Appendix A – Options Assessment Report

Lake Lothing Third Crossing

Appendix A

Option Assessment

24 December 2015
Produced for
Suffolk County Council

Prepared by
Rob Surl
Technical Director

Export House
Cawsey Way
Woking
Surrey
GU21 6QX
UK

T +44 (0)1483 731000
F +44 (0)1483 731003
E rob.surl@mouchel.com

Document Control Sheet

Project Title

Report Title Lake Lothing Third Crossing, Option Assessment

Report ref no.

Version 2

Status Draft

Report Date 24 December 2015

Record of Issue

Version	Status	Author	Date	Checked by	Date	Approved by	Date
1	Draft	Rob Surl	15 Dec 2015	Ian Baker	16 Dec 2015	Ian Baker	16 Dec 2015
2	Final	Rob Surl	15 Dec 2015	Ian Baker	16 Dec 2015	Ian Baker	16 Dec 2015

Distribution

Date	Organisation	Contact	Format	Copies
24.12.2015	Suffolk County Council	Dave Watson Graeme Mateer	e	

Limitations

This report is presented to Suffolk County Council in respect of Lake Lothing Third Crossing Project and may not be used or relied on by any other person. Notwithstanding anything to the contrary contained in the report, Mouchel Consulting is obliged to exercise reasonable skill, care and diligence in the performance of the services required by Suffolk County Council and Mouchel Consulting 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 Consulting. 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.

Contents

Table of figures

Tables

1 Introduction

1.1 Overview

This report forms part of the Outline Business Case (OBC) for the proposed scheme and should be read in conjunction with the main document. It follows the principles set out in Department for Transport's WebTAG guidance[1] for the Stage 1 Appraisal process and describes:

- The generation of a **long list** of options for a third crossing of Lake Lothing, Lowestoft.
- The assessment of the long list against the scheme objectives and other criteria to produce a **short list** of options for more detailed appraisal.
- The appraisal of the short-listed options to identify a **preferred option** for the scheme.

The final, detailed assessment of the preferred option is set out in Chapter 3 of the OBC (Economic Case).

1.2 Location of the proposed scheme

The proposed scheme is a new road crossing over Lake Lothing, a large saltwater lake which flows into the North Sea. The lake measures approximately 180m at its widest point, and forms the inner harbour of the Port of Lowestoft. This area has suffered greatly from the decline of shipbuilding and traditional industries, and is a key area for regeneration. A third crossing offers the potential to support regeneration by improving access to the lake area as well as relieving congestion in, and around, the town centre.

Figure 1-1 shows the area of the scheme in relation to the town and the local road network. Lake Lothing separates the north and south parts of the town. The A12 forms a north-south route on the eastern (seaward) side of Lowestoft, providing access to the town centre (on the north side) and crossing Lake Lothing by means of a bascule bridge at the entrance to the inner harbour. The southern section of the A12 (the Southern Relief Road) is a trunk road. To the west, another north-south route is provided by the A1177 (the Northern Spine Road) which crosses Lake Lothing by means of another lifting bridge at Mutford Lock, and the A146. There are no other road crossings. The two north-south routes are linked by the A1144 and

[1] Transport Analysis Guidance: The Transport Appraisal Process – Guidance for the Technical Project Manager (January 2014) paragraphs 2.3 to 2.11

Denmark Road (north of Lake Lothing) and a section of the A146 (south of Lake Lothing).

Figure 1-1: Location of the scheme in the context of the Lowestoft town centre

The A146 links Lowestoft to Norwich with its international airport. The A12 runs northwards to Great Yarmouth, and southwards towards the A14 for Ipswich and Felixstowe, and to London.

The existing bridges and other local roads which will be referred to in this report, are shown in Figure 1-2 below.

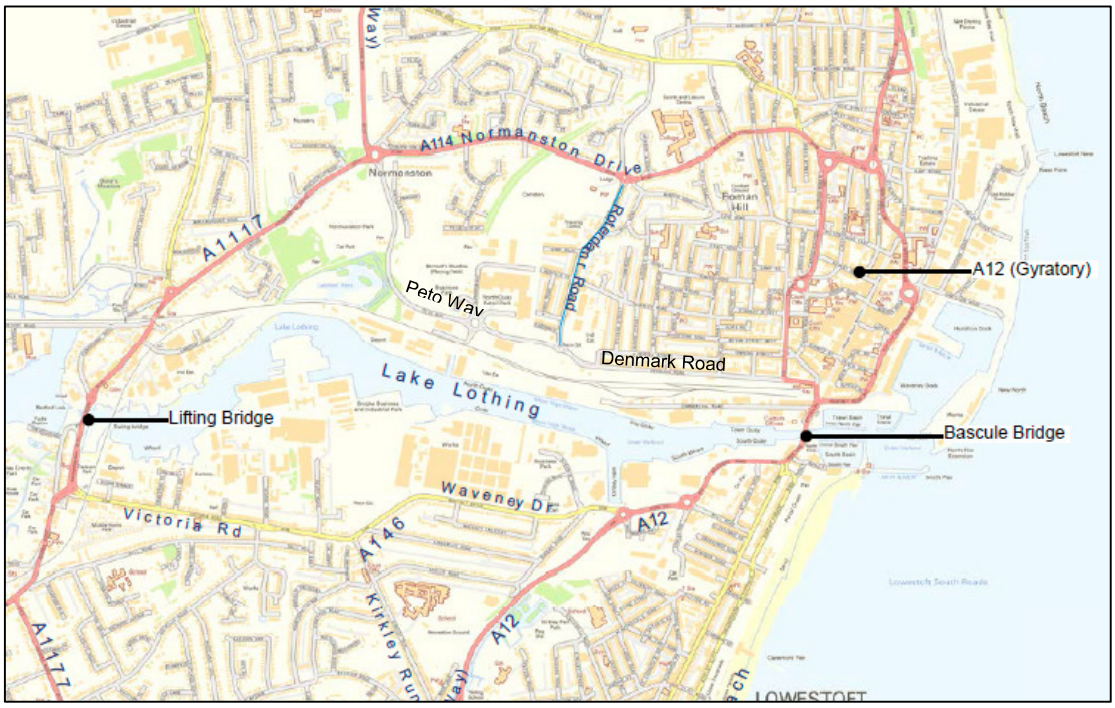


Figure 1-2: Existing bridges and local roads

2 Context

2.1 Step 1 – Understanding the current situation

The OBC (Strategic Case) describes the current situation in terms of the current transport and other policies, the existing demand for travel, constraints and opportunities. The key points are summarised below. More detailed information is given in Section 2.2 of the OBC.

2.1.1 Current transport and other policies

The proposed Lake Lothing Third Crossing is closely aligned with national, regional and local transport plans and policies, including:

- National Infrastructure Plan;
- Strategic Economic Plan (SEP);
- Local Transport Plan (LTP);
- Lowestoft-Great Yarmouth Enterprise Zone;
- Assisted Areas;
- Local Development Framework (LDF);
- Area Action Plan;
- Lowestoft Transport Strategy; and
- Lowestoft Transport and Infrastructure Prospectus.

The proposed scheme reflects the Government's view, in the **National Infrastructure Plan**, that high quality infrastructure is needed to improve productivity and support jobs and growth. The scheme will increase capacity, tackle congestion, support development, strengthen connectivity, improve reliability and resilience and improve the quality of the local road network.

The **Strategic Economic Plan** identifies opportunities for growth in Lowestoft. The limited opportunities to cross Lake Lothing are seen as a barrier to growth, and the plan supports the development of the scheme. The **Local Transport Plan** identifies the third crossing as a "much needed improvement for which there is a very strong desire in the local community but with, at present, no clear delivery mechanism".

The area around Lake Lothing is part of the **Lowestoft-Great Yarmouth Enterprise Zone** and has **Assisted Area** status from the EU, in recognition of the urgent need for regeneration and growth. The proposed scheme will improve access and connectivity, supporting regeneration. The **LDF Core Strategy** sets out spatial

policies for regeneration growth and states that "the District Council will continue to promote the creation of a third road crossing of Lake Lothing, as an integral part of dealing with transport problems and issues in Lowestoft and the sub-region". The **Area Action Plan** notes that Lake Lothing creates a significant barrier to movement within the AAP area and across the wider town and identifies a third crossing as a longer term ambition. Suffolk County Council's **Lowestoft Transport Strategy** notes that whilst the focus for growth will be around Lake Lothing, congestion is problem. It gives support to developing and securing funding in the longer term for a third river crossing of Lake Lothing for motorised traffic.

The **Lowestoft Transport and Infrastructure Prospectus** consolidates the views of key public and private sector bodies by clearly identifying the transport infrastructure needed to support growth and regeneration. It considers options for a third crossing of Lake Lothing and confirms this as a high priority for which central government support will be needed.

2.1.2 Current demands and levels of service

Traffic on the existing bridges

The volume of traffic crossing each of the existing bridges is given in Table 2-1 below.

	Observed traffic (2 way) veh/hr		
Crossing location: / **Time period:**	On Mutford Lock bridge	On Bascule bridge	Both bridges (total)
Morning peak hour (08:00 to 09:00)	1,918	2,451	4,369
Evening peak hour (17:00 to 18:00)	2,162	2,547	4,709
Daily total (07:00 to 19:00)	22,505	24,105	46,610

Table 2-1: Weekday traffic flows on existing bridges (from counts 17th – 19th March 2015)

2.1.3 Traffic data

Extensive traffic surveys have been undertaken in order to calibrate and validate the traffic model used in the detailed appraisal of the scheme. These include Automatic Traffic Count (ATC) and Manual Classified Count (MCC) surveys. All MCCs are turning counts at junctions. In addition, traffic matrices are being built from Automatic Number Plate Recognition (ANPR) surveys. Details are provided in the Data Collection Report[2] and the Local Model Validation report[3].

[2] Lake Lothing Lowestoft Data Collection Report (WSP), October 2015
[3] Lake Lothing Third Crossing Local Model Validation Report (WSP) December 2015

2.1.4 *Opportunities for growth and regeneration*

A common theme running through the policies and strategies detailed above is a bold vision for economic growth and regeneration in Lowestoft, with a very specific focus on the area around Lake Lothing. The proposed third crossing is part of that vision. It is a key component of the transport infrastructure which will stimulate growth and help to sustain it for the long term.

The vision for growth is not just aspirational; it is related to site specific proposals and opportunities for new jobs, new homes and new transport, leisure and cultural facilities which together have the potential to regenerate the area. The **Area Action Plan** identifies the specific site allocations within the area which need to be developed to realise the regeneration and revitalisation of the Lake Lothing and Outer Harbour area.

These sites are shown in Figure 2-1 below.

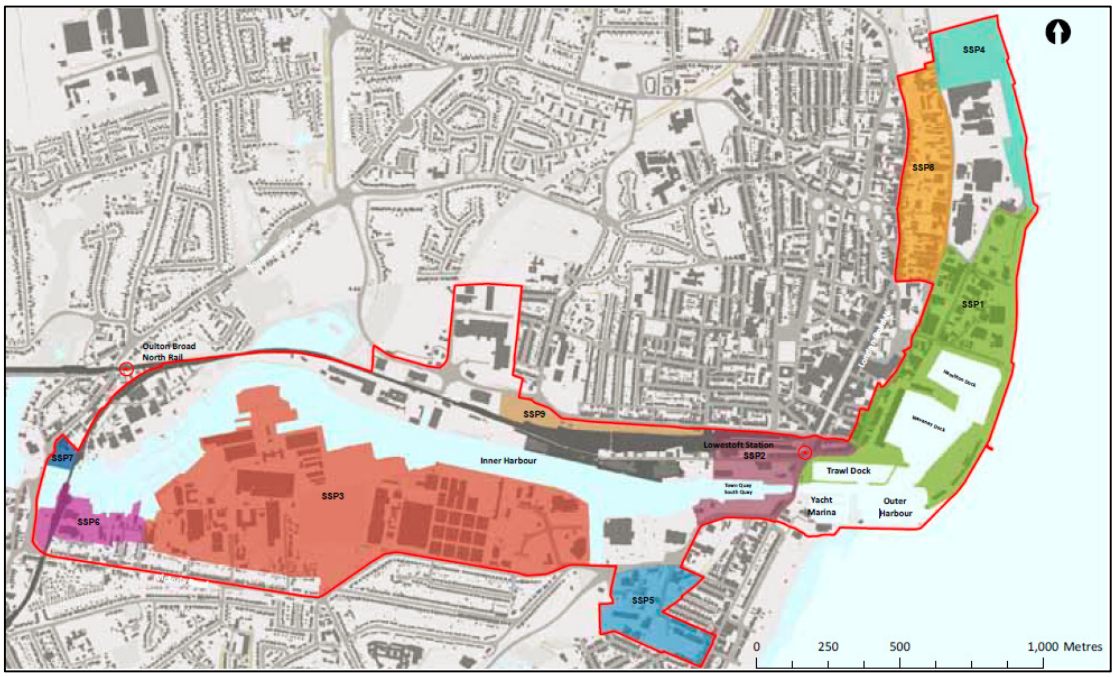


Figure 2-1: Area Action Plan Site Allocations

The creation of an additional crossing of Lake Lothing will help to stimulate the regeneration of these sites, by providing the high quality transport infrastructure needed to access new developments and by reducing congestion on the existing bridges and local road network.

Equally, as the sites are developed, they will generate additional demand for travel by car, cycle, and bus, and on foot. The third crossing will help to meet this demand without putting additional pressure on the existing transport networks. However, because regeneration is the main driver for the scheme, these developments are treated in the Business Case as opportunities, not problems.

A summary of the development planned for each site is given in Section 2.4 of the OBC. Full details are given in Appendix B (AAP site allocations) of the OBC.

2.1.5 Constraints

There are a number factors which could constrain the ability to deliver the scheme, or limit the choice of options or timescale, including:

- Physical constraints;
- Environmental constraints;
- Financial and contractual constraints; and
- Public acceptability constraints.

The impacts of these types of constraint are considered in Section 2.10 of the OBC, and briefly summarised below:

Physical constraints

Lake Lothing needs to continue functioning as an operational port. It forms a physical barrier between the north and south sides of the town, and this is compounded by the presence of the railway line which runs alongside the northern shore to a terminus. Fundamental physical constraints therefore arise from the need to maintain port operations and the safe passage of shipping, and to provide for the continued operation of the railway line. Any new crossing will also need to connect effectively to the existing road network and conform to standards for acceptable vertical and horizontal alignments and junction configurations. See Paragraph 2.10.1 of the OBC.

It will also need to minimise impact on existing development, and on the planned developments described above.

Environmental constraints

The principal environmental constraints affecting the option assessment are:

- **Leathes Ham Local Nature Reserve.** Leathes Ham is a small freshwater lake, located to the west of Peto Way, and sandwiched between Normanston Park and Lake Lothing. The reserve has a reedbed, a dyke network and marshes which are breeding sites for wildfowl. In devising options for a third crossing, the need to protect the nature reserve limits the options for connecting to Peto Way.

