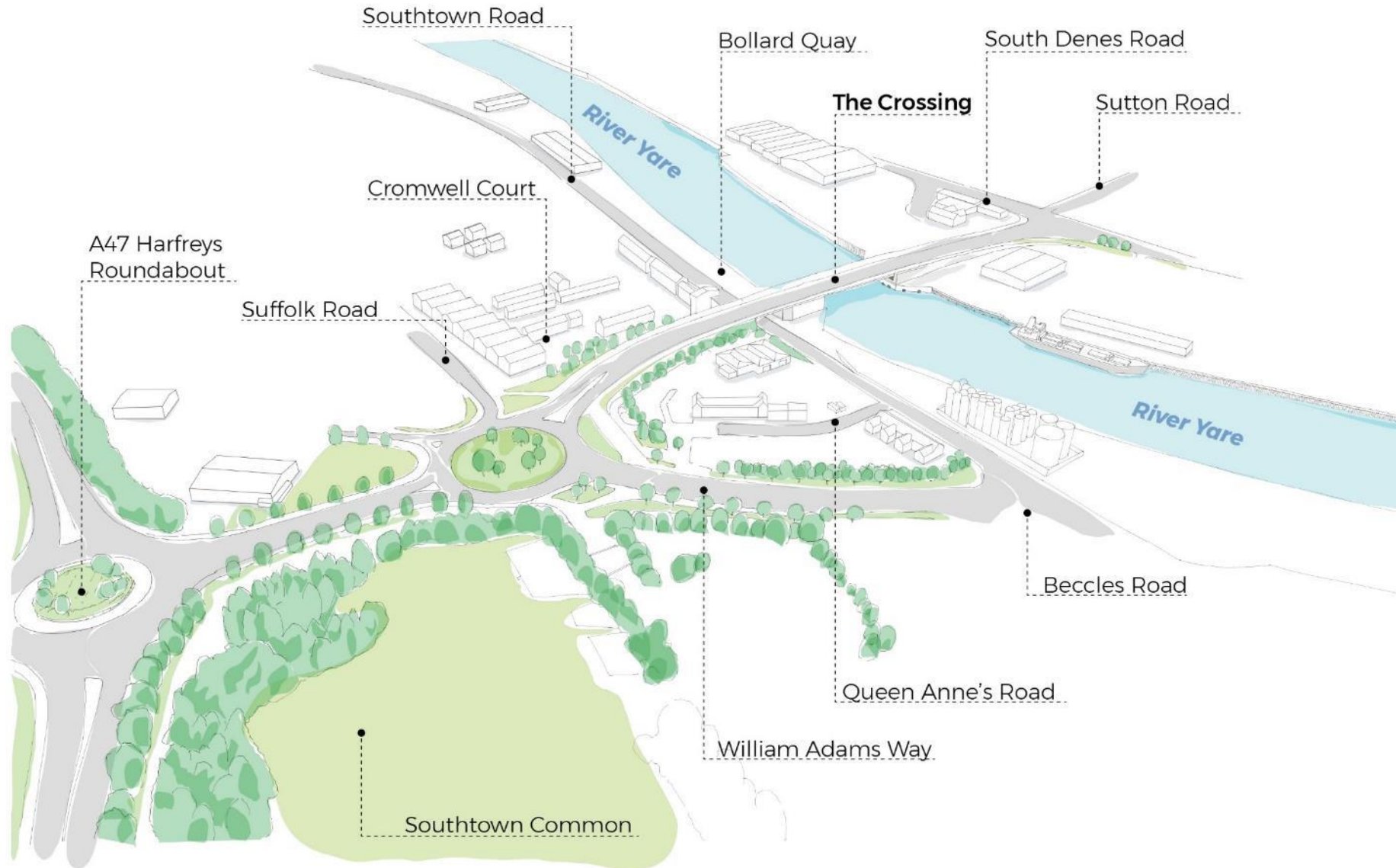
- A new signalised junction connecting the new road with A1243 South Denes Road.
- The closure of Queen Anne's Road, at its junction with Suffolk Road, and the opening of a new junction onto Southtown Road providing vehicular and pedestrian access to residential properties and the MIND Centre and Grounds at the eastern end of Queen Anne's Road;
- Revised access arrangements for existing businesses onto the local highway network;
- Dedicated provision for cyclists and pedestrians which ties into existing networks;
- Implementation of part of a flood defence scheme along Bollard Quay that is proposed to be promoted by the Environment Agency, and works to integrate with the remainder of the flood defence scheme;
- A control tower structure located immediately south of the crossing on the western side of the river. The control tower would facilitate the 24/7 operation of the opening span of the new double-leaf bascule bridge;
- A plant room located on the eastern side of the river for the operation of the opening span of the new double-leaf bascule bridge;
- The demolition of an existing footbridge on William Adams Way;
- Associated changes, modifications and/or improvements to the existing local highway network;

- Additional signage, including Variable Message Signs (VMS) at discrete locations, 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 Scheme and other works, including those at the MIND Centre and Grounds; and
- New public realm, landscape, ecology and sustainable drainage measures.

2.3.3 The Scheme also includes 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; and
- Provision of vessel waiting facilities to the north and south of the new crossing, either as floating pontoons or additional fendering to the existing berths, including any dredging and quay strengthening works that may be required.

Figure 2-3: Sketch overview of the Scheme design



3 Planning context

3.1 Introduction

- 3.1.1 The Case for the Scheme (CftS) (document reference 7.1) describes relevant policy and guidance applicable to the Scheme. For this reason, the Design Report only deals with policy relating to design matters.
- 3.1.2 Design is considered in national and local policy (as listed in 3.2 and 3.3 of this report) which the Scheme would adhere to throughout its development.
- 3.1.3 Guidance for the design of infrastructure projects within the urban realm has also been considered and is listed in 3.4 of this report.
- 3.1.4 See Section 7 of this report for a review of the design against the relevant sections of the National Policy Statement for National Networks (NPS NN).

3.2 National policy

National Policy Statement for National Networks²

- 3.2.1 The NPS NN urges applicants to include design as an integral consideration from the outset of a proposal. The Secretary of State will consider the application for development consent for the Scheme in accordance with the NPS NN.
- 3.2.2 Paragraphs 4.28 to 4.35 of the NPS NN describes the 'Criteria for "good design" for national network infrastructure'. The policy

2

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387223/npsnn-web.pdf

acknowledges that visual appearance should be a key factor in considering the design of new infrastructure, as well as functionality, fitness for purpose, sustainability and cost (paragraph 4.29). It also acknowledges that given the nature of much national network infrastructure development, there may be a limit on the extent to which it can contribute to the enhancement of the quality of the area (paragraph 4.30).

- 3.2.3 Paragraph 4.33 of the NPS NN advises the need for a Scheme to be sympathetic to its setting and contribute to the surrounding area:

"The applicant should therefore take into account, as far as possible, both functionality (including fitness for purpose and sustainability) and aesthetics (including the scheme's contribution to the quality of the area in which it would be located)."

- 3.2.4 Chapter 7 of this report reviews the Scheme design against this section of the NPS NN.

National Policy Statement for Ports³

- 3.2.5 Similarly to the NPS NN, the National Policy Statement for Ports (NPS for Ports) describes a criteria for good design, 'for port infrastructure' in Section 4.10. It explains that this goes far beyond aesthetics, the design must be "attractive, durable, and adaptable" whilst acknowledging that the options for appearance may be limited in a port environment.
- 3.2.6 Good design is referred to a number of times in the NPS for Ports, referring to particular aspects of port developments for consideration. In paragraph 3.3.8 of the NPS for Ports, it states:

3

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/3931/national-policy-statement-ports.pdf

“Good design is fundamental to mitigating the adverse effects of development, as well as a means to deliver positive aesthetic qualities in an industrial setting.”

3.2.7 It is acknowledged that the paragraphs relating to design in the NPS for Ports are not materially different to the equivalent ones within the NPS NN, and are therefore not reviewed separately in Section 7 of this report.

3.3 Adopted Local policy

The Great Yarmouth Local Plan: Core Strategy 2013-2030⁴

3.3.1 The Great Yarmouth Local Plan (adopted December 2015) establishes the spatial vision and objectives for the borough (outside of the Broads Authority Executive Area) to inform how it will develop and grow in the future.

3.3.2 Policy CS9 titled *‘Encouraging well-designed, distinctive places’* of the Core Strategy promotes the following items which are relevant to the Scheme design:

- *Drawing inspiration from the local area and built form characteristics, responding to the identity of the area*
- *Ensuring places are safe, attractive and functional*
- *Providing suitable facilities for pedestrians and cyclists*
- *Conserving and enhancing biodiversity*

3.3.3 Policy CS16 titled *‘Improving accessibility and transport’* sets out wider policies for the improvement of transport and

accessibility within the Borough and which supports proposals for a third river crossing over the River Yare.

3.3.4 The CftS provides a full description of this policy and its relevance to the Scheme.

Great Yarmouth Town Centre: Regeneration Framework and Masterplan⁵

3.3.5 The Great Yarmouth Town Centre Regeneration Framework and Masterplan was published in May 2017 by Great Yarmouth Borough Council. It presents the Council’s ambitions for regeneration in the town centre.

3.3.6 Whilst the Masterplan does not directly respond to the Scheme to provide direction, the proposals reflect the aspirations featured for waterfront activation and enhancements, referencing the opportunities that the Scheme would unlock for the town centre.

3.3.7 It explains:

“In the medium term, no single investment is likely to do more to boost the regeneration of the town centre than the proposed Third River Crossing. Costing over £100m, construction of this bridge would begin in 2021 to connect South Denes directly to Harfrey’s roundabout on the A47, with the potential to significantly relieve the town centre of port-related traffic.”

