Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 3A: Options Assessment Report

Planning Act 2008

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

APFP regulation Number: 5(2)(a)

Planning Inspectorate Reference Number: TR010043

Author: Norfolk County Council

Document Reference: 6.2 – Technical Appendix 3A

Version Number: 0 – Revision for Submission

Date: 30 April 2019

Great Yarmouth Third River Crossing

Options Assessment Report

May 2016

Produced for
Norfolk County Council

Prepared by
Mouchel

Export House
Cawsey Way
Woking
Surrey
GU21 6QX
UK

Document Control Sheet

Project Title	Great Yarmouth Third River Crossing
Report Title	Options Assessment Report
Report ref no.	
Version	5
Status	Final
Report Date	31 May 2016

Record of Issue

Version	Status	Author	Date	Checked by	Date	Approved by	Date
1	Draft	Rob Surl					
3	Draft	Rob Surl	19 May 2016				
4	Draft	Rob Surl	22 May 2016				
5	Final	Rob Surl	31 May 2016	DW	31 May 2016	JL	31 May 2016

Distribution

Date	Organisation	Contact	Format	Copies
19 May 2016	Mouchel	J Lyon, D Wildman, Brijesh Singh, Amanda Fogg	E	
22 May 2016	Mouchel	J Lyon, D Wildman, Brijesh Singh, Amanda Fogg	E	
31 May 2016	Norfolk County Council	Ian Parkes	E	

Limitations

This report is presented to Norfolk County Council in respect of the Great Yarmouth Third River Crossing and may not be used or relied on by any other person. It may not be used by Norfolk County Council in relation to any other matters not covered specifically by the agreed scope of this Report.

Notwithstanding anything to the contrary contained in the report, Mouchel Limited is obliged to exercise reasonable skill, care and diligence in the performance of the services required by [Client Name] and Mouchel Limited shall not be liable except to the extent that it has failed to exercise reasonable skill, care and diligence, and this report shall be read and construed accordingly.

This report has been prepared by Mouchel Limited. No individual is personally liable in connection with the preparation of this report. By receiving this report and acting on it, the client or any other person accepts that no individual is personally liable whether in contract, tort, for breach of statutory duty or otherwise.

Acknowledgment

This report quotes extensively from earlier reports commissioned by Norfolk County Council from Mott MacDonald, including the Stage 1 and Stage 2 Scheme Assessment Reports and Traffic & Economic Appraisal Reports, and the supporting technical reports quoted in these.

Mapping

Maps and plans in this report are based upon the Ordnance Survey map with the sanction of the Controller of Her Majesty's Stationery Office.

AL100019340

Contents

Table of figures

Tables

1 Introduction

1.1 Overview

This report describes the first stage of the Transport Appraisal for the proposed Great Yarmouth Third Crossing, and will support subsequent stages leading eventually to the submission of a full business case. It is structured in general accordance with Department of Transport (DfT) guidance[1].

The first stage of a transport scheme appraisal involves identifying the need for an intervention, and developing options to address a clear set of locally defined objectives. These options are then sifted to enable the better performing option(s) to be taken on to further, more detailed, appraisal in Stage 2.

DfT guidance states that appraisals to be undertaken in a proportionate manner and with a 'lighter touch' approach, where appropriate. In the early stages of appraisal, it may not be cost-effective or feasible to appraise a large number of options in great detail. However, the option assessment process must ensure that proposals are developed in a robust manner, supported by fit-for-purpose and proportionate analysis. This work should form a sound basis for identifying problems and developing solutions.

This report:

- Sets out the rationale for the scheme, based on clearly identified problems and challenges
- Describes the consideration of genuine, discrete options and a range of solutions
- Clearly identifies the best performing option(s) which will be subject to further appraisal
- Summarises the public and stakeholder support for the scheme and describes the engagement processes.

1.2 Location of the proposed scheme

Great Yarmouth is located about 30 km east of Norwich on Norfolk's North Sea coast. The Great Yarmouth urban area, as defined by the Office of National

[1] Transport Analysis Guidance (WebTAG): The Transport Appraisal Process (January 2014), Paragraphs 2.1 – 2.11

Statistics, has a population of about 68,000[2]. The wider Borough of Great Yarmouth has a population of about 97,000[3] people.

Figure 1-1 Location of Great Yarmouth

Great Yarmouth is located further east than any other town in the UK, apart from Lowestoft. It is connected to Norwich and Lowestoft by rail, and by road. The A47 from Norwich, the A12 from Lowestoft, and the A143 from Gillingham terminate in the town.Great Yarmouth is, by virtue of its location, relatively isolated. It is a destination, but not a place that people pass through.

Great Yarmouth lies at the mouth of the River Yare, which separates the town from the other parts of the Borough. The River Yare is navigable to small coastal vessels between Norwich and the North Sea. The historic town centre and sea front lie on a narrow peninsula, sandwiched between the river and the sea. It is linked to Gorleston-on Sea and other parts of the Borough by two bridges over the river:

- The Haven Bridge (two lanes in each direction, single carriageway)
- The A12 Breydon Bridge (one lane in each direction, single carriageway)

[2] Population 68,317 in 2002 (ONS)

[3] Population 97,277 in the 2011 census

Both are lifting bridges, to enable boats and ships to pass through. To the west of Breydon Bridge lies Breydon Water, a large, sheltered estuary which forms the gateway to the Norfolk Broads. It is a SSSI and Local Nature Reserve.

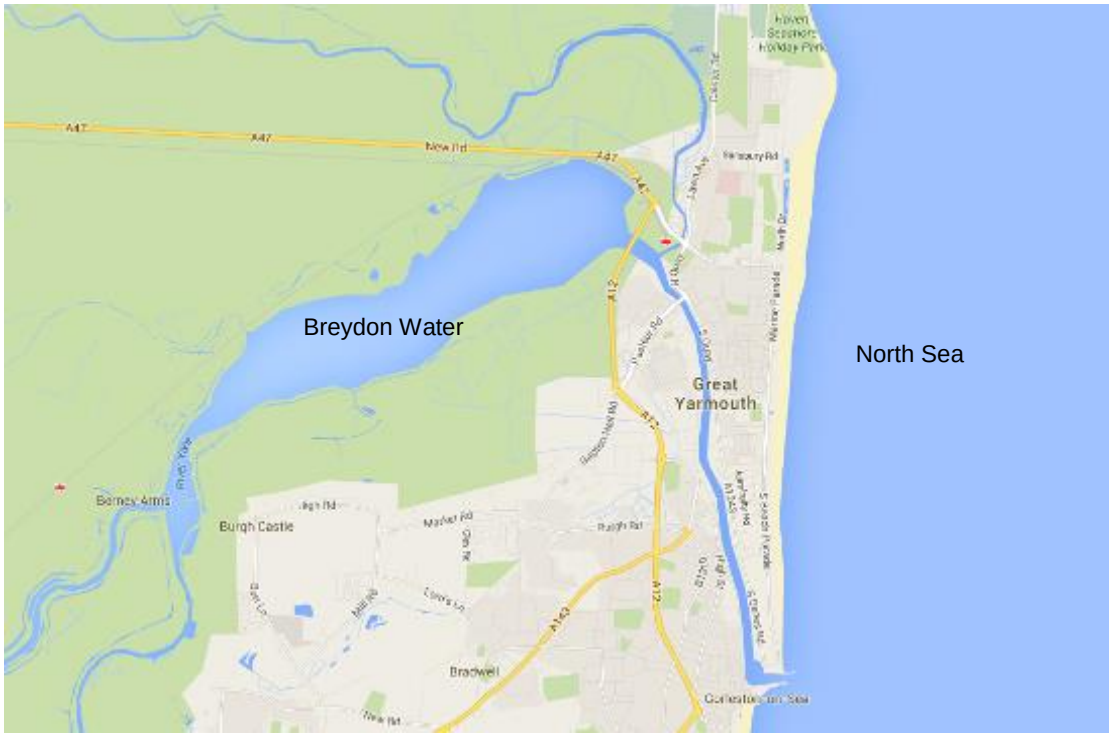


Figure 1-2 Great Yarmouth

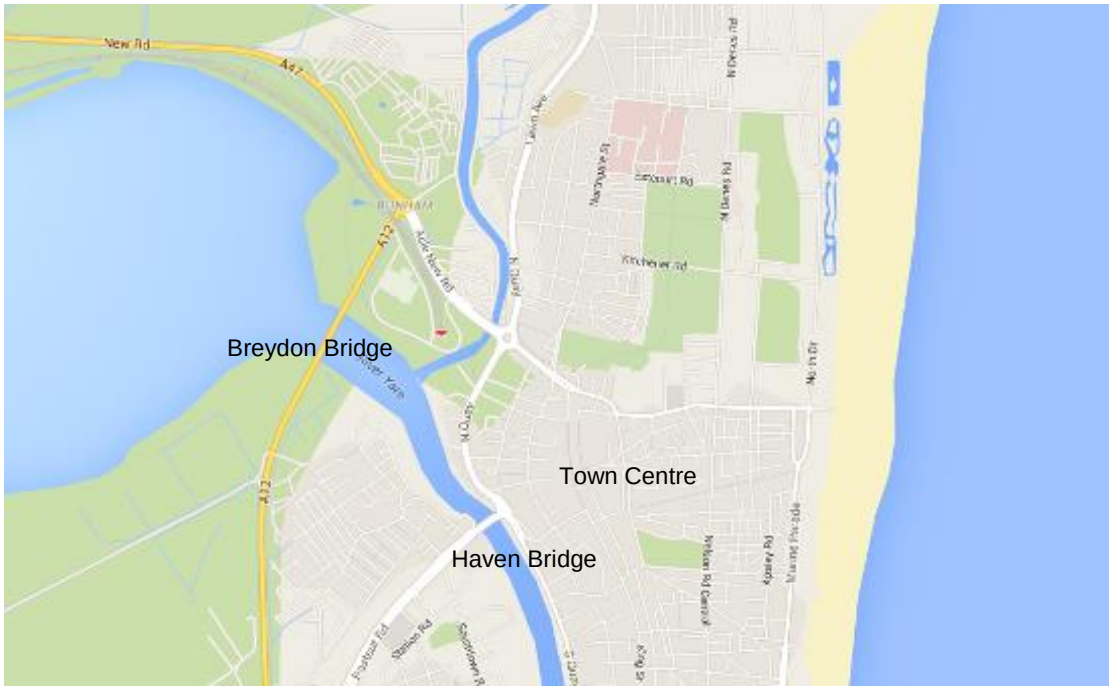


Figure 1-3 Bridges

The Breydon Bridge, constructed in 1985, enables A12 traffic to bypass the centre. The Haven Bridge provides access into the northern part of the town centre.

There are, however, no bridges further south than this. As a result, the southern part of Great Yarmouth, which is built on the peninsula, is effectively isolated from the rest of the Borough.

Despite its severe lack of accessibility, the peninsula is developed and includes several distinct character areas:

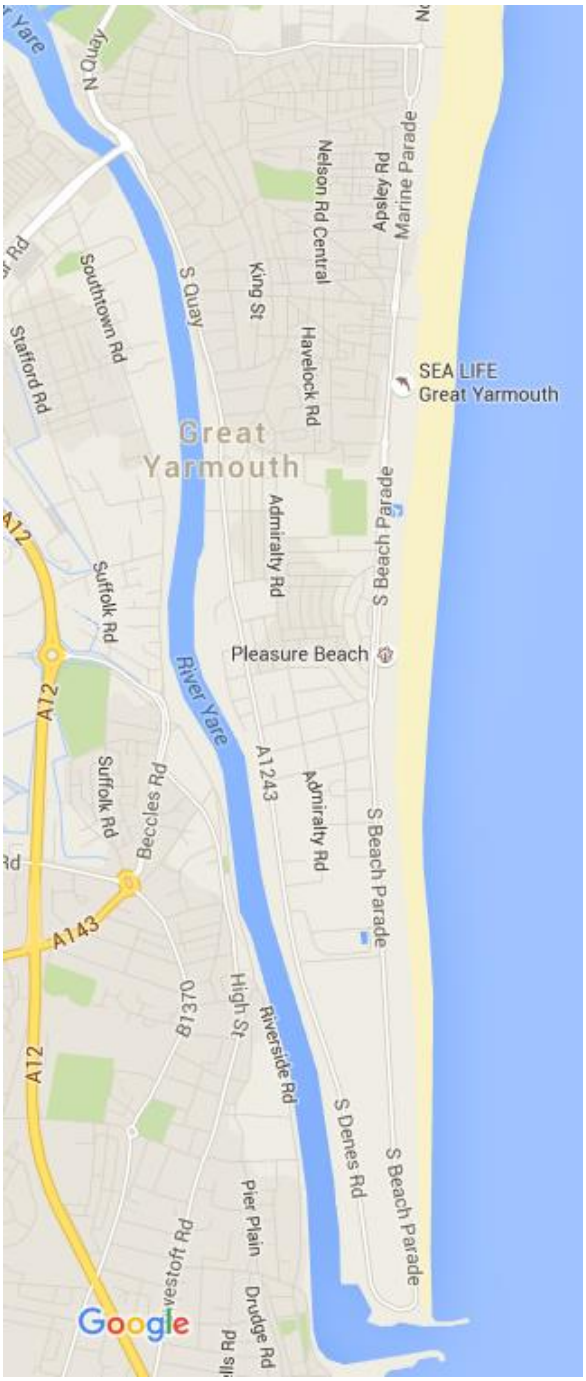


Figure 1-4 The Great Yarmouth Peninsula

The main shopping centre is located in the northern part of the peninsula. To the east of the centre is the traditional sea front, beach and pier with a wide range of visitor attractions. Major public realm improvements have recently been undertaken to Marine Parade and the northern part of South Beach Parade help regenerate the sea front. Further south is an extensive traditional residential area.

On the east bank of the river lies the historic South Quay. This leads into South Denes Road - an extensive industrial and quay area which is subject to a Local Development Order. At the southern extremity of the peninsula is the Outer Harbour, a deep water harbour constructed between 2007 and 2009. Originally intended as a 'Ro-Ro' ferry terminal and container terminal, these plans did not come to fruition. The outer harbour has been designated as an Enterprise Zone and is re-focusing on the offshore wind industry.

The only routes into and out of the peninsula are by means of the existing bridges at its northern end. The proposed scheme is to provide a third crossing of the River Yare linking the southern part of the Great Yarmouth peninsula with the A12 and A143, and the rest of the built up area. The general location of the scheme is illustrated in Figure 1-5 below.

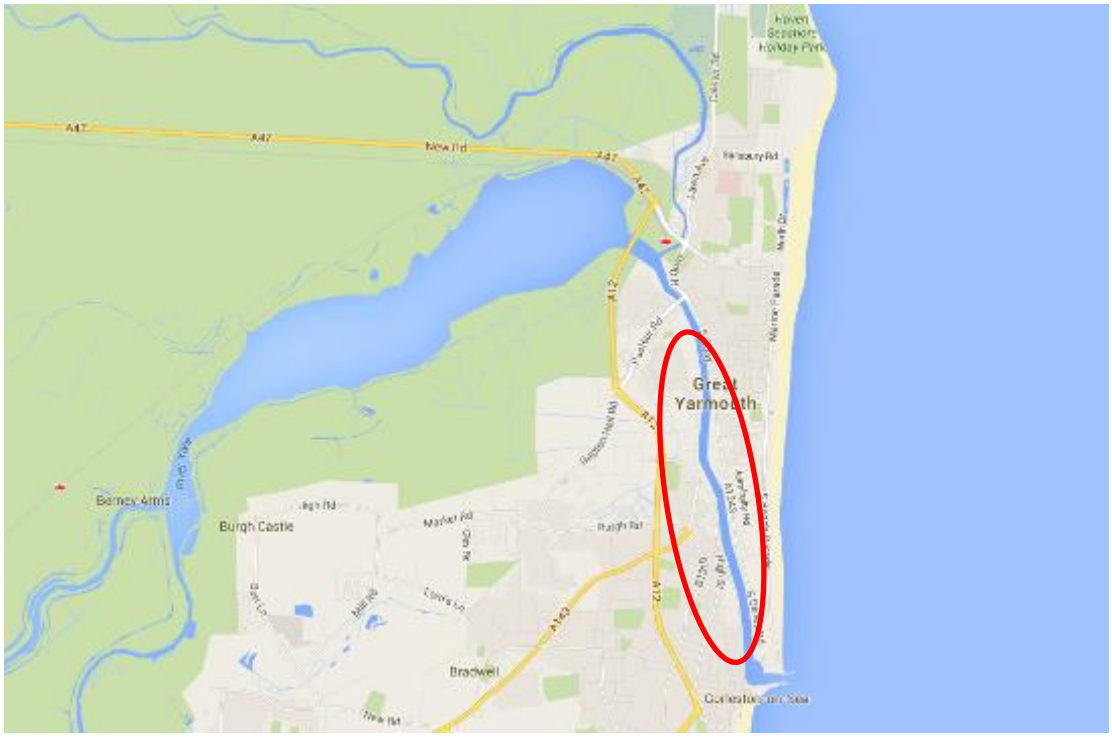


Figure 1-5 General location of the scheme

2 Context

This part of the Option Assessment Report describes the context of the scheme. It reviews the relevant policies and strategic objectives for the area and looks at existing travel conditions. It considers the opportunities for, and constraints on, growth. It considers how things are likely to change over time, and identifies the need for intervention. It sets out clear objectives for the scheme and identifies the area on which it will have an impact.

2.1 Step 1 – Understanding the current situation

As described in Section 1, Great Yarmouth is located on a narrow peninsula, physically separated by the River Yare from the rest of the built-up area. The peninsula includes the main town centre, historic and residential areas, the famous seaside resort, industrial areas, port facilities and a modern deep water harbour. All of this is accessible only from the north, using the two existing bridges.

The economic context is defined by a decline in traditional industry and tourism in the 20th century, coupled with new opportunities for growth and regeneration in the 21st century.

In the early 20th century, Great Yarmouth was a major fishing port and centre of the herring fishing industry, with over 1,000 vessels landing 120,000 tonnes of fish each year. The loss of the traditional fishing industry contributed to the economic decline of the port in the second half of the century. In the 1960s, growth in the offshore oil industry provided a short term economic stimulus, but this too has now declined. Great Yarmouth lacked facilities for vessels with a large draught, and this prompted the construction of a deep water harbour in 2009, in the hope of attracting container and ferry traffic. The worldwide economic recession from 2008 put paid to these aspirations. More recently however, as the closest deep water facility to the East Anglia Array offshore wind farm, the port is starting to benefit from growth in the new sustainable energy sector. It is now the main supply base for the offshore gas industry in the Southern Basin of the North Sea, and for offshore windfarms. There is also a small cluster of high-tech electronics and engineering companies.

Great Yarmouth is also one of the classic seaside towns of the British Isles. The coming of the railway in the first half of the 19th century led to its growth as a resort, and the 20th century saw the rise of the holiday camp. But changing tastes and the affordability of foreign holidays led to a decline in visitors to Great Yarmouth and similar resorts. In more recent years, public realm investment in the sea front area has improved the image of the town as it seeks to attract new visitors. Great Yarmouth remains one of the most popular British seaside resorts and has over 70,000 available bed spaces, caters for around 4 million day visits and nearly 5 million visitor nights each year. There is heavy dependency on the tourist industry, which has an estimated worth of over £530 million per year, and 78 per cent of the jobs in the borough are service-based. In the summer months the population effectively doubles, adding to the demands on the transport network.

2.1.1 *Current transport and other policies*

The strategic policy context is determined by:

- The New Anglia Strategic Economic Plan (2014)
- Local Development Framework documents, including:
    - The Great Yarmouth Local Plan Core Strategy (Adopted Dec 2015)
    - Great Yarmouth Waterfront Area Action Plan (Supplementary Planning Document) Consultation Draft (Nov - Dec 2010)
- Connecting Norfolk: The Norfolk Local Transport Plan for 2026 (April 2011)
- The Great Yarmouth and Gorleston Area Transportation Strategy (2009)

New Anglia Strategic Economic Plan (SEP)

The **New Anglia Strategic Economic Plan** sets out the ambition of the Local Enterprise Partnership (LEP) to deliver more jobs, improved skills, new business and housing, including:

- 95,000 growth in jobs from 2012 to 2026
- 10,000 new businesses from 2012 to 2026
- Increasing GVA by 10% to equal the national average

Figure 2-1 Greater Anglia Strategic Economic Plan area

The SEP identifies Great Yarmouth as a Growth Location, with a strong base in manufacturing and food processing. Manufacturing has seen job losses in the past decade, but there is potential to attract more investment in this sector, as well as in tourism and leisure.

The SEP sees the energy sector as the main opportunity for growth, identifying the area as a major base for the construction, operation, maintenance and servicing of offshore energy production - oil, gas, wind and tidal energy - in the North Sea. It recognises the broader supply chain of energy-related businesses, including design, engineering and manufacturing for the renewable energy industry. Great Yarmouth with Lowestoft has been designated one of six Centres for Offshore Renewable Engineering (CORE), and will receive a comprehensive package of business support. Additional investment in wind energy – including the 6,000 km2 East Anglia Array – will significantly boost activity related to offshore renewables particularly in wind farm assembly and manufacturing.

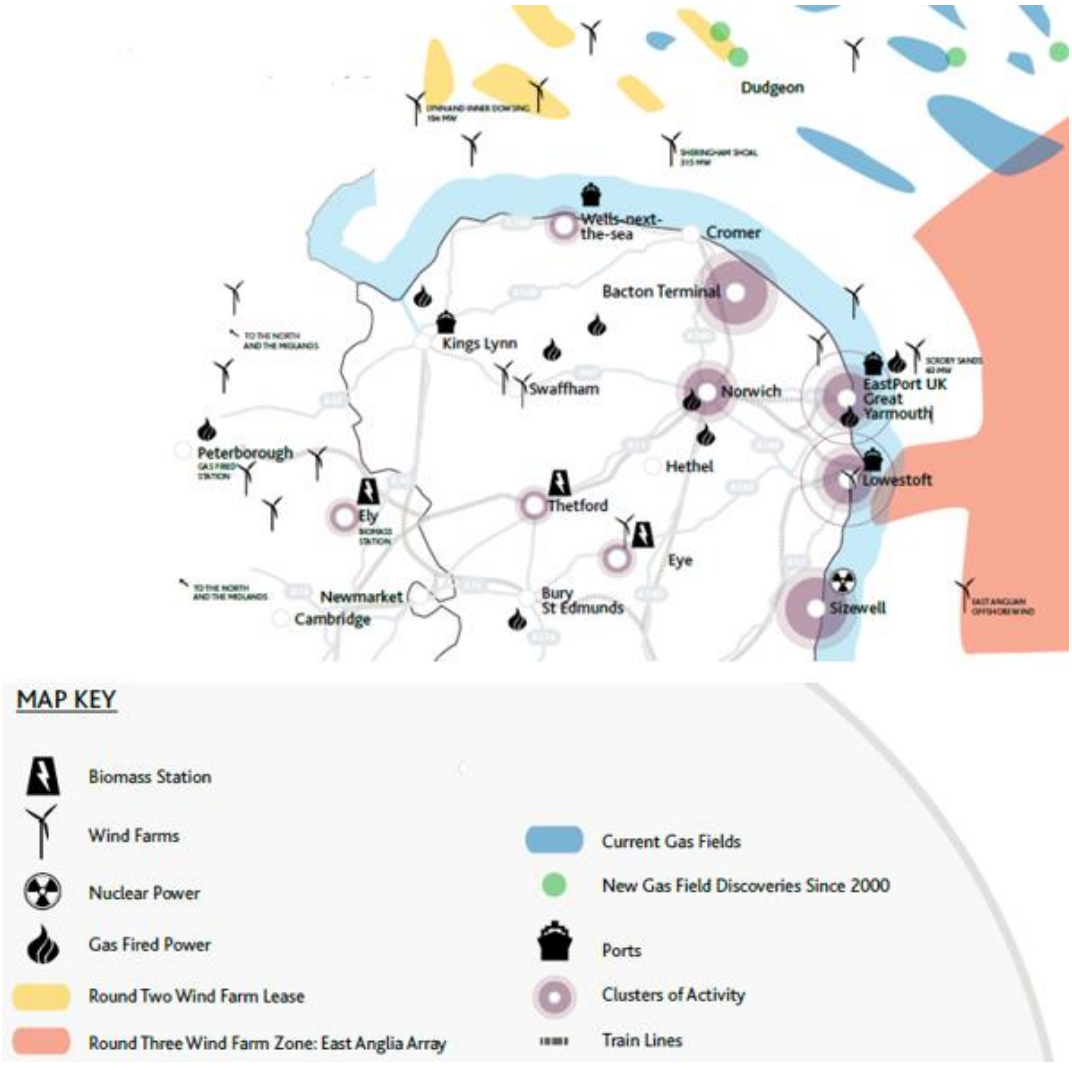


Figure 2-2 Great Yarmouth in the context of the East of England Energy Zone

The SEP acknowledges the concentration of offshore engineering businesses in Lowestoft and Great Yarmouth, together with equipment manufacturing supporting both primary production and food processing.