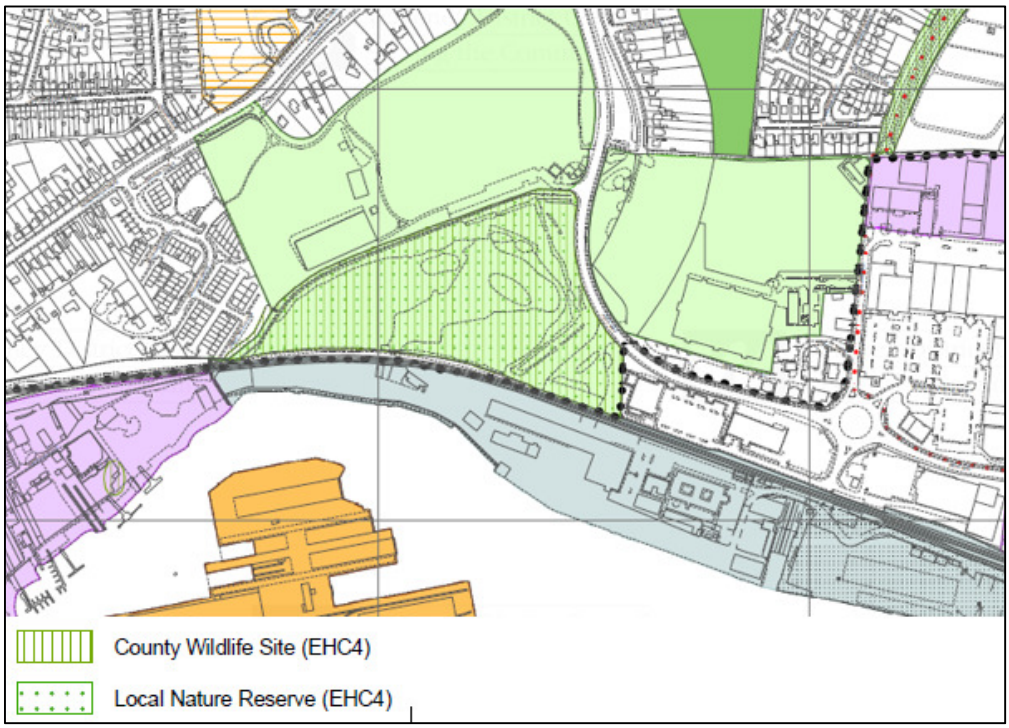


Figure 2-2: Leathes Ham Local Nature Reserve

- **The visual impact of a new bridge.** A new bridge across Lake Lothing would be a significant feature in its own right. In appraising options, and in developing the preferred scheme, the potential visual impact on the townscape has been an important consideration.

See Paragraph 2.10.2 of the OBC.

Financial constraints

Details of the way the scheme is to be financed are given in the Financial and Commercial Cases of the OBC (Chapters 4 and 5, respectively). Apart from the fact that the scheme requires Government funding, there are no financial constraints on its delivery.

Contractual constraints

Details of the arrangements for delivery of the scheme are given in the Management Case of the OBC (Chapter 6). There are no particular constraints on its delivery.

Public acceptability constraints

There is strong public support for the provision of a third crossing of Lake Lothing. However, a public consultation exercise in 2014 demonstrated that this support is very dependent on the location of a proposed third crossing.

In response to the question: “Do you think a new road crossing of Lake Lothing is needed for Lowestoft, over 93% of people answered “yes”:

Response	Percentage
Yes	93.71%
No	2.86%
No response	3.43%
Total	**100.00%**

Table 2-2: Public consultation: the need for a new crossing

But in response to a question about the location of a potential crossing, a very clear preference was stated for a "central" option:

Preferred location	Percentage
West	23.9%
Central	60.6%
East (3 options)	8.3%
Other	4.4%
No response	2.8%
Total	**100.00%**

Table 2-3: Public consultation: the location of a new crossing

In a survey of local businesses in September 2015, only 12% of businesses favoured an eastern location for the third crossing.

These results suggest that public acceptability is unlikely to be a constraint on the scheme in principle, but it would be difficult to gain public support for an "eastern" option, especially if other options were available[4].

2.2 Step 2 – Understanding the future situation

The demand for travel will increase as the town develops. The OBC (Strategic Case) describes the future situation in terms of future land uses and policies, and changes to the transport system. These are detailed in the Uncertainty Log and taken into account in the modelled "Do Minimum" scenario against which the short listed

[4] The assumed locations of "western", "central" and "eastern" crossings at the time of the consultation were very similar to those considered in the present assessment, so the results are still considered relevant.

options will be assessed. The estimation of future demand in the study area is described in detail in the Forecasting Report[5].

2.3 Step 3 – Establishing the need for the scheme

The need for a third crossing of Lake Lothing is set out in detail in the OBC (Strategic Case). To summarise, Lake Lothing – Lowestoft's inner harbour – forms a 2.7 km long physical barrier between the two halves of the town. Many of the traditional industries in the area around Lake Lothing have declined, and the area is in urgent need of regeneration.

All north-south movement of people and goods must presently use either the lifting bridge at Mutford Lock at the western end of the lake, or the A12 Bascule Bridge at the eastern end. This causes congestion, delay, and unpredictable journey times.

Recent improvements to the highway network mean that Lowestoft now has a northern spine road (Peto Way) and a southern relief road (Tom Crisp Way) designed to modern standards. There is a gap of less than 650m between these routes, as the crow flies, but the actual driving distance (via the Bascule Bridge) is nearly 2km. A third crossing – located between the existing two bridges – is needed to address existing problems, and to support and encourage regeneration, growth and new development.

The specific problems which a third crossing needs to address are:

- Loss of traditional industries and employment;
- Difficulty accessing potential regeneration sites;
- Community severance;
- Congestion;
- Barriers to walking and cycling, and gaps in pedestrian and cycling networks;
- Difficulties for local bus services; and
- Accidents.

Section 2.5 of the OBC discussed these problems in detail, whilst Section 2.6 considers the likely consequences if the scheme is not delivered.

[5] Lake Lothing Third Crossing, Lowestoft: Forecasting Report – Modelling (WSP), 2015

2.4 Step 4a – Scheme objectives

Section 2.7 of the OBC describes how the aims and objectives for the scheme have been developed. They take account of wider policy objectives, and opportunities for regeneration, as well as the identified problems. Potential options will be assessed against these objectives.

The overall aim of the scheme is:

To stimulate regeneration, sustain economic growth and productivity, and enhance Lowestoft as a place to live and work in, and to visit.

The scheme objectives are:

- To open up opportunities for regeneration and development in Lowestoft.
- To provide the capacity needed to accommodate planned growth.
- To reduce community severance between north and south Lowestoft.
- To reduce congestion and delay on the existing bridges over Lake Lothing.
- To reduce congestion in the town centre and improve accessibility.
- To encourage more people to walk and cycle, and reduce conflict between cycles, pedestrians and other traffic.
- To improve bus journey times and reliability.
- To reduce accidents.

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

As a pre-requisite to the generation of options, it is necessary to define the area over which the scheme is intended to have an impact. Following WebTAG guidance, this is determined through analysis of the current and future situation (Steps 1 and 2) and the geographical extent of the problems the scheme needs to address (Step 3).

The current situation in Lowestoft is characterised by:

- Physical severance between the north and south halves of the town;
- Congestion at the two crossings, which handle all of the north-south traffic; and
- Gaps in the town's walking and cycling networks.

Future plans and aspirations for Lowestoft include:

- Regeneration of the local economy;

- Creation of new jobs, especially in the offshore energy sector;
- Development of brownfield sites around Lake Lothing and Outer Harbour Area; and
- Provision of new homes and employment areas within Lowestoft.

The problems which give rise to the need for a third crossing are mainly in Lowestoft and most relate to the issues of severance, lack of accessibility to sites around Lake Lothing and lack of capacity at the existing crossings.

For these reasons, the expected main geographical area of impact of the scheme is defined as the boundary of the built-up area (Figure 1-1).

Potential corridors for a third road crossing

Having taken account of the principal physical and environmental constraints it is clear that there are three main corridors of opportunity to provide an additional crossing of Lake Lothing:

- A **western** crossing, linking Peto Way with Waveney Drive;
- A **central** crossing, linking Peto Way with Waveney Drive; and
- A **eastern** crossing, close to the existing Bascule Bridge.

These are illustrated diagrammatically below:

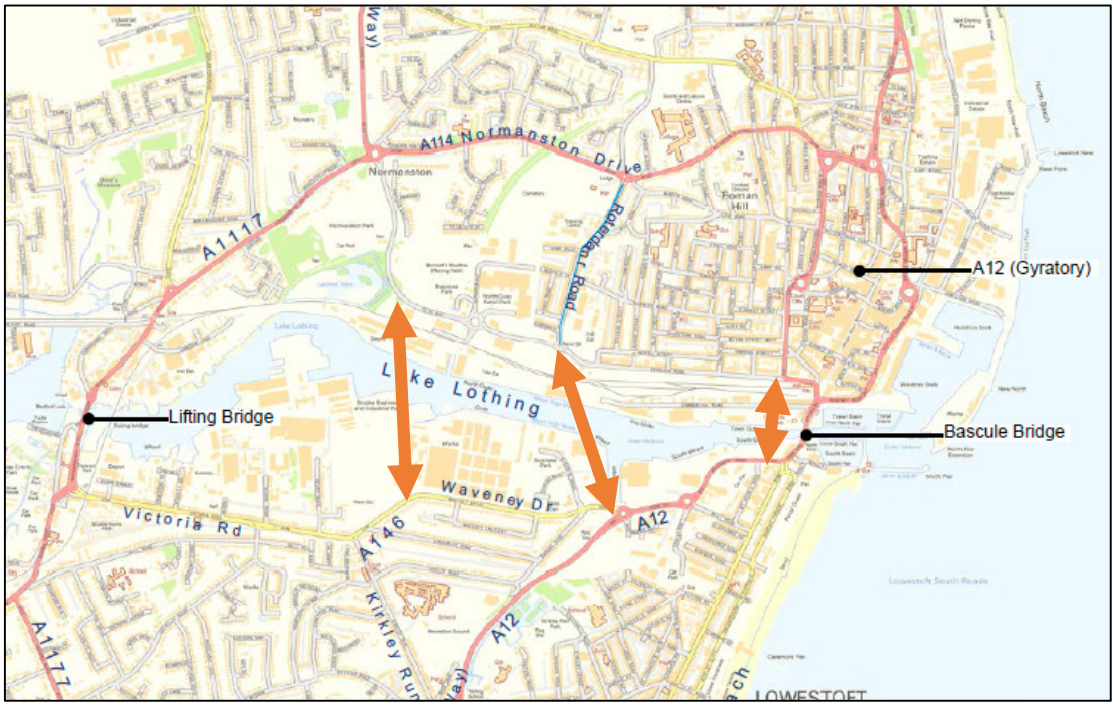


Figure 2-3: Possible corridors for a third crossing

3 Option Development

3.1 Step 5 – Option generation (long list)

An initial long list of 15 options for a third crossing was compiled. This included a number of options described in historic studies, together with additional options generated by means of desktop studies, site observations and an options workshop[6]. The long list includes bridge, tunnel, non-road and low-cost options.

The long-listed options are described below and illustrated diagrammatically in Figure 3-1 to Figure 3-14. This does not necessarily mean that all of the options are feasible as drawn.

Ten different options for a single lifting bridge were included in the initial "long list", four in the east, and three in each of the central and western corridors. For the purposes of the option comparison, some basic design parameters were agreed, following a client workshop and discussion with the port authority. The new crossing would:

- provide for a 7.3m single carriageway road with footways and a cycle lane;
- connect to the existing network with at-grade junctions wherever possible;
- provide, where feasible, 12m clearance above the high water level when closed (noting however that some eastern options would need to be at the level of the existing bascule bridge);
- provide 6.8m clearance above the railway line (a level crossing would not be acceptable);
- allow large vessels to turn safely within the confines of the channel;
- relate logically to the existing highway network;
- have minimal impact on existing development; and
- avoid conflicting with planned new development.

[6] An Options Workshop was held in Lowestoft on 15 September 2015, including key officers from Suffolk County Council and Waveney District Council, together with specialists in the main disciplines involved in the study (highways, transport planning, development planning, transport policy, environmental, structures, and geotechnical engineering).

Each of the above options is illustrated diagrammatically below. The diagrams should not be seen as demonstrating that any of the options is feasible as drawn; rather, they represent initial design concepts to be investigated further.

3.1.1 Initial option W1

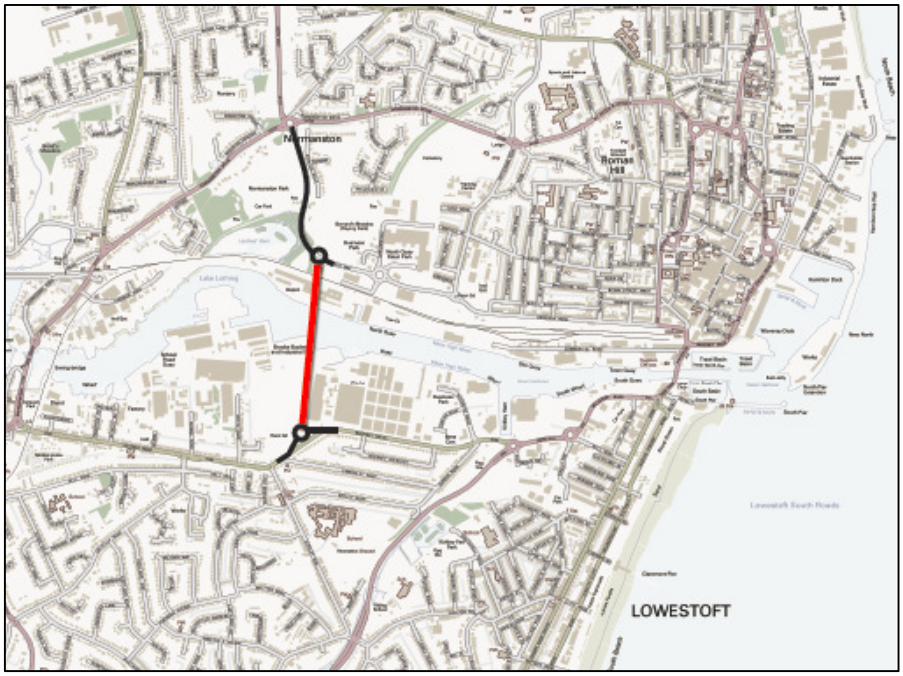


Figure 3-1: Initial option W1 (diagrammatic)

Option W1 envisages a direct link between a new junction on Peto Way (north of Lake Lothing) and a new junction on Waveney Drive (south of Lake Lothing).