⁴ <https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=1884&p=0>

⁵ <https://www.great-yarmouth.gov.uk/CHttpHandler.ashx?id=2289&p=0>

3.4 Other guidance

Design manual for roads and bridges

- 3.4.1 The Design Manual for Roads and Bridges (DMRB) provides standards and advice for the design, assessment and operation of trunk roads and motorways in the United Kingdom. It contains a number of volumes which cover topics such as drainage, pavement design, road geometry, signage, lighting and so on.
- 3.4.2 The highway authorities retain the right to influence the design as required, and advise on any relaxations or departures required from the standards.
- 3.4.3 Situations may arise which require a relaxation or departure from standard to work with the site conditions, or accommodate necessary features of the Scheme. For example, a gap in the vehicle restraint system to allow pedestrian access to a staircase – could be considered a necessary and appropriate departure where the restraint is not continuous. These are explained in Appendix B ‘Departure from Standards Report’.
- 3.4.4 The design for the Scheme has generally been produced in accordance with the guidance and standards set out in the DMRB, as appropriate.

Manual for Streets⁶ (2007) and Manual for Streets 2 (2010)

- 3.4.5 The guidance set out in Manual for Streets and Manual for Street 2, is for the design of roads not classified as trunk

roads. The guidance advises how to enhance streets to create better places, mindful of distinctiveness and identity.

- 3.4.6 It is relevant to the Scheme’s connections with existing roads and works to other roads required as part of the Scheme.

Sustrans’ Design Guidance

- 3.4.7 Sustrans is a charity organisation who provide advice and collaborate with designers, to improve the safety and quality of pedestrian and cycle environments.
- 3.4.8 They provide a catalogue of design guidance⁷ documents which deal with good practice in design for walking and cycling.

Norfolk County Council: Highway guidance for development

- 3.4.9 Norfolk County Council’s website⁸ provides guidance for highway developments including residential areas, highways, and details on drainage and lighting.
- 3.4.10 Regarding residential streets, the guidance refers to the standards provided by Manual for Streets (described in 3.41 and 3.42 of this report).

‘A design led approach to infrastructure’

- 3.4.11 The Design Council is a Royal Charter charity that works and is recognised as a leading authority on the use of strategic design.

⁶https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/341513/pdfmanforstreets.pdf

⁷ <https://www.sustrans.org.uk/our-services/our-expertise/route-design/sustrans-design-guidance>

⁸ <https://www.norfolk.gov.uk/rubbish-recycling-and-planning/planning-applications/highway-guidance-for-development>

3.4.12 It published 'A design-led approach to infrastructure'⁹ in November 2012, which provides design principles applicable to infrastructure projects from all sectors to inform 'good design'.

3.4.13 These principles are intended to help NSIP applicants design successful proposals as set out in the criteria for good design in the National Policy Statements.

3.4.14 The design principles provide broad guidance that can be applied to the full spectrum of projects within the Planning Act 2008 regime, which may include (but is not limited to) projects in the energy, highways, rail, waste, water sectors. For this reason, the principles are a high-level consideration for NSIP schemes and may be interpreted in their relevance to each project.

3.4.15 The ten Design Council design principles are as follows:

1. *Setting the scene*
2. *Multi-disciplinary teamwork*
3. *The bigger picture*
4. *Site masterplan*
5. *Landscape and visual impact assessment*
6. *Landscape design*
7. *Design approach*
8. *Materials and detailing*
9. *Sustainability*
10. *Visitor Centre*

The UK National Infrastructure Commission

3.4.16 The National Infrastructure Commission (NIC) was established as an executive agency of HM Treasury on 24 January 2017.

3.4.17 The role of the Commission is to provide advice and make independent recommendations to government on national infrastructure priorities.

3.4.18 In the NIC report 'The Value of Design in Infrastructure Delivery'¹⁰ (July 2018) is explained:

"The National Infrastructure Commission wants to see design at the heart of national infrastructure planning – saving money, reducing risk, adding value and creating a legacy that looks good and works well."

3.4.19 As part of its work, NIC has compiled exemplar case studies, providing examples of infrastructure projects which have proved the use of 'good design' to reduce risk, add value, and look good.

3.4.20 From the twelve examples presented in the report, the NIC categorised the value of design into the following areas:

- *"Customer experience: user experience*
- *Social value: beyond users to wider community*
- *Placemaking: Identity of place and wider context*
- *Capital cost: investment up to bringing project into operation*
- *Whole life cost: maintenance and operation*

⁹ https://www.designcouncil.org.uk/sites/default/files/asset/document/A_design_led_approach_to_infrastructure_Cabe.pdf

¹⁰ https://www.nic.org.uk/wp-content/uploads/NIC_Value-of-Design_double.pdf

-
- *Environmental: carbon footprint and sustainability”*

3.4.21 The Applicant acknowledges the recommendations made by the NIC and their relevance to the delivery of the Scheme.

4 The approach to good design

4.1 Good design in infrastructure

- 4.1.1 Good design is a key factor in the success of infrastructure projects, and in the case of the Scheme, it will assist in achieving its objectives and securing benefits for Great Yarmouth.
- 4.1.2 The NPS for National Networks (NPS NN) and Ports (NPS for Ports) set out the 'Criteria for good design' which the Applicant has considered throughout the development of the Scheme design. The Scheme is reviewed against this policy in Section 7 of this report.
- 4.1.3 Good design means more than the appearance of a completed project. It is about the process undertaken to deliver a quality solution which is efficient, attractive and sustainable.

4.2 Achieving good design

- 4.2.1 The Applicant has engaged a multi-disciplinary expert team to produce the Scheme design included in the application. This includes but is not limited to architects, landscape and urban designers, engineering specialists and environmental specialists.
- 4.2.2 Through a collaborative and iterative approach to design, ideas were tested and design decisions made in order to arrive at a solution which is feasible from a buildability perspective.
- 4.2.3 The Applicant considers that the Scheme would be a new 'place' in Great Yarmouth, primarily providing a new route in

the town, whilst providing a positive pedestrian and cycling environment. This includes good connections to the existing networks, and designing for a user experience that is safe, appealing, and would encourage sustainable modes of transport in the town.

- 4.2.4 Where practicable, the Scheme aims to improve or enhance existing townscape as part of the proposals, and ensure that benefits for the communities and environment are realised.

4.3 Design Principles

- 4.3.1 The Applicant has developed Design Principles in response to the relevant policies and guidance summarised in Section 3 of this report.
- 4.3.2 The design principles for the Scheme are as follows:
- To support the regeneration of Great Yarmouth by improving strategic connectivity for the port, businesses and individuals, creating a positive experience for all users.
 - To integrate with and complement Great Yarmouth by providing a 'place', not just a piece of infrastructure.
 - To ensure an integrated design narrative that unites the various elements of the Scheme as a coherent whole.
 - To ensure the use of high quality materials and detailing that responds to the local context, cultural heritage and future aspirations of the town.
 - To minimise environmental impact and promote environmental sustainability.

- To create a safe, accessible and inclusive built environment.

4.3.3 The Applicant has developed the Design Principles into practical design requirements in Appendix A 'Approach to detailed design'. This document also identifies design aspirations and opportunities for further enhancement to be considered during the detailed design of the Scheme.

4.4 Influence of consultation on design

4.4.1 Through non-statutory consultation, statutory consultation, and stakeholder engagement, the design has been communicated to interested parties to ensure they are informed about the Scheme and have an opportunity to voice their views.

4.4.2 Non-statutory consultation involved engagement with affected parties and local groups to take into account their views during Scheme development and minimise adverse impact as so far as is practicable within the requirements of the Scheme. Particular areas of the Scheme design have been dealt with through meetings or direct correspondence with relevant parties.

4.4.3 Two non-statutory consultations were held during the development of the Scheme design, to keep local people and businesses informed of the emerging proposals. This also offered the Applicant a way to seek views on the design options that were being explored at the time for the opening mechanism of the bridge.

4.4.4 The majority of respondents to this consultation were in favour of the bascule bridge mechanism, rather than a swing bridge alternative.

4.4.5 A statutory pre-application consultation period was held during which the Scheme was presented to the public, who were notified through letters and local publicity of events and information available.

4.4.6 The Applicant sought engagement with local groups and relevant organisations to inform areas of the design such as the MIND Centre and Grounds and the allotments. Elements of the design were developed iteratively in response to consultation with this stakeholder.

4.4.7 A comprehensive explanation of the consultation undertaken for the Scheme is captured in the Consultation Report (document reference 5.1), which also presents the outcomes of the consultation, and level of support for the Scheme.

4.4.8 Elements of the Scheme design have been further developed for the Application through consultation and engagement activities. These are described further in Table 10-15 of the Consultation Report (document reference 5.1).

4.4.9 These refinements to the Scheme design as described by the Consultation Report broadly include:

- Amendments to the red line boundary (Order Limits)
- Removal of a large commercial vessel waiting facility
- Provision for a vehicle underpass beneath the structure

4.4.10 These changes have been undertaken for various reasons such as:

- To accommodate construction methods and associated vehicles

- To return land no longer required as part of the Scheme
- To improve or retain current operation on a property
- To retain green areas

or unforeseen circumstances can be accommodated through detailed design.

4.5 The Limits of Deviation

- 4.5.1 To ensure that the likely impacts of the Scheme can be suitably assessed and presented in the application, Limits of Deviation (LoD) have been set to provide parameters within which the final design must be constructed. The LoD stipulate minimum and/or maximum dimensions for relevant elements of the Scheme design.
- 4.5.2 The LoD are documented in Article 6 of the Development Consent Order (document reference 3.1) and assessed in the Environmental Statement (document reference 6.1).