A key part of the SEP "offer" is the Enterprise Zone (EZ) which designates four sites for energy businesses, offshore engineering, ports and logistics. It is one of the best performing EZs in the country, in terms of jobs already created and floor space built, because local resources were used to get development started. One of the locations is at the South Denes Energy Park in Great Yarmouth which is covered by its own Local Development Order. The EZ is centred on the deep sea harbour on the Great Yarmouth peninsula.

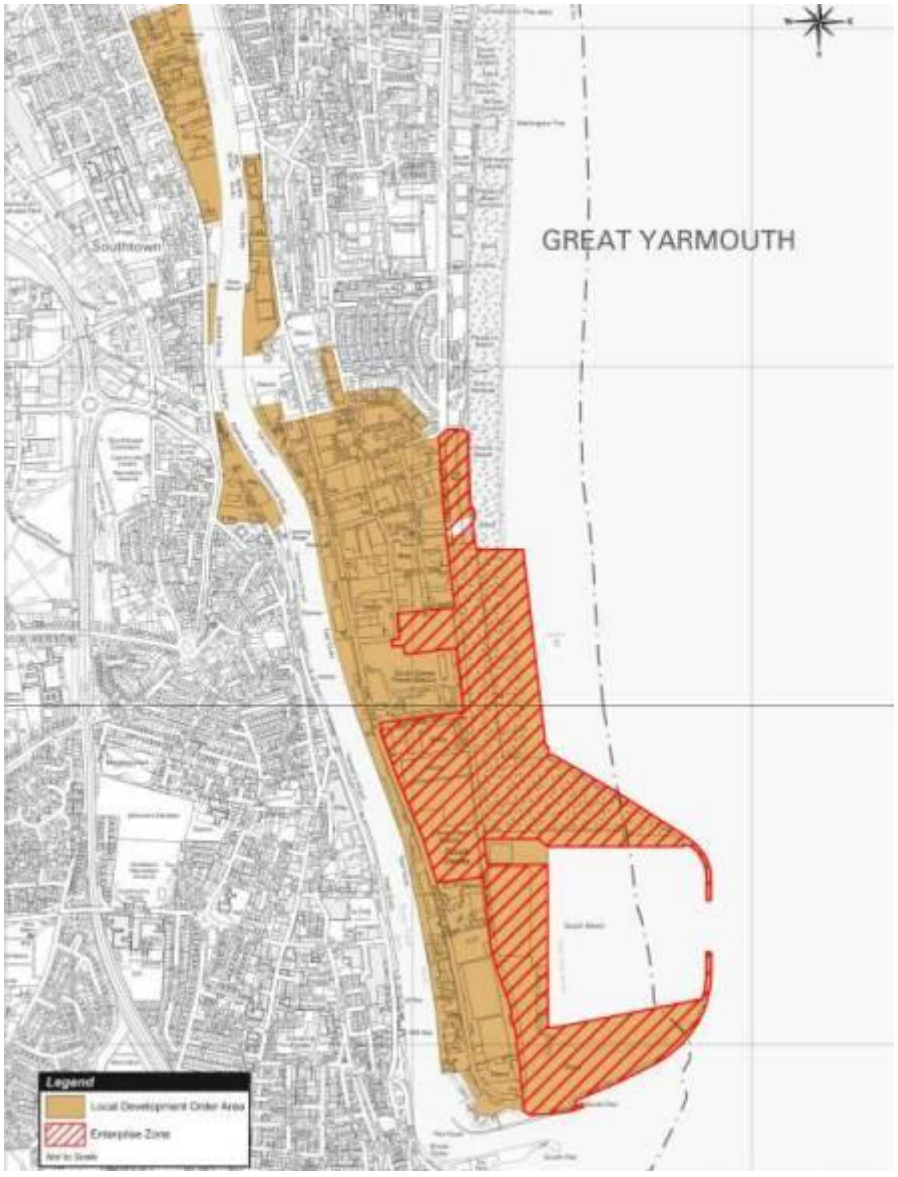


Figure 2-3 Local Development Order and Enterprise Zone, South Denes, Great Yarmouth

Incentives include business rates relief worth up to £275,000 over five years; simplified planning regulations; and Government support for the provision of super-

fast broadband. Business rates growth within the Zone will be retained by the LEP to support economic priorities for at least 25 years. It is estimated that the Enterprise Zone as a whole will create up to 9,000 direct jobs and 4,500 indirect jobs by 2025.

The SEP also includes housing growth of around 2,000 dwellings in Great Yarmouth.

The SEP also presented a strong case for Great Yarmouth and Lowestoft to be designated with Assisted Area status, and this has been recognised with inclusion in the Government's draft map. This means projects can be given more support from New Anglia's Growing Business Fund and EU pot, thus making the EZ more attractive to inward investment.

The SEP strategy addresses a very real need. Unemployment, including long term worklessness, remains high, especially among the young. This is exacerbated by poor education performance with GCSE attainment consistently failing to meet national levels. Alongside this, 40% of local graduates enter non-graduate jobs and too few enter the SME sector. The SEP will deliver a Skills Capital Investment Programme and prioritise investment that drives capacity and excellence in science and technology including investment in innovative new approaches to skills training in partnership with the private sector. The programme will promote the development of HE/FE Clusters linked to major key growth assets including the Great Yarmouth-Lowestoft Enterprise Zone and will seek to address the low participation rates in HE in areas including Great Yarmouth.

The SEP initiatives in Great Yarmouth are, necessarily, centred on parts of the town which are presently isolated with poor accessibility by land. The SEP recognises this and acknowledges that Great Yarmouth suffers from congestion arising from bottlenecks, including at North Quay and the Haven Bridge, and that the limited river crossings force traffic onto a few congested routes. It specifically supports the preparation of a scheme for **a third river crossing in Great Yarmouth**. The SEP, which pre-dates the announcement of the Local Majors Fund, envisaged that this work would lead to the inclusion of a scheme in the (then) Highways Agency's national programme.

Great Yarmouth Local Plan Core Strategy

The **Great Yarmouth Local Plan Core Strategy** is the main document in Great Yarmouth Borough Council's Local Plan (2013 – 2030) It establishes the spatial vision and objectives for how the borough will develop and grow in the future. It also sets out strategic policies and site allocations, called 'Core Policies' and 'Key Sites', which provide the strategic context for other Local Plan Documents, Supplementary Planning Documents and Neighbourhood Development Plans.

The Core Strategy sets out a vision for the borough as a more attractive and aspirational place to live, work and play, with strong links to Lowestoft, the Broads, Norwich, rural Norfolk and the wider New Anglia Local Enterprise Partnership area. It

notes that Great Yarmouth will continue to have a thriving relationship with Lowestoft, and describes a complementary and integrated approach to the regeneration of the two towns, taking advantage of the huge growth potential in the renewable energy and port sectors to create thousands of new jobs.

A **third river crossing** over the River Yare is envisioned in the Core Strategy, along with improvements to public transport and the creation of attractive walking and cycling routes from the train station to the waterfront, town centre and seafront, which will relieve congestion and provide essential links to key facilities and services, including the outer harbour.

The Core Strategy sets seven strategic objectives:

SO1 Minimising impact on the environment
SO2 Addressing social exclusion and reducing deprivation
SO3 Accommodating a growing population
SO4 Strengthening the competitiveness of the local economy
SO5 Capitalising on the successes of the local visitor economy
SO6 Protecting and enhancing the quality of the local environment
SO7 Securing the delivery of key infrastructure

Under Objective SO7, the Core Strategy aims to encourage efficient patterns of movement by recognising the strategic role that the A47, a **third river crossing**, the river port, outer harbour and rail corridor (including a rail freight interchange) will play in meeting the borough's needs.

The Core Strategy envisages provision of 1,000 new homes at the Great Yarmouth Waterfront area (at least 350 during the plan period), and:

- Encourages the redevelopment and intensification of existing employment sites, and exploring the potential to develop 22 hectares of land reclamation north of the Outer Harbour at South Denes

- Supports port-related development proposals related to the Outer Harbour and existing river port

- Encourages a greater presence of higher value technology and energy-based industries, including offshore renewable energy companies

- Supports the local visitor and retail economies

In safeguarding 118 hectares of existing employment land at South Denes, including the Outer Harbour and South Quay, the Core Strategy considers that there is considerable scope for the already thriving energy and port-related sectors to expand as a result of the Enterprise Zone (EZ) and Local Development Orders.

South Denes is a priority area for industrial and warehousing development, attracting businesses operating in, or providing essential support services to the energy, offshore engineering and ports & logistics sectors. The development of the Outer Harbour is of strategic importance to the borough's economy and is a key driver for the regeneration of Great Yarmouth. It complements the existing river port and increases its overall operating capacity. The prospects for new business for the port are starting to be realised with investment for handling grain, aggregates and wind farm maintenance. The Outer Harbour has the potential to accommodate a large range of vessels and operations, including freight ferries, general and bulk cargo, oil and gas, decommissioning and special projects, including offshore wind. The possibility of a 'roll-on, roll-off' ferry service remains a part of the port's longer-term ambitions.

The Core Strategy recognises the challenges of Great Yarmouth's unique geography, noting that the seafront, central shopping area and outer harbour are on a peninsula, separated from a high percentage of the resident population by the River Yare. The two existing river crossings; Breydon Bridge and Haven Bridge are subject to high traffic flows and become severely congested during peak hours. Great Yarmouth and Gorleston also experience a dramatic increase in traffic flows during the holiday season. This extra traffic conflicts with town centre, port and commercial traffic, creating congestion problems on the road network, particularly on the A47 and A12, South Quay, North Quay, Fullers Hill and Lawn Avenue.

For these reasons the Core Strategy specifically supports the development of a **third river crossing** to reduce congestion within the heritage area of North Quay and South Quay, reducing pressure on Haven Bridge and generally improving access across the River Yare, and to help the Outer Harbour realise its long-term potential.

Great Yarmouth Waterfront Area Action Plan (AAP)

The **Great Yarmouth Waterfront Area Action Plan** is a Supplementary Planning Document which covers a total area of some 40 ha of predominantly brownmfield land in Great Yarmouth (Figure 2-4). . It sets out a detailed vision, objectives, plans and proposals for development in this area, in line with the Core Strategy. Five Strategic Sites are identified, the development of which will contribute to the regeneration and revitalisation of the Great Yarmouth waterfront area:

- North Quay 6.98 ha
- The Conge 2.4 ha
- Runham Vauxhall 14.6 ha
- Bure Harbour Quay 7.9 ha
- Ice House Quay 7.5 ha

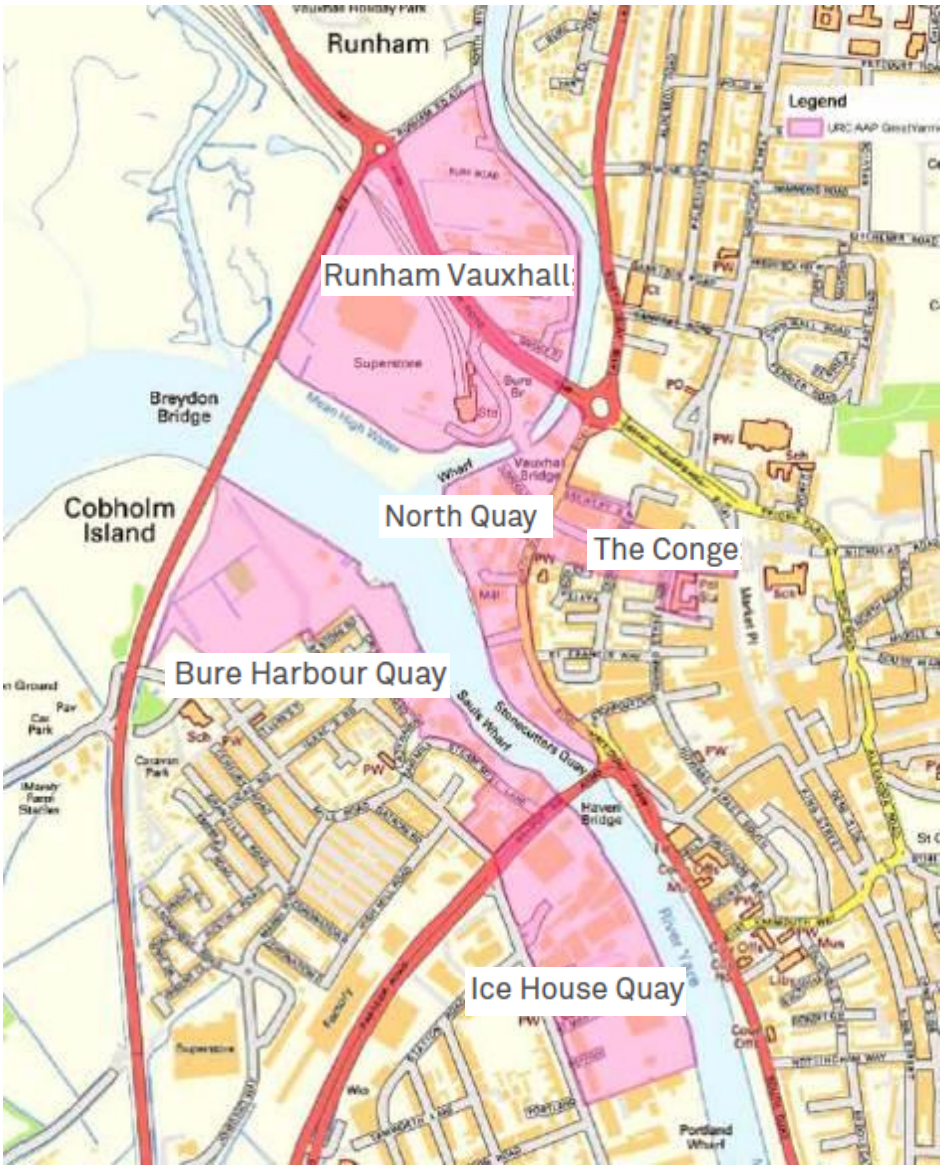


Figure 2-4 Great Yarmouth Waterfront Area Action Plan - Plan area

The North Quay strategic site occupies a triangular area defined by an extensive waterfront on two sides and the North Quay thoroughfare. The site is connected to the Station Gateway via the Vauxhall Bridge to the north of the site where there is a significant amount of vacant land. Much of the site is in fragmented land use and ownership with a mixture of residential, industrial, storage and showroom activities. North Quay provides a significant opportunity to deliver high quality waterfront development and a new focus for activity in Great Yarmouth, complementing the offer provided in the town centre and seafront areas.

The area immediately to the west of Haven Bridge is dominated by a heavily trafficked dual carriageway, Bridge Road, with a poor pedestrian and cycle environment. The inclusion of this area in the AAP seeks to ensure that an appropriate gateway is provided here on the approach to Great Yarmouth's historic river frontage and South Quay area.

The AAP notes that large vehicle flows, and in particular heavy vehicles, passing along North Quay, causes severance between the riverside sites and the town centre. It acknowledges that the development of the port beyond the AAP area will add pressure on the highway network and increase the number of larger vehicles moving through the town.

The AAP states that new developments need to minimise additional vehicle trip generation routing via Bridge Road, as the area of the network around the Haven Bridge is at risk of being declared an Air Quality Management Area (AQMA). However it notes that it is unclear what measures could be employed to mitigate air quality issues on this key route to the port, prior to the construction of a Third River Crossing.

The AAP notes that a third river crossing would provide a further vehicle connection across the River Yare to the south of Haven Bridge. Though itself outside the AAP area, it would provide access to the port from the strategic network (A12 / A47) without the need for port-related traffic to pass through the town centre.

The AAP envisages an improvement scheme at the North Quay / The Conge junction, including bus priority measures and wider footways, but states that more radical proposals for a shared layout at this junction will not be considered until a third river crossing is delivered.

The AAP identifies the third crossing as an essential long term infrastructure requirement, justifying contributions from all development sites in the AAP area.

Connecting Norfolk – The Norfolk Local Transport Plan for 2026 (LTP)

The **Norfolk Local Transport Plan for 2026** identifies six strategic aims for transport in Norfolk:

- Maintaining and managing the highway network
- Delivering sustainable growth
- Enhancing strategic connections
- Reducing emissions
- Improving road safety
- Improving accessibility

The LTP (Policy 7) identifies a number of strategic connections including to Norfolk's gateways, Norwich Airport and the ports at King's Lynn and Great Yarmouth.

The LTP notes the importance of enhancing connections to Norfolk's three international gateways: Norwich Airport and the ports at Kings Lynn and Great Yarmouth. At Great Yarmouth, the focus is on achieving a sustainable distribution of freight journeys to and from the port, including provision of a future **third crossing** of the River Yare, which will provide an enhanced link to the port from the strategic road network and help remove traffic from the town centre.

Great Yarmouth and Gorleston Area Transportation Strategy

The **Great Yarmouth and Gorleston Area Transportation Strategy** (2009) examined a wide range of strategic solutions to the areas transport problems and opportunities.

It identified a third crossing as a major scheme aimed at overcoming the problem of limited access to the peninsula of Great Yarmouth and the congestion that this causes. It would do this by offering a more direct route into the town from the south, and providing relief to the two existing road bridges. As such it would provide the missing link between the A12 trunk road and the expanding port facilities. In addition, it would provide accessibility benefits to the town by providing more direct routes between housing and employment areas, supporting regeneration.

High levels of support were reported for the provision of a third crossing, with 92% of respondents in a 2009 consultation exercise supporting the need for a new crossing.

Current transport and other policies – conclusions

Common themes in all of the above policies are:

- The need for economic regeneration in Great Yarmouth
- The potential for growth associated with the offshore energy industry, especially in the Enterprise Zone and outer harbour,
- The lack of adequate links between potential development areas on the peninsula and the strategic road network, especially to the A12 (south)
- The problem of heavy traffic on the existing bridges, and congestion in adjacent areas of the town such as North Quay, which carries traffic between the port and the A47
- The need for a third crossing of the River Yare to provide traffic relief, and better access to strategic routes, supporting regeneration and growth on the peninsula.

2.1.2 *Current demands and levels of service*

Traffic levels on the existing bridges are high, as detailed below:

2-way traffic flows 2003	12 hrs ALL (7 am – 7 pm) Observed	12 hrs HGV (7 am – 7 pm) Observed	24hr ALL AADT Modelled
A12 Breydon Bridge (across River Yare)	29,912	1,308	38,544
A1243 Haven Bridge (across River Yare)	23,813	764	35,125

Table 2-1 Traffic on existing bridges (2003)

Extensive observed data collected in 2003 – traffic flows and journey times – was used to calibrate and validate a SATURN traffic model for a 2003 base year. This model forms the basis of the scheme modelling undertaken to date, and will be updated for the Outline Business Case.

More recent observed data[4] from June 2015 is detailed below:

2-way traffic flows Thursday 18June 2015	12 hrs ALL (7 am – 7 pm)	12 hrs HGV (7 am – 7 pm)
A12 Breydon Bridge (across River Yare)	30,677	710
A1243 Haven Bridge (across River Yare)	22,429	950

Table 2-2 Traffic flow on existing bridges, 2015

Surveys show that traffic on both bridges has been increasing steadily since 2013:

2-way traffic flows 2013 - 2015	12 hrs ALL (7 am – 7 pm) 2013	12 hrs ALL (7 am – 7 pm) 2014	12 hrs ALL (7 am – 7 pm) 2015
A12 Breydon Bridge (across River Yare)	29190	29934	30677
A1243 Haven Bridge (across River Yare)	18716	20573	22429

Table 2-3 Traffic growth on bridges 2013-2015

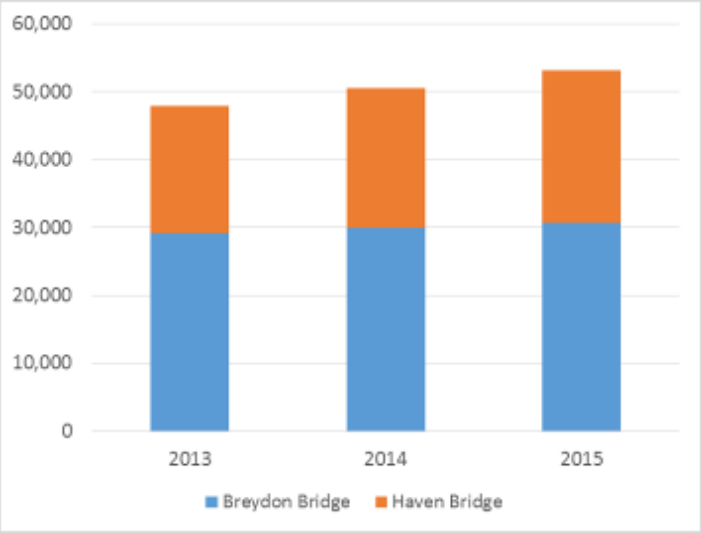


Figure 2-5 Traffic growth on bridges 2013 – 2015 (12 hour totals)

Detailed classified traffic counts and queue length surveys were undertaken by Norfolk CC at key locations in the vicinity of the Haven Bridge and town centre (Figure 2-6) on Thursday 15 October 2015.

[4] From Great Yarmouth Cordon Survey – Norfolk CC

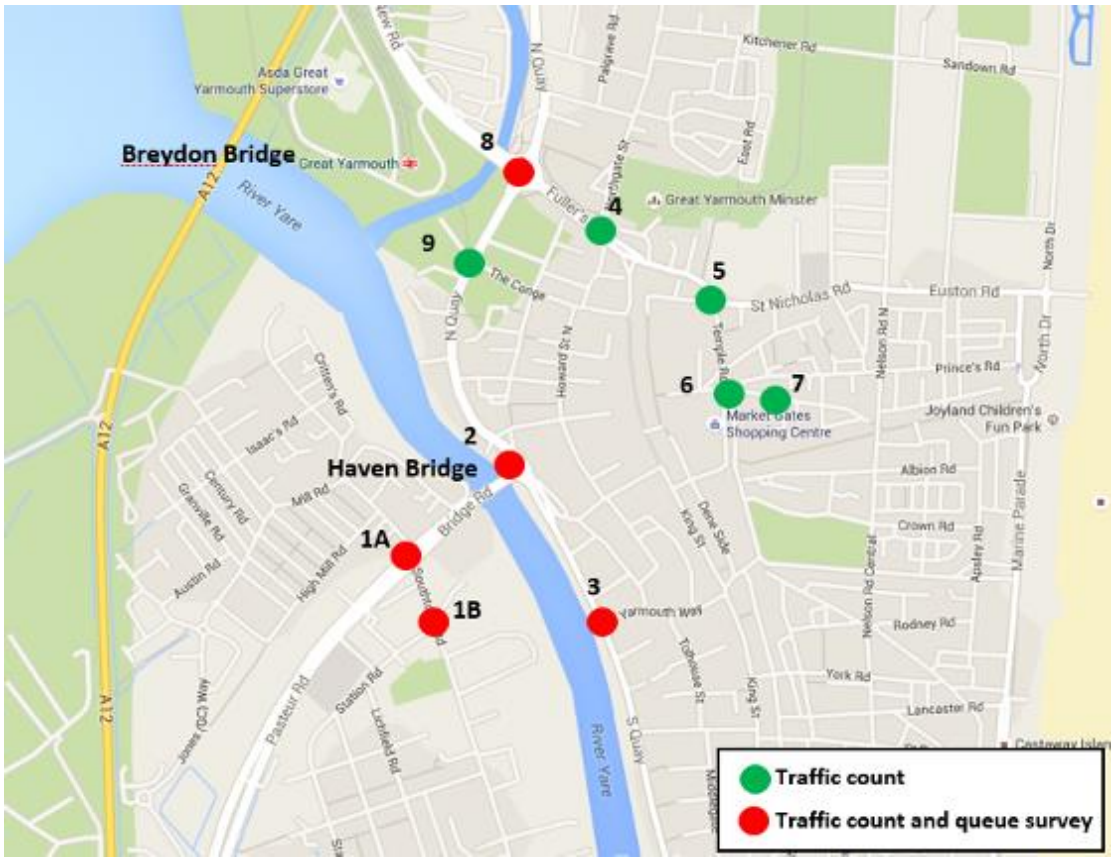


Figure 2-6 Location of traffic count and queue surveys, October 2015

Key results are summarised below:

Location	Direction	Maximum queue (veh)
1A	From Pasteur Road	>150
1A	From Bridge Road	>150
1A	From Southtown Road	100
2	From North Quay	127
2	From South Quay	>150
2	From Bridge Road	142
3	From the north	137
3	From the south	92
8	From Acle New Road	>150
8	From North Quay (north)	>150
8	From Fullers Hill	40
8	From North Quay (south)	>150

Table 2-4 Maximum observed queue lengths, 15 October 2015

2-way traffic flows Thursday 15 October 2015	12 hrs ALL (7 am – 7 pm)
A1243 Haven Bridge (across River Yare)	22,513

South Quay, south of Haven Bridge	19,697
North Quay, north of Haven Bridge	11,709
Acle New Road (across River Bure)	22,226
Fullers Hill	9,316
Temple Road	21,816

Table 2-5 Traffic flows, October 2015

These surveys illustrate the high levels of traffic on key roads in the centre of Great Yarmouth, especially around the existing bridges, and the high levels of queuing which result from the limited capacity of the local road network.