3.1.2 Initial option W2

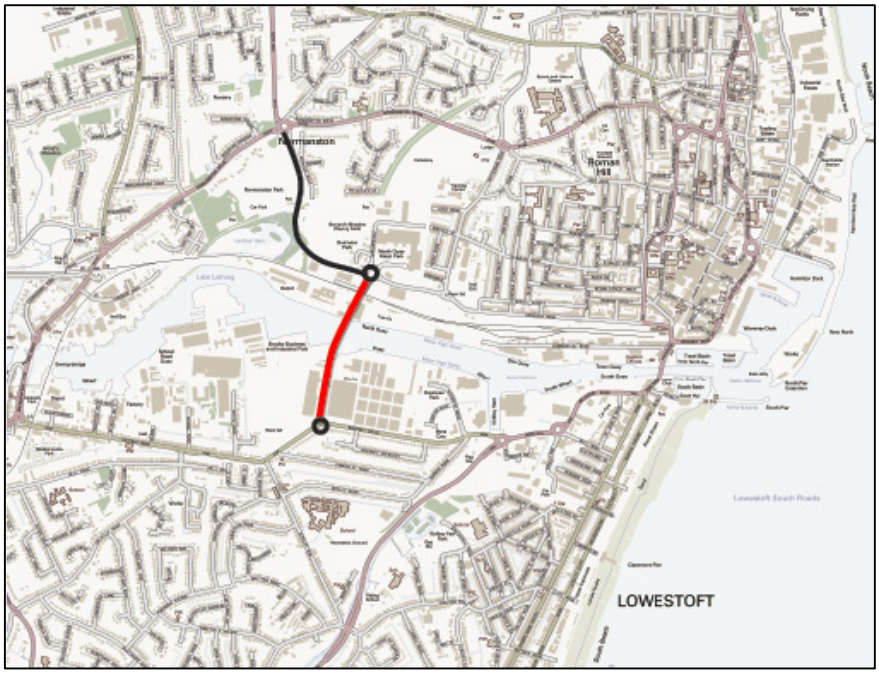


Figure 3-2: Initial option W2 (diagrammatic)

Option W2 envisages a direct link between the existing roundabout on Peto Way and a new junction on Waveney Drive slightly further east than W1.

3.1.3 Initial option W3

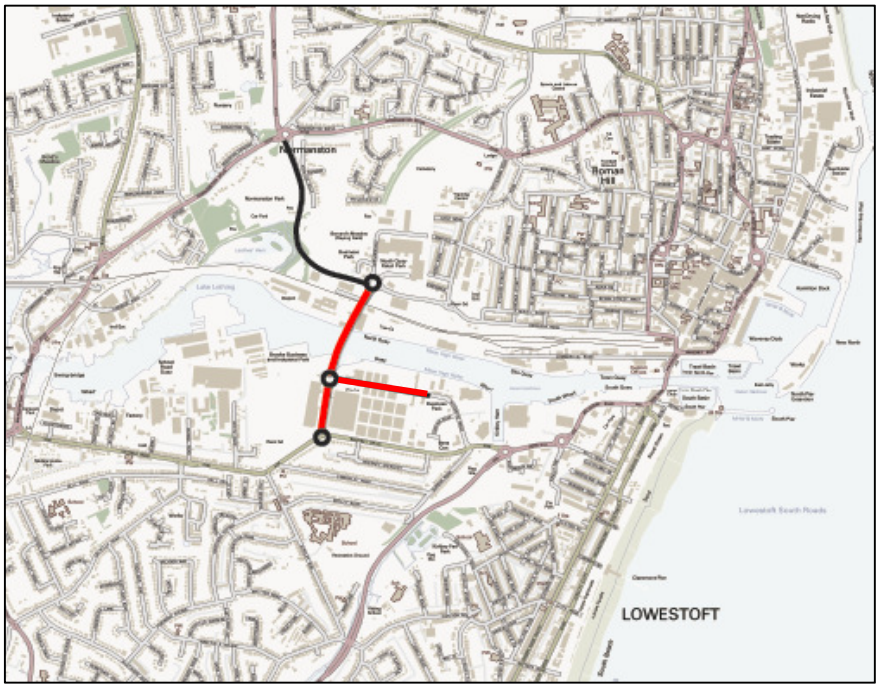


Figure 3-3: Initial option W3 (diagrammatic)

Option W3 is based on W2, with the addition of a new east-west link through the Kirkley Waterfront regeneration site, connecting via Riverside Road to Waveney Drive in order to reduce the pressure on Waveney Drive, a residential street.

3.1.4 *Initial option C1*

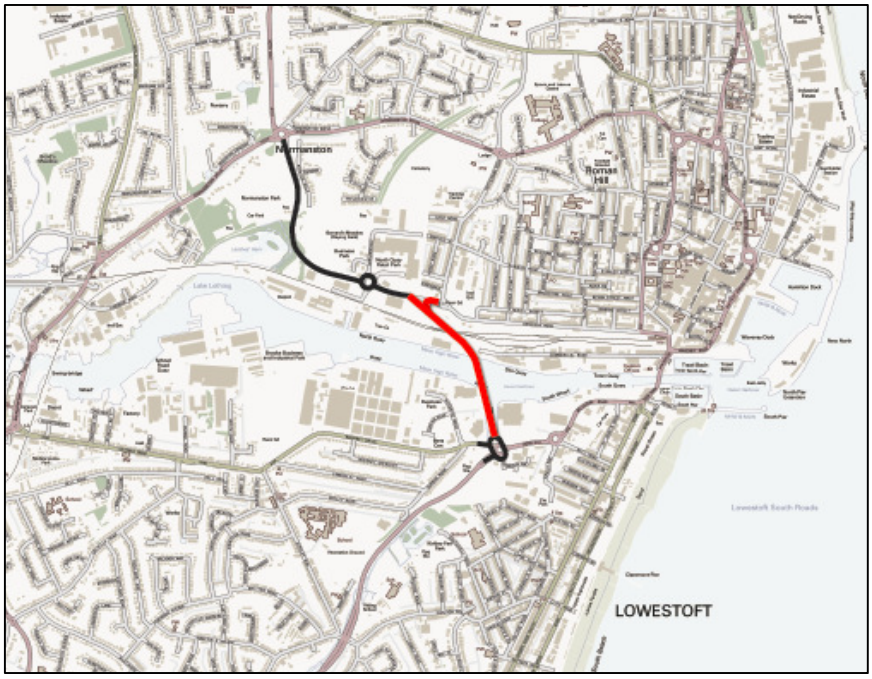


Figure 3-4: Initial option C1 (diagrammatic)

Option C1 links Peto Way and Denmark Road in the north to the Waveney Drive / A12 junction of in the south. It would require Kirkley Ham to be filled or spanned.

3.1.5 Initial option C3

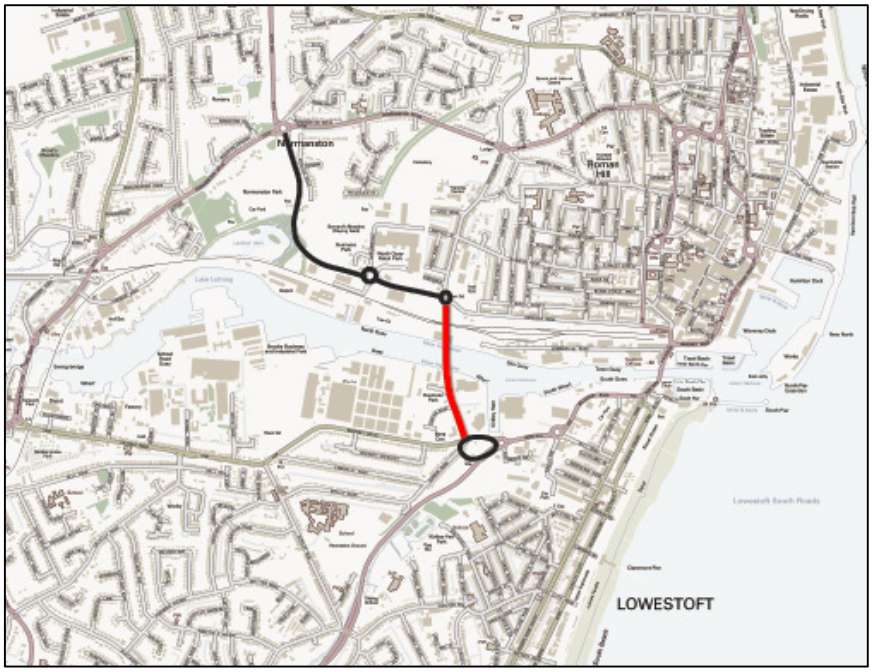


Figure 3-5: Initial option C3 (diagrammatic)

Option C3 is further west than C1 and would start at the Rotterdam Road/Denmark Way junction in the north, and connect to Riverside Road on the south side.
(Note: An option C2 was subsequently re-numbered L1 and is described elsewhere.)

3.1.6 Initial option C4

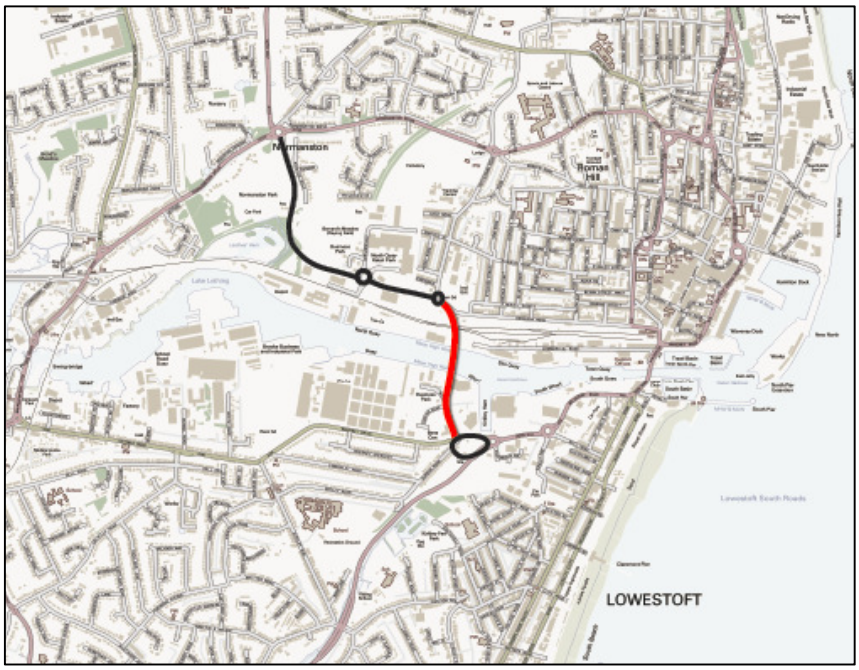


Figure 3-6: Initial option C4 (diagrammatic)

Option C4 is very similar to C3, but follows a slightly different alignment to enable the new bridge to be perpendicular to the channel.

3.1.7 *Initial option E1*

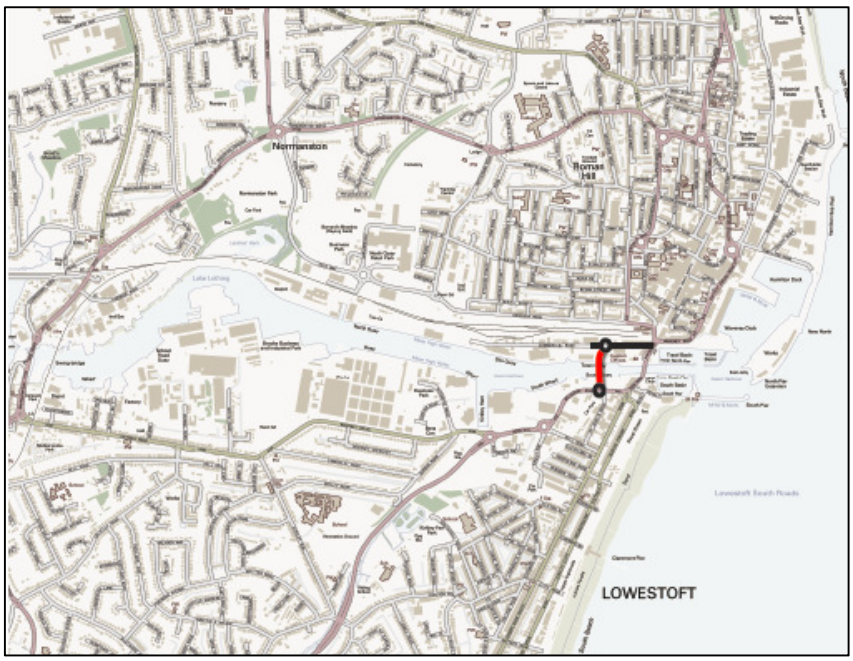


Figure 3-7: Initial option E1 (diagrammatic)

Option E1 is parallel to the existing Bascule Bridge, and at a similar level. It connects to Commercial Road but does not cross the railway line on the north side.

3.1.8 *Initial option E2*

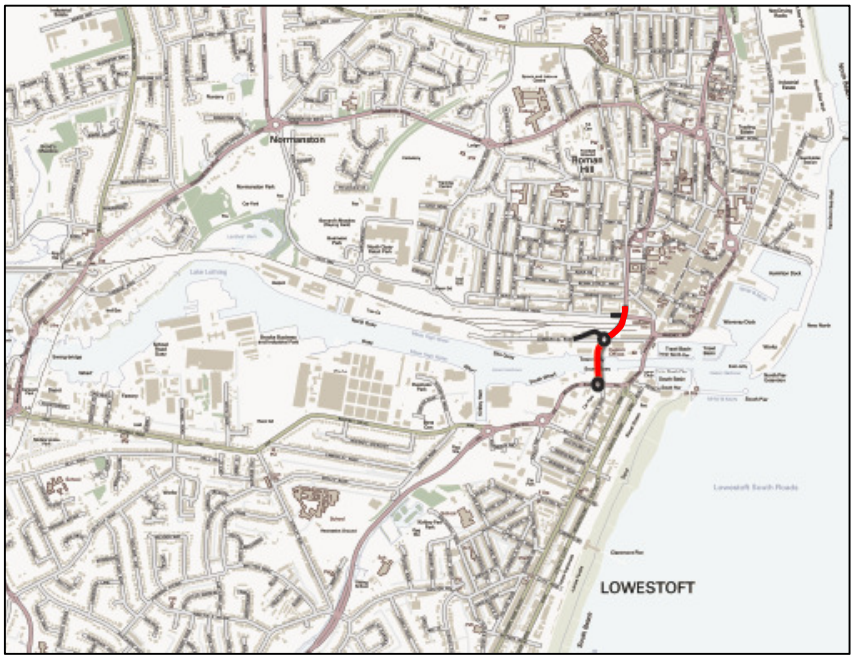


Figure 3-8: Initial option E2 (diagrammatic)

Option E2 is based on E1, but extends to form a junction with Katwijk Way. To achieve this, the railway station would need to be re-located further west.