4.6 Maintaining flexibility in design

- 4.6.1 The design submitted in this Application provides a buildable solution which may be assessed in terms of its environmental impact, and offers sufficient information to communicate what would be delivered by the Scheme.
- 4.6.2 Therefore the Application design should be read as a solution that aligns with the Design Principles of the Scheme, and would be refined through detailed design in accordance with the Appendix A: 'Approach to detailed design.'
- 4.6.3 The guidance set out in Appendix A provides assurance of the design quality that they implemented Scheme would achieve.
- 4.6.4 It is critical to have a degree of flexibility in what is secured by the Development Consent Order, to ensure future innovation

5 Site context

5.1 The site

- 5.1.1 The Scheme would be situated amongst residential, industrial, and port land uses providing a key new connection to the coastal peninsula east of the River Yare.
- 5.1.2 The location of the Scheme has been carefully considered for its strategic and operational benefits, as well as its connections to the existing highway networks.
- 5.1.3 Chapter 3 of the Environmental Statement (document reference 6.1) sets out the reasonable alternative locations and routes for the Scheme considered by the Applicant before the Principal Application Site was selected for the Scheme.
- 5.1.4 This section of the Design Report considers the context of the Principal Application Site chosen by the Applicant for the Scheme and its design opportunities and constraints.

5.2 Design opportunities

- 5.2.1 There are opportunities to realise public benefits and enhancements to the locality through design:
- Protecting and enhancing local bio-diversity
 - Improving walking and cycling facilities; including additional crossing points and the relocation of the southbound bus stop on Southtown Road
 - Utilising spaces around the structures to provide planting or public space where appropriate; including Bollard Quay
 - Making the opening mechanism of the bridge an

- ‘attraction’ to the area, to educate people about its engineering and method of operation
- Contributing to the identity of the town with quality products and materials which are sympathetic to their surroundings
- Providing a place for local groups to undertake meaningful community projects, such as artworks or planting, encouraging a sense of ownership and pride for the area.

5.3 Design constraints

- 5.3.1 The Scheme faces physical, social, environmental and financial constraints that are summarised below. The Applicant has considered these constraints carefully in the development of the design for which development consent is sought.

Physical

- Condition of existing site: location across a water body with quays, presence of structures to be demolished, topography to which the Scheme must connect with, ground conditions, utilities and other assets present in the area
- Land uses and activities: the Scheme borders residential, industrial and port uses and needs to maintain access and limit adverse impact on these parties
- Accessibility: the design must consider the needs of all users, providing safe, legible, and convenient routes
- Operational requirements: the Scheme design must accommodate all users including vehicular, non-motorised users, and vessels (through the inclusion of an opening span of the bridge). The air-draft (space between the

water level and the underside of the bridge) is restricted by the gradients required on the crossing to ensure safety and comfort is provided in line with good practice guidance.

Environmental

- Drainage and flooding: surface water run off and the potential for flooding must be addressed through the design.
- Ecology and habitat: the presence of species (including aquatic ecology) must be managed appropriately with consideration given to enhancing biodiversity through design, where appropriate and practicable.
- Coastal conditions: coastal conditions require appropriate tree and planting species. It has been noted that trees located north of the Scheme along South Quay were unsuccessful due to potential saline incursion and have since been removed.
- Townscape and visual impact: the Scheme would be a new feature within the townscape of Great Yarmouth.
- Other environmental issues including climate change adaptation and resilience.

Social and contractual

- Land ownership and acquisition: land would need to be possessed temporarily or permanently acquired to facilitate the construction, operation, and maintenance of the Scheme. The existing land uses, that would be affected or displaced by the Scheme, are a key consideration. It is important that the Scheme's land requirements are sufficient to secure deliverability of the

- Scheme but take no more land than is necessary to do so.
- Public acceptability: the design for the Scheme must be appropriate to its setting and contribute to the identity of the town to ensure locals and businesses can feel a sense of pride and ownership of the crossing. It also needs to be reliable and efficient to ensure minimal delay or inconvenience to people, road users and vessels.

5.3.2 Figures 5-1 and 5-2 illustrate some of the site constraints and considerations on the Scheme design in elevation and plan.

Figure 5-1: Elevation illustrating some of the constraints on the Scheme

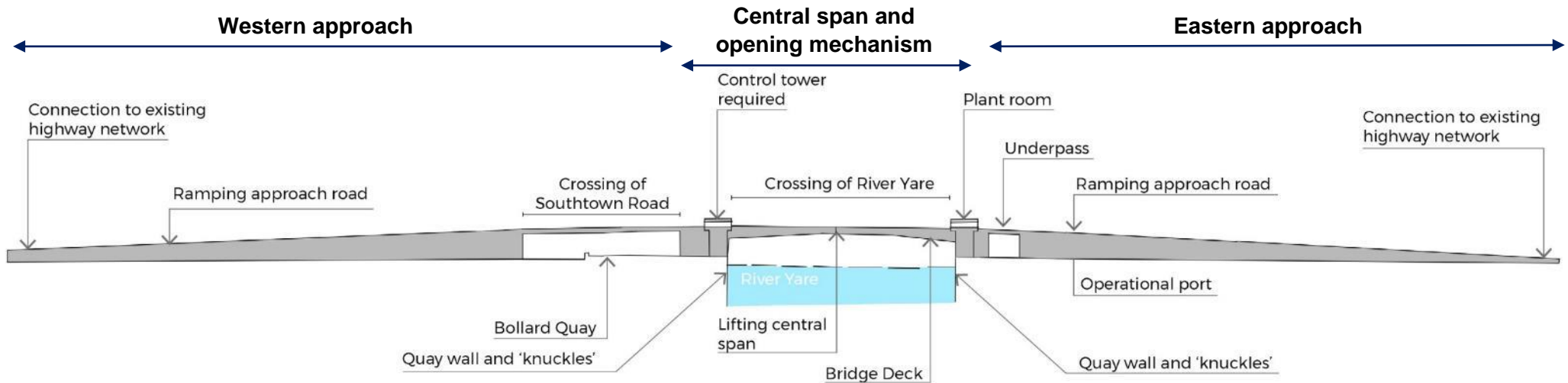
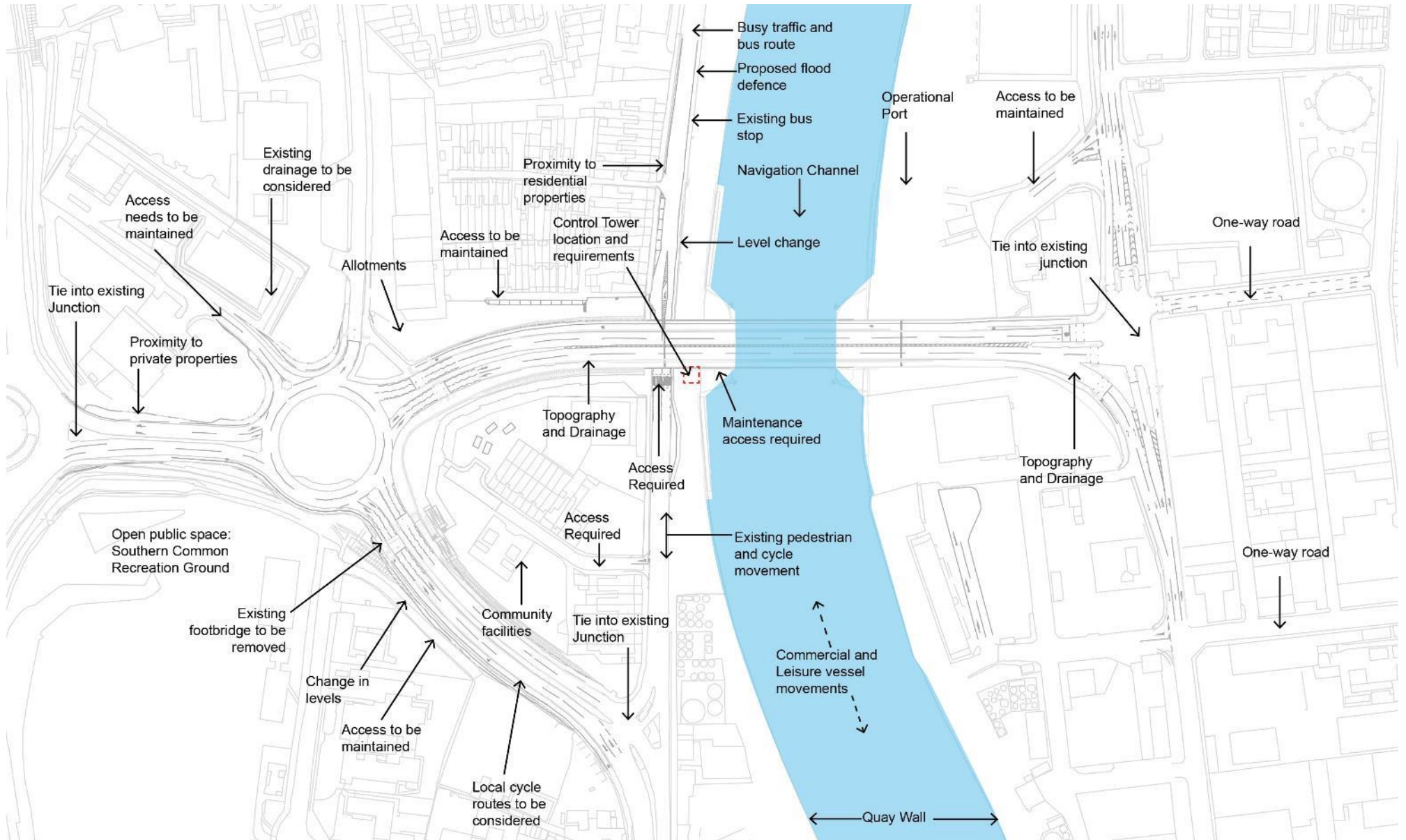


Figure 5-2: Plan illustrating some of the constraints on the Scheme



6 The Scheme design

6.1.1 This section of the Design Report explains the design for which the Applicant seeks development consent and how it was derived and alternative elements of the design that were considered but discounted. In particular the roundabout design (see paragraph 6.2.9 – 6.2.10) and the opening mechanism type (see paragraph 6.3.37 – 6.3.42).