One consequence of this for road users is that journey times in peak periods are significantly longer than in the off peak. This may be illustrated by using open access data from Google Maps to compare journey times on various routes at different times of the day.

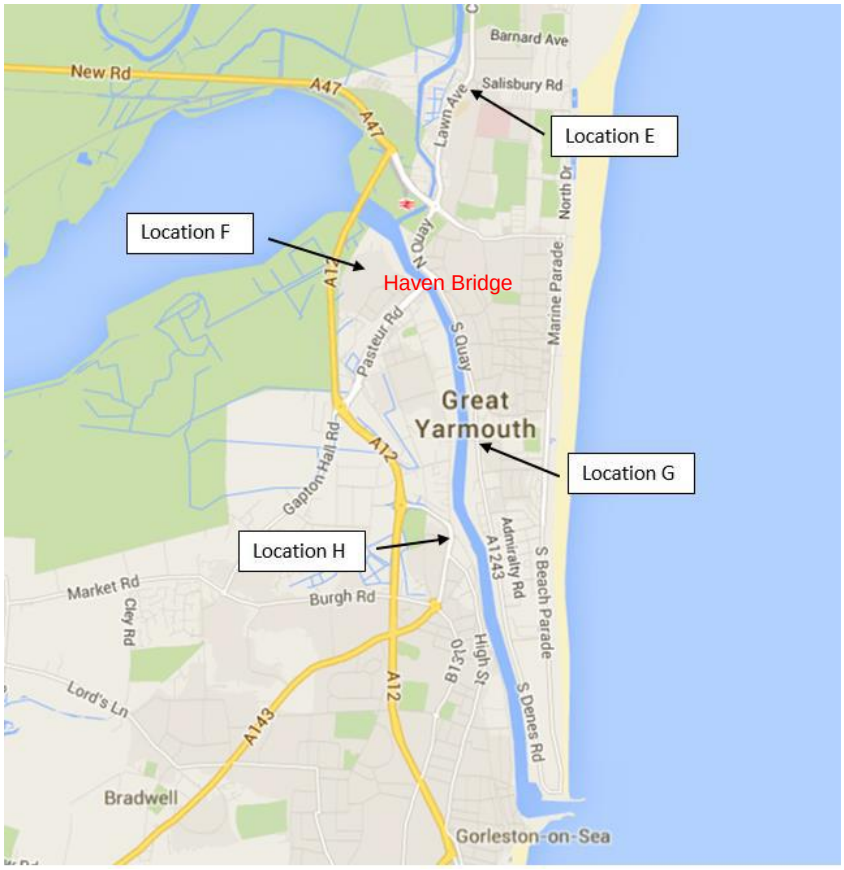


Figure 2-7 Journey times via Haven Bridge – end points for measurement

Journeys using Haven Bridge were tracked between four locations, as illustrated in Figure 2-7.

E - Caister Rd junction with Lawn Avenue (Northeast)
F – Cobholm Primary School (Northwest)
G – Newcastle Rd junction with Southgates Rd (Southeast)

H – Alpha Rd Junction with Beccles Rd (Southwest)

	To:	To E			To F			To G			To H		
From:		**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**
E	Minutes				12	12	12	8	7	8	14	12	16
	% over OP				0%		0%	14%		14%	17%		33%
F	Minutes	7	7	8				6	6	6	5	5	6
	% over OP	0%		14%				0%		0%	0%		20%
G	Minutes	6	6	8	6	6	7				7	8	9
	% over OP	0%		25%	0%		17%				-13%		+13%
H	Minutes	9	9	10	6	5	10	10	9	14			
	% over OP	0%		11%	20%		100%	11%		56%			

Table 2-6 Peak and off peak journey times via Haven Bridge, Nov 2015

	To:	To E			To F			To G			To H		
From:		**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**
E	Minutes				14	10	12	10	7	8	14	12	14
	% over OP				40%		20%	43%		14%	17%		17%
F	Minutes	7	7	8				6	6	7	5	5	5
	% over OP	0%		14%				0%		17%	0%		0%
G	Minutes	6	6	7	6	6	7				8	8	9
	% over OP	0%		17%	0%		17%				0%		13%
H	Minutes	9	9	10	6	5	9	10	9	14			
	% of OP	0%		11%	20%		80%	11%		56%			

Table 2-7 Peak and off peak journey times via Haven Bridge, March 2016

Similarly, journeys using Breydon Bridge were tracked between four locations, as illustrated in Figure 2-8.

A - Branch Rd junction on the A47 (West)
B – Caister Rd junction with Lawn Avenue (North)
C – Nelson Rd N junction with Euston Rd (East)
D – Gapton Hall Retail Park (South)

Figure 2-8 Journey times via Breydon Bridge - end points for measurement

	To:	To A			To B			To C			To D		
From:		AM	OP	PM	AM	OP	PM	AM	OP	PM	AM	OP	PM
A	Minutes				18	10	14	20	12	14	20	12	16
	% over OP				80%		40%	67%		17%	67%		33%
B	Minutes	12	12	14				4	4	4	9	8	12
	% over OP	0%		17%				0%		0%	13%		50%
C	Minutes	10	12	16	3	3	3				7	7	12
	% over OP	-17		33%	0%		0%				0%		71%
D	Minutes	12	10	14	7	7	9	7	7	9			

	% over OP	20%		40%	0%		29%	0%		29%			

Table 2-8 Peak and off peak journey times via Breydon Bridge, Nov 2015

	To:	To E			To F			To G			To H		
From:		**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**	**AM**	**OP**	**PM**
A	Minutes				20	10	14	20	12	16	20	12	14
	% over OP				100%		40%	67%		33%	67%		17%
B	Minutes	14	12	14				4	4	4	10	8	10
	% over OP	17%		17%				0%		0%	25%		25%
C	Minutes	10	12	14	3	3	3				8	7	9
	% over OP	-17		17%	0%		0%				15%		29%
D	Minutes	12	10	12	7	7	9	7	7	10			
	% of OP	20%		20%	0%		29%	0%		43%			

Table 2-9 Peak and off peak journey times via Breydon Bridge, March 2016

Current demands and levels of service - conclusions

The above analyses of traffic data, queuing and journey time information illustrates and supports the body of anecdotal evidence which has consistently highlighted the problems of congestion in Great Yarmouth, especially that which is associated with the constrained access to the peninsula. These problems are further exacerbated by the large seasonal variation arising from Yarmouth's role as a major resort attracting both staying and day visitors at holiday times.

The quantitative impact of the traffic conditions illustrated and described above has been assessed objectively using the Great Yarmouth SATURN model which has a base year of 2003.

2.1.3 Opportunities and constraints

Opportunities

There is an opportunity to improve accessibility to the Great Yarmouth peninsula and port whilst relieving congestion, by providing a third crossing, to the south of the existing Haven Bridge. This:

- Provide a more direct route between Great Yarmouth and the A12 (south), including Lowestoft
- Provide a direct access to the A12 and A47 for traffic to/from the north, including Norwich without passing through the congested town centre
- Facilitate employment growth in the peninsula and Outer Harbour
- Provide a more direct route into the southern part of the peninsula for pedestrians, cyclists and buses

Constraints

The main physical constraints are:

- Development on either side of the River Yare means there are only a limited number of locations where a third crossing could be constructed
- The need to tie into the existing highway network. The simplest location is for a tie in to the A12 at Halfrey's Roundabout.
- The need to maintain access for shipping. A clear navigable width of at least 50m will be required for a bridge solution. Also, a bridge would either need an air draught of at least 40m above the Mean High Water Spring Tide level, or be able to open to allow the largest vessels to pass through. An air draught of 7.5m when closed would enable most power driven small craft to pass under a bridge reducing the number of times it would need to be opened.
- The need to minimise adverse impact on existing port activities.
- With a lifting bridge, there is a balance to be struck between a southerly location (which provides more direct access to the port) and a bridge further up-river (which would need to open less often).

Detailed information on the physical constraints, including topography, geology and hydrology is set in the Stage 1 and Stage 2 Scheme Assessment Reports[5] [6] and associated documents.

[5] Great Yarmouth Third River Crossing, Stage 1 Scheme Assessment Report (Mott Macdonald for Norfolk CC, 2007)

[6] Great Yarmouth Third River Crossing, Stage 2 Scheme Assessment Report (Mott Macdonald for Norfolk CC, 2009)

2.2 Step 2 – Understanding the future situation

Step 1 above has described the current situation. Step 2 considers what is expected to change in the future in terms of:

- Future land-uses and policies
- Future changes to the transport system
- Future travel demands and levels of service

Future land-uses and policies

An overview of the policies and proposals which will shape Great Yarmouth in future has been set out in Paragraph 2.1.1 above.

The current[7] version of the Great Yarmouth SATURN model has a base year of 2003. Forecasts for 2008 were developed taking account of major developments since 2003 including:

- B&Q superstore, Thamesfield Way – 11,842 m²
- Tesco superstore, Jones Way – 8,834 m²
- Gapton Hall Retail Park
- New housing development, Marsh Road – 149 houses

Traffic generation from these sites has been derived from the TRICS 2008(b) database with the exception of Gapton Hall Retail Park, where origin and destinations were observed on 11th September 2008. Overall traffic growth was constrained to TEMPRO.

Future developments in the Great Yarmouth area were added into the appropriate model zone. Development traffic was estimated using trip rates derived from the TRICS 2008 (b) database. Developments included within the model are listed in the Stage 2 Traffic and Economics Appraisal Report, Appendix A. Growth has been constrained to TEMPRO (version 5.4) levels in the remaining zones.

Future changes to the transport system

Highways England (HE) has identified schemes to address congestion hotspots on the A47 around Norwich, Peterborough and Great Yarmouth. These will include dualling of single carriageway sections and various junction improvements. The improvements will take place at six locations on the A47 between its junctions with

[7] As noted in the Stage 2 Traffic and Economic Assessment Report, any further work on the appraisal will require a comprehensive review of the model including re-validation and possible use of variable demand modelling.

the A1 near Peterborough and Great Yarmouth and on the northern section of the A12 between its junction with the A47 at Great Yarmouth and Lowestoft.

The improvements in Great Yarmouth, scheduled to start in 2020, are to the following junctions and roundabouts on the A12 and A47: Vauxhall, Gapton, Harfreys, Bridge Road and James Paget Hospital

A route map outlining the six schemes across the whole route is shown in Figure 2-9 below.

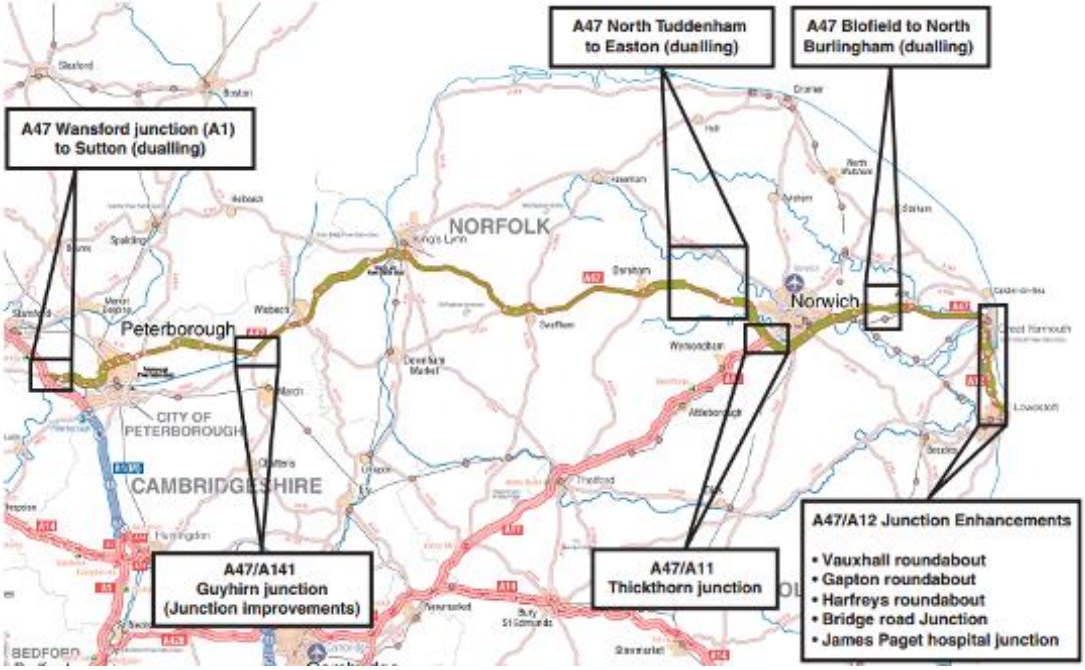


Figure 2-9 HE A47 Corridor Improvement Programme

These improvements to the Strategic Road Network will complement the provision of a third river crossing in Great Yarmouth, as users of the new crossing will also have the benefit of less congested routes to the west and south of the town, improving connectivity. However the A47/A12 improvements will not in themselves address the problems of congestion within Great Yarmouth or the lack of direct access to the peninsula and Outer Harbour. The County Council and the LEP will work closely with the HE to ensure that the two schemes take account of each other, especially in relation to the A12 Hafrey's roundabout.

Future travel demands and levels of service

Forecast flows and journey times for the Do Minimum scenarios have been derived from the future year SATURN models. Annual Average Daily Traffic (AADT) flows have been calculated using the method described in the Stage 2 Traffic and Economic Appraisal Report.

Figure 2-10 shows the modelled base flows for 2003 and 2008 on a selection of roads in Great Yarmouth, and Figure 2-11 shows the forecast ‘do minimum’ flows for 2015 and 2030.

As already noted, any further work on the appraisal will require a comprehensive review of the model including re-validation and possible use of variable demand modelling.

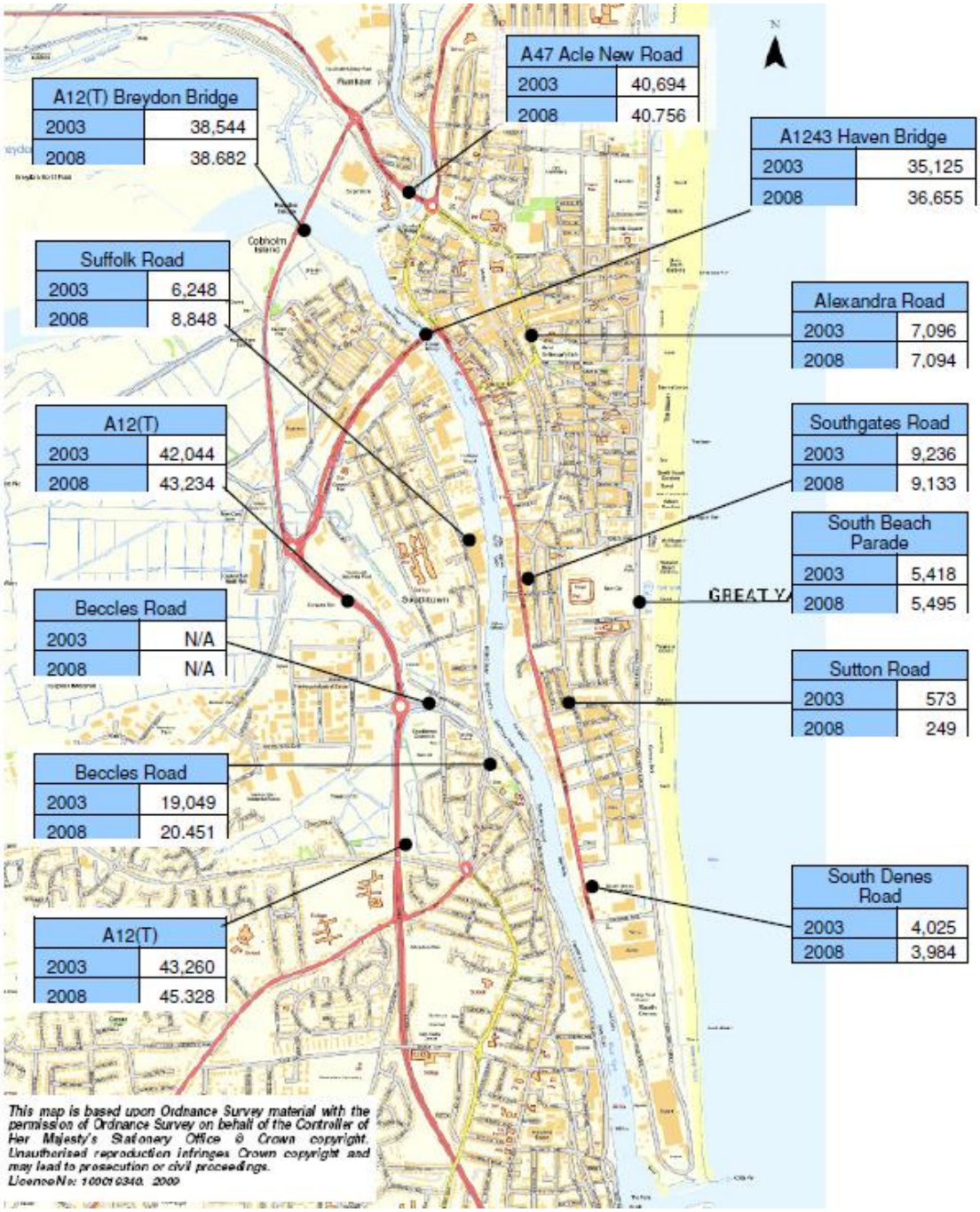


Figure 2-10 Base 2003 and 2008 AADT flows (from SATURN model)

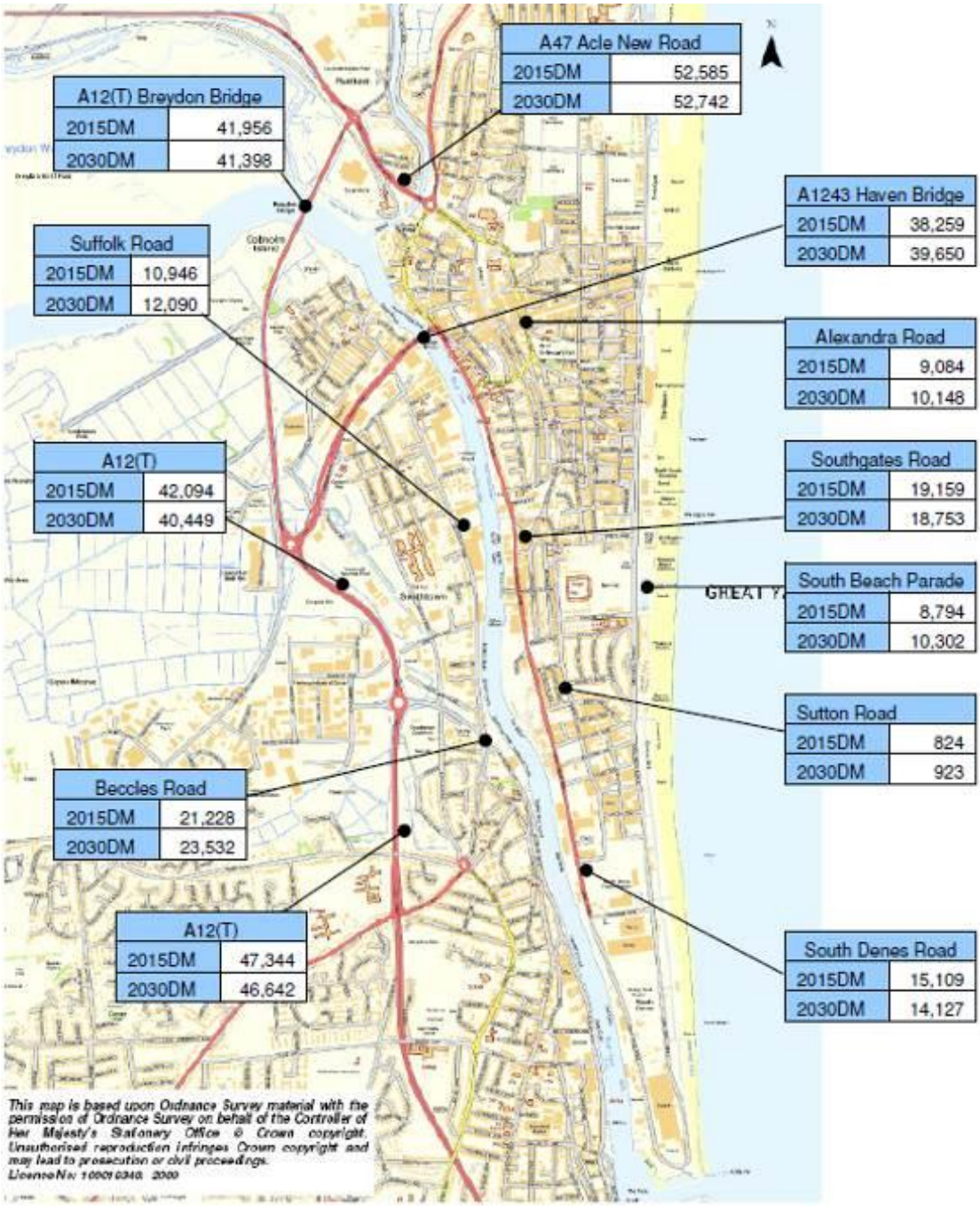


Figure 2-11 Forecast Do Minimum 2015 and 2030 AADT (from SATURN model)

The level of traffic on the existing bridges is forecast to increase, as detailed below:

Forecast AADT (all vehicles)	2003	2008	2015	2030
A12 Breydon Bridge	38,544	38,682	41,956	41,398
A1243 Haven Bridge	35,125	36,655	38,259	39,650

The forecast general increase in traffic will be associated with a general worsening of the current problems of congestion and delay, further exacerbating the problems of access to the peninsula and port.

2.3 Step 3 – Establishing the need for the scheme

This section of the report sets out the reasons why the scheme is needed. It builds on the information set out in Paragraph 2.1.2 above, and considers the problems which the scheme will address, including:

- Current transport problems, and their underlying reasons
- Future transport problems and opportunities for improvement

The main problems and related opportunities are listed in paragraphs 2.3.1, 2.3.2 and 2.3.3 below, and described in more detail in paragraphs 2.3.4 - 2.3.14.

2.3.1 Current transport problems, and their underlying reasons

- Congestion
- Inadequate access to employment areas and the harbour,
- Difficulty accessing to the town centre, sea front and leisure facilities
- Decline in town centre retailing
- Inefficient and indirect bus services into the southern part of the peninsula
- Lack of direct walking and cycle routes into the southern part of the peninsula
- Perception that Great Yarmouth is remote, discouraging inward investment
- Community severance.
- Impact of traffic on historic areas
- Emissions of CO2 and other greenhouse gases
- Impacts of traffic on air quality
- Accidents
- Lack of resilience in the local road network

All of the above problems are, to varying degrees, a consequence of the inadequacies of the transport networks accessing the Great Yarmouth peninsula.

2.3.2 Future transport problems

- Increased congestion and related problems
- Failure to achieve the full potential for growth in the Local Development Order (LDO) area and Enterprise Zone, including the port and outer harbour

2.3.3 *Opportunities for improvement*

- To improve connectivity between the port of Great Yarmouth and the strategic road network, especially the A12 towards Lowestoft and the south.
- To improve cohesion between businesses in the LDO area and Enterprise Zone, and similar businesses at Beacon Park and in Lowestoft.
- To help Great Yarmouth to contribute to, and benefit from, growth in the offshore energy industry.
- To complement recent investment in the town centre and sea front area and support continued regeneration.
- To develop more efficient bus services
- To create improved networks for pedestrians and cyclists

2.3.4 *Congestion*

Evidence of congestion and delay is set out in Paragraph 2.1.2 above. Congestion is a longstanding local concern, as evidenced by the results of a survey undertaken in connection with the Great Yarmouth and Gorleston Area Transport Strategy in 2009:

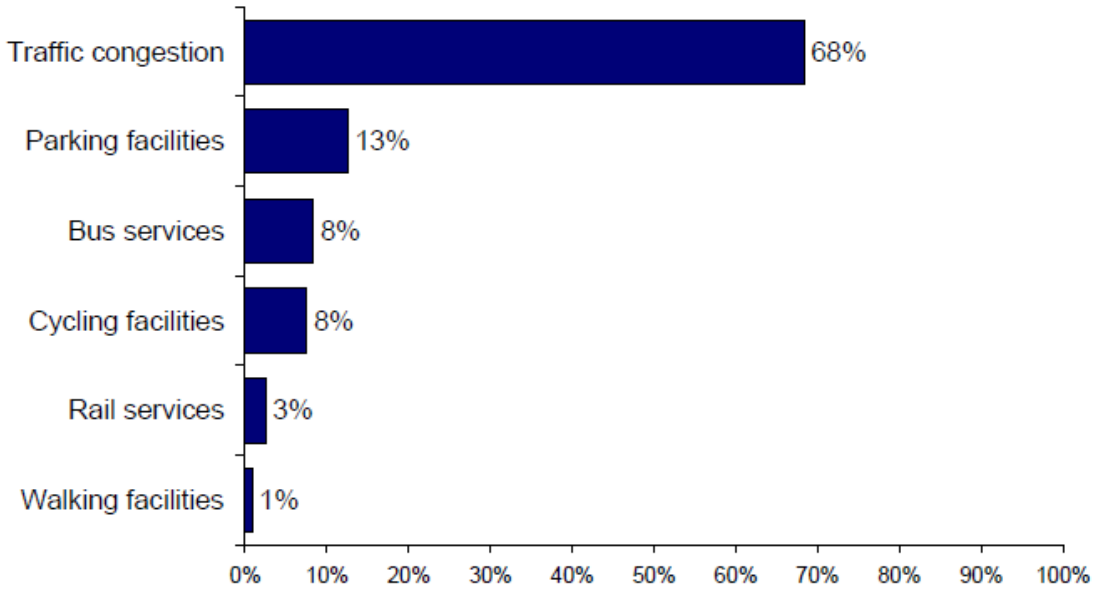


Figure 2-12 Aspects of transport which are the most important to improve. (Surveyed in 2009)

2.3.5 *Inadequate access to employment areas and the harbour*

All traffic to and from the outer harbour and the industrial areas on the Great Yarmouth peninsula have to use the existing bridges. This contributes to the congestion on and around the bridges, and makes employment areas and the port more difficult to get to. It restricts businesses' access to the labour market and

makes delivery of materials, products and imports more expensive. Access to and from the south has the additional problem that the distance by road is far greater than the distance as the crow flies, because there is no direct link between the A12 and the peninsula.