3.1.9 Initial option E3

Figure 3-9: Initial option E3 (diagrammatic)

Option E3 also connects to Katwijk Way, but achieves this with a flyover across both Commercial Road and the railway station.

3.1.10 Initial option E4

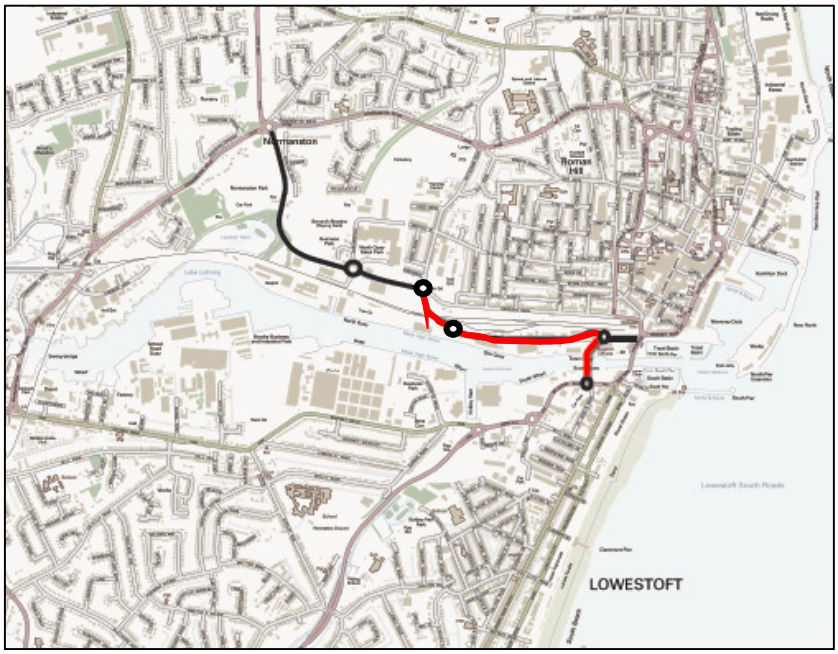


Figure 3-10: Initial option E4 (diagrammatic)

Option E4 is similar to E1, but with the addition of a new railway bridge at the western end of an improved Commercial Road, linking to Denmark Road.

3.1.11 *Lock/flood barrier option (Initial option L1)*

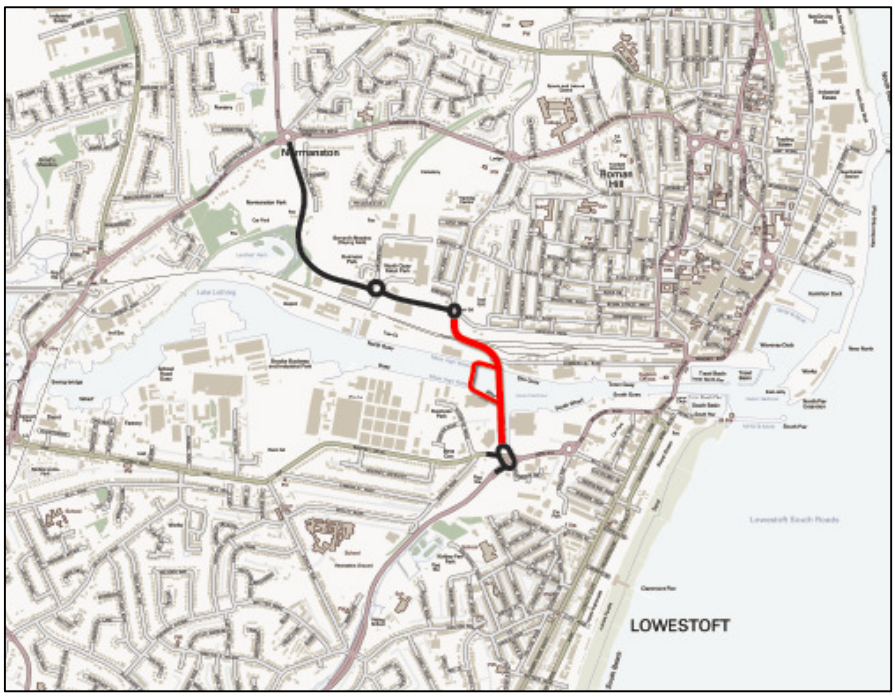


Figure 3-11: Initial option L1 (diagrammatic)

The concept of combining a new crossing with a flood barrier was also put forward as an option in the *Lowestoft Transport and Infrastructure Prospectus* (sketch scheme illustrated below). Located in the central crossing corridor, it envisaged a pair of lifting bridges, separated by a lock to provide partial flood protection. This option was included in the long list (as option L1).

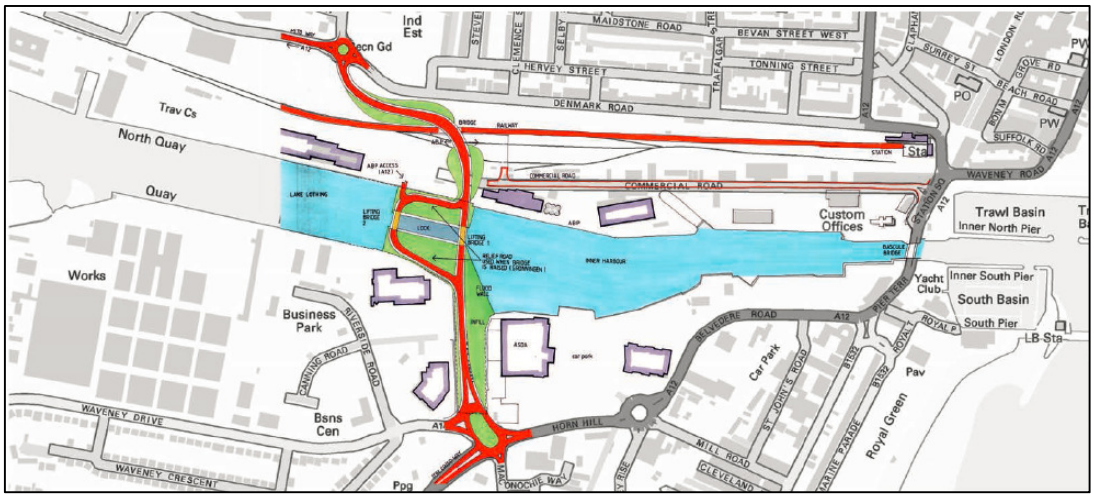


Figure 3-12: Option L1 (from Lowestoft Transport Prospectus)

3.1.12 *Tunnel option (T1)*

In addition to the bridge options, a tunnel option was considered. At this stage, it was assumed that a tunnel might follow either a western or a central alignment, similar to a bridge, or run diagonally from NW to SE.

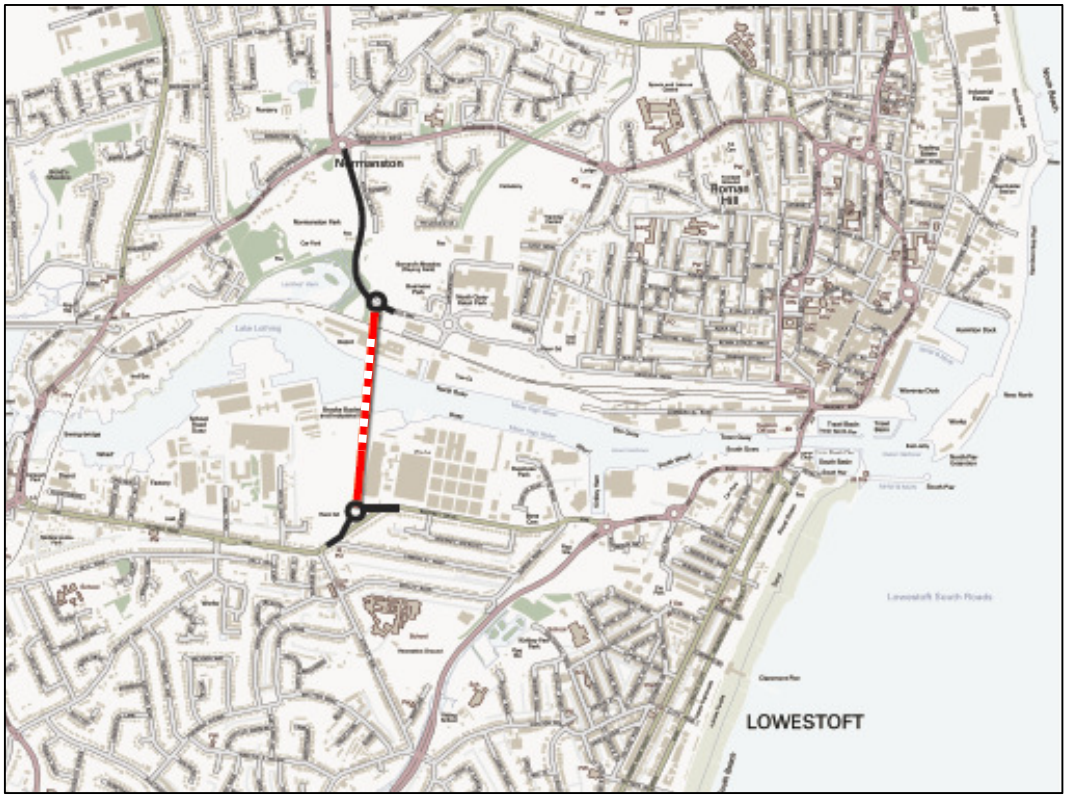


Figure 3-13: Initial option T1 (indicative)

A tunnel would not provide pedestrian or cycle routes. It was however included in the long list (as option T1).

3.1.13 *Junction improvements (J1)*

A separate study commissioned by Highways England (HE) and Suffolk County Council examined congestion issues at the two Lowestoft harbour crossings and associated 'problem' junctions. The aims included:

- Encouraging efficient use of the highway network when the (existing) bridges are open to traffic; and
- Re-establishing smooth traffic flow as soon as possible following bridge closures.

A particular objective was to integrate traffic signals on the HE network with those in SCC's urban traffic control (UTC) system. As a result of the study a package of, mainly minor, improvements was recommended. The measures include addition of HA junctions to SCC's UTC system, modifications to traffic signal layouts and control, minor changes to one way working and improved signage.

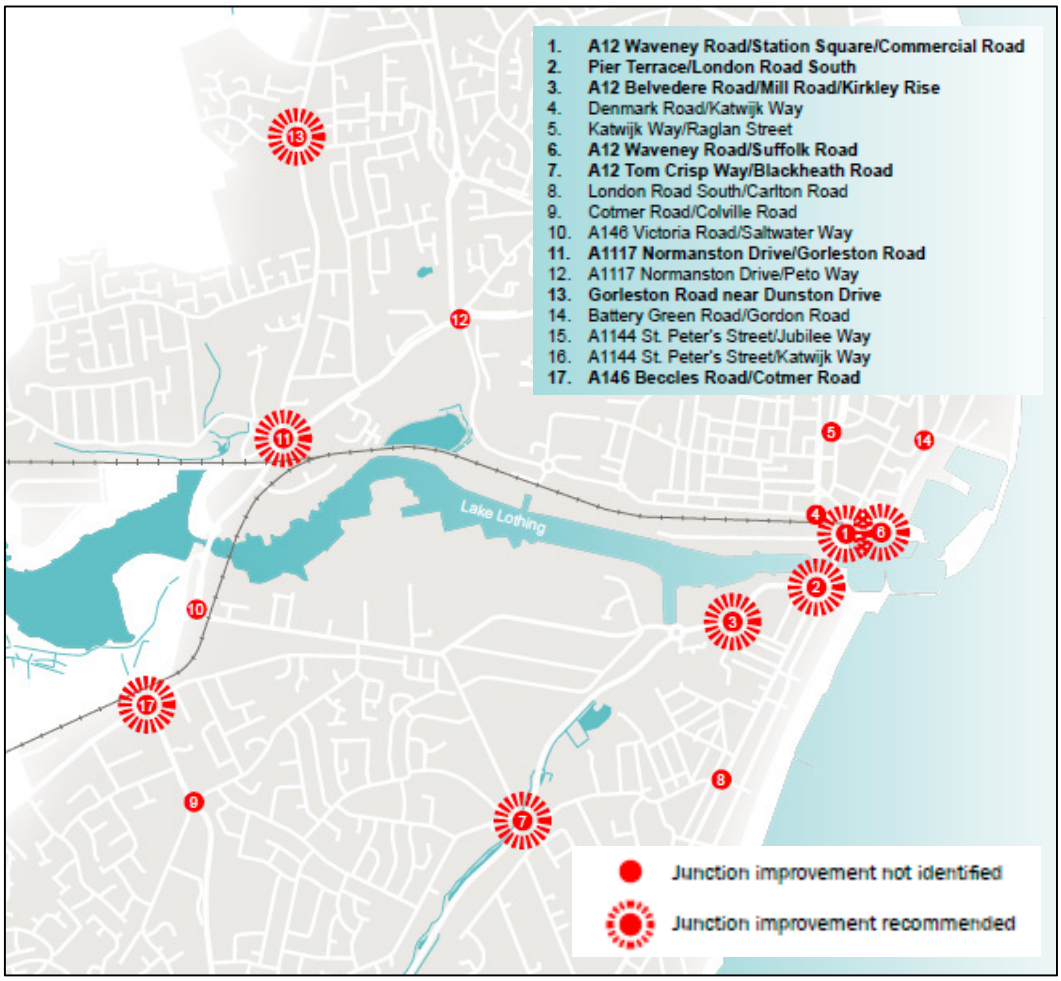


Figure 3-14: Option J1

The junctions identified for improvement are illustrated in Figure 3-14. The package of junction improvements was included in the long list as Option J1.

3.1.14 Smarter Choices (S1)

WebTAG guidance states that "as wide a range of options as possible should be considered, including all modes …. and other ways of influencing behaviour".

Smarter Choices initiatives aim to reduce car dependence and encourage a mode shift towards more sustainable modes of transport through a range of activities designed to produce behavioural change. Key measures include workplace and school travel planning, personalised travel planning, networking, promotional activities and incentives. The UK Sustainable Travel Towns programme (2004 - 2009) demonstrated that such measures can be effective.

The potential for a package of smarter choices measures to achieve the scheme's objectives is included in the long list as Option S1.

3.1.15 *Road pricing options (P1)*

WebTAG guidance states that "as wide a range of options as possible should be considered, including all modes, infrastructure, regulation, pricing and other ways of influencing behaviour". The potential for road pricing measures to achieve the scheme's objectives is included in the long list as Option P1.