6.1.2 For the purposes of explanation, the Scheme has been divided into the following geographical areas (as shown in Figure 6-1):

- Western approach
- Central span and opening mechanism
- Eastern approach

6.1.3 Within each of these areas, the following components of the design are explained where relevant:

- Highways design:
including carriageways, cycletracks, and pedestrian facilities
- Structures design:
including supporting substructure, the bridge, opening mechanism, control tower
- Public realm and landscape design:
including Bollard Quay public realm, other pedestrian/cycle connections, lighting, and planting

6.1.4 The section does not consider the Satellite Application Sites within which Variable Message Signs would be located. These are standard highways structures for which there is limited opportunity for further consideration of design.

6.1.5 The design for the Scheme has been produced in accordance with relevant standards and technical guidance, as described in Section 3 of this report.

6.1.6 Safety of all users has been considered throughout the development of the design, a road safety audit has been carried out – See Appendix C.

Figure 6-1: Areas of the Scheme as described by this report

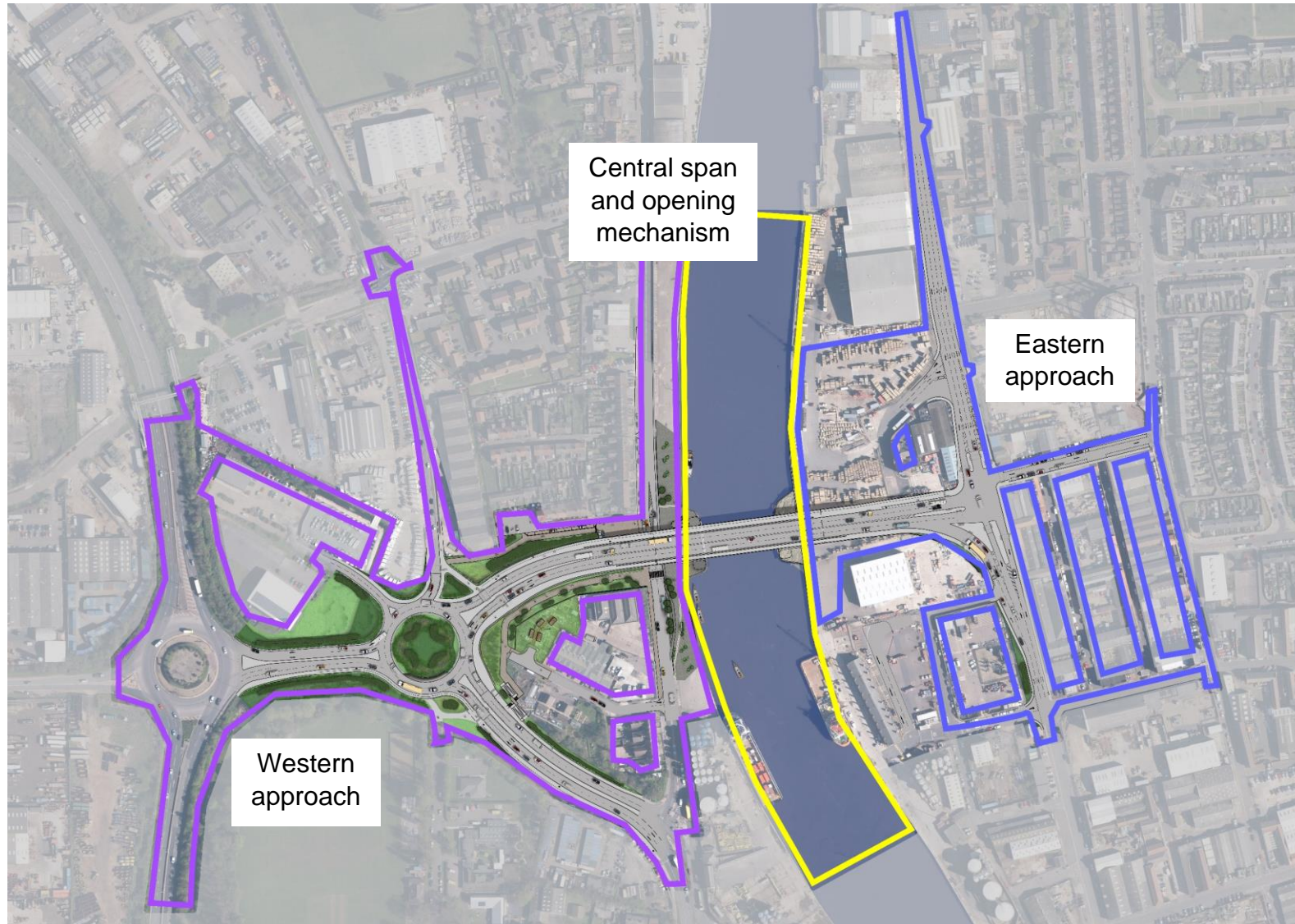


Figure 6-2: Indicative render of the Principal Application Site of the Scheme



6.2 Western approach

6.2.1 The western approach of the Scheme would comprise in summary:

- A new five-arm roundabout connecting the new dual carriageway road with Suffolk Road, William Adams Way and the western end of Queen Anne's Road;
- A single-span bridge over Southtown Road, with reinforced earth embankments joining that bridge to the new roundabout at William Adams Way;
- The closure of Queen Anne's Road, at its junction with Suffolk Road, and the opening of a new junction onto Southtown Road providing vehicular and pedestrian access to residential properties and the MIND Centre and Grounds at the eastern end of Queen Anne's Road;
- Revised access arrangements for existing businesses onto the local highway network;
- Dedicated provision for cyclists and pedestrians which ties into existing networks;
- Associated changes, modifications and/or improvements to the existing local highway network;
- The relocation of existing allotments to compensate for an area to be lost as a result of the Scheme and other works, including those at the MIND Centre and Grounds;
- New public realm, landscape, ecology and sustainable drainage measures;
- Demolition of a number of existing residential and commercial / business properties

Figure 6-3: The western approach area of the Scheme



Highway design

6.2.2 The highways design for the western approach comprises a vertically rising approach to the crossing, and connections of the Scheme to the surrounding road networks.

6.2.3 A roundabout is the most appropriate type of junction to accommodate the number of roads, and volume of traffic, meeting at this point. The roundabout would have five arms as follows:

- William Adams Way western arm (connecting to A47 Harfrey's roundabout)
- Queen Anne's Road arm
- Suffolk Road arm
- Arm connecting with the double leaf bascule bridge
- William Adams Way eastern arm

6.2.4 To cater for pedestrian and cycle users at the roundabout, controlled pedestrian and cycle crossing facilities would be provided across the William Adams Way eastern arm of the roundabout, the arm connecting the double leaf bascule bridge to the roundabout and across the Suffolk Road arm of the roundabout.

6.2.5 These crossings would connect into the existing network of walking and cycling routes on either side of these arms of the roundabout and on the northeast side of Queen Anne's Road, west of the new roundabout.

6.2.6 In accordance with relevant guidance and standards, the carriageways and footways have been designed to a maximum gradient of 5% or 1:20 slope for the comfort and safety of all users.

6.2.7 A new dual carriageway road would be provided between the roundabout and the double leaf bascule bridge. The alignment of the existing William Adams Way dual carriageway, on either side of the new roundabout, would be altered to tie-in with the new roundabout.

6.2.8 A central median would be provided for a short distance on some arms of the roundabout where required to accommodate the controlled crossing points.

6.2.9 An earlier alternative design for the proposed roundabout in this location included an access to Kingsgate Community Centre which allowed entry from eastbound traffic from Harfrey's roundabout and exit onto Suffolk Road (as shown in Figure 6-4).

6.2.10 The design proposed was preferred by those consulted and was considered by the design team to still meet the requirements of the Scheme, and so is included in the Scheme.

6.2.11 A new vehicular access to Queen Anne's Road would be provided from Southtown Road, with a turning head provided at the eastern section of Queen Anne's Road.