Poor accessibility makes it more difficult to encourage investment in the Local Development Order area and Enterprise Zone (Paragraph 2.1.1) especially as any new development will itself generate traffic and add to the problems. In particular the relative inaccessibility by land of the new deep water harbour could make it more difficult to attract the new business needed to regenerate the port.

A third crossing providing a direct, high standard access into the employment areas present an opportunity to attract more investment, and could be a catalyst for much needed regeneration and growth.

2.3.6 Difficulty accessing the town centre and decline in town centre retailing

Congestion around the existing bridges restricts the access into the town centre.

The town centre has experienced decline over the years. In January 2015 the Marks and Spencer store in King Street closed and moved to an out-of-town site – a significant loss to traditional centre. The Borough Council has recently invested £1m in physical improvements to help regenerate the town centre.

A third crossing would be an opportunity to complement this investment by improving access to the town centre for all modes of transport, whilst reducing the impact of traffic in key areas.

2.3.7 Difficulty accessing the sea front and leisure facilities

The sea front too can only be accessed via the congested bridges at the northern end of the peninsula. Recent investment in the public realm has led to major improvements to the northern part of the sea front; by contrast, the southern, less accessible part, is desolate and unfrequented by visitors.

A third crossing would be an opportunity to complement recent public realm improvements by improving access to all parts of the sea front, for all modes of transport, and dispelling the perception that Great Yarmouth is remote and inaccessible

2.3.8 Inefficient and indirect bus services into the southern part of the peninsula

Existing bus routes in Great Yarmouth are illustrated in Figure 2-13. Two existing bus routes penetrate part of the way into the South Denes area. In common with routes into the town centre, these services are affected by congestion at the existing bridges. Provision of a third crossing would relieve this congestion and could allow the development of more efficient services incorporating the new crossing.

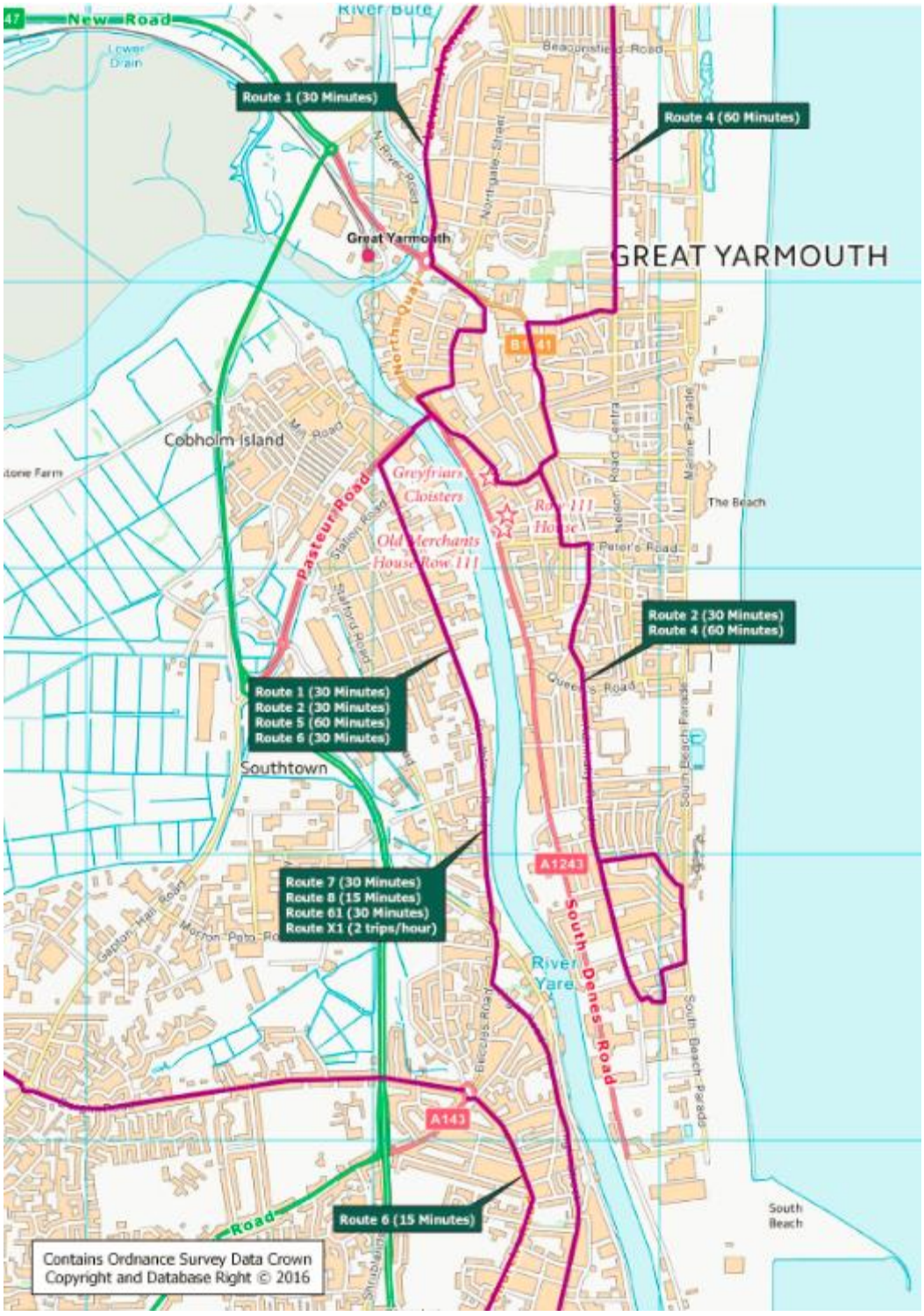


Figure 2-13 Bus routes and frequencies, Great Yarmouth

2.3.9 *Lack of direct walking and cycle routes into the southern part of the peninsula*
Similarly, pedestrians and cyclists from other parts of Great Yarmouth, or from the south or west have to use the existing bridges to access the town centre, sea front and employment areas. Existing cycle routes and facilities are illustrated in Figure 2-14. A dedicated off-road cycle route has been provided as part of the recent improvements to Marine Parade; there is an off-road route on Southtown Road on

the west side of the river and a network of advisory or traffic calmed routes on each side. A third crossing with dedicated cycle facilities would enable these to be linked to form a greatly improved cycle network. It would make it easier to encourage people to walk or cycle to work from locations that are presently too far apart.

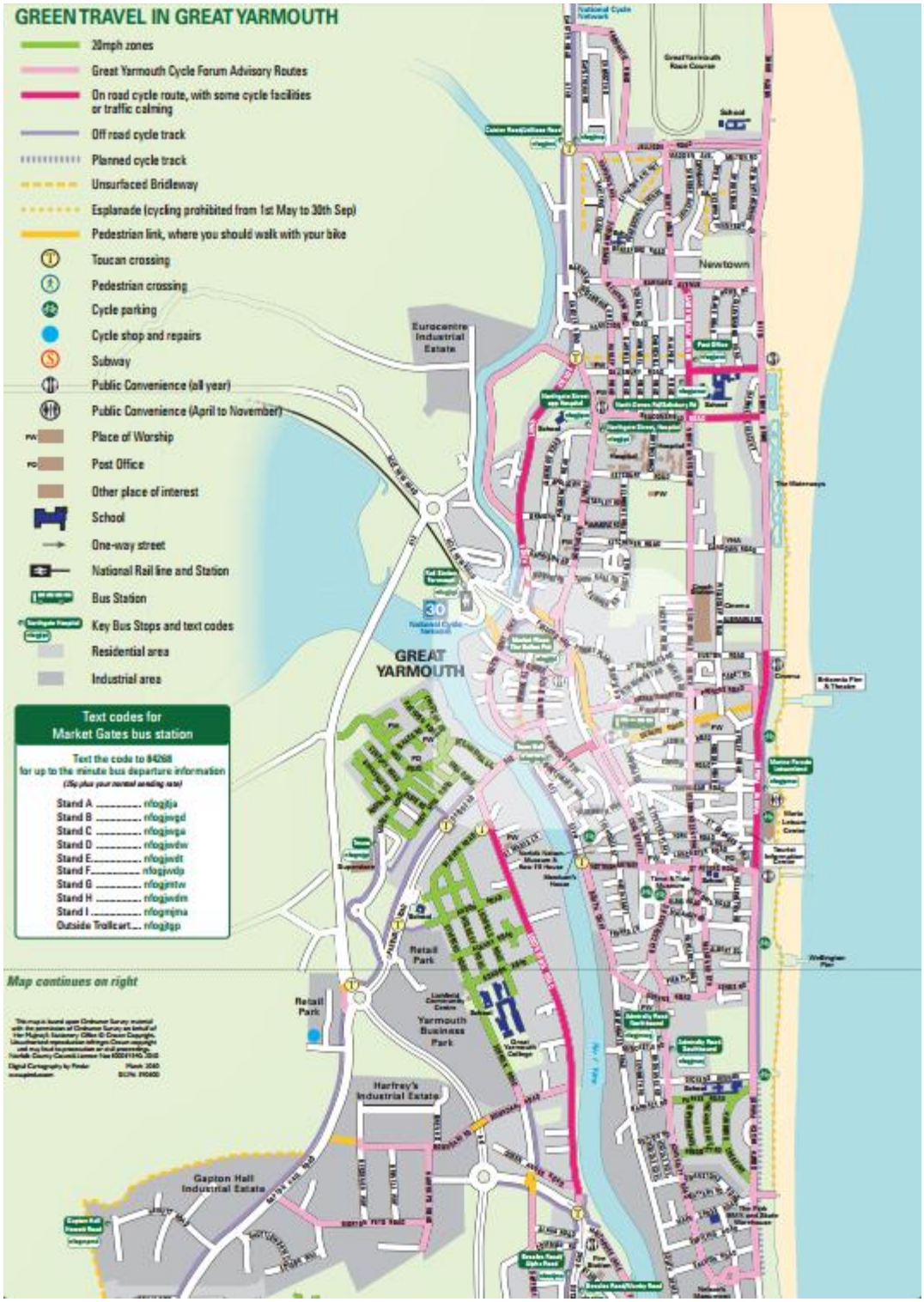


Figure 2-14 Cycle routes and facilities, Great Yarmouth

2.3.10 Community severance

The lack of a southern crossing means that the River Yare isolates Great Yarmouth from Gorleston and other parts of the Borough. The Haven Bridge is about 4 km from the river mouth and harbour, and whilst both the east and west sides of the 80m wide estuary are fully developed, the two communities are completely separated. For example, a person living on Riverside Road, Gorleston, would have to travel 6 miles to reach a place of work on South Denes Road which is physically less than a quarter of a mile away.

Provision of a third crossing would reduce community severance and improve accessibility to jobs and services throughout the Borough.

2.3.11 Impact of traffic on historic areas

As noted in Table 2-5 above, the historic North Quay carries some 11,700 vehicles over a 12 hour period. Hall Quay, directly opposite the Haven Bridge, carries ###### vehicles in 12 hours.

Figure 2-15 North Quay and Hall Quay

Figure 2-16 Hall Quay

Heavy traffic detracts from these character areas and is detrimental to efforts to improve them. A third crossing would reduce traffic in both areas.

2.3.12 Emissions of CO2 and other greenhouse gases

A third crossing would reduce the length of some trips, and would reduce congestion, leading to a net reduction in greenhouse gas emissions.

2.3.13 Accidents

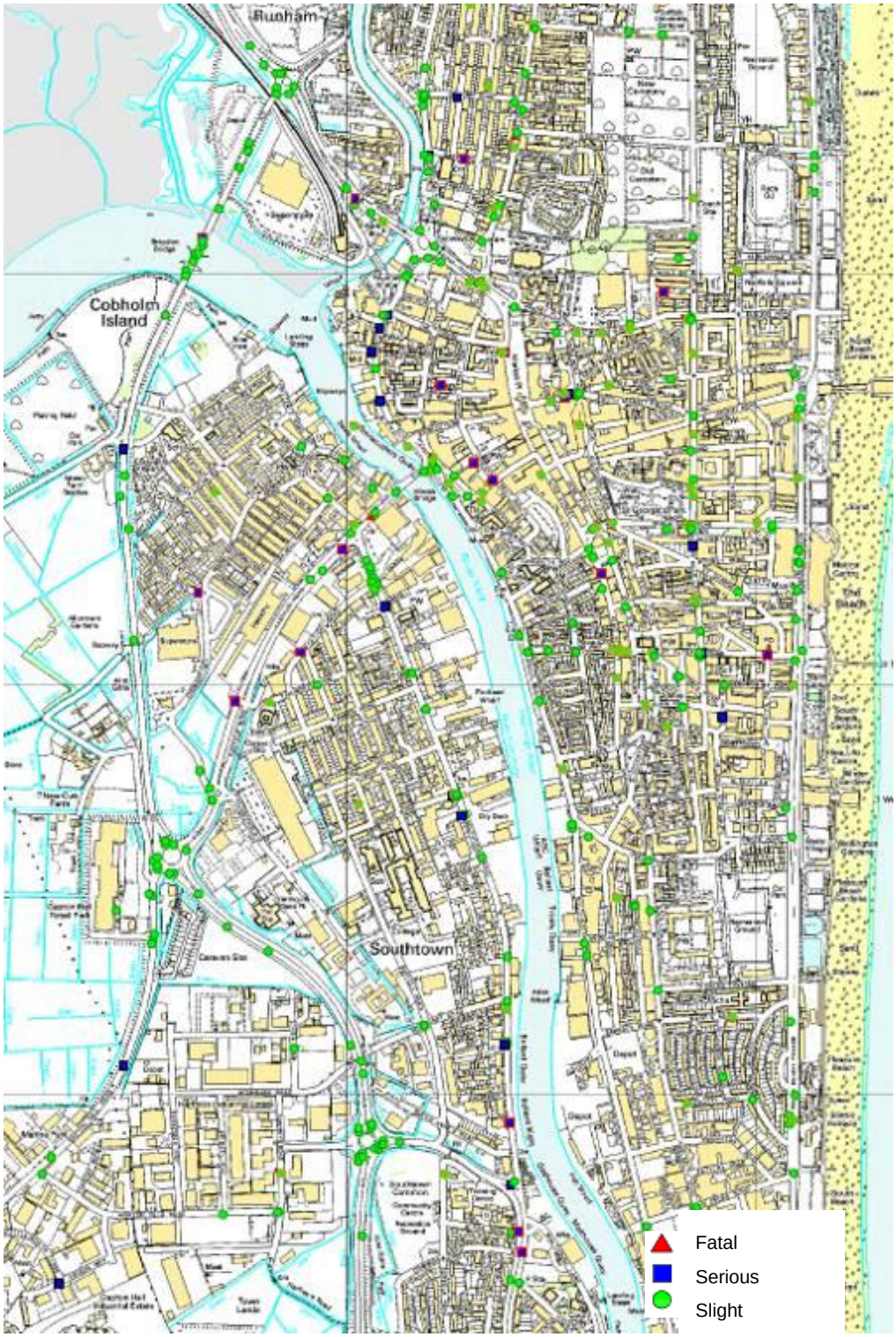


Figure 2-17 Injury accidents 2011 – 2015 (Pedestrian accidents outlined in red)

In the five years from 2011 to 2015, there were 394 recorded collisions in the Great Yarmouth area, involving 489 casualties:

Severity	Collisions	Casualties
Fatal	2	2
Serious	46	47
Slight	346	440
Total	**394**	**489**

Table 2-10 Accidents and casualties Great Yarmouth 2011-2015

Of the 489 casualties, 99 (20%) were pedestrians and 50 (10%) were cyclists. 72 casualties (15%) arose from accidents involving motorcycles. There are clusters of accidents on the approaches to the existing bridges, including North Quay

A third crossing should reduce overall vehicle kilometres, and thus exposure to accident risk, and is expected to produce a net reduction in casualties.

2.3.14 Lack of resilience in the local road network

Traffic congestion and the lack of any alternative to the existing bridges mean that the local road network is not resilient to the effect of disruptions such as road works or accidents.

A third crossing will provide a greater choice of routes into Great Yarmouth and improve the resilience of the network to disruption.

2.4 Step 4a – Scheme objectives

The objectives for the scheme are set out below, divided into:

- High level, or strategic, outcomes
- Specific, or intermediate, objectives
- Operational objectives

The **high level objectives** are:

- To support the creation of new jobs especially in the South Denes Local Development Order area and the Enterprise Zone
- To support Great Yarmouth as a Centre for Offshore Renewable Engineering, and as a port
- To support the regeneration of Great Yarmouth, including the town centre and the sea front, helping the visitor and retail economy
- To improve strategic connectivity, and reduce community severance
- To protect and improve the environment

The **specific, or intermediate, objectives** are:

- To provide traffic relief to Breydon Bridge and Haven Bridge
- To reduce congestion and delay in the town centre
- To improve journey time reliability
- To reduce traffic in historic areas, especially North Quay and Hall Quay
- To improve vehicular access to South Denes and the outer harbour, especially from the A12
- To improve access to the Great Yarmouth peninsula for buses
- To improve access to the Great Yarmouth peninsula for cyclists
- To improve access to the Great Yarmouth peninsula for pedestrians
- To reduce road accident casualties
- To reduce emissions of greenhouse gases
- To improve the resilience of the local road network

The **operational objectives** are:

- To provide an additional crossing of the River Yare for vehicles, cyclists and pedestrians
- To reduce overall journey times and vehicle kilometres in Great Yarmouth
- To minimise environmental impact, compulsory purchase and demolition of residential and commercial property.
- To achieve a balance between the needs of road and river traffic

Targets

Targets will be developed related to the above objectives at a later stage in the Assessment process. Wherever possible, these will be quantitative. These will feed in to a Monitoring and Evaluation Plan associated with the business case for the scheme.

2.5 Step 4b – Geographic area of impact to be addressed by the scheme

The geographical area of impact of the scheme is defined by:

- The geographical scope of the travel market and key origins and destinations
- The geographical extent of current and future transport problems and underlying drivers

At this stage of the assessment, scheme options have been tested using the Great Yarmouth SATURN model (2003). The model structure was developed to be compatible with the Norwich Area Transportation Strategy model (2002), but with the zoning system amended to take account of its different purposes – zoning in Great Yarmouth is more detailed whereas that around Norwich has been compressed.

It is recognised that the previous modelling work will need to be reviewed and updated if the scheme progresses to the next stage of appraisal. The proposed modelling methodology will be compliant to latest DfT guidelines and will also be supplemented by lower tier modelling (microsimulation) to enable a more detailed comparison of the different options and impact on the local and strategic road network around the tie in points. Further details are included in the ASR document accompanying this bid.

Figure 2-18 below illustrates the current model area, which represents the full geographical area of the assessment:

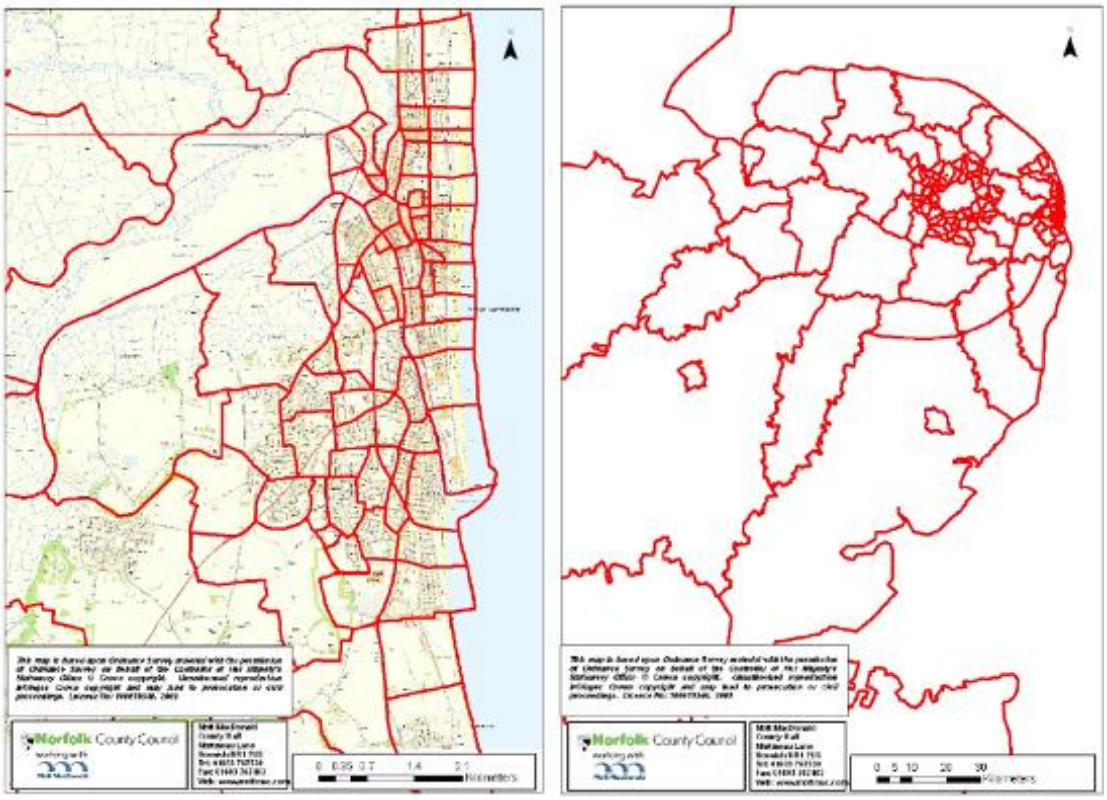


Figure 2-18 Model zoning plan

3 Option development

The assessment to date of options for a third crossing of the River Yare has been undertaken in two main stages, as detailed below.

Stage 1 (2007)

A **Stage 1 Scheme Assessment Report** (SAR)[8] was commissioned by Norfolk County Council in 2007, in order to understand the existing constraints to, and potential engineering solutions available for, the provision of a crossing of the River Yare in Great Yarmouth.

The report, prepared by consultants Mott Macdonald in March 2007, followed the methodology prescribed in the Design Manual for Roads and Bridges Volume 5, Section 1, Part 2, TD36/93 (Scheme Assessment Reporting). Stage 1 identifies the environmental, engineering, economic, and traffic advantages, disadvantages and constraints associated with broadly defined improvement strategies. The Stage 1 SAR was supported by a Stage 1 Traffic and Economic Assessment[9].

A broad area of interest was identified, and within this area nine potential options were considered, including high and low level bridge options as well as options for a tunnel.

The Stage 1 SAR recommended that three options should be taken forward for further assessment: a high level and low level bridge and an immersed tube tunnel.

Stage 2 (2009)

A **Stage 2 Scheme Assessment Report**[10] was commissioned by Norfolk County Council in 2009, in order to develop options further. This included engineering and environmental assessment and further analysis of shipping information to determine the most appropriate location for a bridge crossing. Different types of crossing were again considered, including a fixed bridge, swing bridge, lifting bridge, bascule bridge and a tunnel.

---

[8] Great Yarmouth Third River Crossing – Stage 1 Scheme Assessment Report, March 2007. Mott Macdonald for Norfolk County Council

[9] Great Yarmouth Third River Crossing – Stage 2 Traffic and Economic Assessment, October 2009. Mott Macdonald for Norfolk County Council

[10] Great Yarmouth Third River Crossing – Stage 2 Scheme Assessment Report, September 2009. Mott Macdonald for Norfolk County Council

Three options were taken forward to the outline design and simple environmental assessment process. These included 2 options for a Bascule Bridge and one tunnel option. The Stage 2 SAR was supported by a Stage 2 Traffic and Economic Assessment[11].

Adoption of a preferred route (2009)

Following public consultation from June to August 2009, Norfolk County Council adopted a preferred route in December 2009[12]. The preferred scheme was for a dual carriageway bascule bridge.

This report

This report provides a brief summary of the very comprehensive work undertaken by Norfolk County Council over a number of years to identify a preferred scheme. It does not attempt to reproduce the earlier work, as this is already set out in detail in the existing reports, which should be referred to as required.