3.1.16 *Summary of the long-listed options*

The final long-list of options is shown in Table 3-1.

	Type	From (N)	To (S)	Notes
W1	Bascule bridge	Peto Way	Waveney Drive	
W2	Bascule bridge	Peto Way/Denmark Rd	Waveney Drive	
W3	Bascule bridge	Peto Way/Denmark Rd	Waveney Drive / Riverside Rd	
C1	Bascule bridge	Peto Way/Denmark Rd	Waveney Drive / A12 Horn Hill	Affects Kirkley Ham basin
C3	Bascule bridge	Denmark Road	Waveney Drive / A12 Horn Hill	Via Riverside Avenue
C4	Bascule bridge	Denmark Road	Waveney Drive / A12 Horn Hill	Via Riverside Avenue
E1	Bascule bridge	Commercial Road	Belvidere Road	No railway bridge
E2	Bascule bridge	Katwijk Wy/Denmark Rd	Belvidere Road	Relocate station
E3	Bascule bridge	Katwijk Way	Belvidere Road	Bridge over station
E4	Bascule bridge	Commercial Road	Belvidere Road	With railway bridge to Denmark Rd
L1	Lock / flood barrier with lifting bridges	Denmark Road	Waveney Drive / A12 Horn Hill	Two bridges and lock
T1	Road tunnel	Peto Way / Denmark Rd	Waveney Drive / A12 Horn Hill	Alternatives to be considered
J1	Junction improvements	A package of measures to increase capacity and improve traffic flow at problem junctions throughout Lowestoft without a third crossing		As alternative to a third crossing.
S1	Smarter Choices	A package of "Smarter Choices" measures, to encourage people to make fewer journeys by private car.		As alternative to a third crossing.
P1	Road pricing	Introduction of road pricing to discourage traffic from congested routes and encourage people to make fewer journeys by private car.		As an alternative to a third crossing.

Table 3-1: Long-listed options

3.2 Options considered, but not included in the long-list

3.2.1 Fixed bridge options

The provision of a fixed bridge high enough to remain open to both traffic and shipping at all times was considered in principle. It would need to have 35m clearance and would be more expensive than a lifting bridge, more visually intrusive and – because of the levels involved –more difficult to tie back in to the existing roads. For these reasons, fixed bridge options were **excluded** from the long list.

3.2.2 Floating bridge options

Consideration was also given to the possibility of constructing a floating bridge. The superstructure would float on the surface of the lake, constrained by fixed piers. A pivoted central section would open as a swing gate to allow vessels to pass through. This method of construction has been used successfully elsewhere, for example in Dubai[7]. Although a floating bridge could be significantly cheaper than a conventional bridge, it would not be feasible for this scheme because of the railway line on the north shore. It would not be possible to achieve sufficient clearance over, or under, the tracks from a bridge just above water level, and a level crossing would not be acceptable to Network Rail. A floating bridge would also have to open for any size of vessel, whereas a conventional bridge would allow smaller vessels to pass without opening. For these reasons, floating bridge options were **excluded** from the long list.

3.2.3 Dual carriageway options

The provision of a dual carriageway crossing had been mooted in an earlier study, and was considered at a design workshop. However, Lowestoft's major road network has been developed exclusively with new single carriageway roads (e.g. Northern Spine Road, Southern Relief Road).

A dual carriageway crossing would also be a more expensive option than a single carriageway, which would lower the Benefit Cost Ratio of the scheme (making it less feasible), for no immediate benefit, as the existing road network either side of the bridge is not designed to accommodate dual carriageway traffic flows, and there would be no intension to change the junctions and highway along this route (due to further cost constraints). Additional land take would be required, further increasing the cost.

Furthermore, the wider structure and increased land take would increase the engineering difficulty of the scheme (in terms of sight lines / geometry considerations) at the connections to the existing network.

---

[7] Floating bridge over the Dubai Creek, Dubai, U.E.A. completed in 2007. Built by Waagner-Biro for Dubai Road and Transport Authority

A dual carriageway crossing was therefore **excluded** from the long list on the grounds of route consistency and likely cost.

3.3 Step 6 – Initial sifting

Having identified a long list of fifteen options, the next stage was to identify any which do not represent realistic solutions. An initial sift was therefore undertaken to identify any "showstoppers" which are sufficiently serious to rule an option out.

The sifting was undertaken in two stages. Firstly a subjective assessment was made of each option against the eight scheme objectives set out in Step 4a (Section 2.4) except "reduce accidents" which would require more detailed assessment. The results of this assessment are shown in Table 3-2 as of a RAG analysis in which each option is allocated to one of the following categories:

- Significant contribution to achievement of objective
- Some contribution to achievement of objective
- Minimal or no contribution to achievement of objective

Any option which is considered likely to make a significant contribution to fewer than five objectives was categorised as "does not achieve the scheme objectives". Seven of the long listed options were eliminated on this criteria.

The second stage of the initial sift then involves **discarding** any options which:

- Do not achieve the scheme objectives (from first stage);
- Do not fit with existing local or national strategies and priorities;
- Would have severe adverse impacts (economic, environmental, geographical or social);
- Are not considered to be technically sound;
- Are considered unlikely to be affordable; and
- Are unlikely to be acceptable to stakeholders and the public.

This was undertaken as a desktop exercise, informed by site inspections, a technical workshop and the findings of earlier studies. The results are shown in Table 3-2 which simply indicates where an option fails to meet one or more of the above criteria. The reasoning is set out in paragraphs 3.3.1 to 3.3.7 below.

The results are set out at the bottom of Table 3-3 and summarised in paragraph 3.3.8.

Five of the options, W3, C1, C3, C4 and T1 passed all of the criteria and were selected for further assessment. Of the ten options which failed to meet one of the criteria, two – J1 and S1 - are being taken forward through other projects.

Objective	W1	W2	W3	C1	C3	C4	E1	E2	E3	E4	L1	T1	J1	S1	P1
To open up opportunities for regeneration and development	🟡	🟡	🟢	🟢	🟢	🟢	🟡	🟡	🟡	🟢	🟢	🟡	🔴	🔴	🔴
To provide the capacity needed to accommodate planned growth.	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟡	🟡	🔴
To reduce community severance between north and south Lowestoft.	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟢	🔴	🔴	🔴
To reduce congestion and delay on the existing bridges over Lake Lothing.	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟡	🔴
To reduce congestion in the town centre and improve accessibility.	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟢	🟡	🟡	🟡
To encourage more people to walk and cycle, and reduce conflict with other traffic.	🟡	🟡	🟡	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟡	🟡	🟢	🟡
To improve bus journey times and reliability.	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟢	🟡	🟡	🟡
To reduce accidents.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Achieves 5 or more objectives (yes/no)	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🟢	🟢	🔴	🔴	🔴

Table 3-2: Assessment of long-listed options against scheme objectives

Long list sifting criteria	W1	W2	W3	C1	C3	C4	E1	E2	E3	E4	L1	T1	J1	S1	P1
Achieves key objectives (see detail above)							🔴	🔴	🔴	🔴			🔴	🔴	🔴
Strategic fit															🔴
Impacts	🔴	🔴							🔴		🔴				
Technically sound											🔴				
Affordability								🔴			🔴				
Stakeholders											🔴				🔴
Public opinion (where known)							🔴	🔴		🔴					
Retain for further analysis?	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**No**	**No**	**Yes***	**No****	**No**	**No**

Table 3-3: Initial sift of long-listed options

* Subject to alternative cycle provision being provided

** Include in "do minimum"

3.3.1 *Western crossing options*

Options W1 and W2 do not connect effectively to the existing road network on the southern side of Lake Lothing. Both options tie into Waveney Drive which, although forming part of the A146, is also a residential street, with numerous homes having frontage access. Option W1 and, to a lesser extent W2 would also be likely to increase traffic on Kirkley Run, another residential street which also gives access to a school, and this would be unacceptable. Option W1 could also have an adverse environmental impact on the Leathes Ham recreation area to the north of Lake Lothing and on the County Wildlife site to the south.

It was therefore concluded that **Options W1 and W2** are likely to have adverse impacts on residents and the environment and should be **excluded** from the more detailed assessment.

Option W3 includes a connection to Riverside Road. With improvements between Riverside Road and Horn Hill it could provide an effective link between strategic routes in the north and south sides of the town.

It was concluded that **Option W3** was the most appropriate western option and should be **included** as the starting point for more detailed assessment of the option

3.3.2 *Central crossing options*

Options C1, C3 and C4 are all fairly similar, and represent alternative alignments for a central route between the northern spine road, Peto Way (or the western part of Denmark Road) and the A12 southern link road, Horn Hill (via the western end of Waveney Drive). Options C3 and C4 are almost identical, both connecting to Riverside Road. The initial sieve was not considered sufficiently detailed to discriminate between these options.

It was therefore concluded that **option C1,** and **an option based on C3 and C4** should be **included** in the next stage of the analysis, whilst recognising that the best "central" alignment might be developed with elements from some or all of these.

3.3.3 *Eastern crossing options*

Options E1, E2, E3 and E4 all involve provision of an additional crossing at the eastern end of the Lake, close to the existing Bascule Bridge. Whilst this could increase the overall capacity of the eastern crossing, it would also encourage more traffic, not less, to use the existing A12 corridor, putting more pressure on the existing gyratory system around the town centre, and on residential roads forming part of the A12 to the north of the town centre. **Options E1, E2 and E3** are considered unlikely to meet fully a number of the scheme objectives. In particular, they would not significantly improve access to the regeneration areas south of Lake Lothing. They would not fully address the problem of severance, as Lake Lothing would still form a barrier, more than 2.5 km long, between the north and south halves of the town. The eastern options have also proved very difficult to tie into the existing network, due to the level differences and limited space available, and the proximity of

the railway station. **Option E1** only connects directly to Commercial Road, providing no traffic relief to Station Square and creating a potential pinch point north of the Bascule Bridge. **Option E2** would connect to both Commercial Road and Katwijk Way, but this could only be achieved by relocating the railway station further west. This would significantly increase the cost and add to the difficulty of delivering the scheme. It is therefore considered to fail the affordability criterion. **Option E3** envisages a new bridge at a higher level, with a flyover of Commercial Road, the railway station and Denmark Road before descending to connect with Katwijk Way (only). Even if the levels could be made to work, this option would be very visually intrusive due to the height of the structures involves and would have an unacceptable impact on the townscape. It is therefore considered to fail the adverse impact criterion.

Figure 3-15: Option E3 – Impact on townscape north of the station

For the above reasons, it was concluded that **Options E1, E2 and E3** should be **excluded** from the next stage of the assessment.

Option E4 is similar to E1, but with the addition of a separate new railway bridge from the end of Commercial Road to Denmark Road. This provides a (rather indirect) link between the northern spine road and the southern link road, potentially taking some traffic away from the town centre. For this reason, E4 is considered to be the best of the eastern options. It does, however, have a number of drawbacks:

- A bridge at this location would have to be constructed at a similar height to the existing Bascule Bridge. This means that it would have to open every time the existing bridge opens, and for shipping of all sizes. This compares badly with the potential bridges on other alignments which, by virtue of their height, would not need to be raised to allow passage of smaller craft. A bridge in this location would also have to open for vessels which only needed to access the eastern part of the inner harbour, whereas bridges on the other corridors would not have to be raised for these. Option E4 would therefore not address one of the main local concerns which have led to demands for a third crossing.

- It does not have the support of local people. In a public consultation exercise in June 2014[8], local people were asked for their views on a number of possible crossing locations, including schemes similar to options E1, E2 and E4. Support for these was very low indeed, with only 2.2% favouring Option E1, 2.8% favouring E4 and 3.3% favouring E2. This compared with 60.6% support for a central option (similar to C1) and 23.9% support for a western option (similar to W1).

- A crossing in the eastern corridor would also be less effective in providing traffic relief to the existing bridges than a new crossing in either of the other corridors. This is evidenced by preliminary tests with the traffic model, which indicated that it would carry 50% less traffic than other options in the morning peak hour. It would provide more capacity and reduce delays, but it would not reduce traffic volumes on the congested A12 corridor or provide significant traffic reductions on Mutford Lock Bridge.

For the above reasons, it was concluded that **Option E4** should be **excluded** from the next stage of the assessment.

3.3.4 Tunnel option

Option T1, a tunnel crossing, has a number of advantages in that it could take a direct line, relatively unconstrained by the Lake or features above ground. It would not directly address the key objective of encouraging more people to walk and cycle, as it could not accommodate a footway or cycleway, although any reduction of traffic on the existing bridges would offer some benefit to cyclists and pedestrians.

On balance, it was concluded that a tunnel **option T1** should be **included** in the next stage of the analysis, allowing the concept to be examined further.

3.3.5 Lock / flood barrier option

Option L1, as initially conceived, involves a large lock between two lifting bridges. It was inspired by a similar arrangement at Groningen in the Netherlands, in which a canal lock, 230m long and 15m wide has lifting bridges at each end, as well as lock gates.

The main attractions of replicating such an arrangement on Lake Lothing were that:

- it would allow one of the two bridges to remain down (and open to traffic) at all times, reducing traffic delays; and

- the lock could also form part of a tidal barrage.

[8] Lowestoft, Lake Lothing Crossing Study: Consultation Report, WSP (September 2014)

However, a study in 2009[9] concluded that such a scheme "would probably not be viable" as it was "envisaged that the Environment Agency would probably object to any form of barrage as they are carrying out their own assessment of flood risk and are proposing other schemes in the vicinity".

Proposals for a strategic tidal flood barrier have since been developed further and funding secured for a scheme involving a combination of fixed and demountable barriers between the outer harbour and the town. This makes it unnecessary to consider combining a flood barrier with a central crossing. Furthermore, Associated British Ports (ABP) would object to the scheme because of its impact on the ship turning area, and advise that, if such an arrangement were possible, both bridges would need to be opened at the same time. This removes one of the main perceived advantages of this option. There would be an adverse impact on port operations. In visual terms, a double bridge and lock would appear very different from the prototype at Groningen, as the Netherlands scheme is at a very low level, whereas a Lowestoft scheme would be much higher and more intrusive, because of the need to clear the existing railway line and the fact that the quay walls would need to be raised, adding to the cost.

It was therefore concluded that **Option L1** fails the criteria of adverse impacts, feasibility, affordability and stakeholder acceptance and should be **excluded** from further assessment.

3.3.6 Junction improvement option

Option J1 (junction improvements) was based on a separate study commissioned by Highways England (HE) and Suffolk County Council. This identified a package of, mainly minor, improvements which is now likely to be taken forward by SCC. The measures include addition of HE junctions to SCC's UTC system, modifications to traffic signal layouts and control, minor changes to one way working and improved signage.