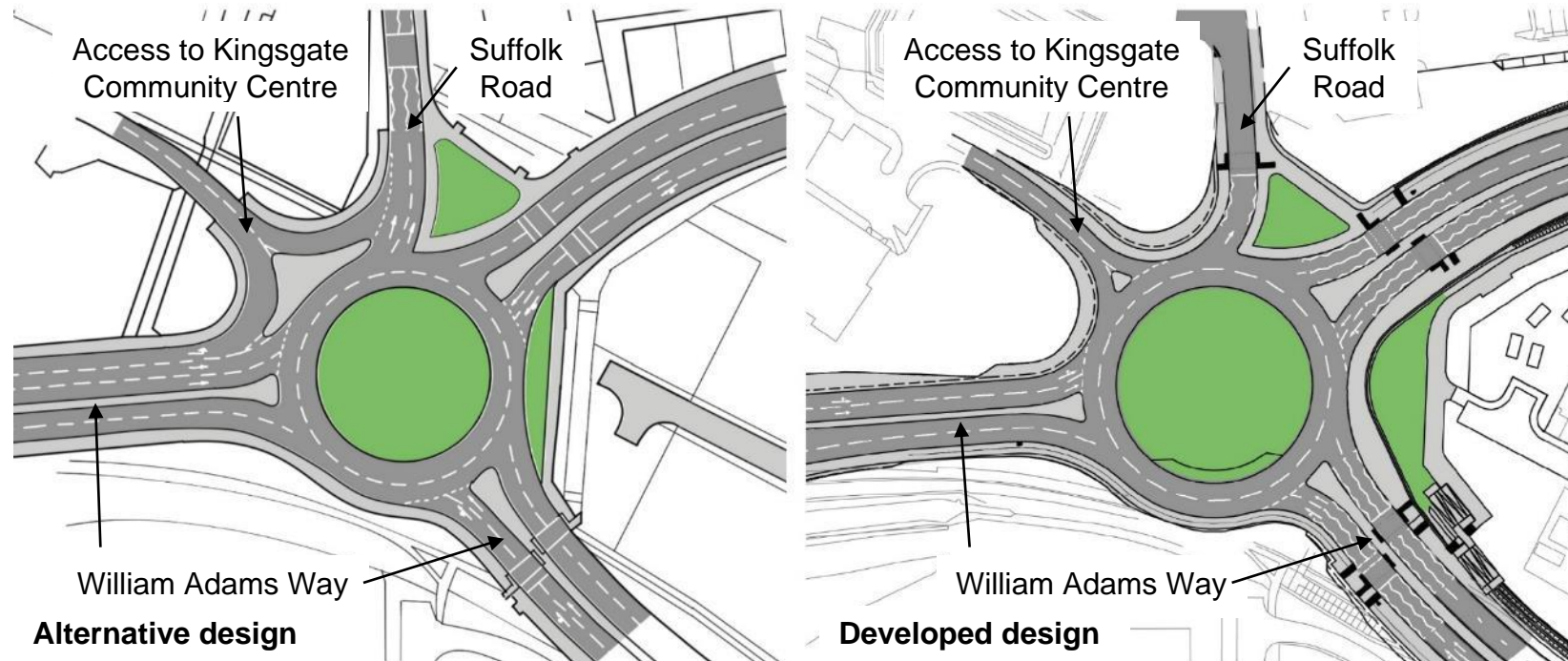
6.2.12 Access to Cromwell Road from Southtown Road is retained, with improved pedestrian facilities providing a connection to Suffolk Road and additional on street parking.

6.2.13 It was identified during early analysis of the site, that a southbound bus stop on Southtown Road would benefit from improvement, which could be included in the Scheme design.

6.2.14 The Scheme offers an opportunity to improve this bus stop facility, by relocating it, allowing space for a safer waiting/alighting area to be provided, and potentially a shelter, in line with good practice guidance.

6.2.15 A new controlled crossing is also proposed on Southtown Road, in proximity to the relocated bus stop.

Figure 6-4: Plans illustrating previous roundabout design and the developed design for access to Kingsgate Community Centre



Structures design

6.2.16 The structures proposed at the western approach include the pile supported reinforced earth embankments upon which the approach to the crossing rises upwards towards the opening span of the bridge, the span of bridge oversailing Southtown Road, and a control tower from which the opening span is operated.

6.2.17 From the crossing's connection to the proposed roundabout, the footways/cycletracks and carriageway rise towards the opening span.

6.2.18 This approach road would require a reinforced earth structure beneath the highway design to support it.

6.2.19 Sloped reinforced earth walls provide the structural support required to connect the highway to the proposed roundabout, and the existing ground levels.

6.2.20 These walls could either be finished with treatment such as concrete panel cladding, or a geotextile accommodating planting. Planting is the preferred solution, to soften the appearance of the structure and offer bio-diversity benefits.

6.2.21 The proposed levels of the new roundabout are higher than

the current level of Queen Anne’s Road. To account for the change in levels a retaining wall would be required to support the roundabout at this location.

- 6.2.22** At the point where the crossing oversails Southtown Road, the reinforced earth structure meets an abutment to allow an open span, through which non-motorised users and vehicles can continue to move beneath the crossing in a north to south direction along Southtown Road.
- 6.2.23** Near the corner of Cromwell Road and Southtown Road, a substation is required to power the opening mechanism of the bridge. It also provides a power source to the street furniture required on the bridge deck, such as highway lighting, wig-wag warning lighting (similar to that seen on level rail crossings), pedestrian and vehicle barriers.
- 6.2.24** Adjoining Bollard Quay wall north and south of the bridge structure, vessel waiting facilities are proposed to allow leisure craft a safe place to stop whilst awaiting a bridge lift sequence.
- 6.2.25** Separately to the development of the Scheme, the Environment Agency are developing flood defence improvements. Part of these works are situated within the order limits of the Scheme, between Southtown Road and Bollard Quay. The Applicant is working with the Environment Agency to integrate the Scheme with their proposals.
- 6.2.26** A footbridge currently located on William Adams Way would be demolished as part of the works to deliver the Scheme. Through the introduction of at grade crossings pedestrians and cyclists would be better accommodated, and accessibility for all improved in this area.

Public realm and landscape

- 6.2.27** The public realm and landscape on the western approach of

the Scheme would include the areas surrounding the highway alignment, an area of Bollard Quay, and remaining spaces within the Order Limits which the design looks to enhance. It would also include the replacement of allotments and community garden assets affected by the Scheme in this area, and environmental mitigation.

- 6.2.28** Pockets of space around the proposed roundabout offer the opportunity for varied landscaping to soften the streetscape visually and provide a soft buffer between carriageway and footway/cycletrack.
- 6.2.29** Either side of the embankment between Southtown Road and the proposed roundabout at William Adams Way, adequate space is required for maintenance access. This offers an opportunity to provide shared pedestrian and cycle routes at this location to enhance connectivity to Queen Anne’s Road and Suffolk Road from Southtown Road.
- 6.2.30** It is proposed that these routes feature landscaping to benefit bio-diversity and add visual interest, for which reason these routes are referred to as ‘green routes’. This also refers to the nature of them being routes only for pedestrians and cyclists.
- 6.2.31** The green routes would benefit from the new controlled crossing on Southtown Road providing safe access across the road for all users as shown in Figure 6-5.
- 6.2.32** Chapter 8 of the ES ‘Assessment of Nature Conservation’ (document reference 6.8) and the Code of Construction Practice (document reference 6.16) detail environmental mitigation, particularly for water voles and black redstarts. They include a series of measures related to nature conservation that are treated as ‘embedded’ mitigation.
- 6.2.33** With regards water voles, a mitigation protocol is outlined which includes retention and protection of existing habitat.
- 6.2.34** Where habitat cannot be retained, habitat enhancement of sub-

optimal watercourses would be provided in order to achieve an overall net gain in optimal water vole habitat within the design for the Scheme.

- 6.2.35 Though the ES does not conclude that black redstarts will be significantly impacted by the Scheme, mitigation measures are included to enhance the environment for this species.
- 6.2.36 Areas of the Principal Application Site will be reserved for the use of aggregates and low nutrient substrates in order to promote arid habitats.
- 6.2.37 Appendix A 'Approach to detailed design' deals with design for landscaping that would focus on this species, which has a preference for open brownfield sites.
- 6.2.38 East of Southtown Road lies Bollard Quay, an unused part of the operational port offering an informal pedestrian/cycletrack approximately 1 metre above road level. As a portion of the quay is required for bridge structures, this offers the opportunity to enhance the route and public realm offering here around the structure.
- 6.2.39 It is proposed that the area of Bollard Quay immediately surrounding the structure be reprofiled to provide an area at grade with Southtown Road. This would provide direct access for maintenance, and could be utilised as public realm with street furniture, tree planting, and the relocated bus stop.
- 6.2.40 To connect to the raised parts of Bollard Quay north and south of the Scheme, steps and ramps would be provided to ensure suitable access for all users. At this location, cyclists re-join the carriageway to the existing facilities (as shown in Figure 6-6).
- 6.2.41 The public realm design for Bollard Quay would be refined during detailed design, in general accordance with Appendix A 'Approach to detailed design'.
- 6.2.42 Land owned by the Great Yarmouth and Gorleston Allotment Association Limited located on the adjacent to the existing

junction of Suffolk Road and Queen Anne's Road is required for the Scheme. The Scheme relocates this land use to the west of the new roundabout.

- 6.2.43 The Applicant has endeavoured to minimise the impact of the Scheme on operations at the MIND Centre and Grounds adjacent to the allotments. Engagement has been undertaken with the organisation and occupiers of the land to understand their needs and how they might be accommodated within the Scheme design.
- 6.2.44 The MIND Centre and Grounds features outdoor artwork which may be reinstated as part of the Scheme. Affected parties were consulted with to change the design and minimise impact as so far as is practicable.
- 6.2.45 The Scheme would not affect the Southtown Common Recreation Ground, located to the southwest of the Scheme, outside of the Order Limits.