It is now nearly seven years since the last scheme assessment work was undertaken and the preferred route adopted. It is acknowledged that some of the scheme preparation work will need to be updated, especially the traffic model. This report considers the extent to which the preferred scheme will need to be reviewed and alternatives assessed within the identified corridor, to ensure that best value for money is achieved.

3.1 Step 5 – Initial option generation

The Stage 1 Assessment identified an area of interest for the scheme, illustrated in Figure 3-1 below.

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 is at the Harfreys Roundabout on the A12.

Any bridge crossing would be required to open to allow the safe passage of shipping and pleasure craft that access the inner harbour. 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

[11] Great Yarmouth Third River Crossing – Stage 2 Traffic and Economic Assessment Report, March 2007. Mott Macdonald for Norfolk County Council

[12] Report by Director of Environment, Transport and Development to Norfolk County Council Cabinet, 7 December 2009, Item 22

pleasure craft. The other factor considered was 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.

These considerations, and the need to minimise any impact on existing built development, enabled an initial area of interest to be determined. The Stage 1 report noted that highways alterations may be required outside the area to achieve effective tie in to the existing network.

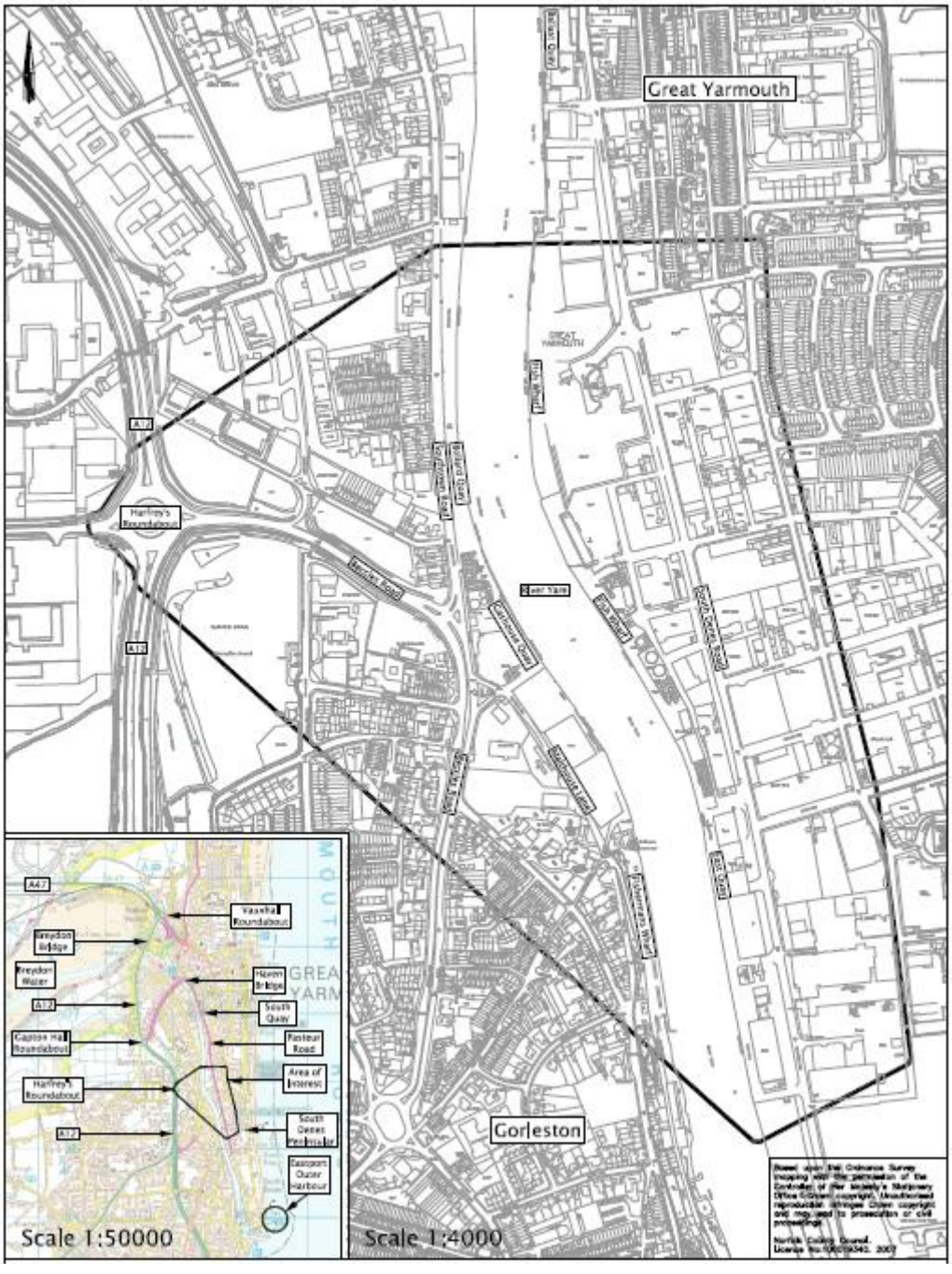


Figure 3-1 Area of interest for initial option generation

Within this area of interest, three broad alignment corridors were considered (northern, central and southern). Within each corridor, a high level and low level opening bridge feasibility alignment was produced (on similar alignments), as well as a tunnel feasibility alignment. This resulted in nine different options, with six different alignments.

The nine crossing options considered are illustrated in Figure 3-2 and listed in Table 3-1.

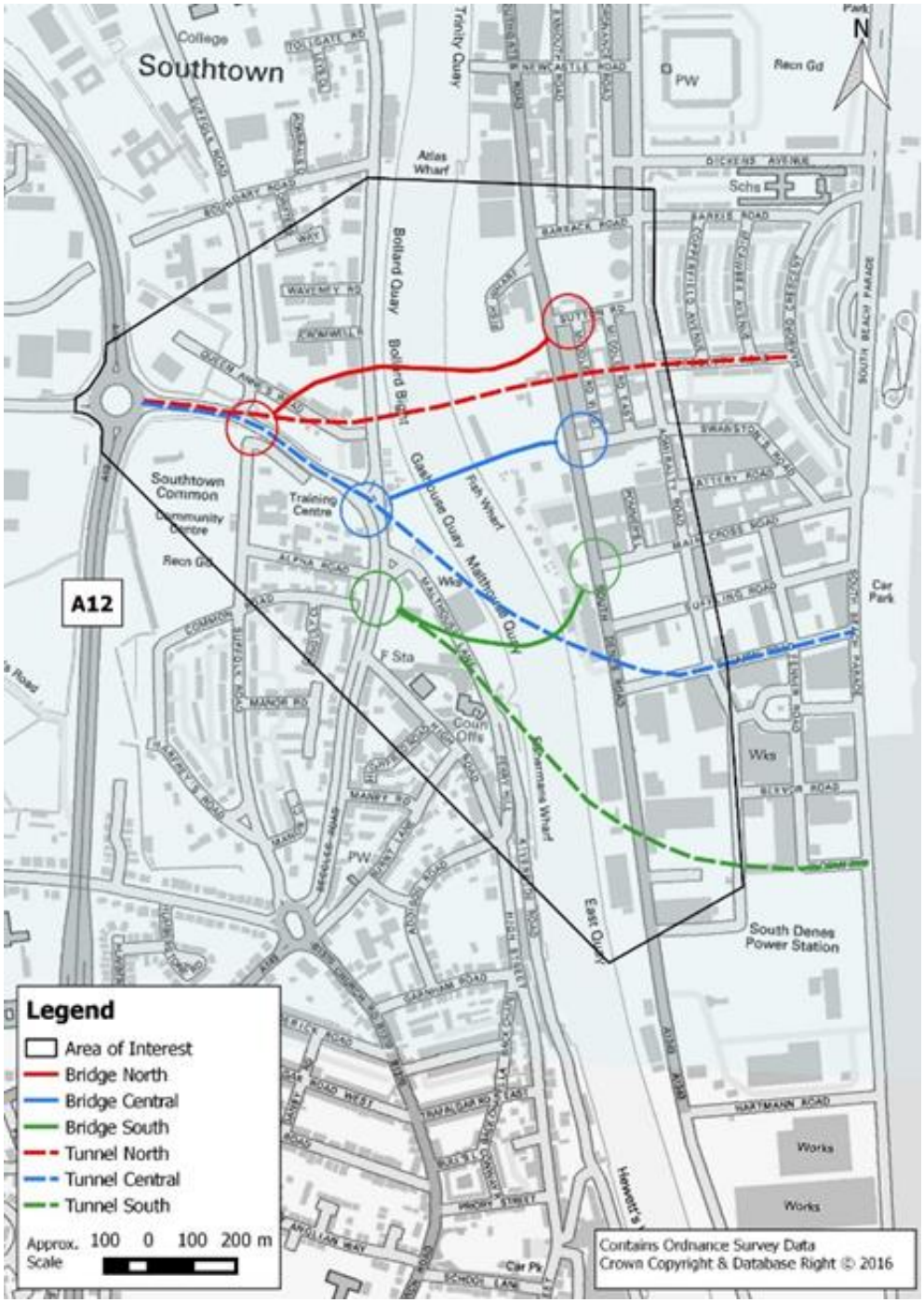


Figure 3-2 Potential locations - Stage 1 Assessment

Alignment	Type of crossing
Northern alignment	High level opening bridge
	Low level opening bridge
	Tunnel
Central alignment	High level opening bridge
	Low level opening bridge
	Tunnel
Southern alignment	High level opening bridge
	Low level opening bridge
	Tunnel

Table 3-1 Potential options - Stage 1 Assessment

Bridge options – Stage 1

For the Stage 1 assessment:

- The high level bridge was envisaged as a bascule-type bridge with an air draft of 7.50m. The preliminary engineering design of this structure envisaged a full 95.00m span of the harbour, with no structures being placed within the navigable channel. The high air draft of this structure would minimise the number of openings required to allow the passage of leisure craft, but would still require the structure to open for the majority of the existing off-shore supply vessels and all leisure craft with high masts.

- The low level bridge is envisaged as a bascule-type bridge with an air draft of 5.00m. The preliminary engineering design of this structure envisaged a full 95.00m span of the harbour, with no structures being placed within the navigable channel. The lower air draft of this structure would require more frequent opening to allow vessels to pass (reducing the overall benefit of the crossing in terms of congestion relief), but it would be less expensive than the high level bridge.

Tunnel options – Stage 1

For the Stage 1 assessment, the tunnel construction was assumed to be a combination of an immersed tube tunnel section, with cut and cover tunnels linking the ends of the immersed tube section to the tunnel portals. Alternative methods of cut and cover construction were considered – “top down” or “bottom-up” with the latter option being found more cost-effective. Details are given in the Stage 1 SAR.

The tunnel options would have no impact on the operation of the port once complete, but the approach roads and portals would require more land than a bridge at the same location.

Non-road options

All of the options generated at Stage 1 were road based, involving a physical crossing of the River Yare either by bridge or tunnel. The Stage 1 SAR considered that due to the particular geography of the Great Yarmouth area, plus the envisaged road-based developments in the area action plans, it is difficult to perceive alternative multimodal improvements that would meet the objectives of the scheme.

The sort of non-road options that might be considered as an alternative to a major highway scheme – either separately or in combination - are:

- **Traffic restraint** – physically restricting movement in sensitive areas by traffic management or traffic calming to reduce capacity and encourage traffic to choose alternative routes or alternative modes of travel, or to reduce demand overall.

- **Charging** – for use of the existing bridges, to encourage traffic to choose alternative routes or alternative modes of travel, or to reduce demand overall.

- **Improving the existing network** – e.g. increasing the capacity of the existing bridges to accommodate current and forecast demand without a new bridge.

- **Improving other modes** – e.g. improvements to public transport, cycling and walking without a new bridge

In the particular context of Great Yarmouth and its needs, it is difficult to see how these options could by themselves achieve the objectives of the scheme (as set out in Paragraph 2.4).

These objectives focus on improving the connectivity of the Great Yarmouth peninsula so as to support employment growth and the regeneration of the port, the town centre and resort. Traffic restraint or charging would generally make the peninsula less accessible and less attractive to development.

Improvements to the existing bridges – even if that were feasible - would not improve access to and from the south but could exacerbate current problems in the town centre. Furthermore, there are limitations on what can be achieved in terms of, for example, road space reallocation to sustainable modes without the removal of through traffic that a third crossing would achieve.

Improvements for other modes, whilst desirable in themselves, would not improve the connectivity of the port and new or existing industry to suppliers and markets.

For these reasons, non-road options were not considered further in the Stage 1 assessment.

3.2 Step 6 – Initial sifting (Stage 1 Assessment)

Estimated scheme costs – Stage 1

At Stage 1, cost estimates were prepared for options in the northern and southern corridors only, as this was considered sufficient to obtain an indication of the value for money of a third crossing scheme. The indicative construction costs, excluding land, are set out in Table 3-2 below:

Alignment	Type of crossing	Estimated out-turn costs (2015) excluding land cost
Northern alignment	High level bridge	£74,774,000
	Low level bridge	£70,542,000
	Tunnel	£131,181,000
Central alignment	High level bridge	n/a
	Low level bridge	n/a
	Tunnel	n/a
Southern alignment	High level bridge	£68,228,000
	Low level bridge	£66,997.000
	Tunnel	£185,555,000

Table 3-2 Estimated costs of potential options - Stage 1

The costs assumed a start on site in 2013 and opening year of 2015.

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.

Stage 1 Environmental Assessment

The Stage 1 Environmental Impact Assessment[13] (EIA) considered all nine route options. It reported that the scheme would have numerous impacts on the local environment; some of which would be beneficial, and some of which would be adverse. In some cases, an adverse impact in the study area could have a corresponding beneficial impact on other parts of Great Yarmouth.

The specific findings of the Stage 1 EIA are summarised below:

- Each of the routes would lead to a minor adverse impact on local **air quality** caused by the increase in traffic levels in the study area. A central corridor alignment would affect the least number of properties, whilst a southern corridor alignment would affect the most number of properties. Mitigation should concentrate on finding an alignment with the least impact in this

[13] Great Yarmouth Third River Crossing – Stage 1 Environmental Impact Assessment Report, (Mott Macdonald for Norfolk County Council, 2007)

respect (balanced against all the other objectives of the scheme). The scheme would benefit local air quality in Great Yarmouth town centre where traffic volumes are predicted to be reduced.

- It is unlikely that impacts on the **cultural heritage** within the study area will be anything more than minor in magnitude. Very few features would be directly affected, although several would be affected indirectly. However, these impacts should be weighed against the beneficial impacts felt elsewhere in Great Yarmouth, where the reduction in traffic will go a long way to improving the integrity and setting of the buildings, monuments, features and areas that contribute to the cultural heritage of the town. Enhancement of some areas may be possible to improve the setting of some listed buildings, although these may not be part of the envisaged scheme.

- There are many aspects of **construction** that will cause disruption to aspects of the natural environment within the study area, most notably noise and vibration, air quality, water quality and drainage and ecology and nature conservation. Some mitigation should be possible, with careful planning and forethought, although it is likely that these measures will not be able to mitigate for the impacts completely; the significance of the impacts will only be reduced.

- The **ecological** value of terrestrial habitats within the study area is of negligible value; however the River Yare, which is tidal at this location, regularly flows to and from Breydon Water, which is protected under International, European and National legislation. The current crossings envisaged should not affect the river flow regime or water quality in any way, so only a negligible effect would be inflicted on the estuarine ecosystem of Breydon Water.

- With both bridge [height] options the main impact on the **landscape and townscape** would be the presence of traffic within the view of nearby houses, and the presence of a possible bridge structure across the open river. In this respect the high level bridge option may be more intrusive, but overall it may not appear out of place within an essentially industrial townscape, particularly if the design is of a high visual quality. The tunnel would largely remove traffic impacts, but the extensive areas required for the approach ramps may have greater impacts on residential areas than either of the bridge options in terms of townscape.

- There could be adverse impacts on **land use** caused by the required demolition of residential buildings and port-related buildings/apparatus. Each of the routes would have the same magnitude of effects in this respect, with no route being significantly better or worse than the others. In such a built up area the potential to design such a major structure without needing to demolish buildings is very limited.

- It is not possible to determine the overall changes in **noise and vibration** arising from the scheme at this early stage. However, there will be a general trend whereby the more properties that are affected, the more significant the effect. An alignment in the central corridor is predicted to affect the least properties, whereas an alignment in the southern corridor is predicted to affect the most. The scheme would benefit local conditions in Great Yarmouth town centre where traffic volumes are predicted to reduce, and so noise and vibration in these areas would lessen.

- **Pedestrians and cyclists** would benefit from the construction of a bridge across the river, and journeys by foot or cycle are likely to replace some of those currently made by car. No equestrians currently use, or are likely to use, the study area due to its urban, industrial nature. A tunnel would offer no discernible change from the existing situation for non-vehicular users.

- A [new] river crossing would have moderate beneficial impacts for **vehicle users**. Reduced journey times and congestion would mean that driver stress would also reduce, although the magnitude of this is not calculable at this early stage. The view from the road, which is currently very restricted, would also improve by permitting wide open views of the river and surroundings. The construction of a tunnel would have the most beneficial effects for vehicular travellers, as a bridge would require the deck to be lifted on a regular basis to allow shipping through, which would mean vehicular travellers would have to queue. This temporary queuing would reduce the overall beneficial effect on driver stress that the bridge would have.

- The fact that the bridge/tunnel crosses a major watercourse means that impacts on **water quality and drainage** are likely, both in terms of surface water and groundwater flows. Pollution represents the greatest risk, from both vehicle spray in wet weather and accidental fuel spillages, so effective drainage systems will be required to ensure that the quality of the water is not affected. A tunnel will impact groundwater flows, and this impact is not able to be mitigated, although only a minor adverse impact is envisaged at this time.

- The underlying **geology** is largely alluvium, over London Clay Formation. No important geological features exist. The scheme will cause minimal adverse impacts on the geology and soils in the study area, partly due to its existing built-up nature, so no mitigation measures are envisaged at this time.

Stage 1 Traffic Assessment

Three of the options identified at Stage 1 were tested using the Great Yarmouth SAURN model. The Stage 1 Traffic and Economic Assessment Report describes the development and use of the model.

The initial options tested were:

Alignment	Type of crossing
Northern alignment	Opening bridge (no distinction between high and low level bridges)
Central alignment	Tunnel (Beccles Road to Salmon Road / South Beach Parade
Southern alignment	Opening bridge (no distinction between high and low level bridges)

Table 3-3 Options tested in traffic model (Stage 1)

The forecast impact of each of these options on traffic flows is illustrated in Table 3-4 and Table 3-5 below.

Two-way traffic flow	Do minimum 2003 AADT	Northern bridge 2015 AADT	Southern bridge 2015 AADT	Central tunnel 2015 AADT
A12 Breydon Bridge	35,300	31,400	33,700	31,800
A1243 Haven Bridge	32,500	20,300	21,500	26,000
Third river crossing		23,300	20,100	15,800
TOTAL	**67,800**	**75,000**	**75,300**	**73,600**

Table 3-4 Forecast traffic on bridges, 2015 Stage 1 Assessment

Two-way traffic flow	Do minimum 2003 AADT	Northern bridge 2030 AADT	Southern bridge 2030 AADT	Central tunnel 2030 AADT
A12 Breydon Bridge	35,400	32,200	33,000	32,600
A1243 Haven Bridge	35,000	20,500	24,100	26,500
Third river crossing		28,300	24,400	18,900
TOTAL	**70,400**	**81,000**	**81,500**	**78,000**

Table 3-5 Forecast traffic on bridges - 2030 (Stage 1 Assessment)

The key findings are that either of the bridge options would carry more traffic (and hence provide more traffic relief) than the tunnel option. A northern bridge alignment would provide a greater level of traffic relief to the existing bridges than a southern alignment. It should be noted that at Stage 1 no distinction was made between the number of bridge openings required to let ships through at the north or south locations. A southern bridge might have to open more often.

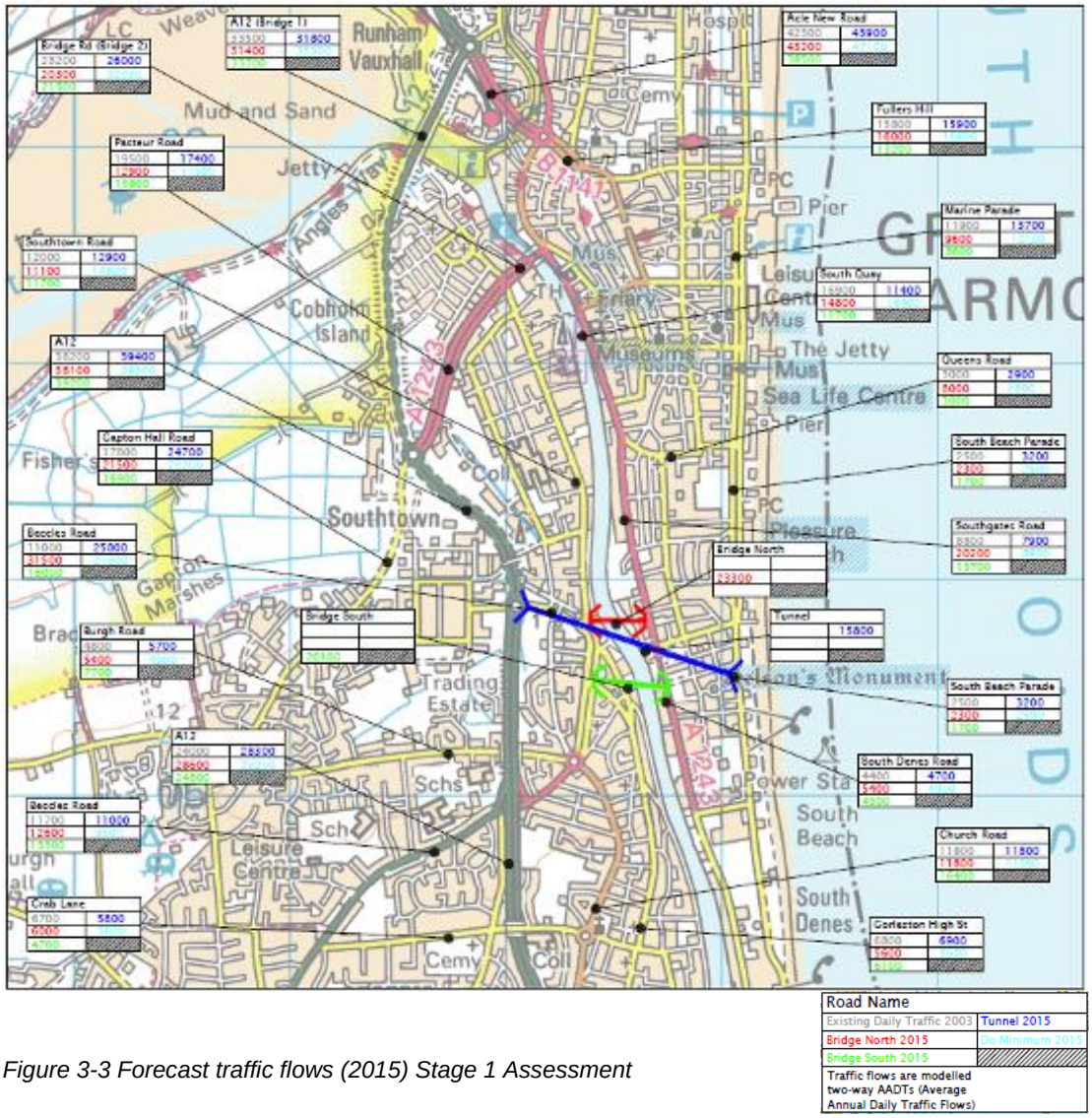


Figure 3-3 Forecast traffic flows (2015) Stage 1 Assessment

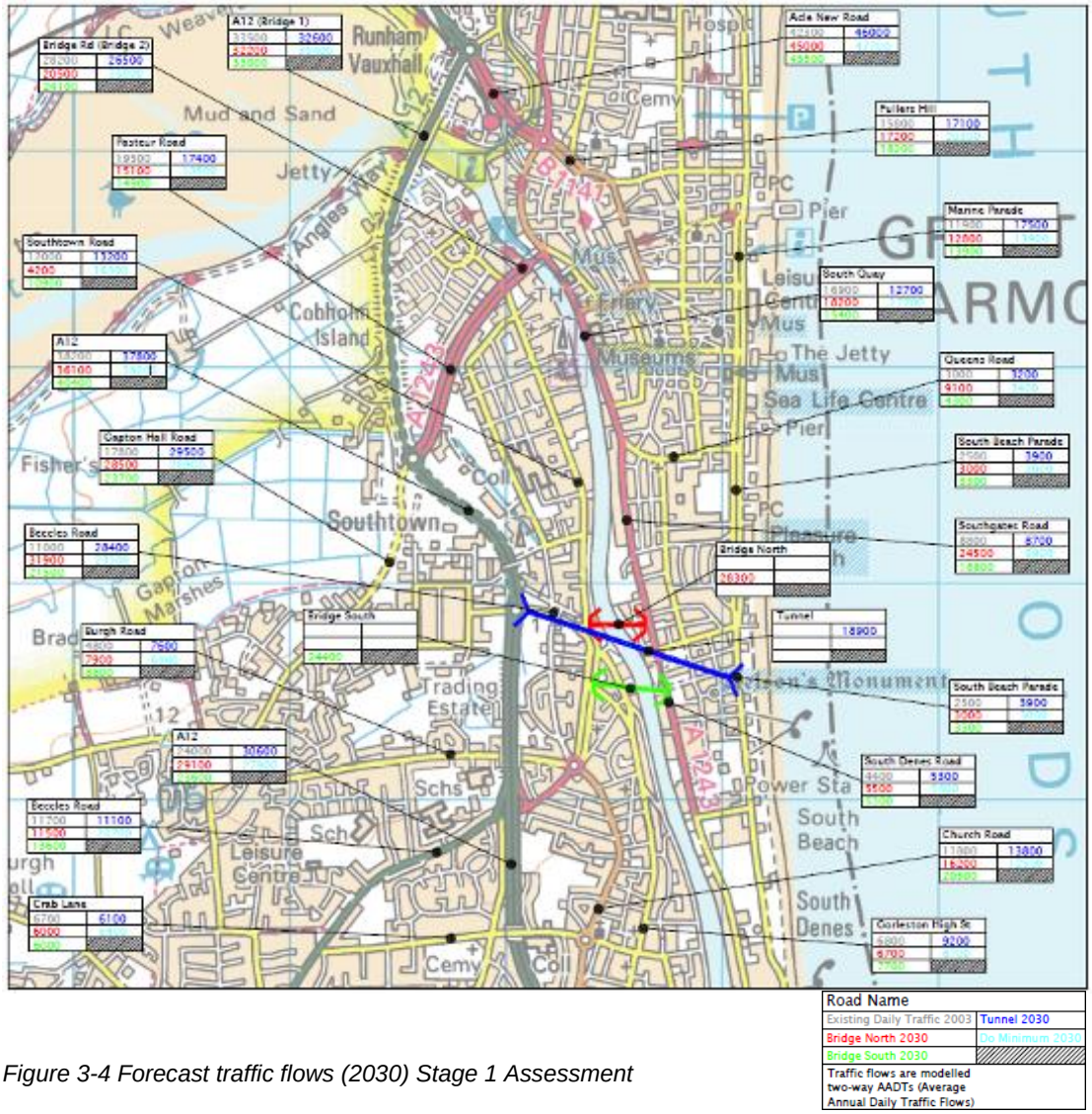


Figure 3-4 Forecast traffic flows (2030) Stage 1 Assessment

Stage 1 Accident Assessment

Accidents were forecast over a 60 year assessment period. Expected casualty reductions are set out in Table 3-6 below.