In simple terms, these improvements aim to produce benefits by "fine tuning" the existing network. The benefits will not, however be of the order of magnitude that could potentially be achieved by a third crossing, because they do not address the fundamental problem of physical severance caused by Lake Lothing which divides the town in half. It was concluded that this option would not fully meet the objectives set for the scheme.

For this reason it was considered that **option J1** should be **excluded** as an alternative to the provision of a third crossing.

[9] A12 Lowestoft Study, WSP (February 2009)

Elements of the package of minor improvements will instead be treated as a committed scheme and included in the Uncertainty Log (appended to the Outline Business Case). Subject to the limitations of modelling, it will be included in the "Do Minimum" (DM) scenario against which other schemes are assessed, rather than as an alternative scheme in its own right. Including it in the DM means that any scheme will have to demonstrate benefits over and above those offered by the junction improvement package.

3.3.7 Smarter choices option

Option S1 (smarter choices) is already being delivered, as Lowestoft is covered by Suffolk County Council's *Travel Smart Lowestoft* project. This aims to reduce car journeys in Lowestoft by encouraging people to use alternative modes of transport, including cycling, walking and public transport. Much has already been achieved. An evaluation by Sustrans[10] of an Individualised Travel Marketing (ITM) project in 2008 and 2009 described how the initiative has already resulted in a 13% reduction in "car as driver" trips and a 19% increase in walking trips amongst the target population of 25,000 households – the great majority of households in Lowestoft. Trips by cycle and public transport also increased, though from a very low base. The surveys were based on household questionnaires, rather than on traffic counts, and the findings were similar to those achieved in similar projects in other towns. The *Lowestoft Local Links* initiative was allocated £5 million from the DfT''s Local Sustainable Transport Fund (LSTF) in 2011-15 in order to build on the success of the TravelSmart initiative. This project address Lowestoft's role as a key employment centre and tourist destination. Improved transport measures will include improvements for pedestrians and cyclists; bus and rail improvements, including a station travel plan; implementation of a new bus route; an area-wide integrated ticketing system; and rural demand responsive transport services.

During the development of the Area Action Plan (AAP), sensitivity tests were undertaken to examine the likely impact of sustainable transport initiatives. It was concluded that the development of the AAP initiatives would result in unacceptable congestion by 2025 at both the existing Lake Lothing crossings, even with the existing Travel Smart initiative. The AAP identifies potential improvements for pedestrians, cyclists and public transport and makes it clear that developers will be expected to contribute towards these, whilst also encouraging development of travel plans for workplaces, schools and residential areas.

[10] TravelSmart Lowestoft – Final report on the Individualised Travel Marketing Project in Lowestoft (2008-2009). Report by Sustrans and Socialdata to Suffolk CC and Waveney DC (October 2010)

It is evident that Travel Planning and Individualised Travel Marketing can be, and indeed have been, effective in achieving modal shift and reducing demand for motorised transport. However, given that so much has already been achieved, or is being normalised as part of the development planning process, it is doubtful whether it would be possible to devise a scheme which would generate additional benefits on the scale needed to deliver the scheme objectives. In particular, it is unlikely to fully address the objectives of reducing severance and unlocking opportunities for regeneration.

It was therefore concluded that **option S1 should not be included** as an alternative to the provision of a third crossing.

Travel plans and other measures to promote sustainable transport will however continue to be promoted through the development planning process. In addition, the impacts of the third crossing scheme on sustainable travel will be assessed by means of an Active Mode Appraisal, in line with WebTAG guidance, and included in the economic case of the OBC.

Option P1 (road pricing) is not considered to be a viable alternative to the provision of a third crossing. Although road pricing has proved effective in London, it has proved remarkably difficult to establish viable schemes elsewhere in the UK. The large scale Transport Innovation Fund (Congestion TIF) project supported the development of potential pricing schemes in a number of UK towns and cities, including Shrewsbury, Greater Manchester, Tyne and Wear and the West Midlands, but despite significant pump priming funds and strong central government support, none of these schemes came to fruition. Whilst area-wide road pricing would in theory be a way to reduce congestion, it is inconceivable that a system could be successfully introduced in Lowestoft in the present economic climate, nor would it be acceptable to the public. On a smaller scale, the introduction of tolls on a new bridge would discourage its use and therefore reduce its benefits. And the introduction of tolls on all of the crossings would aggravate, rather than solve, the fundamental problem of severance, and could discourage inward investment and regeneration.

For these reasons, it was concluded that **option P1 should not be included** as an alternative to the provision of a third crossing, or as part of a third crossing scheme.

3.3.8 Summary of options short listed for further assessment

Following the initial sift, a short list of four options was taken forward for more detailed assessment:

	Type	From (N)	To (S)	Notes
W3	Bascule bridge	Peto Way/Denmark Rd	Waveney Drive & Riverside Road	
C1	Bascule bridge	Peto Way / Denmark Rd	Waveney Drive / A12 Horn Hill	Affects Kirkley Ham basin
C3/4	Bascule bridge	Denmark Road	Waveney Drive / A12 Horn Hill	Via Riverside Road (all or part)

T1	Tunnel	Peto Way / Denmark Rd	Waveney Drive / A12 Horn Hill	Alignments to be investigated

Table 3-4: Options accepted for further assessment

The next stage involved:

- Developing these potential options to a sufficient level of detail to determine feasibility and relative cost; and
- A further, more detailed, assessment of these options to identify a preferred option.

3.4 Step 7a – Further development of potential options

The potential crossing options, **W3, C1, C3** / **C4**, and the tunnel option **T1**, were the subject of a more detailed investigation to determine their feasibility and relative cost. This was primarily a desk-based design exercise, supplemented by site observations, meetings with stakeholders and information from previous studies.

This included consideration of:

- Feasibility of vertical and horizontal alignment;
- Connections to existing roads;
- Impact on port operations;
- Other physical constraints; and
- Environmental constraints.

At this stage, it became evident that the need to achieve a satisfactory vertical and horizontal alignment for the new bridge or tunnel, in accordance with highways design standards would severely constrain the design of the scheme. On the north side of Lake Lothing, there are only limited opportunities for the new road to pass over (or under) the railway line before connecting to existing roads, without involving an unacceptable gradient. Similarly, on the south side of the Lake, there are only limited opportunities to provide the clearance required over (or under) the lake, whilst also connecting to existing roads. In addition, it was necessary to ensure that the central lifting section of a new bridge would be perpendicular to the channel, to minimise its length and for ease of navigation, and this has to be achieved without introducing unacceptably tight horizontal curves on the approaches.

To avoid the risk of selecting a “preferred option” which, upon more detailed design, might prove more difficult and expensive to deliver than anticipated, more detailed options were produced for each of the west and central corridors, and for the tunnel option. The design process involved considering a large number of minor variants, in

order to identify, in design terms, the most robust option for each corridor (west and central) and for a tunnel.

Central option C1 was reviewed in more detail at this stage, and a trial vertical and horizontal alignment produced, as illustrated below.

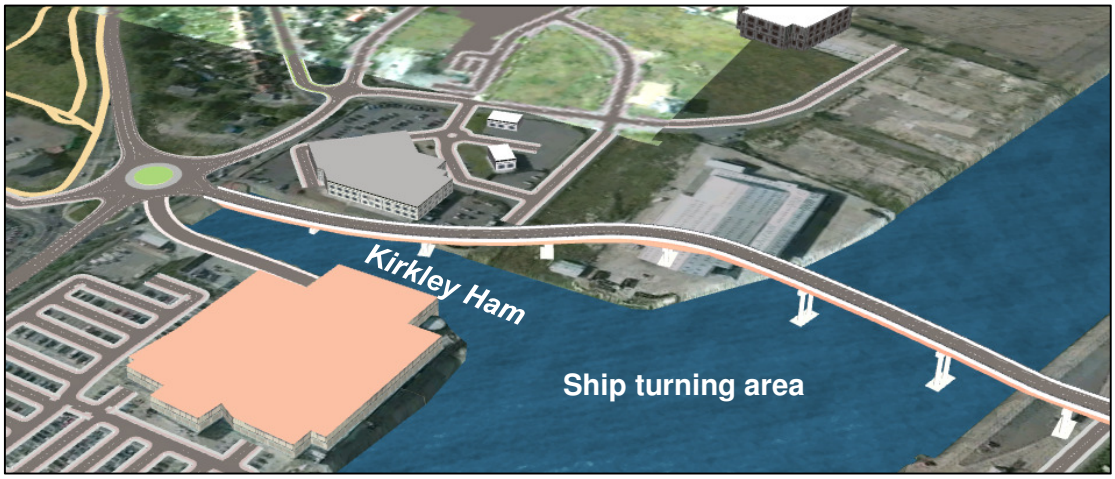


Figure 3-16: Option C1, trial vertical and horizontal alignment

It was concluded that this option, which would involve either filling the body of water known as Kirkley Ham, or spanning it with a lengthened bridge structure, should not be progressed further for the following reasons:

- The main bridge structure would still be very close to the designated ship turning area and it would be difficult to gain the support of the port operators;
- It would have a major impact on buildings on the south side of Lake Lothing;
- It would involve a six arm roundabout with the A12 trunk road; and
- Cost of an extended structure / filling Kirkley Ham.

As previously noted, Central options C3 and C4 were very similar to each other. By examining the vertical and horizontal alignment and optimising the connections to existing roads, it was possible to produce a single central option for further assessment. Overall, this process involved testing and discarding ten variants for the central corridor alone, in order to produce a single, robust central alignment for further assessment.

The resulting options are identified as **Western Bridge option, Central Bridge option** and **Tunnel option.** Their correspondence to the short listed options is summarised below.

Short listed option	Refined option	Main features / changes made to short listed option	Shown in
W3	**Western bridge option**	• New roundabout and flyover on Peto Way • Link to Kirkley Waterfront deleted.	Figure 3-17 to Figure 3-19
C1, C3, C4	**Central bridge option**	• Runs between new roundabouts on Denmark Road and Waveney Drive/Riverside Road. • Additional access to commercial estate from Waveney Drive. • Increased distance from ship turning area • C1 variant dropped • C3/C4 optimised	Figure 3-20 to Figure 3-22
T1	**Tunnel option**	• Similar alignment to western bridge option. • New roundabout and flyover on Peto Way • New roundabout on Waveney Drive	Figure 3-23 to Figure 3-25

Table 3-5: Refined options

The advantage of this approach, which focuses on robustly tested, “best” schemes in each category (west, central and tunnel), is that the final stage of option appraisal becomes a fair comparison between these different strategies for providing a third crossing, giving greater confidence in the eventual choice of a preferred scheme.

General arrangement plans of the three refined options are set out in Appendix A of this report. Each of the options are described and further illustrated in paragraphs 3.4.1 and 3.4.3.

3.4.1 Western bridge option

The refined Western bridge option is illustrated in Figure 3-17 (below), Figure 3-18 and in Figure 3-19.

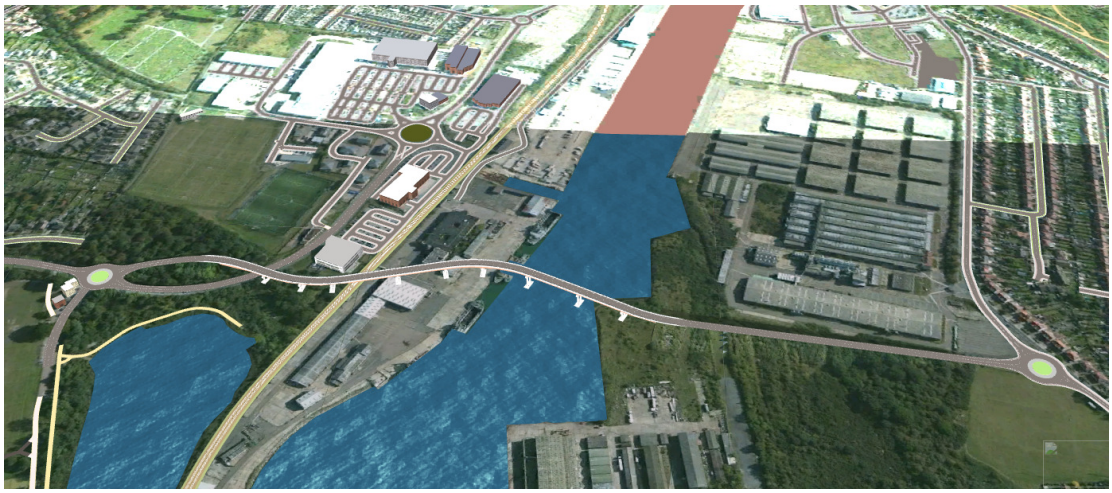


Figure 3-17: Western bridge option – viewed from the west

The new road starts from a new roundabout on Peto Way, on the north side of Lake Lothing. It rises on an embankment, curving to the right and crossing Peto Way on a flyover. The bridge then curves to the left and crosses the railway line and waterfront obliquely, then curves again to the right to cross the lake. The central, lifting section is perpendicular to the main channel across a relatively narrow section of the lake.

The bridge is longer than had been envisaged in the first sift of preliminary options (W3) and the horizontal alignment is more complex. This is because it proved impossible to form a simple connection onto the existing Peto Way/Denmark Road roundabout and gain sufficient height to clear the railway line without introducing a gradient of more than 5%. The solution shown provides a more direct connection to Peto Way, but requires an additional flyover and a series of curves to minimise impact on existing development north and south of the railway line.

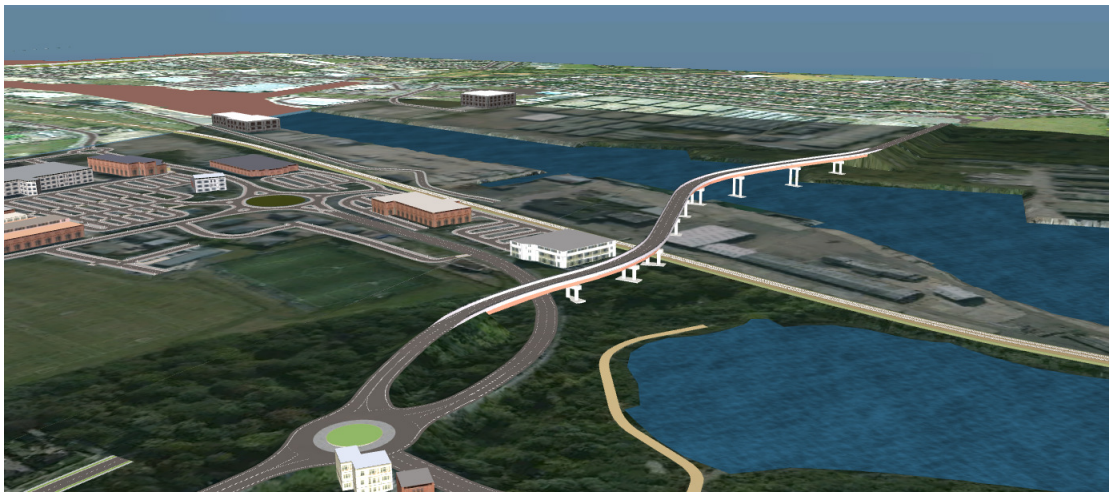


Figure 3-18: Western bridge option – northern approach to bridge

On the southern side of the Lake, the new road descends on an embankment, running between the former Jeld Wen timber yard and the Mosaic County Wildlife

Site – part of the Kirkley Waterfront and Sustainable Urban Neighbourhood identified in the Area Action Plan (Paragraph 2.4.3 in the Outline Business Case).