Figure 6-5: Indicative render from proposed controlled crossing on Southtown Road towards 'green route'



Figure 6-6: Indicative render view from Southtown Road towards Bollard Quay

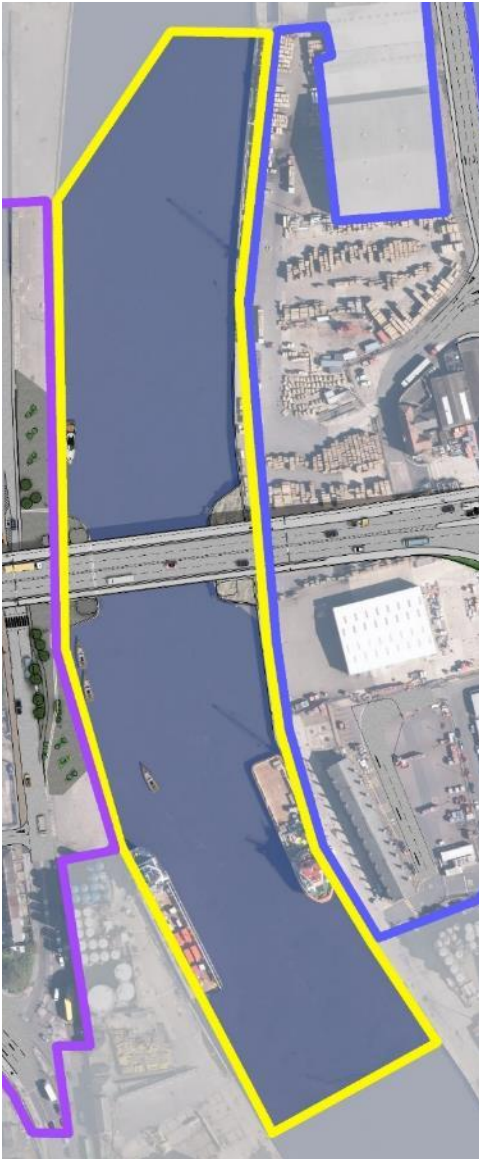


6.3 The central span and opening mechanism

6.3.1 The central span and opening mechanism of the crossing includes:

- A new double-leaf bascule bridge providing an opening span to facilitate vessel movement within the river. This would include structures to support and accommodate the operational requirements of the bridge-opening mechanism, including counterweights below the level of 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, requiring new permanent "knuckle" walls, creating cofferdams in the waterway to accommodate their construction;
- A control tower structure located immediately south of the crossing on the western side of the river. The control tower would facilitate the 24/7 operation of the opening span of the new double-leaf bascule bridge;
- A plant room located on the eastern side of the river for the operation of the opening span of the new double-leaf bascule bridge;
- Revised access arrangements for existing businesses onto the local highway network;
- Dedicated provision for cyclists and pedestrians which ties into existing networks.

Figure 6-7: The central span and opening mechanism area of the Scheme



Highway design

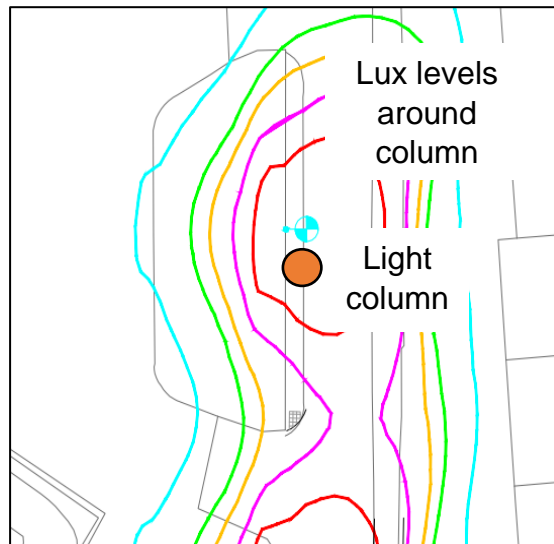
- 6.3.2 The highway in this location comprises of dual lanes in each direction and footway and cycletrack facilities on the crossing.
- 6.3.3 The highway reaches its highest point vertically, this point is constrained by the maximum gradient of 5% (or 1:20 slope) informed by good practice guidance and the DMRB and the need to tie into the existing ground levels on either side.
- 6.3.4 The structure requires appropriate vehicle restraint systems to comply with safety standards and protect the structure from impact. These are envisaged to be located either side of the carriageway, allowing a visually lighter parapet to be used on the outer edges of the bridge structure.
- 6.3.5 The use of a lighter parapet on the outer edges of the bridge deck would enhance the pedestrian visibility and experience on the bridge, and would accentuate a slender appearance of the bridge deck structure when viewed from afar.
- 6.3.6 Vehicular and pedestrian barriers, with wigwag lighting and associated safety equipment are required either side of the opening span on the bridge deck to alert bridge users of the imminent lifting of the bridge, and to stop the movement of traffic, pedestrians, and cyclists.
- 6.3.7 Appendix A 'Approach to detailed design' includes guidance on the refinement of the parapets, and other furniture to inform a coherent solution for the Scheme design.
- 6.3.8 The lighting design for the Scheme must be carefully considered on the bridge deck and areas surrounding the River Yare to ensure minimal glare or visual impact on vessels.
- 6.3.9 Lighting columns cannot be located on the opening span of the bridge, low level or integrated lighting would need to be considered during detailed design.
- 6.3.10 There is an opportunity for lighting to emphasise the structural components during hours of darkness and enable them to be

a feature in the town’s skyline and for passers-by.

6.3.11 Figure 6-8 illustrates the way highway lighting is designed and tested to ensure sufficient light levels across the highway.

6.3.12 Further information on the lighting considered for the Scheme can be found in Appendix D ‘Lighting Report’.

Figure 6-8: Diagram showing modelling of light columns to ensure sufficient lux



Structures design

6.3.13 The structure in this location would be made up of two bascule chambers, their supporting structures / foundations, and a Control Tower from which the opening span would be operated.

6.3.14 The opening span of the bridge would feature an orthotropic

type deck over the river which is typical of this type of structure, and minimises the weight of this span required to lift. This would be painted to ensure longevity of these structural components and ease of maintenance.

6.3.15 The bascule chambers would support the spans cantilevered from them over the river, and provide a space for the opening span of the bridge to move into during a bridge lifting sequence (as shown in Figure 6-9).

6.3.16 The opening mechanism requires a substantial supporting structure due to the length of the span across the river and the mechanism required to lift it. This includes the bascule chambers which house the hydraulic cylinders and counterweight when the bridge is raised.

6.3.17 The bascule chambers would be hollow structures located on the quayside, one on each side of the River Yare.

6.3.18 There is an aspiration to provide openings in the bascule chamber walls on Bollard Quay to allow the public to see inside the structure and expose these structural components as a feature, particularly during a lifting sequence.

6.3.19 To provide adequate space for the bascule chambers whilst minimising impact on the adjacent land uses, ‘knuckles’ are proposed to provide additional space required. These would be built out from the existing quay walls into the river and designed to withstand ship impact.

6.3.20 The ground conditions of the site are considered best suited to driven piles, rather than a bored alternative which is less suited to the ground conditions.

6.3.21 Protective fendering would be required around the structures in the River Yare and on the approach to the opening span to guide vessels to the navigation channel.

Figure 6-9: Indicative render of the opening span in lifted position



6.3.22 Efficiencies have been made in the development of the knuckle design, through the use of ‘cofferdam’ structures which are able to be permanent structures rather than just a temporary alternative to facilitate construction. A cofferdam is a watertight enclosure which would be pumped dry to permit construction work below the waterline of the River Yare.

6.3.23 The accessibility and safety of these components during construction and for maintenance, were important considerations in their development.

6.3.24 The visible area of the exposed sheet piles used for this foundation type could be painted if required.

6.3.25 A staircase would provide pedestrians with access from the bridge deck to Southtown Road, and it would be situated on Bollard Quay.

Control Tower design

6.3.26 A Control Tower would be required for the operation of the opening span by a bridge operator. This would include suitable welfare facilities for the operator, and house a plant room for electrical equipment associated with the opening mechanism.

6.3.27 The Control Tower would be located east of Southtown Road on Bollard Quay, as this is the most appropriate location for the functional requirements of the structure.

6.3.28 A number of locations were considered for the control tower, which had to take into account the functional and visibility requirements, accessibility for operators, structural efficiency and feasibility to construct, visual impact, and impact on local residents to ensure their privacy is retained.

6.3.29 Consultation with the statutory harbour authority and likely operator of the bridge aided development of the Control Tower design and its location.

6.3.30 The Control Tower would be designed to maximise the sightlines to marine traffic and the bridge users from the control room. This would be supplemented with closed circuit television cameras.

6.3.31 Careful consideration has been given to the design of the control tower to ensure it is sympathetic to its surroundings and provides a positive contribution to the site visually as it would be visible from a distance.

6.3.32 A plant room would also be located on the eastern edge of the River Yare to house electrical equipment for the opening mechanism.

6.3.33 There is an opportunity for this structure to mirror the visual appearance of the Control Tower on the opposite side of the River Yare through its massing and materials (Figure 6-11).

6.3.34 Appendix A ‘Approach to detailed design’ provides guidance on the refinement of the design of this structure.

Figure 6-10: Indicative render of the Control Tower



Figure 6-11: Indicative render of how the Control Tower and Plant Room structures could look



Lifting mechanism design

- 6.3.35 To provide commercial vessels with on demand passage up and down the River Yare, an opening span of the bridge would be required over the navigation channel.
- 6.3.36 The opening span is approximately 68m wide, providing a minimum navigable width of 50m between protective fendering. It would be operated from the Control Tower.
- 6.3.37 Various mechanism types were investigated during the development of the design for their appropriateness to the Scheme, considering factors such as: operational efficiency/reliability, vertical clearance achievable, cost (construction and whole life), visual impact, potential impact on port operations, and risk during construction.
- 6.3.38 The mechanism types and number of leaves (number of opening spans single meaning one span, double for two spans) considered include:
- Vertical lift bridge
 - Single leaf swing bridge
 - Twin leaf swing bridge
 - Single leaf swing bridge (cable stayed)
 - Twin leaf swing bridge (cable stayed)
 - Twin leaf bascule – **proposed for the Scheme**
 - Twin leaf bascule variations (including alternative location of counterweight and pivoting/rolling movements)
- 6.3.39 Assessment of the mechanism options was undertaken using criteria including but not limited to:

- Construction cost (superstructure)
- Construction cost (sub-structure)
- Other construction cost (Mechanical, Electrical, Instrumentation, Control, Automation)
- Whole life cost
- Reliability
- Operational efficiency and cost
- Maintenance and associated cost
- Available air-draft over the navigable channel in the river
- Land-take required
- Visual appearance

- Impact on the river
- Interface with river users
- Consequence of ship impact.