	Total	Reduction (60 yrs)		
	Base	Northern bridge	Southern bridge	Central tunnel
Accidents	44,398	-2,260	-2,644	-2,385
Casualties	61,270	-3,092	-3,619	-3,230

Table 3-6 Forecast accident and casualty reductions, 60 yrs (Stage 1 assessment)

All options would produce accident and casualty savings of more than 5%. The southern bridge would produce the largest savings.

Stage 1 Economic Assessment

An economic assessment was undertaken using TUBA, with accident benefits calculated using COBA.

All of the options tested show a positive benefit-cost ratio, as set out below:

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

The results are set out in more detail in Table 3-7 below.

Benefits/Disbenefits/Costs	Northern bridge £,000	Southern bridge £,000	Central tunnel £,000
Consumer User Benefits	112,727	121,295	78,468
Business User Benefits	110,153	117,174	83,266
Private Sector Provider Impacts	0	0	0
Carbon Benefits	1,501	1,696	987
Accident Benefits	85,611	96,844	88,551
Present Value of Benefits (PVB)	**309,992**	**337,009**	**251,272**
Investment Costs	61,674	57,544	109,971
Indirect Tax Revenue	10,189	11,475	6,714
Present Value of Costs (PVC)	**71,863**	**69,019**	**116,685**
Net Present Value (NPV)	**238,129**	**267,990**	**134,587**
BCR (PVB/PVC)	**4.3**	**4.9**	**2.2**

Table 3-7 Economic assessment results (Stage 1)

Conclusions from the Stage 1 appraisal (2007)

The Stage 1 assessment included a number of simplifications. Not all of the potential alignments were subject to modelling and economic assessment. The likely differences in frequency of opening between northern and southern bridges (or between high level and low level bridges) were not modelled. Only advance design work was undertaken and land costs were excluded. These simplifications were considered appropriate because the main purpose of the Stage 1 assessment was to establish the general feasibility of a third crossing in engineering terms and to test whether it could be justified in economic terms.

Although a simplified assessment, it served to show that a third crossing would be feasible, and that either a bridge or a tunnel could produce benefits in excess of its costs, although a bridge would be less expensive and therefore produce a significantly better benefit-cost ratio than a tunnel.

The conclusions and recommendations of the Stage 1 Assessment in 2007 were:

"Due to the perceived viability of the high level bridge, low level bridge and the tunnel option to provide a new crossing of the River Yare with good benefit to cost ratios, the following should be considered for inclusion for assessment at the start of the Stage 2 scheme assessment process: -

1. *High Level Opening Bridge*
2. *Low Level Opening Bridge*
3. *Immersed Tube Tunnel*

"The exact route alignment will depend on the cost (environmental, social and economic) of the alignment, and will require detailed discussions with landowners and the statutory bodies.

"Due to the difference in opening frequencies envisaged for the two bridge options between the upper and lower sections of the area of interest, it is envisaged that the most benefit would actually be derived from the placement of the bridge options in the upper part of the area of interest, rather than in the southern area as the current economic modelling predicts. It is recognised that this may not the most advantageous position for the redevelopment of the waterfront area, but the scheme objective is primarily to relieve existing congestion elsewhere on the highway network. The placement of any crossing within the area of interest will give substantial benefits to the regeneration area in terms of access. It may be appropriate to consider in more detail the difference in benefits between bridge options at different geographic locations within the area of interest once additional information is made available during the Stage 2 assessment.

"It is envisaged that a tunnel option would cross the river in a north-west to south-east direction. This could allow the highway approach from Harfreys Roundabout to fit amongst the existing residential and industrial development with the minimum of disturbance. It may also allow a more suitable connection into the highway network on the South Denes peninsular. However, consideration should be given in Stage 2 to realigning the tunnel into a southwest to northeast alignment, to better fit the desire line of traffic wishing to access the peninsular, although it is recognised that the desire lines may change with the potential opening of the outer harbour development."

3.3 Step 7a – Further development of potential options

For the Stage 2 Assessment, a wider range of possible crossing types was considered:

- A fixed bridge
- A swing bridge
- A lift bridge
- A bascule bridge
- A tunnel option

The detailed investigation of these options was described in a Structural Options working paper[14] and is briefly summarised below.

Fixed bridge options

A fixed bridge would be available to traffic and shipping at all times and would not include any opening mechanism. It would therefore need to be tall enough to allow all vessels currently using the inner harbour to pass beneath it. This would require a clearance of at least 40m. In order to gain this height from ground level, approach structures of more than 650m in length would be needed, as well as connections to existing roads.

Six potential alignments were identified for a fixed bridge option – options F1, F2, F3, F4, F5 and F6. These are illustrated diagrammatically in Figure 3-5. They were evaluated in terms of their likely impact on traffic flow, and in terms of the type and area of land that would be required for their construction. Details are set out in the Structural Options Working Paper. Option F1 was identified as the best of the six, as it would require the least amount of land, mainly industrial and highway land. A variant, F1A was identified which would allow a greater vertical clearance than the other options.

Despite this, it was not possible to devise any fixed bridge option high enough not to obstruct some existing shipping movements. Option F1A would cost £75 million (2009 out-turn costs, excluding land and service diversions), significantly more than a movable bridge. It would have a significant adverse environmental impact. For these reasons, the idea of providing a fixed bridge was rejected.

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

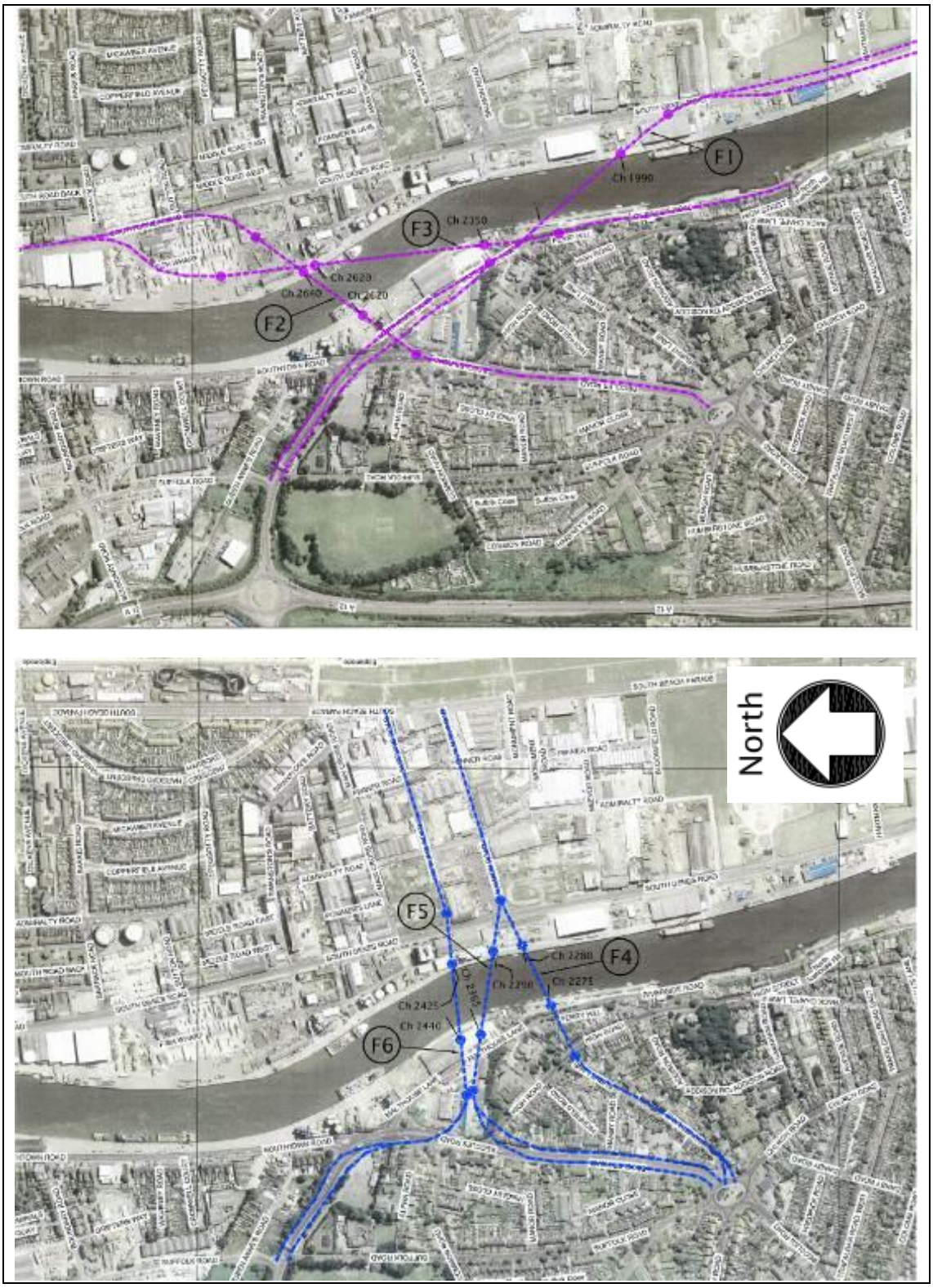


Figure 3-5 Potential fixed bridge alignments

Swing bridge option

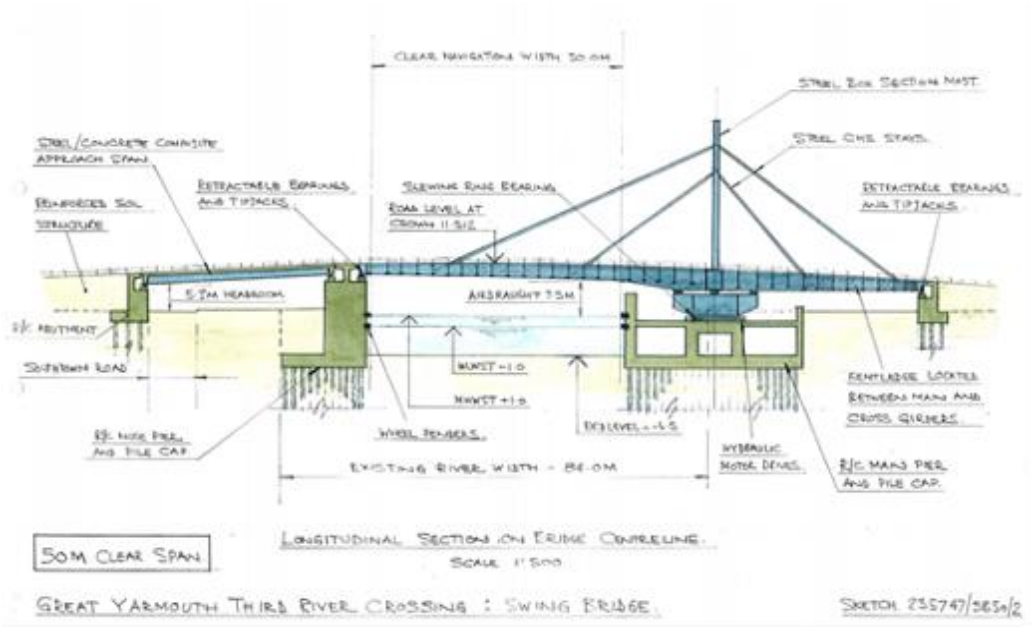


Figure 3-6 Swing bridge

A swing bridge option was considered, but rejected. The superstructure would be very vulnerable to damage from ship collision and the cost of protecting against this would be prohibitive.

Lifting bridge option

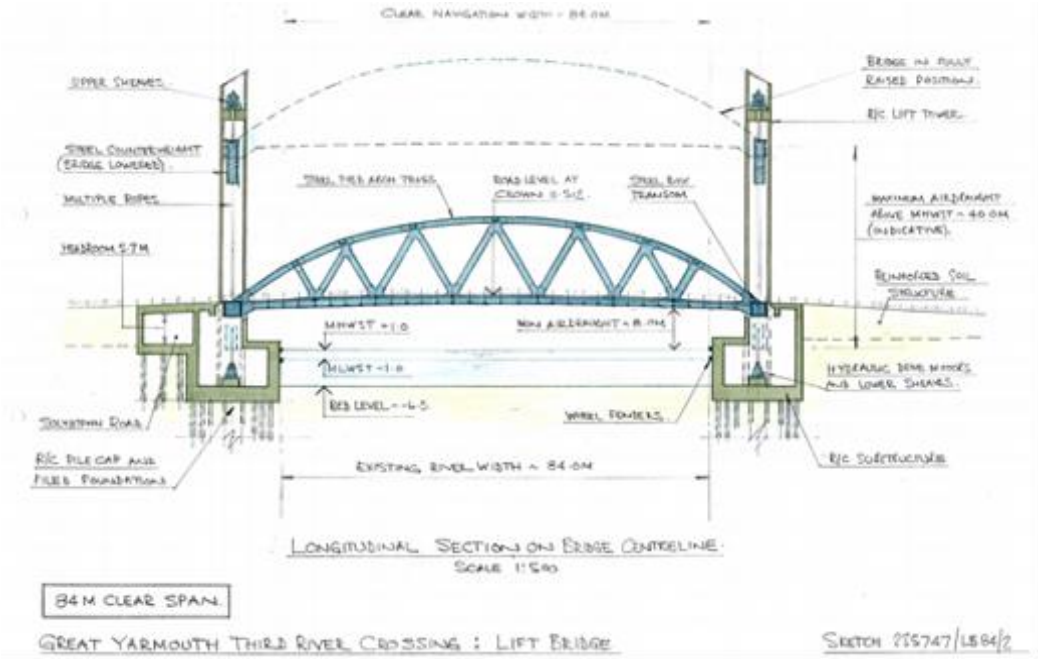


Figure 3-7 Lifting bridge

A lifting bridge option was considered but rejected. The towers would have to be at least 40m high, with a high adverse visual impact, and the maintenance cost would be higher than with a bascule bridge.

Bascule bridge option

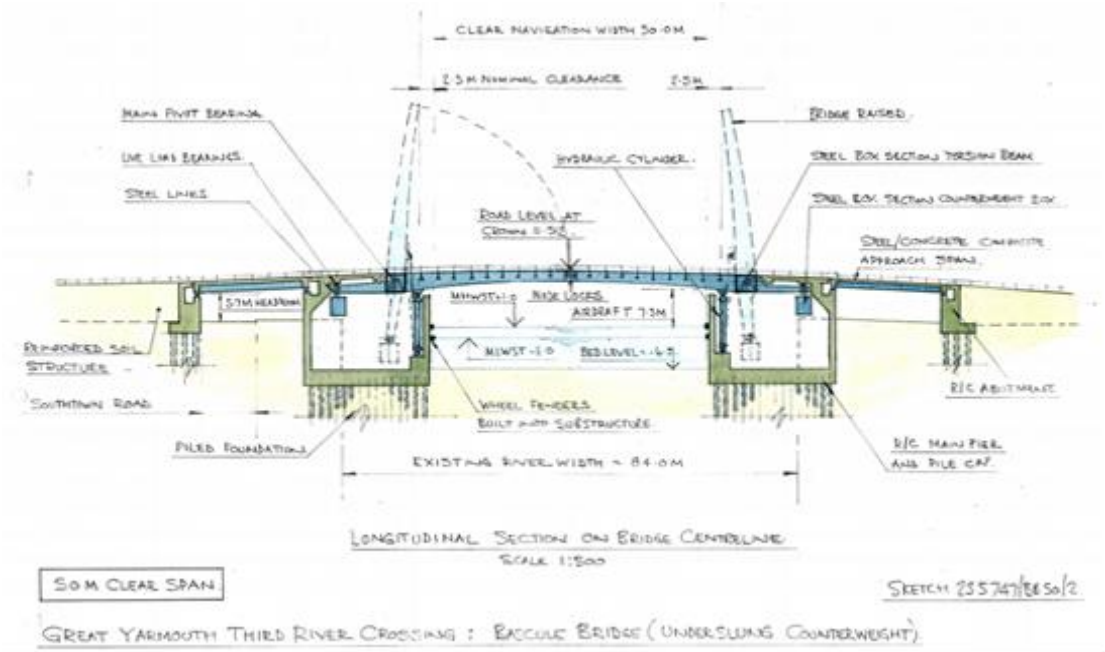


Figure 3-8 Bascule bridge option (example)

The Structural Options Working Paper concluded that a bascule bridge was the most appropriate type for this location. It would be less expensive than the other types of bridge considered, have a lower visual impact, especially when closed, and would allow passage of vessels of any height when opened.

Optimising the bridge location

Having confirmed that a bascule bridge was likely to be the best type of bridge, the Stage 2 Assessment gave further consideration to the options which had emerged from the initial sift (Stage 1 Assessment).

A navigation simulation was undertaken to determine the scope for reducing the opening spans of a bascule bridge to reduce the overall cost, and to optimise the alignment of the bridge.

Detailed data on commercial vessel movements within the inner harbour was obtained and used to estimate the number of bridge openings required per day and different possible bridge locations. This was used to determine the optimum location for a bridge. A bridge with the shortest route across the river from A12 Harfrey's Roundabout would require on average 6 openings a day. Further south, the number of openings would increase. Further north, the number of openings would be fewer, but more land would be required for longer approach roads, increasing the costs.

Tunnel option

The ground investigation confirmed that only an immersed tube tunnel, or a tunnel cast *in situ* into the river bed would be feasible due to the poor ground conditions. The overall length of the tunnel scheme would be longer than the tunnel options as the road level of the scheme would need to change from ground level to c. 16m below ground level, whereas the bridge options only require a c. 9.5m level change.

Any tunnel option would require mechanical and electrical systems for ventilation, drainage and fire protection. It would be difficult to prevent flood waters from entering the tunnel so it a temporary closure of the tunnel due to inundation must be considered a possibility. A tunnel would take approximately 3 years to construct, and would have a material impact on the current commercial operation of the inner harbour during construction.

Optimising the tunnel location

The tunnel alignments considered in the Stage 1 report were further reviewed, in the light of the initial finding that they did not adequately cater for the desire line of traffic movement. An improved alignment, running generally from the SW to the NE was identified, tested and found to be capable of attracting 35% more traffic than a NW – SE alignment.

3.4 Step 7b – Further assessment of shortlisted options (Stage 2 Assessment)

Three options – two bridge options on the shortest alignment and an improved tunnel option - were therefore shortlisted and developed for more detailed assessment. They are described in detail in the Stage 2 Scheme Assessment and Traffic & Economic Assessment reports, and their key features are summarised and illustrated below:

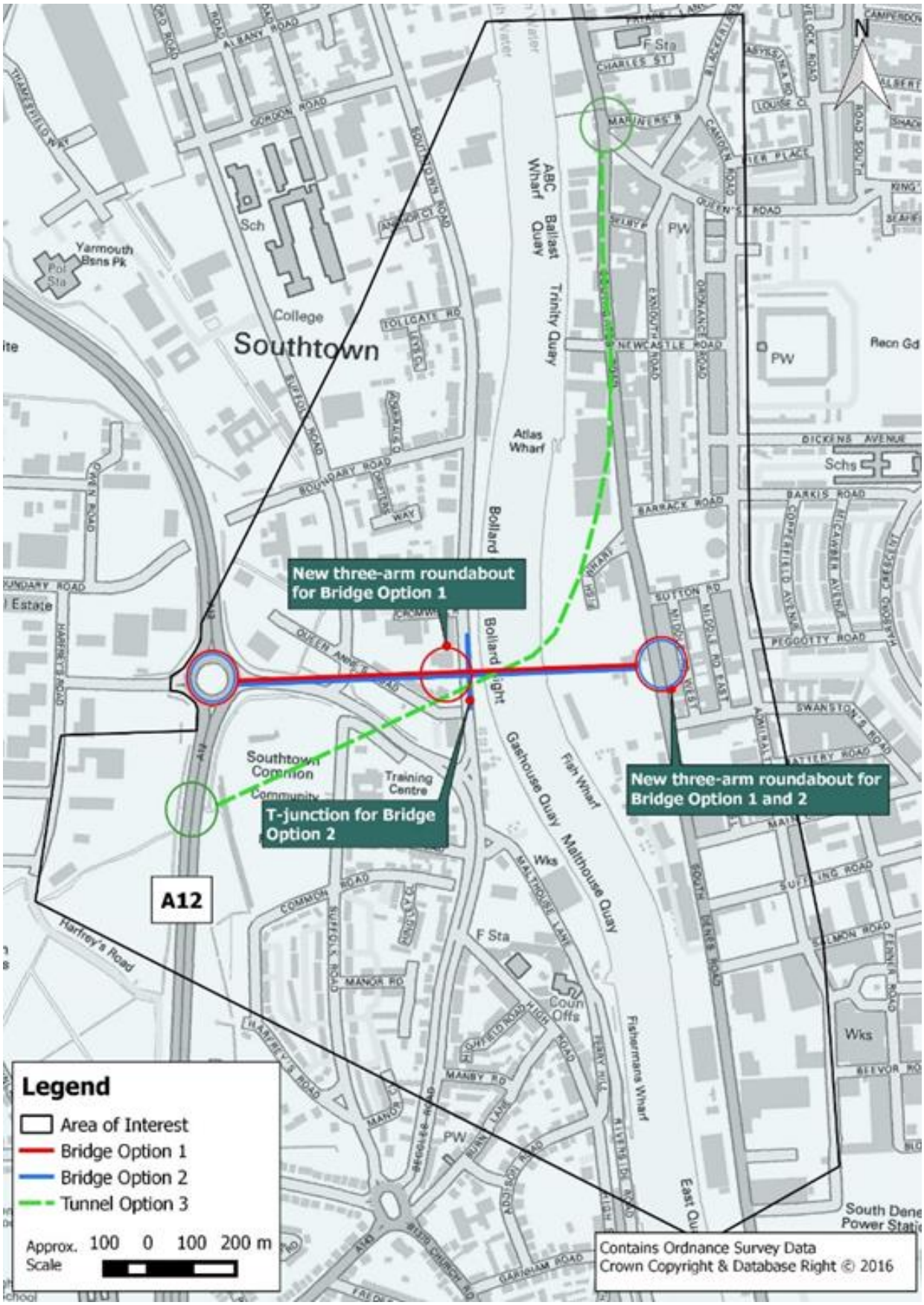


Figure 3-9 Shortlisted options

Bridge option 1 – Bascule Bridge with roundabout on Southtown Road

This option would provide a dual carriageway bascule bridge between the A12 Harfrey's Roundabout over Southtown Road and the River Yare to a new three-arm roundabout on South Dene Road between Sutton Road and Swanston's Road. This would give a headroom clearance of 5.3m on Southtown Road and 7.5m clearance to mean high tide level of 1m Above Ordnance Datum (AOD) when closed.