The scheme differs again from that envisaged in the initial sift of preliminary options, in that it was found to be impossible to form a simple new connection into the northern part of the regeneration site, due to the height of the embankment required at this point. The new road connects to Waveney Drive at a new roundabout.

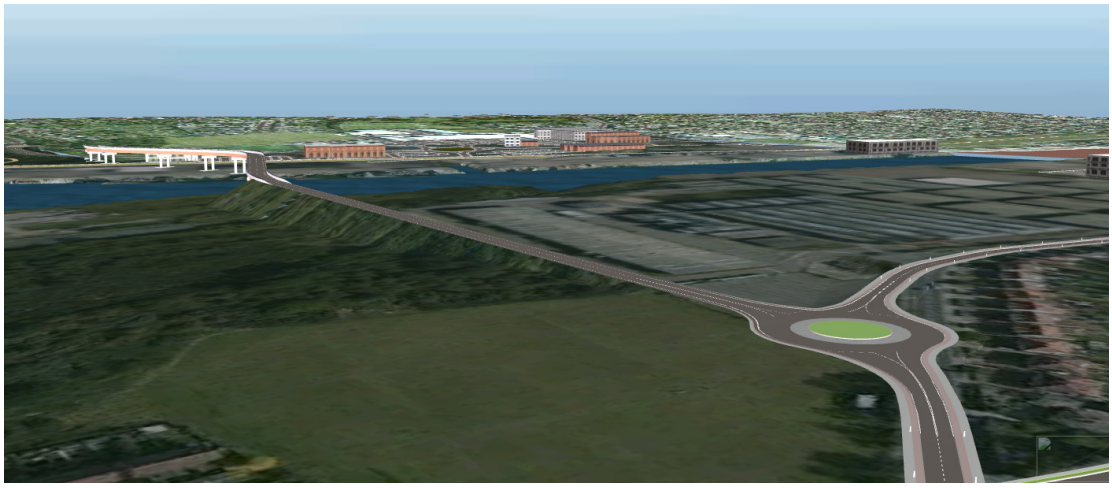


Figure 3-19: Western bridge option – southern approach to bridge

The refined Western bridge option is therefore different from, and in some ways less satisfactory than, the initial options from which it was developed. Nevertheless, it represents a feasible option within the western corridor.

In design terms, the main advantages of the Western bridge option are:

- Good connection to Peto Way;
- Relatively short, perpendicular span across the channel;
- Location and height of bridge means fewer closures to allow ships to pass through, compared with the existing bridges; and
- Provides for segregated footways and cycle tracks, connected into existing networks.

The main disadvantages identified in the design review are:

- Requires significant volume of imported fill for embankments;
- Relatively long structure overall;
- Northern approach impacts on woodland and SW corner of Leathes Ham County Wildlife Site;

- Southern approach affects recreational area and Mosaic County Wildlife Site;
- Northern roundabout may affect existing buildings;
- Requires reconstruction of Peto Way (north of new roundabout) to achieve an acceptable gradient;
- New roundabout on Waveney Drive will affect residential properties;
- Poor connectivity to major routes on south side;
- May increase traffic flow on Kirkley Run, south of Waveney Drive, affecting local school;
- Impacts on port buildings on northern waterfront and dock area; and
- Proposed road alignment within flood zone.

3.4.2 Central bridge option

The refined Central bridge option is illustrated in Figure 3-20 (below), Figure 3-21 and in Figure 3-22.

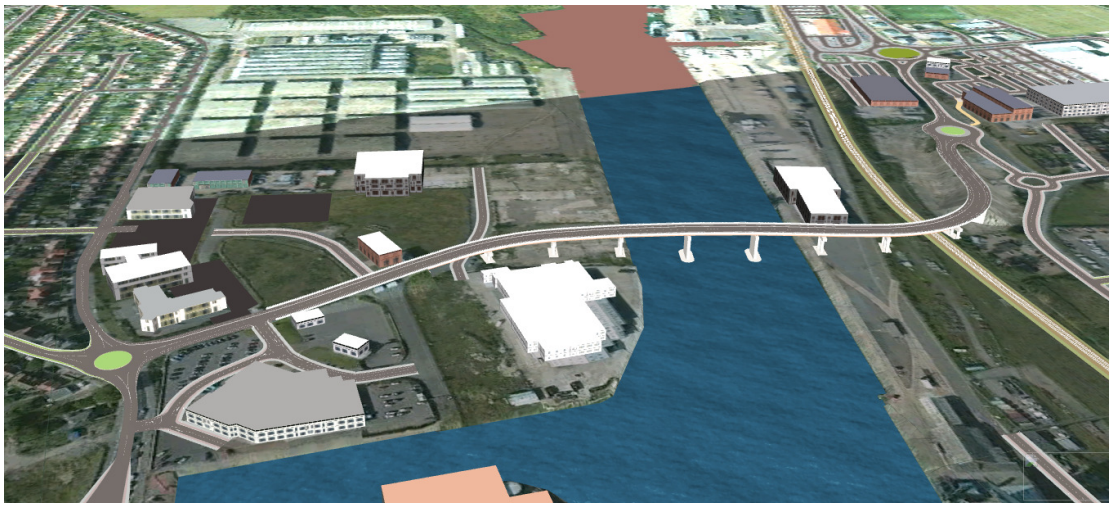


Figure 3-20: Central bridge option – viewed from the east

The new road starts from a new roundabout on Denmark Road, located between the existing Denmark Road / Peto Way roundabout and the Denmark Road / Rotterdam Road roundabout on the northern side of Lake Lothing. It gains height on an embankment and curves to the right in order to cross the railway line, and continues to gain in height over the lake towards the central, lifting, section of the main bridge.

Figure 3-21: Central bridge option – northern approach roads

On the southern side of the lake, the bridge structure continues at a high level to avoid splitting the commercial site nearest to the lake, and to enable an existing access road to pass underneath. From here the new road descends to connect with Riverside Road. Access is maintained into the car showroom on the north side of Kirkley Ham. A new roundabout is provided at the junction of Riverside Road with Waveney Drive.

Figure 3-22: Central bridge option – southern approach roads

In order to minimise the number of accesses onto the bridge approach, a new access is proposed from Waveney Drive into the Kirkley Waterfront site.

In design terms, the main advantages of a Central bridge option are:

- Good connectivity to the existing road network: Denmark Road on the north side and, indirectly, A12 Tom Crisp Way on the south side. Provides simple link between Southern Relief Road and Northern Spine Road;

- Improves access to existing development and regeneration areas;
- Location and height of bridge means fewer closures to allow ships to pass through, compared with the existing bridges;
- Provides for segregated footways and cycle tracks, connecting into existing networks;
- Utilises existing corridor along Riverside Road to minimise direct impact on existing property; and
- Low impact on the railway during construction, as the railway bridge supports can be constructed with minimal impact and with short possessions to lift bridge deck.

The main disadvantages identified in the design review are:

- Requires re-organisation of parking and access roads in the commercial area served by Riverside Road, including a new access onto Waveney Drive; and
- New junctions on Waveney Drive will have some impact on residential properties (mainly gardens).

3.4.3 Tunnel option

A number of variants for a tunnel option have been considered. These include both bored and immersed tube tunnels. Both these options would require cut-and-cover approach portals. The key constraint of either tunnel option is achieving a vertical alignment which meets the Manual for Streets and DMRB advice on grade (maximum desirable grade) of 6% whilst also tying into the existing road network at the desired locations. This has culminated in the identification of a preferred option of an immersed tube tunnel located in the western corridor, as illustrated in Figure 3-23 (below), Figure 3-24 and in Figure 3-25.

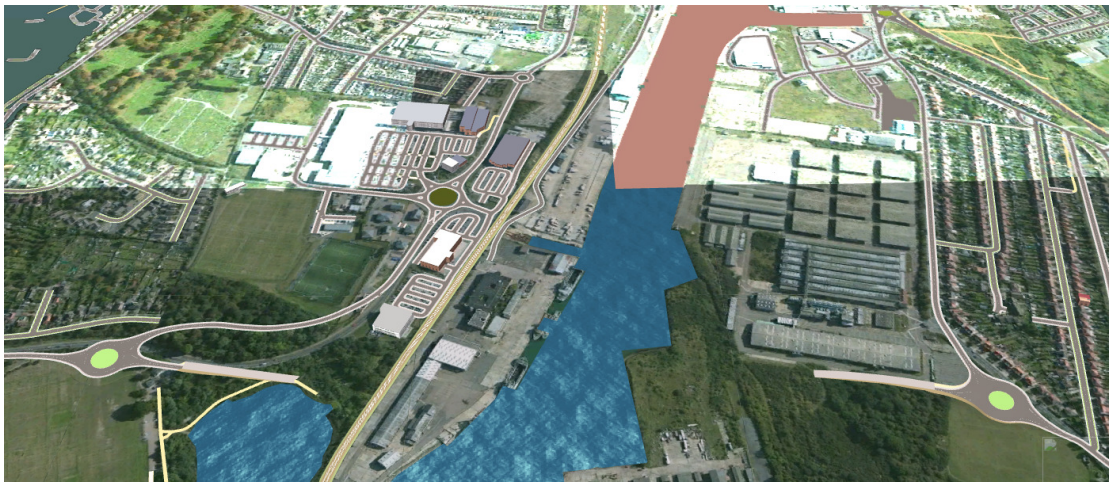


Figure 3-23: Tunnel option – viewed from the west

On the north side, the tunnel approach would start from a roundabout on Peto Way, requiring the diversion of a section of existing road.

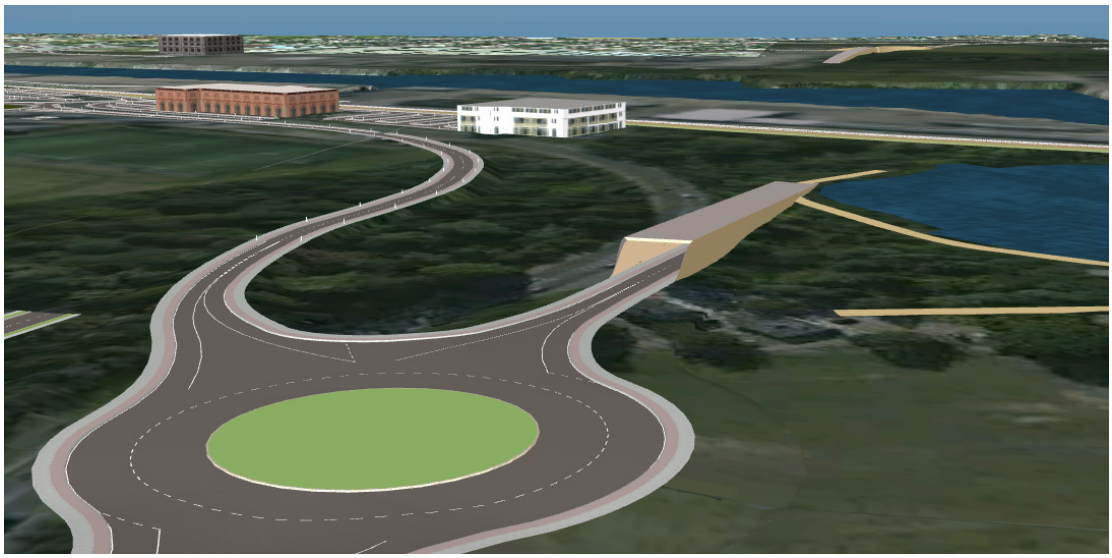


Figure 3-24: Tunnel option – northern approach and roundabout

On the southern side, the tunnel would emerge onto a new roundabout on Waveney Drive.

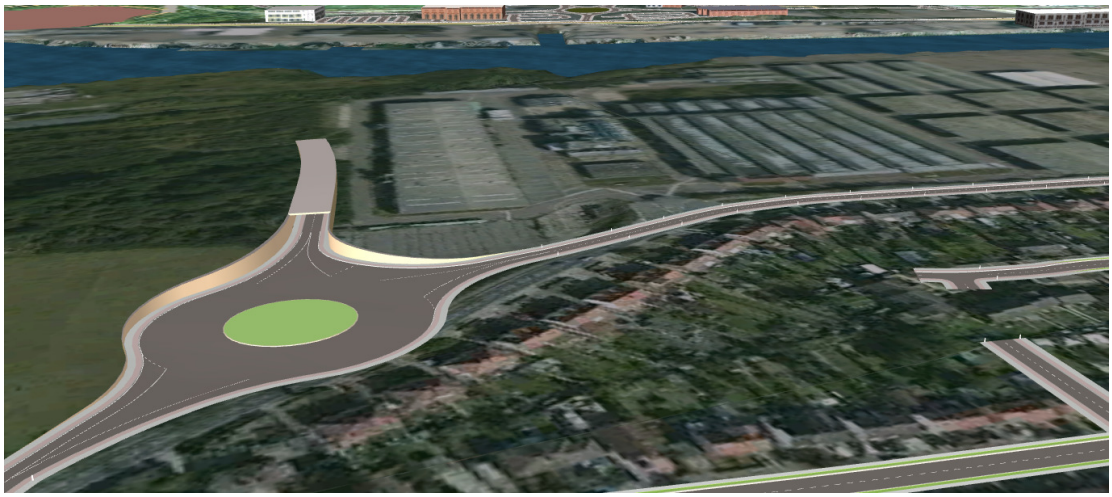


Figure 3-25: Tunnel option – southern approach and roundabout

As noted above, two methods of tunnel construction were considered:

Bored Tunnel option

Based on the requirements of BD 78/99 a single bored tunnel of approximately 12m internal diameter would probably need to be adopted for the crossing. The diameter of the tunnel allows for a 3.65m carriage way with a 1.0m verge in each direction, and a 2.0m separation / crash barrier between.

Construction of a bored tunnel usually requires its roof to be at least 1 to 1.5 times the tunnel diameter beneath an open water surface i.e. the base of the channel. This would mean the crown of the bored tunnel would be a minimum of 12m below the base of the channel.

Given the extra depth required for a bored tunnel compared to an immersed tube, the required highway vertical alignments for the western and central tunnel options cannot be achieved. Unacceptable gradients would be needed to enable the tunnel to tie in into the road network at the desired location.