6.3.40 It was concluded through analysis and consultation of options, that a double leaf ‘trunnion’ bascule bridge was most appropriate in meeting the objectives of the Scheme.

6.3.41 Haven Bridge located north of the Scheme near Great Yarmouth town centre is also a double leaf trunnion bascule bridge.

Figure 6-12: Sketch of (discounted) swing bridge mechanism option



6.3.42 It was noted that a bascule bridge with horizontal counterweight, which rotated 'below deck' during an opening sequence, meets the operational requirements of the Scheme and offers the following benefits:

- The below-deck simple trunnion option is a 'tried and trusted' form of construction for these site conditions and constraints. For the below-deck counterweight trunnion option, the bascule span is supported by simple trunnions under the crossing carriageway.
- The opening span consists of two leaves or sections which cantilever over the river and meet in the middle over the navigation channel. These leaves are balanced in position by a counterweight located horizontally on the land side of each leaf.
- The two leaves rotate about a fixed point known as a 'trunnion', enabled by actuators such as hydraulic cylinders.
- The counterweight, trunnions, and bridge operating machinery are contained within the bascule pier. This arrangement provides long-term reliability and durability of the structure by protecting the machinery and counterweight from the environment, adverse weather conditions, and unauthorised personnel.
- The below deck simple trunnion option provides a design solution that may provide an efficient lifting cycle time, minimise initial and maintenance costs, and provide reliability,
- The counterweight and machinery can be accessed for routine maintenance mainly without closing the bridge to traffic or using overhead access equipment.

- The below deck counterweight type deck gives a simplified appearance when compared with an above-deck counterweight alternative design. This design incurs the least visual impact on the surrounding environment when compared with alternatives.

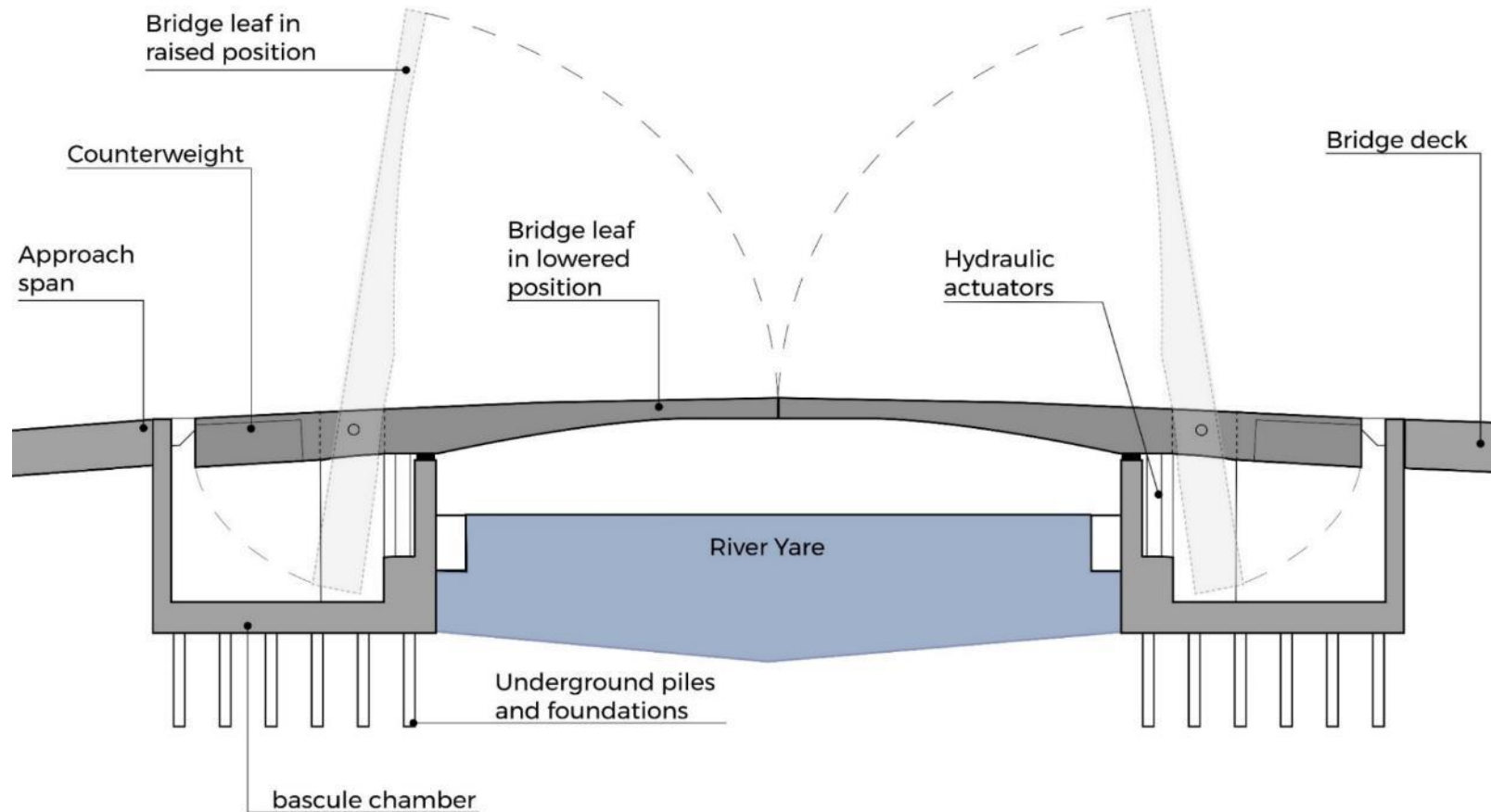
6.3.43 This mechanism features two symmetrical spans which rotate about a fixed point or 'trunnion' each supported by a bascule chamber on either side of the river.

6.3.44 '*Bascule*', meaning 'see-saw' in French relates to the counterweight located horizontally at the 'approach span' side of each span which balance the structure in its closed position.

6.3.45 This type of mechanism incurs less visual impact than alternative mechanisms which could have located the counterweight above the bridge deck, such as the Breydon Bridge design (located on the A47, north of the Scheme).

6.3.46 This design also allows the mechanism components to be concealed by the bascule chambers, therefore separate to the publicly accessible areas of the Scheme.

Figure 6-13: Diagram showing the components of a twin-leaf bascule bridge mechanism



6.3.47 The opening mechanism has been designed to operate in prevailing winds of up to 20m/s (ten-minute average) wind speed, which is typical of an opening bridge in this setting.

6.3.48 During a bridge lift sequence, hydraulic cylinders located centrally beneath each leaf, work to lift the spans upwards.

6.3.49 The counterweight aids this movement, tilting downwards as the bridge lifts, into hollow structures, the bascule chambers.

6.3.50 There are a number of variables in the hydraulic cylinder design, including the number used (two, three, or four per leaf), and their location centrally or at the extents of the bridge deck. This depends on the weight of the bridge deck to be lifted, the accessibility for maintenance, and redundancy – which would allow the bridge to lift even in the unlikely event of a cylinder failing.

6.4 Eastern approach

6.4.1 The eastern approach includes

- A single-span bridge to provide an underpass on the eastern side of the river, with reinforced earth embankments joining that single span bridge to South Denes Road;
- A new signalised junction connecting the new road with A1243 South Denes Road;
- Revised access arrangements for existing businesses onto the local highway network;
- Dedicated provision for cyclists and pedestrians which ties into existing networks;
- Associated changes, modifications and/or improvements to the existing local highway network.

Highway design

6.4.2 The highway design in this location connects the crossing to South Denes Road by means of a signalised T-junction arrangement with controlled crossing facilities.

6.4.3 Traffic modelling undertaken as part of the design development process ensures the design can withstand predicted traffic volumes and accommodate their movements with the new crossing in place.

South Denes Road would be reconfigured in this location to include pedestrian refuge islands, to allow staggered crossing movement.

Figure 6-14: Eastern approach area of the Scheme



- 6.4.4 To improve the connection of Sutton Road and Swanston's Road to the Scheme, these side roads would be subject to improvements. The one-way system would be reversed, and formal parking bays introduced.

Structures design

- 6.4.5 The structure in this area of the Scheme comprises pile supported reinforced earth walls supporting the crossing as it slopes down to connect with existing ground levels at South Denes Road.
- 6.4.6 There is an underpass provided beneath the crossing, east of the knuckle in this location to allow a private means of access for vehicles across the operational port land (as shown in Figure 6-15).
- 6.4.7 There is a substation required in this area to power the opening mechanism of the bridge, and any street furniture required in this area of the Scheme, such as highway lighting, wig-wag warning lights, and the pedestrian and vehicle barriers on the bridge.

6.5 Sustainability considerations for the Scheme design

- 6.5.1 The following are considerations which would be made during detailed design to promote sustainable practices in the Scheme's design and construction.
- 6.5.2 Where reasonably practical, sustainable and low energy materials would be used for the Scheme design, to minimise greenhouse gas emissions during construction and operation.

Figure 6-15: Indicative render of the underpass for vehicles on operational port land



- 6.5.3 The face of the reinforced earth embankments on the west approach would be constructed at approximately a 70-degree slope to the horizontal and would be vegetated. This solution actively reduces greenhouse gases as the flora absorb excess CO² in the atmosphere.
- 6.5.4 The Scheme would use planting and landscaping which offers environmental and ecological benefits.