Other changes to the road network will also be necessary to accommodate the bridge. Beccles Road will be stopped up at its junction with Southtown Road, whilst Queen Annes Road will also be closed from its junction with Suffolk Road. A new roundabout will be provided on Southtown Road beneath the bridge and slip roads will be provided from this junction into the link to the A12 Harfrey's Roundabout.

.

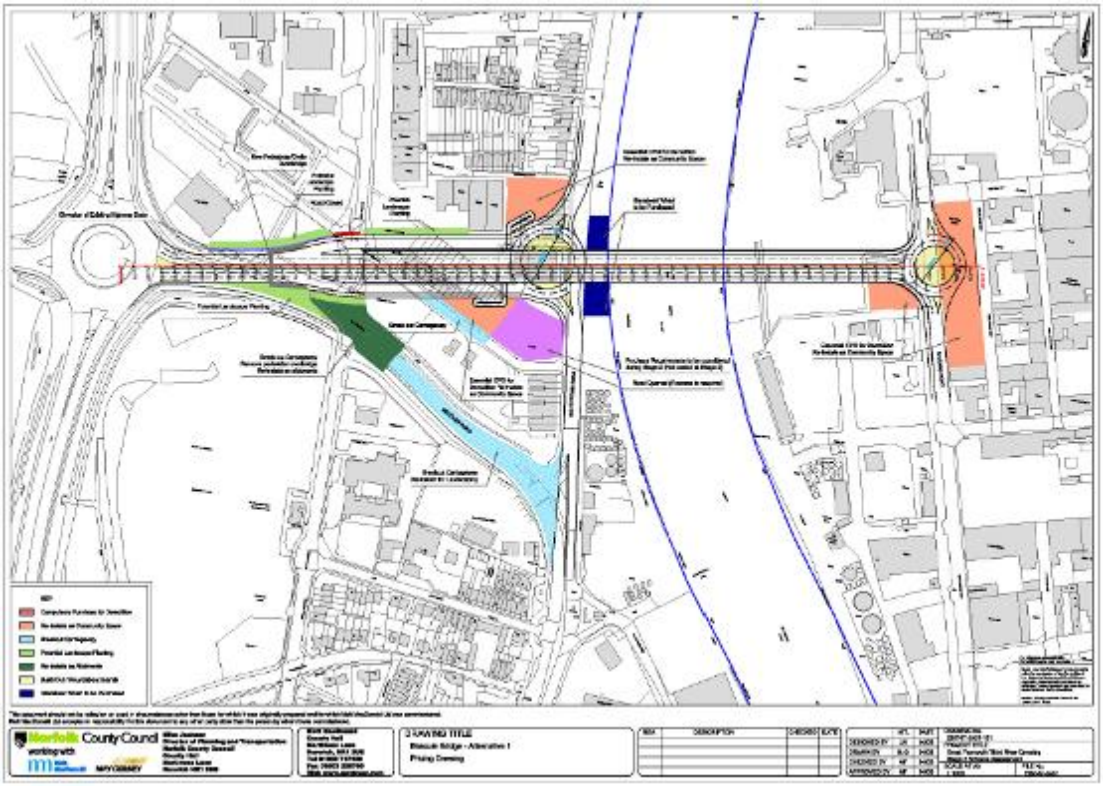


Figure 3-10 Bridge option 1 (Stage 2)

Costs for option 1 are set out below:

- Construction £ 105.426 million
- Land £ 10.900 million
- Preparation £ 2.125 million
- Supervision £ 3.225 million

The construction costs include optimism bias at a rate of 65%

Bridge option 2 – Bascule Bridge with T-junction on Southtown Road

This option would provide a dual carriageway bascule bridge between the A12 Harfrey's Roundabout over Southtown Road and the River Yare to a new three-arm roundabout on South Dene Road between Sutton Road and Swanston's Road. This would give a headroom clearance of 5.3m on Southtown Road and 7.5m clearance to mean high tide level of 1m Above Ordnance Datum (AOD) when closed.

Beccles Road would remain open from its junction with Southtown Road, but would provide a westbound one-way link towards the A12. Queen Annes Road would be closed to vehicle traffic from its junction with Suffolk Road. An eastbound off-slip will be provided from the bridge into Southtown Road

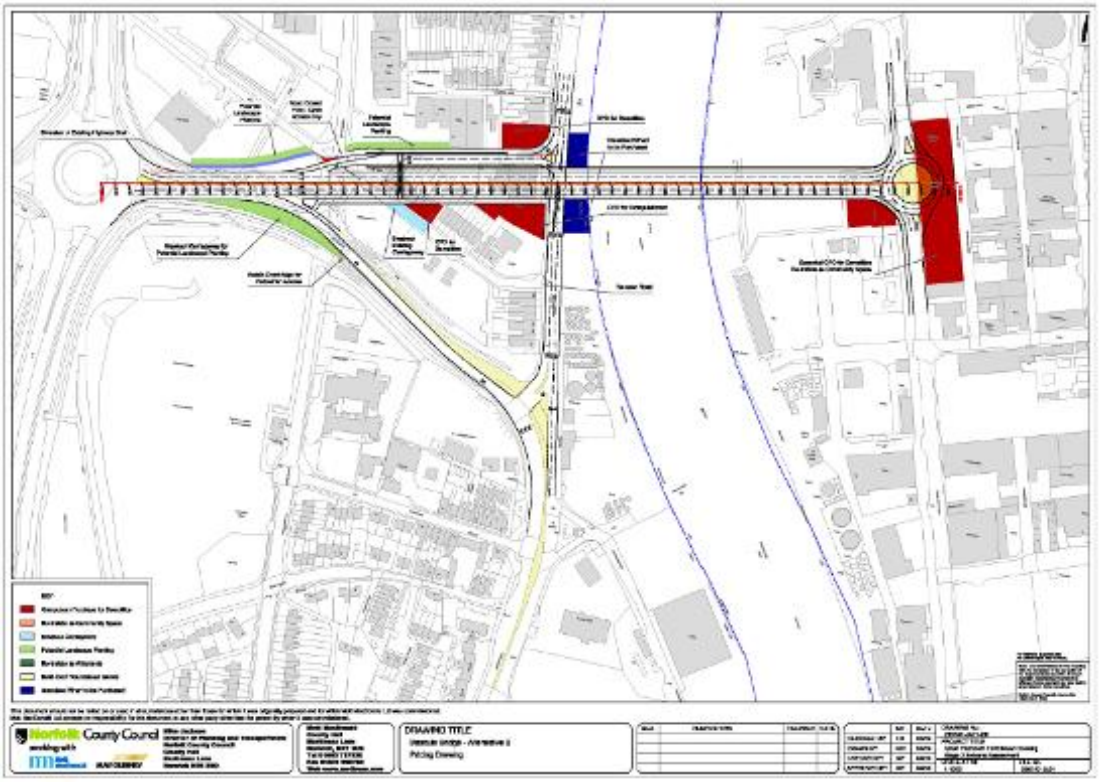


Figure 3-11 Bridge option 2 (Stage 2)

Costs for option 2 are set out below:

- Construction £ 97.169 million
- Land £ 10.200 million
- Preparation £ 1.959 million
- Supervision £ 2.973 million

The construction costs include optimism bias at a rate of 65%.

Tunnel option – Tunnel from A12 north east onto Southgates Road

This option would provide a dual carriageway tunnel between the A12(T) south of the existing A12 Harfrey's Roundabout and a new three arm roundabout at the junction of South Quay, Queens Road and Southgates Road. It would also provide improvements to Southgates Road and South Dene Road between Queens Road and Sutton Road. The existing access into the Fish Wharf would be replaced and the northbound carriageway of South Denes Road would run through the area. The tunnel portal would be located between Barrack Street and Newcastle Road.

A replacement roundabout to the south of the existing Harfrey's Roundabout would be provided with diversions to the existing Beccles Road and Harfrey's Road to link into the new junction. The existing roundabout will be removed. On and off-slips would be provided onto Southtown Road to retain access to the A12(T).

There would be no pedestrian provision through the tunnel, but cyclists could use the tunnel by travelling on-carriageway with other traffic.

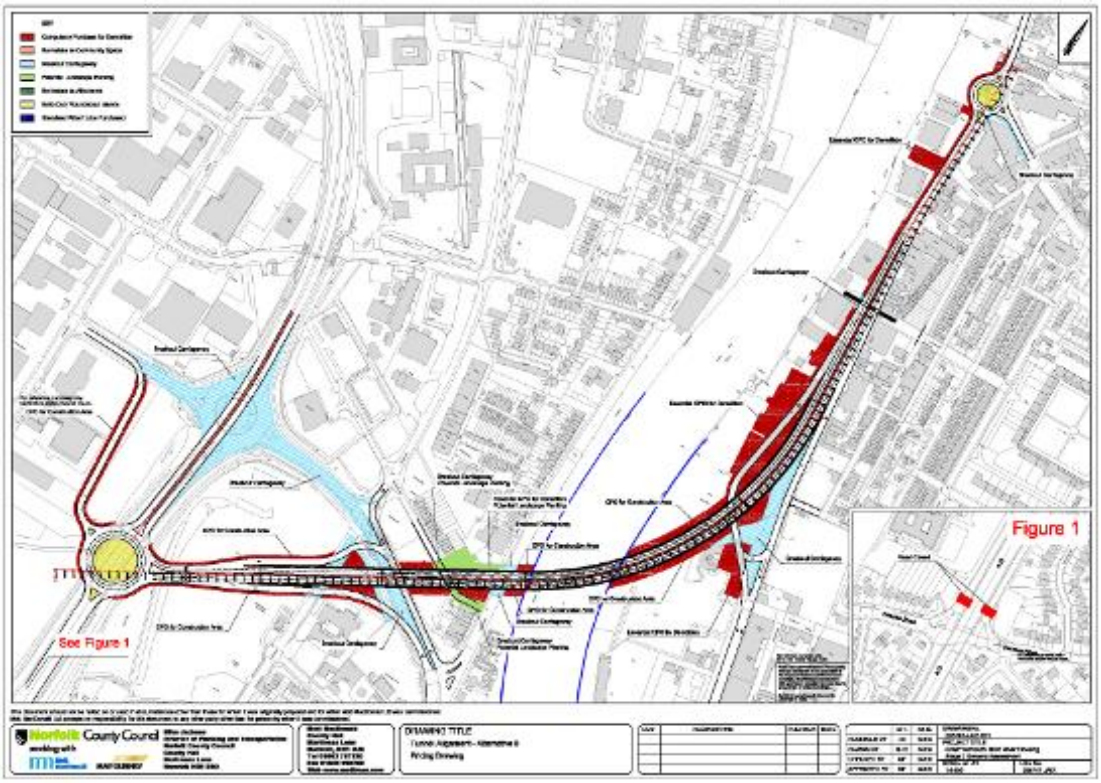


Figure 3-12 Tunnel Option (Stage 2)

Costs for the tunnel option are set out below:

- Construction £ 346.254 million
- Land £ 12.000 million
- Preparation £ 6.981 million
- Supervision £ 10.593 million

Summary of costs

The total cost of each shortlisted option at 2015 out-turn prices excluding VAT is set out in Table 3-8 below:

Option	Bridge option 1	Bridge option 2	Tunnel
Cost 2015 out-turn	£121.676 million	£112.301 million	£375.828 million

Table 3-8 Shortlisted options - costs

Environmental assessment

A Stage 2 Simple Environmental Assessment Report[15] was commissioned by Norfolk County Council in order to understand the existing environmental constraints relating to the three options for a new crossing. The findings are summarised in the SAR and the key findings are set out below:

Air Quality

For all three of the options a number of areas are predicted to experience changes in annual mean NO2 concentrations as a result of changes in traffic flows across the road network. Modelling predicted that all changes in particulate matter (PM10) concentrations would be negligible at all receptors for all three proposed options.

The overall effects on air quality as a result of the three proposed options are similar. Within Great Yarmouth as a whole, it is considered that the beneficial air quality effects caused by any of the proposed options compared to the Do-Minimum scenario outweigh the adverse effects.

Cultural Heritage

Archaeology: Overall, there will be negligible adverse effects on recorded archaeological sites, except for the possible buried shore line on the east side of the river. The most significant of the recorded archaeological remains in the vicinity is likely to be the buried shore and any associated deposits, although the proposed crossing is not expected to affect it at this location.

Historic buildings: In general, the number and significance of historic buildings within the study area is low, and the scheme will have neutral to slight adverse effect on the majority of them. However, both bridge options require demolition of 19th century buildings for which there is no effective mitigation option. Only one listed building (The Dolphin Inn) is judged to be affected to a moderate/large degree, and appropriate mitigation measures should help reduce the significance of this effect.

[15] Stage 2 Environmental Assessment Report, Mott MacDonald for NCC, 2009

Historic Landscape: The historic landscape within the study area has been extensively eroded, with little evidence of pre-20th century land use, and the scheme will therefore have only neutral to slight adverse effect. There is the slight possibility that construction works will uncover evidence of earlier land use, particularly within the Fish Wharf area and mitigation measures should be put in place to provide appropriate recording for any historic features which might be revealed.

Ecology and Nature Conservation

The impacts of ecological assets in the area, both terrestrial and marine, have been assessed following specific site surveys. Both construction and operational phases have been considered.

The construction impacts of Options 1 and 2 include loss of terrestrial habitats e.g. garden allotments, broadleaved trees and drainage ditches, direct loss of aquatic habitat, indirect disturbance to aquatic habitats caused by the disturbance of silts etc, and light and noise pollution, affecting some fauna known to exist locally. Several protected species are known to exist locally, including water voles, several species of bats, and grass snakes, all of which are likely to be affected by construction. No direct effects are considered likely on Breydon Water during construction.

The construction impacts of Option 3 would be similar to Options 1 and 2, but to a greater extent, as the areas of land take would be greater, and in more sensitive areas. A large portion of Southtown Common would be lost to this option, and the impacts on the river bed would be far greater due to the requirement to excavate a trench across the width of the river, rather than locally, as would be the case with the piers for Options 1 and 2.

The operational impacts of Options 1 and 2 include increased light pollution, with its associated impacts on bats and birds, and the possible flight pattern disruption caused by the structure itself. Indirect impacts caused by the increased traffic are likely to have some detrimental effects on ecological assets adjacent to the new traffic corridor, but could also provide improvements to ecological assets within the areas of Great Yarmouth and Gorleston which will experience a reduction in traffic and congestion.

The operational impacts associated with Option 3 are likely to be less significant compared to the other options. Impacts associated with lighting would still occur, as would the indirect effects associated with elevated traffic levels and any control building.

Landscape

The landscape effects resulting from the proposed works have been assessed, in terms of both impacts on the surrounding landscape and on visual intrusion on the local community.

The main impact of Options 1 and 2 would be the presence of traffic and the bulk of the structure within the view of nearby houses, and the presence of the bridge structure across the open river. Option 3 would largely remove traffic impacts across the river, but the extensive areas required for the approach ramps would have greater impacts on residential areas than either of the bridge options.

For all three options construction impacts are likely to be significant but once completed, a bridge structure could be considered as a visually striking iconic gateway feature, with potentially beneficial landscape and visual effects.

Community and Private Assets

The impacts on private and commercial assets and land used by the community, existing pattern of land use and the areas of land lost, and the resultant impact on land use have been assessed.

Option 1 requires the demolition of up to 42 private properties, both residential and commercial, and would require the purchase of suitable exchange land for community allotments.

Option 2 requires up to 25 properties to be demolished, and suitable exchange land is required to compensate for the loss of the community allotments as required by Option 1.

Option 3 requires the demolition of approximately 24 private properties, but has a much larger overall footprint; the tunnel option requires the finding of exchange land for a small area of community used allotments and an area of recreation ground. The recreation ground will be split in two by the tunnel alignment and will thereby be rendered unfit for purpose as a playing field; although not registered as common land or town or village green there would still be a requirement to replace this facility. At present there is no proposed mitigation for the reinstatement of the entire recreation ground so this could represent the option with the most significant effects in terms of loss to communities and private assets.

Option 2 represents the design with the least effects when compared with Options 1 and 3.

Noise and vibration

The impacts on the local environment caused by noise and vibration have been assessed for each option. The assessment has included both construction phase and operational phase impacts.

In general, impacts on people have been quantified, although at this stage detailed impacts associated with construction have not been carried out as a detailed construction strategy is not available. Therefore, a number of assumptions have been made, to permit simple quantitative assessment.

Mitigation has not been considered as at this stage of assessment too many parameters associated with each option are unknown.

During the construction phase, all three options could result in significant adverse noise and vibration impacts at nearby receptors. At this level of assessment there are not marked differences in their respective impacts. Options 1 and 2 would most likely produce nearly identical construction impacts given their similar scheme extents. Options 1 and 2 and would be expected to have lesser construction impacts as they would take approximately 12 months less time to construct compared to Option 3.

During operation of the scheme options, impacts can be either short term or long term.

In the short term, based on current traffic model predictions

- Option 2 could produce a third fewer significant adverse noise impacts and a few more significant beneficial impacts than Option 1.

- Option 3 could result in more than twice as many receptors experiencing a significant adverse noise impact than Option 1, and an even greater number of receptors experiencing a significant adverse noise impact than Option 2.

In the long term, based on current traffic model predictions

- Option 2 could produce a quarter fewer significant adverse noise impacts and the same number of significant beneficial impacts than Option 1.

- Option 3 could result in five times as many receptors experiencing a significant adverse noise impact than Option 1, and seven times as many receptors experiencing a significant adverse noise impact than Option 2.

- Option 3 could result in almost twice as many receptors experiencing a significant beneficial noise impact than either Option 1 or 2.

Overall, Options 1, 2 and 3 could produce similar beneficial impacts. However, Options 1 and 2 should produce fewer adverse impacts in Great Yarmouth town centre than Option 3. Therefore Options 1 and 2 meet their aims of reducing traffic noise in Great Yarmouth town centre, but Option 3 does not.

<u>Pedestrians, cyclists and equestrians</u>

During construction, pedestrians and cyclists would experience minor adverse impacts, as routes would be closed off and diversions put in place. The works are likely to be phased, both spatially and temporally, reducing the potential impacts of the construction process. The construction of Option 3 could last for approximately twice as long as Options 1 and 2, so the impacts associated with this Option would be felt over a longer period.

Once completed, Options 1 and 2 would have beneficial impacts for both pedestrians and cyclists by offering relief from the existing severance that the River Yare creates in the absence of any crossing. Shared use footway/cycle paths would be provided in both directions over the crossing. Existing routes would generally experience negligible impacts.

Option 3 would also have beneficial impacts by offering relief from the existing severance created by the river, although only for cyclists as pedestrians would not be allowed to use the tunnel due to safety reasons. It is likely the pedestrians would benefit indirectly however, as public transport routes would be provided to take advantage of the new crossing.

Vehicular Travellers

Two aspects affecting vehicular travellers have been assessed; the view from the road and driver stress.

The view from the road along the existing route between Harfreys roundabout and South Denes Road, for comparison to that of the crossing options, fluctuates between an intermittent view and no view, except on Haven Bridge where the view is a lot more open. This would remain the case during construction of each of the options, except where the features of the construction site itself reduce the view.

Options 1 and 2 would allow a beneficial impact, permitting an open view for most of their lengths due to the height of the structure. Option 3 would have an overall minor adverse impact, as the route would have no view for the majority of its length.

Driver stress along the existing route between Harfreys roundabout and South Denes Road is moderate to high. Using the simple criteria laid down in DMRB, each of the three alternatives would also have high driver stress levels, in both the opening year and design year.

In real terms, driver stress levels will be reduced, because of the much shorter distance travelled, improved traffic capacity, junctions, surfacing and pedestrian and cycle facilities. Potential disbenefits in Options 1 and 2 would arise when the bridge is open to navigation, meaning vehicular travellers have to either wait or use the original route.

Road Drainage and the Water Environment

During construction, the Option 3 would have a greater negative effect on surface and ground water quality compared to the Bridge Options, due to the larger area and longer duration of dredging works within the River Yare. Release of contaminated sediments could have a negative impact on the ecologically sensitive receptors at Breydon Water. During operation, Option 3 could also have a larger negative effect on groundwater flow (quantity) due to the size and length of the structure within the groundwater table.

During operational activities, Option 3 would have a neutral effect on surface water quality and Options 1 and 2 would have a slight adverse effect. The neutral effect of Option 3 is due to the dilution capacity of the River Yare of the additional road runoff. The slight adverse effect is due to the localised restriction of river water flow, and increased river bed scour expected from Options 1 and 2 pier foundations.

All options are within a high flood risk area. Options 1 and 2 are deemed preferable to Option 3 in terms of flood risk, as they would facilitate the passage of flood flows beneath the approach ramps. The embankments would offer no greater obstruction to flood flows than the existing structures.

It has not been possible to determine the exact effect of flood waters on any of the options at this time as the revised strategic flood risk assessment for the Great Yarmouth area has not yet been made publicly available. It is difficult to see how the tunnel option will meet the scheme objective of providing an essential infrastructure link to the peninsula in times of inundation.

Geology and Soils

No adverse impacts on geology and soils (including terrestrial soils and river sediments) are anticipated, as there are no sensitive receptors that would be affected by construction or operation of any of the options. The removal of any existing contaminated material from site is considered to be potentially beneficial for each option. Option 3 has the potential to lead to the removal of more potentially contaminated material than Options 1 and 2. Similar amounts are likely to be removed between Options 1 and 2.

The impacts of disturbing contaminated soils have the potential to affect ecology, surface water, groundwater and pedestrians, cyclists and equestrians. Option 3 is likely to lead to the greatest disturbance of potentially contaminated soils, and hence have the greatest adverse effect in this respect.

The disturbance of potentially contaminated soils could also lead to impacts on construction workers. However, assuming use of appropriate Personal Protective Equipment and implementation of a suitable Construction Environmental Management Plan, the consequence of contact with contaminated land would be low and the risk is also considered to be low.

The impacts caused by the disturbance of any contaminated river sediments have the potential to lead to effects on ecological and surface water receptors. Option 3 is likely to lead to the greatest disturbance of any contaminated sediments.

Traffic assessment

The three shortlisted options were tested using the Great Yarmouth SAURN model. The Stage 2 Traffic and Economic Assessment Report describes the development and use of the model.

The model is based on detailed surveys in 2003 and updated to 2008 to take account of major developments during that period. The assessment years are 2015 and 2030, with growth constrained to TEMPRO. It is recognised that this model will need to be fully updated if the scheme progresses to the next stage of appraisal.

The options tested were:

Option	Description	Reference
Bridge option 1	Bascule Bridge with T-junction on Southtown Road	Figure 3-10
Bridge option 2	Bascule Bridge with roundabout on Southtown Road	Figure 3-11
Tunnel	Tunnel from A12 north east onto Southgates Road	Figure 3-12

Table 3-9 Shortlisted options tested in traffic model

The forecast impact of each of these options on traffic flows is illustrated in Table 3-4 and Table 3-5 above.

2015 AADT (two way)	Do minimum	Bridge option 1	Bridge option 2	Tunnel
A12 Breydon Bridge	41,956	38,929	38,588	36,661
A1243 Haven Bridge	38,259	25,750	25,032	26,095
Third river crossing		23,870	23,807	23,442
TOTAL	**80,215**	**88,549**	**87,427**	**86,198**

Table 3-10 Forecast traffic on bridges, 2015 (Stage 2 Assessment)

2030 AADT (two way)	Do minimum	Bridge option 1	Bridge option 2	Tunnel
A12 Breydon Bridge	41,398	39,857	39,347	37,648
A1243 Haven Bridge	39,650	27,934	27,341	28,515
Third river crossing		26,879	26,957	25,825
TOTAL	**81,048**	**94,670**	**93,645**	**91,988**

Table 3-11 Forecast traffic on bridges - 2030 (Stage 2 Assessment)

All of the options produce a big reduction in traffic over Haven Bridge and a smaller reduction in traffic over Breydon Bridge. The bridge options are more effective than the tunnel option in reducing traffic on Haven Bridge (by more than 30%), but the tunnel option produces the biggest reductions on Breydon Bridge (more than 9%) at this level of detail.

All of the options produce a net increase in traffic crossing the River Yare (up to 17%). This is because the new crossing enables traffic from South Denes to the west and north to bypass the town centre using the Western Bypass and Breydon Bridge.

Do Minimum traffic flows are illustrated in Figure 3-13. Forecast do something flows for 2015 and 2030 are illustrated in Figure 3-14 and Figure 3-15.

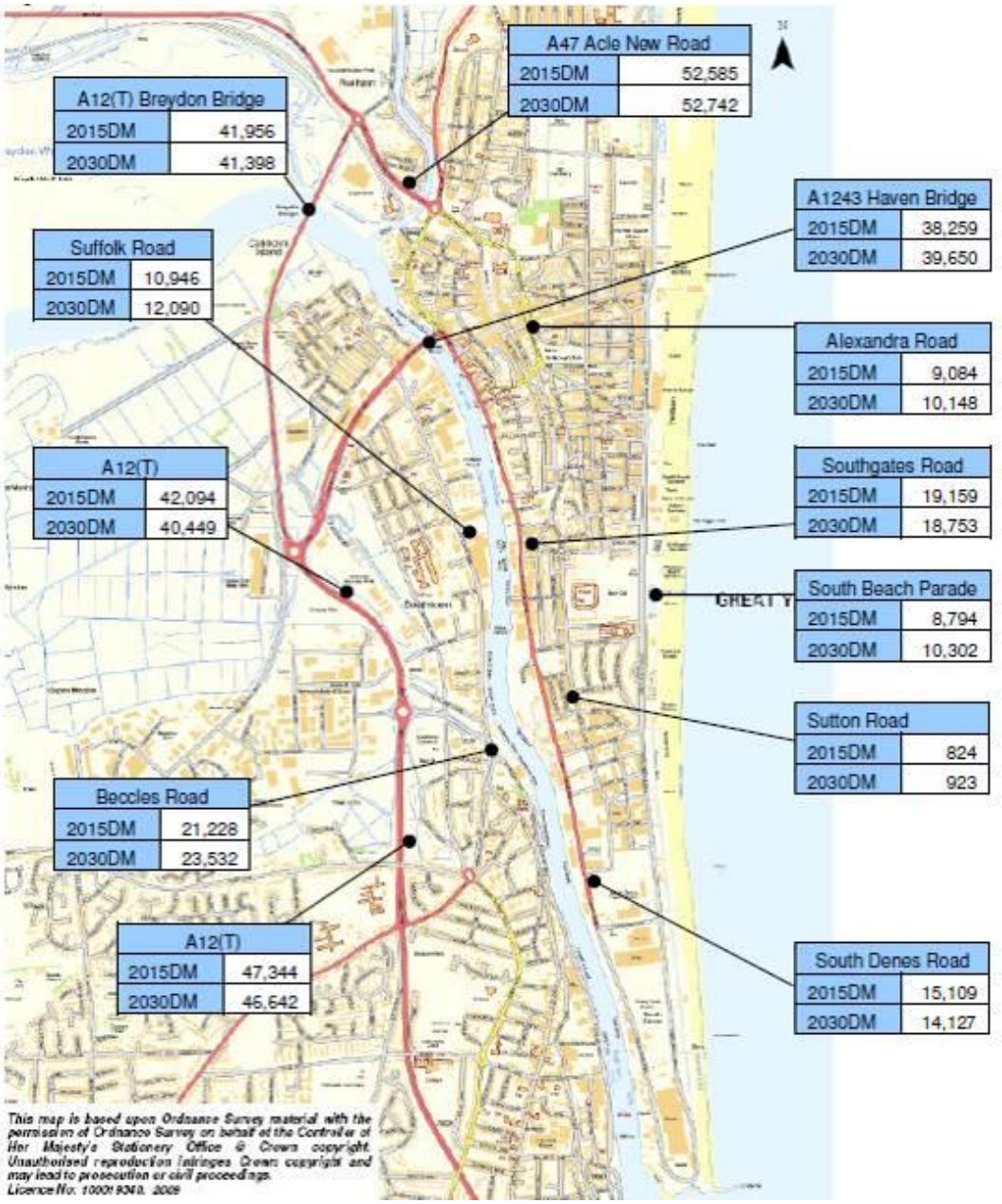


Figure 3-13 Do minimum forecast traffic, 2015 and 2030 (from Stage 2 Traffic & Economic Assessment)

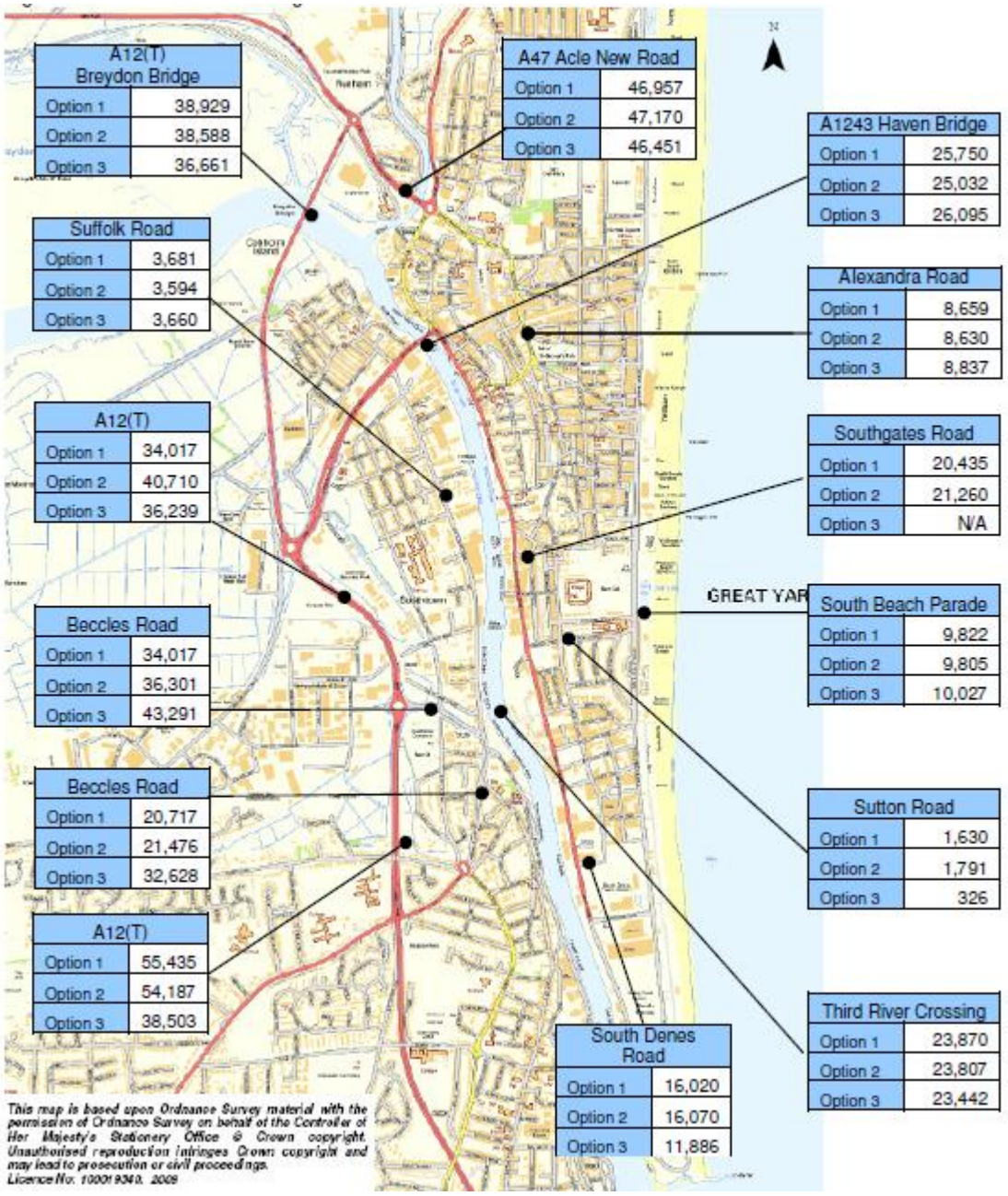


Figure 3-14 Do something forecast traffic 2015 (from Stage 2 Traffic & Economic Assessment)

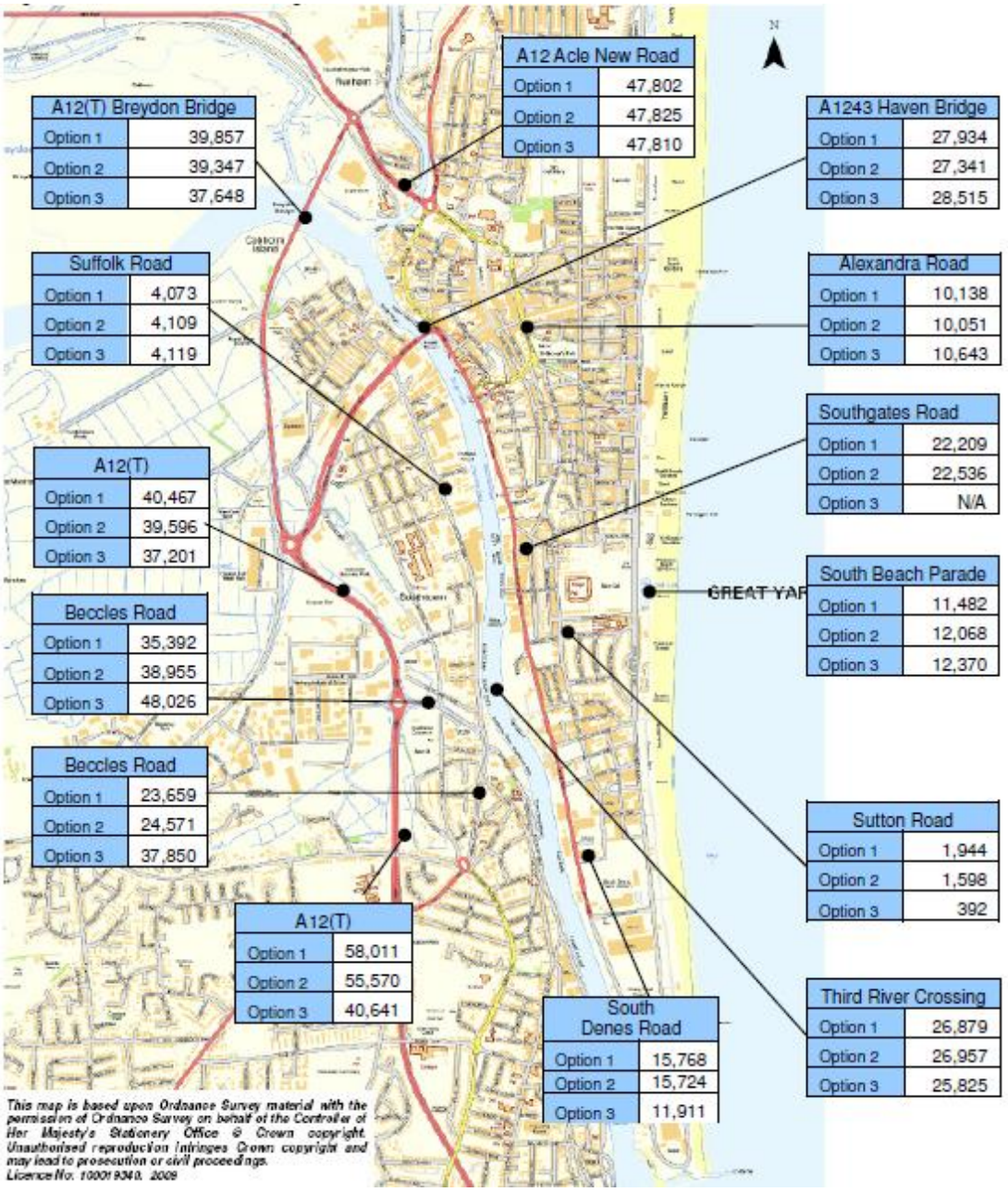


Figure 3-15 Do something forecast traffic 2030 (from Stage 2 Traffic & Economic Assessment)

Journey time savings

The Stage 2 Traffic and Economic Appraisal Report gives details forecast journey time savings on seven routes in the study area. Journey time savings for a route via Pasteur Road and the Haven Bridge in 2030 (p.m. peak) are summarised below:

Route 4 - Pasteur Rd / Haven Bridge Journey time saving (2030) p.m. peak (min)	Bridge option 1	Bridge option 2	Tunnel
Inbound	5.97	5.94	4.27
Outbound	4.15	4.32	3.69

Table 3-12 Indicative journey time savings

All of the options produce significant savings in journey times on existing routes over a wide area. In addition, a third crossing produces significant distance journey time savings for journeys transferring to the new route, especially journeys between the peninsula and the A12 (south).

All of the journey time impacts are captured in the economic assessment.

Accidents

The Stage 1 assessment showed that a third crossing would produce high accident benefits. An assessment of the accident benefits was not undertaken at Stage 2, but it is expected that accident benefits will be similar to those in previous assessments.

Stage 2 Economic Assessment

An economic assessment was undertaken using TUBA. All of the options tested show a positive benefit-cost ratio, as set out below:

- Bridge (option 1) **4.5**
- Bridge (option 2) **4.8**
- Tunnel **1.5**

The results are set out in more detail in Table 3-13 below.

Benefits/Disbenefits/Costs	Bridge option 1 £,000	Bridge option 2 £,000	Tunnel £,000
Present Value of Benefits (PVB)	**£474,450**	**£472,841**	**£441,726**
Present Value of Costs (PVC)	**£105,256**	**£98,042**	**£301,578**
Net Present Value (NPV)	**£369,194**	**£374,799**	**£140,148**
BCR (PVB/PVC)	**4.508**	**4.823**	**1.465**

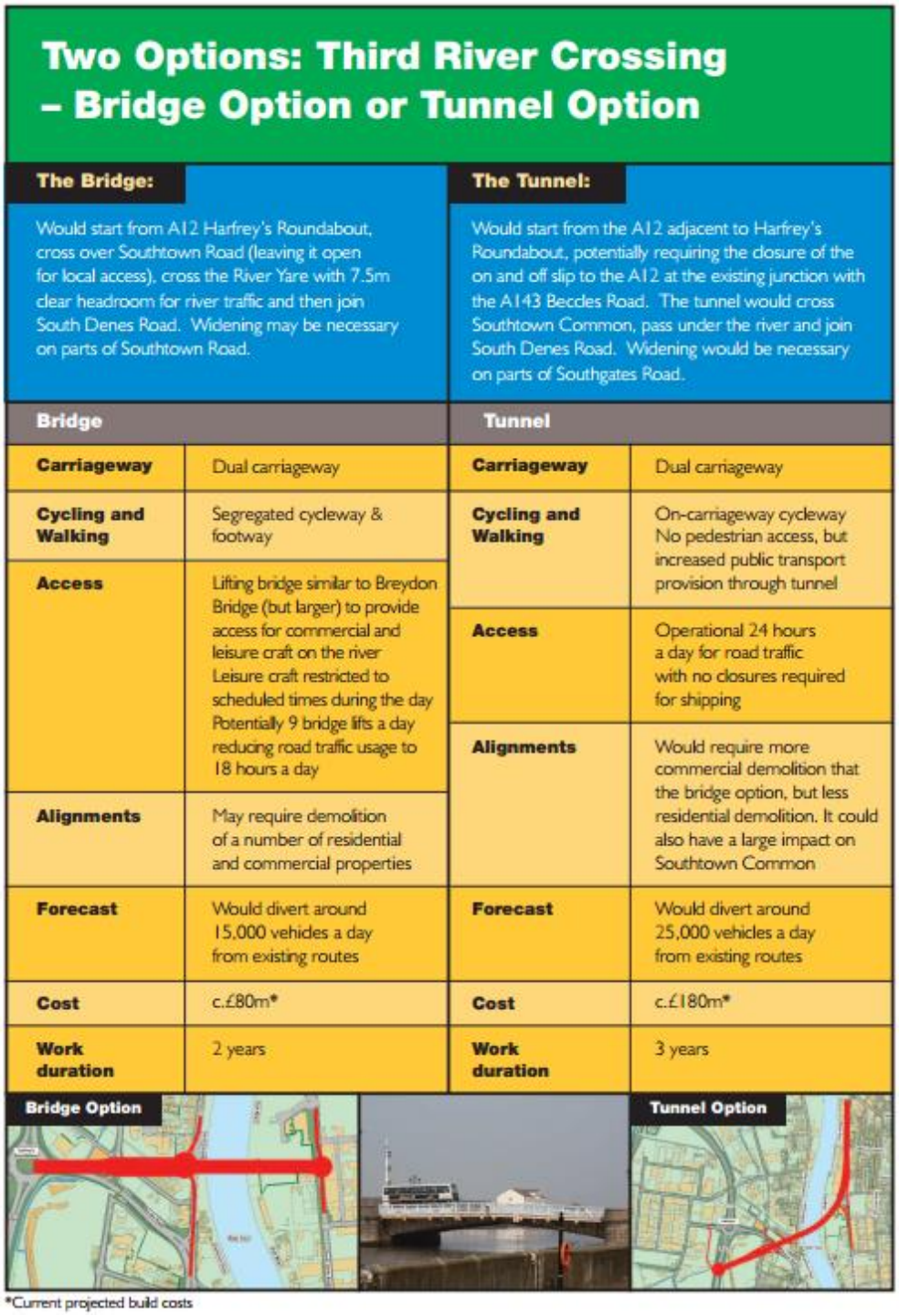
Table 3-13 Economic assessment results (Stage 2)

Although the economic benefits of the tunnel option are nearly as high as those for the bridge options, its cost is much higher. The resulting BCR is less than 2.0 and this confirms that a tunnel option is not a viable solution. There is little difference between the benefits of the two bridge options, but option 2 is a less expensive solution and produces the highest BCR. Both of the bridge options have a BCR of greater than 4.0. Based on the criteria in DfT guidance[16], they offer **very high** value for money.

[16] Value for Money Assessment: Advice Note for Local Transport Decision Makers. (DfT, December 2013)

Public consultation

Norfolk County Council consulted local people on the scheme from 19 June to 38 August 2009 as part of a wider consultation on the Great Yarmouth and Gorleston Area Transportation Strategy. The two main options were presented – a bridge and a tunnel.



Two Options: Third River Crossing – Bridge Option or Tunnel Option

The Bridge:

Would start from A12 Harfrey's Roundabout, cross over Southtown Road (leaving it open for local access), cross the River Yare with 7.5m clear headroom for river traffic and then join South Denes Road. Widening may be necessary on parts of Southtown Road.

The Tunnel:

Would start from the A12 adjacent to Harfrey's Roundabout, potentially requiring the closure of the on and off slip to the A12 at the existing junction with the A143 Beccles Road. The tunnel would cross Southtown Common, pass under the river and join South Denes Road. Widening would be necessary on parts of Southgates Road.

Bridge		Tunnel	
Carriageway	Dual carriageway	**Carriageway**	Dual carriageway
Cycling and Walking	Segregated cycleway & footway	**Cycling and Walking**	On-carriageway cycleway No pedestrian access, but increased public transport provision through tunnel
Access	Lifting bridge similar to Breydon Bridge (but larger) to provide access for commercial and leisure craft on the river Leisure craft restricted to scheduled times during the day Potentially 9 bridge lifts a day reducing road traffic usage to 18 hours a day	**Access**	Operational 24 hours a day for road traffic with no closures required for shipping
Alignments	May require demolition of a number of residential and commercial properties	**Alignments**	Would require more commercial demolition that the bridge option, but less residential demolition. It could also have a large impact on Southtown Common
Forecast	Would divert around 15,000 vehicles a day from existing routes	**Forecast**	Would divert around 25,000 vehicles a day from existing routes
Cost	c.£80m*	**Cost**	c.£180m*
Work duration	2 years	**Work duration**	3 years

Bridge Option

Tunnel Option

*Current projected build costs

Figure 3-16 Consultation information leaflet

The results of the consultation are set out in Table 3-14 below:

Consultation question	Yes, definitely	Yes, possibly	No
Do you support the need for a new river crossing in Great Yarmouth?	**92%**	**-**	**8%**
Would a new crossing, with improved pedestrian and cycle facilities, encourage you to walk or cycle for some of your journeys rather than drive?	**42%**	**25%**	**33%**

Table 3-14 Consultation results

The provision of a third crossing was supported by more people than any other transport measure identified in the consultation.

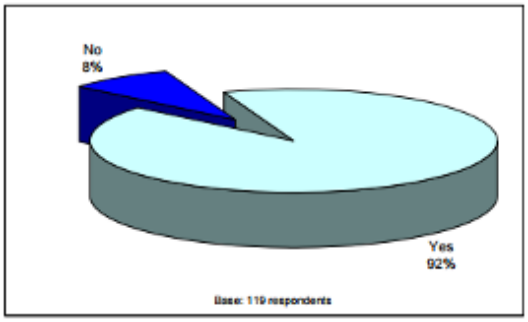


Figure 3-17 Support for a new crossing (2009 consultation)

67% of people said that a new crossing, with improved pedestrian and cycle facilities would, or would possibly, encourage them to walk or cycle for some journeys instead of driving.

63% of people said that they would, or would possibly, support tolling if that was the only way a bridge could be built.

Views of key stakeholders

Great Yarmouth Borough Council fully supports the Third River Crossing scheme. In October 2009 it asked the County Council to declare and endorse the bridge option as its preferred route.

The Highways Agency provided a written response in September 2009, stating:

"The Highways Agency has no objection to the proposal of an additional crossing of the River Yare and sees that there is likely to be benefits to the movement of people in/out and around the town and to the trunk road. The Highways Agency's preference of option would be for the one which provides the best balance between minimising disruption during construction, providing improved safe and reliable journeys, and the best value for money. On balance this currently appears to be the bridge option."

1st East, the Great Yarmouth Waterfront Regeneration Company gave its full support to a third crossing scheme in September 2009, stating:

We believe that this major investment is the single most important infrastructure requirement for Great Yarmouth. It is vital to the town's long term economic development and prosperity. A new crossing would provide connectivity to the South Denes employment area and enable the outer harbour to maximise its full potential. The crossing would also be a new gateway into the town providing a southerly access to support the seafront tourist attractions. An additional river crossing will also positively impact on the priority regeneration areas to the north, Breydon Reach and Ice House Quay, because the bridge will provide increased network capacity and route options for these waterfront developments. In particular, 1st East supports the bridge crossing option which allows for both vehicular and pedestrian access.

3.5 Preferred route (2009)

In December 2009, Norfolk County Council's Cabinet[17] considered the findings of the technical studies and the public and stakeholder consultation, and decided to adopt a preferred route for the bridge option, as illustrated in Figure 3-18 below.

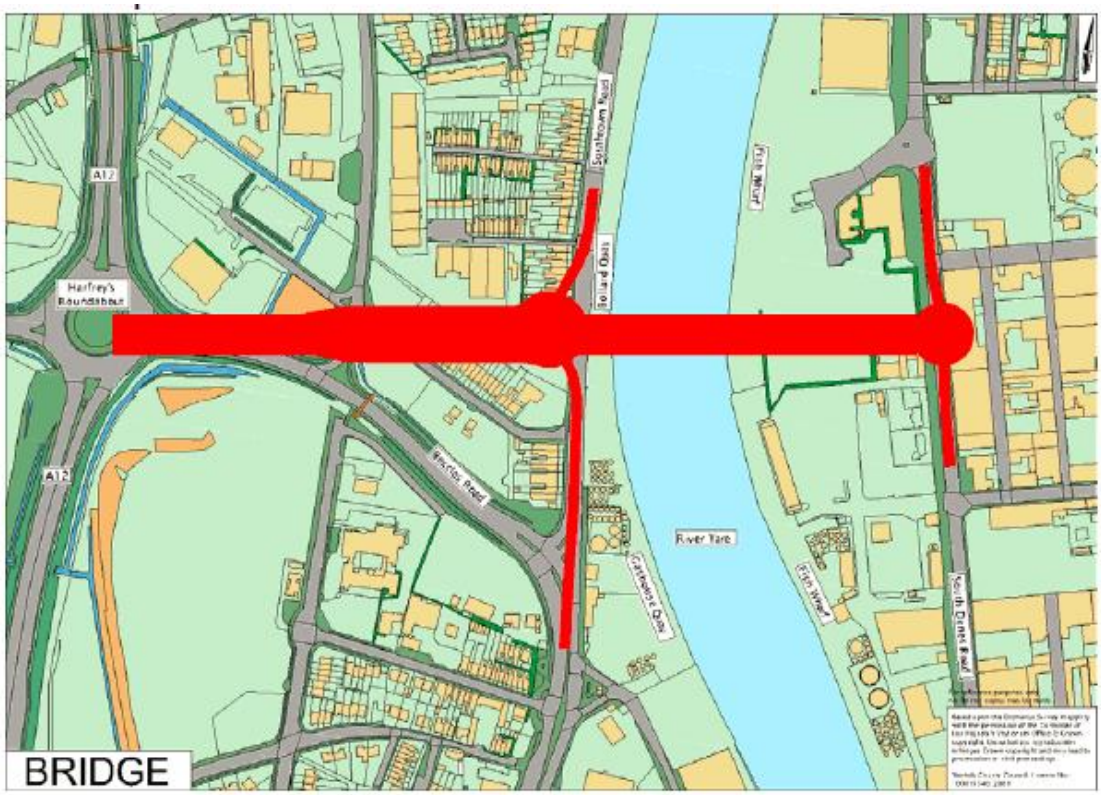


Figure 3-18 Preferred route, adopted by Norfolk County Council, November 2009

[17] Great Yarmouth Third River Crossing Preferred Route, NCC Cabinet, 7 Dec 2009

The Cabinet's conclusion was that:

"Evidence from all of the technical work to date and the results from the public consultation indicate that the bridge option with a dual carriageway link utilising a 50m span bascule bridge over the river is the best option for a preferred route.

"The decision on whether the bridge scheme has a roundabout or a T-junction on Southtown Road can be decided during the detailed design."

The Cabinet also authorised the purchase of properties subject to blight notices and agreed to investigate funding options for the scheme.