-
- 6.5.5 The use of a piled embankment would provide the opportunity to reuse material on site as fill if appropriate, which would reduce the need to transport material.
 - 6.5.6 The vehicle restraint system for the crossing is envisaged to be immediately adjacent to the carriageway, rather than on the outer edges of the structure. This location would enable efficiency in the structural loading, which can result in a material saving throughout when compared with other locations.
 - 6.5.7 Any feasible reduction in bridge deck weight would result in a reduced counterweight, which in turn would have a lower operational load/ demand on the proposed mechanical and electrical equipment.
 - 6.5.8 The use of permanent foundation solutions, rather than temporary ones offers efficiencies in the construction method, reduction of waste material, and the overall use of materials.

7 Reviewing the design

7.1 National Policy Statement for National Networks accordance design review

- 7.1.1** The following table reviews the Scheme design and its adherence to paragraphs 4.28 to 4.35 of the National Policy Statement for National Network (NPS NN) which sets out the “Criteria for ‘good design’” for National Networks. The NPS NN outlines policy to guide the development of NSIPs forming part of national road and rail networks in England, and is the primary policy for the Scheme.
- 7.1.2** This section does not include a review of the Scheme with the National Policy Statement for Ports (NPS for Ports) as the relevant policy described in 4.10 of the NPS for Ports is not considered materially different in so far as it is relevant to the design of the Scheme.
- 7.1.3** This chapter expands on the policy compliance assessment contained within the Case for the Scheme (document reference 7.1).

Table 1: Review of the Scheme design for its adherence to the “Criteria for ‘good design’” set out in the NPS NN.

National Policy Statement for National Networks (NPS NN)		
Paragraph number:	Requirement:	Scheme compliance:
4.28	<i>Applicants should include design as an integral consideration from the outset of a proposal.</i>	<p>This report explains the iterative and multi-disciplinary design process that was undertaken for the Scheme, demonstrating how the Applicant has arrived at a considered solution.</p> <p>It also presents the Design Principles which were prepared by the Applicant, to give direction to the design from the outset.</p> <p>It explains the constraints acting on the Scheme, which informed the design and its limitations. It also presents alternative ideas that were considered in the design and explanation of how they were developed through an iterative process and consultation.</p>
4.29	<i>Visual appearance should be a key factor in considering the design of new infrastructure, as well as functionality,</i>	The Scheme design is appropriate to its setting in the context of its location at the meeting of industrial port uses, residential properties,

	<p><i>fitness for purpose, sustainability and cost. Applying “good design” to national network projects should therefore produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction, matched by an appearance that demonstrates good aesthetics as far as possible.</i></p>	<p>and commercial land uses.</p> <p>The Applicant has produced a design for the Scheme which compliments its surroundings visually and is ‘honest’ in its form by presenting its function through its appearance.</p> <p>The Appendix A of this Design Report ‘Approach to detail design’ provides a framework for ensuring that ensures that the sustainable infrastructure comprised in the design of the Scheme will be developed through detailed designed with good aesthetics as far as is possible.</p> <p>It is considered that superfluous material to provide any decorative feature is unnecessary for the Scheme design, particularly the structures. The form of the crossing is a celebration of the simplicity of its engineering function and the bascule bridge (meaning ‘see-saw’ in French).</p>
<p>4.30</p>	<p>It is acknowledged however, that given the nature of much national network infrastructure development, particularly SRFIs, there may be a limit on the extent to which it can contribute to the enhancement of the quality of the area.</p>	<p>The design for the Scheme includes appropriate contribution to the enhancement to the quality of the area through its provision of new transport connections, public realm and biodiversity enhancement. The quality of its aesthetics are secured through Appendix A ‘Approach to Detailed Design’. Fundamentally, the Scheme remains functional infrastructure and the design recognises this constraint.</p>
<p>4.31</p>	<p><i>A good design should meet the principal objectives of the scheme by eliminating or substantially mitigating the identified problems by improving operational conditions and simultaneously minimising adverse impacts. It should also mitigate any existing adverse impacts wherever possible, for example, in relation to safety or the environment. A good design will also be one that sustains the improvements to operational efficiency for as many years as is practicable, taking into account</i></p>	<p>The design meets the objectives of the Scheme in supporting the growth of the renewable energy sector and port industries in the area. It responds to its setting and aims to minimise adverse impacts where possible. The opening span of the bridge is designed to offer unlimited air-draft for vessels who require passage through the crossing, it is operated from a Control Tower on site to ensure safety is a top priority. As described in 6.3.35 – 6.3.50 of this report, a number of opening mechanism options were considered, and the developed design chosen for its operational and cost efficiency.</p>

	<i>capital cost, economics and environmental impacts.</i>	The Applicant has considered the future-proofing requirements of the design to ensure it works with other development in the area, and provides adaptable public realm.
4.32	<i>Scheme design will be a material consideration in decision making. The Secretary of State needs to be satisfied that national networks infrastructure projects are sustainable and as aesthetically sensitive, durable, adaptable and resilient as they can reasonably be (having regard to regulatory and other constraints and including accounting for natural hazards such as flooding).</i>	<p>The Scheme design has been produced in accordance with good practice guidance and relevant standards to ensure a safe, resilient solution can be delivered. The Applicant acknowledges the importance of good design for the legacy that this Nationally Significant Infrastructure Project has as structure set in a community with approximately a 120-year design life.</p> <p>The Applicant has been working with the Environment Agency in their development of proposals for flood defences in proximity to the Scheme. The design is able to accommodate the likelihood of flood defences being required.</p> <p>An assessment of the Scheme's resiliency to climate change is included in Chapter 16 of the Environmental Statement (document reference 6.1).</p>
4.33	<i>The applicant should therefore take into account, as far as possible, both functionality (including fitness for purpose and sustainability) and aesthetics (including the scheme's contribution to the quality of the area in which it would be located). Applicants will want to consider the role of technology in delivering new national networks projects. The use of professional, independent advice on the design aspects of a proposal should be considered, to ensure good design principles are embedded into infrastructure proposals.</i>	<p>As outlined in this Design Report, the Applicant's multi-disciplinary design team have enabled an iterative and collaborative approach to design to ensure the solution is considered and appropriate whilst meeting the Scheme's objectives. Throughout the development of the design, frequent reviews of the emerging proposals allowed refinement amongst the disciplines to find a balance between the functional and aesthetic requirements.</p> <p>In terms of technology, the Scheme utilises Variable Message Signs (VMS) to inform vehicles approaching the crossing to ensure they can make an informed decision on the best route to take.</p>
4.34	<i>Whilst the applicant may only have limited choice in the physical appearance of some national networks infrastructure, there may be opportunities for the</i>	The Scheme harnesses opportunity to enhance its connections with the existing surroundings through the public realm and planted areas on the western approach offering amenity benefit and routes for

	<p><i>applicant to demonstrate good design in terms of siting and design measures relative to existing landscape and historical character and function, landscape permeability, landform and vegetation.</i></p>	<p>pedestrians and cyclists. The refinement of these areas during detailed design will look to provide bio-diversity benefit where possible as part of the Scheme, responding to the presence of species in the locality. This would be delivered in general accordance with Appendix A ‘Approach to detailed design’ which secures the delivery of good design.</p>
<p>4.35</p>	<p><i>Applicants should be able to demonstrate in their application how the design process was conducted and how the proposed design evolved. Where a number of different designs were considered, applicants should set out the reasons why the favoured choice has been selected. The Examining Authority and Secretary of State should take into account the ultimate purpose of the infrastructure and bear in mind the operational, safety and security requirements which the design has to satisfy.</i></p>	<p>This Design Report supplements the application by explaining the design for which consent is sought and how it evolved during its development. It describes where alternative ideas were considered for components of the design to offer the most appropriate solution, or in response to consultation.</p> <p>Chapter 5 of the Environmental Statement (document reference 6.1) considers the reasonable alternatives considered by the Applicant. This Design Report summarises the design iterative design process undertaken to date and Appendix A ‘Approach to detailed design’ explains how the design for the Scheme will be developed through the detailed design process. Alternative elements of the design that were considered but discounted are described by this report. In particular the roundabout design (see paragraph 6.2.9 – 6.2.10) and the opening mechanism type (see paragraph 6.3.37 – 6.3.42).</p> <p>Security considerations are described in the Case for the Scheme (document reference 7.1). In summary, the threat of hostile vehicles is considered low in Great Yarmouth though vehicle restraint systems included in the design will provide a deterrent to reduce the risk of such events.</p>

8 Next steps

8.1 Approach to detailed design

- 8.1.1 The Scheme design allows flexibility for further development, innovation, and enhancement through detailed design (within the parameters assessed by the environmental statement and secured through the limits of deviation).
- 8.1.2 Consideration has been given to how components of the Scheme design can be developed to ensure continuity with the approach to 'good design' that underpins the design as described in Section 4 of this report.
- 8.1.3 To capture the approach to be taken during detailed design, a guide has been prepared: Appendix A: 'Approach to detailed design guide'.
- 8.1.4 The guide details components of the Scheme design which concern visual / aesthetic appearance.
- 8.1.5 The use of a guide ensures continuity of design and design quality and to ensure that expectations for contractor commitments in the detailed design process are clearly communicated and understood.
- 8.1.6 The guide therefore provides a mechanism for safeguarding the principles of good design that are embedded within the reference design through the detailed design and construction of the Scheme.
- 8.1.7 Further to the content of the guide forming Appendix A of this report, the Contractor team undertaking detailed design and construction may benefit from the use of independent third-party expert advice.
- 8.1.8 Additionally, the Contractor team may consider the use of

'Civil Engineering Environmental Quality Assessment and Award Scheme' (CEEQUAL) or similar, for assessing the benefits realised by the Scheme during detailed design.

- 8.1.9 CEEQUAL is an evidence-based sustainability assessment, rating and awards scheme for civil engineering, infrastructure, landscaping and public realm projects.