Alternatively, if the tunnel was designed to achieve the maximum desirable grade then the tie in points would be some hundreds of metres further in land and would require the purchase of multiple properties for demolition and construction of the tunnel portal.

In addition, the bored tunnel option would have to pass below the toe of the existing river walls. At the time of writing details with respect to the as-built construction for the river walls were unavailable. Assuming that the bored tunnel would need to commence below the existing river walls this would potentially result in the tunnel crown depth being deeper than that described above.

Based on the foregoing, a bored tunnel would not be suitable at either crossing option and has been excluded from further consideration.

Immersed Tube Tunnel Option

An immersed tube tunnel at either crossing location will require significant engineering works to create the temporary opening within the existing river walls to allow construction. The openings will need to comprise embedded pile walls, approximately 20m deep, adjacent and perpendicular to the existing land side river wall.

The required maximum desirable grade of 6% can be achieved at the western crossing whilst tying the tunnel in to the existing road network, though this requires substantial realignment of existing roads. At the central crossing the achievable vertical alignment for an immersed tube tunnel is 10% which exceeds the design guidance.

In order to allow construction of an immersed the tunnel there will be a need to implement significant heavy civil engineering construction as follows:

- Creation of a temporary opening in the existing river walls to allow dredging and immersed tube placement. The tunnel element is lowered to its final place on the bottom of the dredged trench. The opening required would need to be a minimum of 25m in width. After installation of the immersed tunnel the river wall section would need to be reinstated;

- Construction of a casting yard for immersed tube construction and subsequent floatation into position;

- The floor of the casting yard will need to be below the river and hence groundwater level so the walls required to construct the casting yard will need to be water excluding; and

- An immersed tube tunnel will require significant engineering works to create the required cut-and-cover approach portals. The approach portals would be up to a maximum of 20.0m in depth at the location of the river wall.

Comparison of tunnel options

The vertical alignments for construction of an immersed tube tunnel include maximum gradients of 6% and 10% for the western and central locations respectively. The 6% western grade is the maximum desirable design grade for the project, whereas the 10% grade for the central option is in excess of the maximum desirable gradients provided in guidance documents.

It is therefore considered that an immersed tube tunnel option at the central crossing location falls significantly outside design guidance to disregard this option. In addition, a bored tunnel at either crossing location also falls significantly outside design guidance. This leaves the immersed tube tunnel at the western crossing location as the only potentially viable tunnel option.

Construction of an immersed tube tunnel at the western crossing presents significant engineering challenges which will require further design consideration if this option is to progress to outline and detailed design.

In design terms, the main advantages of a tunnel (once completed) are:

- No interruption to shipping passing through the port;
- No interruption to road traffic;
- No impact on port buildings and waterfront (once completed); and
- Less visual impact than a bridge.

The main disadvantages, identified in the design review, are:

- No provision for pedestrians or cyclists;
- Significant temporary works needed for cut and cover tunnel approaches, including difficult de-watering;
- Significant disruption to dockside and railway during construction;
- More disruptive to port operations during construction (compared to bridge);
- Problems associated with construction of a tunnel in the flood zone*;
- Need to divert 340m section of Peto Way affecting woodland area;
- Need to re-construct Peto Way north of new roundabout to achieve acceptable gradients;
- Northern roundabout affects park area;
- Requires demolition of commercial property / café within park area;
- New roundabout on Waveney Drive will affect residential properties;
- Poor connectivity to major routes on south side;
- May increase traffic flow on Kirkley Run, south of Waveney Drive, affecting local school; and
- Tunnel approach on the southern side impacts on recreational area.

* At the option development stage, it became clear that the presence of a tunnel in the flood zone presented significant problems which could not be fully resolved

without more detailed design, which might increase the cost of this option or require other compromises in design standards.

3.5 Step 7b – Further assessment of options (second sift)

The process of developing and refining the three scheme options, as described above, has highlighted clear differences between them.

In order to compare the three options and determine a preferred scheme, a further appraisal was undertaken, based on assessment of the following issues:

- **Delivery of scheme objectives** – updated from the initial assessment;
- **User benefits**, based on time and vehicle operating cost savings calculated using the traffic model and TUBA;
- **Cost of construction**, estimates based on the advance design work described above;
- **Benefit - cost ratio** (BCR);
- **Traffic impacts** – the effectiveness of each option in reducing traffic at the two existing bridges, using the traffic model;
- **Environmental impacts;**
- **Public support** – based on earlier studies; and
- **Stakeholder support** – based on the 2015 stakeholder consultation.

This is considered a proportionate approach in view of the information available at this stage and will enable a clear distinction to be made between the three options.

The preferred scheme will be subject to a more detailed appraisal in the Business Case, including assessment of whole life costs, reliability, regeneration and wider impacts, accident impacts, social and distributional impacts, and active modes appraisal.

3.5.1 Delivery of scheme objectives

The assessment against scheme objectives, undertaken at the first sieve (Table 3-2) was reviewed. The traffic forecasts showed that the western and tunnel options would be less effective than the central option in reducing total traffic on the existing bridges, particularly the existing Bascule Bridge. The score for reducing congestion were reduced to reflect this. The score for encouraging cycling and walking was further reduced for the tunnel option reflecting its lack of provision for pedestrians and cyclists.

Objective	Western bridge option	Central bridge option	Tunnel option
To open up opportunities for regeneration and development	●	●	●
To provide the capacity needed to accommodate planned growth.	●	●	●
To reduce community severance between north and south Lowestoft.	●	●	●
To reduce congestion and delay on the existing bridges over Lake Lothing.	●	●	●
To reduce congestion in the town centre and improve accessibility.	●	●	●
To encourage more people to walk and cycle, and reduce conflict with other traffic.	●	●	●
To improve bus journey times and reliability.	●	●	●
To reduce accidents.	-	-	-
Overall	●	●	●

Table 3-6: Delivery of scheme objectives

Whilst the above scores are, of necessity, subjective at this stage, the assessment does indicate that the central option addresses the scheme objectives more effectively than the other options.

3.5.2 *User benefits (PVB)*

The user benefits are based on time and vehicle operating cost savings calculated using the traffic model and TUBA

Option	PVB (£)
Western bridge option	338,700
Central bridge option	453,300
Tunnel option	338,300

Table 3-7: User benefits

The central option produces significantly higher benefits than the other two options.

3.5.3 *Initial estimates of construction cost*

The cost of each option has been estimated and is set out in Table 3-8. The costs are at 2015 price base and exclude land costs.

Option	Cost (£)
Western bridge option	85,000,000
Central bridge option	79,000,000
Tunnel option	118,000,000

Table 3-8: Initial estimates of construction cost

3.5.4 Benefit-cost ratio

The estimated economic costs and benefits of each option are shown in Table 3-8 and Table 3-9. They are based on the interim traffic model and data available at the option assessment stage. They exclude accident benefits and benefits arising from active mode appraisal, but these will be included in the assessment of the preferred option in the OBC. Similarly, the design of the preferred option will be refined, and cost estimates improved. For these reasons the economic costs and benefits for the preferred scheme in the OBC are likely to be different from the figures below. However, the figures below are based on similar levels of detail for each option, and are appropriate for the purpose of comparing the different options.

Option	Present Value of Costs (PVC) £m	Present Value of Benefits (PVB) £m	Benefit-cost ratio (BCR)
Western bridge option	57.394	338.700	5.90
Central bridge option	53.342	453.300	8.50
Tunnel option	79.308	338.300	4.27

Table 3-9: Comparative economic benefits

The Central bridge option has the highest overall level of benefits (PVB = £453.3 million) arising from journey time and vehicle operating cost savings, and the highest BCR at 8.50.

3.5.5 Traffic impacts

The effectiveness of each option in reducing traffic on the existing bridges is shown in Table 3-10 and Table 3-11 for the a.m. and p.m. peak periods (2020 forecasts)

Traffic flows are in vehicles per hour (two way). The reduction achieved at each of the existing bridges is expressed as a percentage, and the “best” reduction is highlighted.

A.M. Peak hour 2020	Forecast traffic (2 way) veh/hr		
Option	On Mutford Lock Bridge	On New Crossing	On Bascule Bridge
Do minimum (no new crossing)	2,763	0	2,742

With Western bridge option	1,923 (-30%)	1,579	2,327 (-15%)
With Central bridge option	1,814 (-34%)	2,245	1,814 (-34%)
With Tunnel option	1,894 (-31%)	1,619	2,318 (-15%)

Table 3-10: Traffic impacts in a.m. peak

P.M. Peak hour 2020	**Forecast traffic (2 way) veh/hr**		
Option	On Mutford Lock Bridge	On New Crossing	On Bascule Bridge
Do minimum (no new crossing)	2,972	0	3,058
With Western bridge option	2,318 (-22%)	1,653	2,663 (-13%)
With Central bridge option	2,314 (-22%)	2,313	2,053 (-33%)
With Tunnel option	2,201 (-26%)	1,832	2,600 (-15%)

Table 3-11: Traffic impacts in p.m. peak

All of the options would achieve traffic reductions in the region of 22 – 34% on Mutford Lock Bridge, with little to differentiate between them.

The Central bridge option would be the most effective option in reducing traffic on the existing Bascule Bridge, achieving reductions of 34% in the a.m. peak and 33%in the p.m. peak. This is a significantly better reduction than with the other options which achieved 13 – 15% reductions.

In terms of traffic relief to the existing bridges, the Central bridge option performs best, attracting more traffic overall from the existing bridges than the other options.

3.5.6 Environmental impacts

An Environmental Options Appraisal Report has been prepared and is included as Appendix J to the OBC. In line with WebTAG guidance (TAG Unit A3, November 2014) it considers eight sub objectives covering different impacts on the environment and includes a detailed Appraisal Summary Table for each option.

This information is summarised further in Table 3-12 below.

All three options would lead to a net reduction in greenhouse gas emissions, with the Central Bridge option being the most effective as it offers the most efficient alternative routes for traffic. At the Options Assessment stage, air quality has not yet been assessed, nor have Landscape impacts. These and the other assessments will be reviewed and refined as the preferred route is developed further.

An “overall” assessment is given for each option, in order to give a general indication of the relative impacts of the three options under consideration. This is used in the “summary of findings” in paragraph 3.6.

Impact	Western Bridge option		Central Bridge option		Tunnel option	
	£NPV	Qual.	£NPV	Qual.	£NPV	Qual.
Noise		Slight adverse		Slight adverse		Slight adverse
Air quality		n/a		n/a		n/a
Greenhouse Gases	£2.953M		£3.916M		£2.622M	
Landscape	n/a			n/a		n/a
Townscape		Slight adverse		Slight adverse		Slight adverse
Historic environment		Slight adverse		Slight adverse		Slight adverse
Biodiversity		Moderate adverse		Moderate adverse		Moderate adverse
Water environment		Large adverse		Moderate adverse		Large adverse
Overall	● Moderate to large adverse		● Slight to moderate adverse		● Moderate to large adverse	

Table 3-12: Summary of environmental impacts

3.5.7 *Public support*

As previously noted, public support for a third crossing is high at over 93%. People were also asked to indicate their preferred location for a new bridge.

Preferred location	Percentage
West	23.9%
Central	60.6%
East (3 options)	8.3%
Other	4.4%
No response	2.8%
Total	**100.00%**

Table 3-13: Public consultation (2014) – the location of a new crossing

The survey results obtained in 2014 show a clear preference for a centrally located crossing with over 60% of respondents supporting this option. Support for a western crossing was lower, at just under 24% of respondents. Tunnel options were not under consideration at the time of the survey, so it is not possible to infer the likely level of public support for a tunnel option from these results.

3.5.8 *Stakeholder support*

A survey was undertaken of businesses in October 2015. This included a question on which corridor would be most acceptable for a third crossing. The findings (which included an eastern option are set out below.

Preferred corridor	First choice	Second choice	Least preferred
West	61 (40%)	61	20
Central	70 (48%)	66	5
East	18 (12%)	9	99
No response	0	13	25
Total	**149 (100%)**	**149**	**149**

Table 3-14: Business consultation (2015) – the location of a new crossing

Amongst businesses, the western and eastern corridors attracted similar levels of support. The consultation did not distinguish between bridge and tunnel options.

3.6 Summary of findings

The results of the above assessments are summarised below. In each case, quantitative information is reported, where available, with the best result highlighted in bold. An overall score is then given for each assessment area, based on a colour coded 5 point scale:

● ● ○ ● ●

-2 -1 0 (neutral) +1 +2

This very simplified approach allows the differences between the three options to be seen very clearly.

Assessment areas	Western Bridge option		Central Bridge option		Tunnel option	
Delivery of scheme objectives	Less relief to existing bridges	●	**Significant contribution**	●	Less relief to existing bridges, No cycle /ped provision	●
User benefits (PVB)	£338 .7 million	●	**£453.3 million**	●	£338.3 million	●
Cost (£ million)	£85 million	●	**£79 million**	●	£118 million	●
Benefit-cost ratio (BCR)	5.90	●	**8.50**	●	4.27	●
Traffic impacts Bascule Bridge Mutford Bridge	a.m. / p.m. -15% / -13% -30% / -22%	●	a.m. / p.m. **-34%** / **-33%** **-34%** / -22%	●	a.m. / p.m. -15% / -15% -31%/ **-26%**	●
Environmental impacts	Moderate/severe adverse	●	Slight/moderate adverse	●	Moderate/severe adverse	●
Public support	23.9%	●	**60.6%**	●	Unknown	**?**
Stakeholder support	40%	●	**48%**	●	Unknown	**?**

Table 3-15: Summary of findings

3.7 Preferred option

On the basis of the above assessment, it is concluded that the Central bridge option should be the preferred scheme. It is the least expensive, it produces the highest benefits and is most likely to deliver the objectives. It has fewer adverse impacts on the environment, and has a high level of public and stakeholder support.

Appendices

Appendix A – General arrangement plans of the refined options

Notes:

1. Unless shown otherwise or indicated in the Specification, whichever is the more onerous, dimensional tolerance is to be in accordance with Tables 1 and 2 of BS 5606.
2. All dimensions are in millimetres (mm) unless noted otherwise. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY.
3. This drawing is to be read in conjunction with the Specification and any Specialist drawings.
4. UNLESS THE REVISION OF THIS DRAWING IS DENOTED BY THE PREFIX C THEN THIS DRAWING IS NOT FOR CONSTRUCTION.

F01	03/12/15	Issued for Information.	TDN	SE	CF

Issue codes:-
F - Feasibility | T - Tender | P- Preliminary | C - Construction | AB - As built

Drawing status: NOT FOR CONSTRUCTION

Mouchel Consulting
Knights House, Sutton Coldfield, West Midlands B72 1PH
Tel : 0121 3558949
www.mouchel.com
Part of the Kier Group

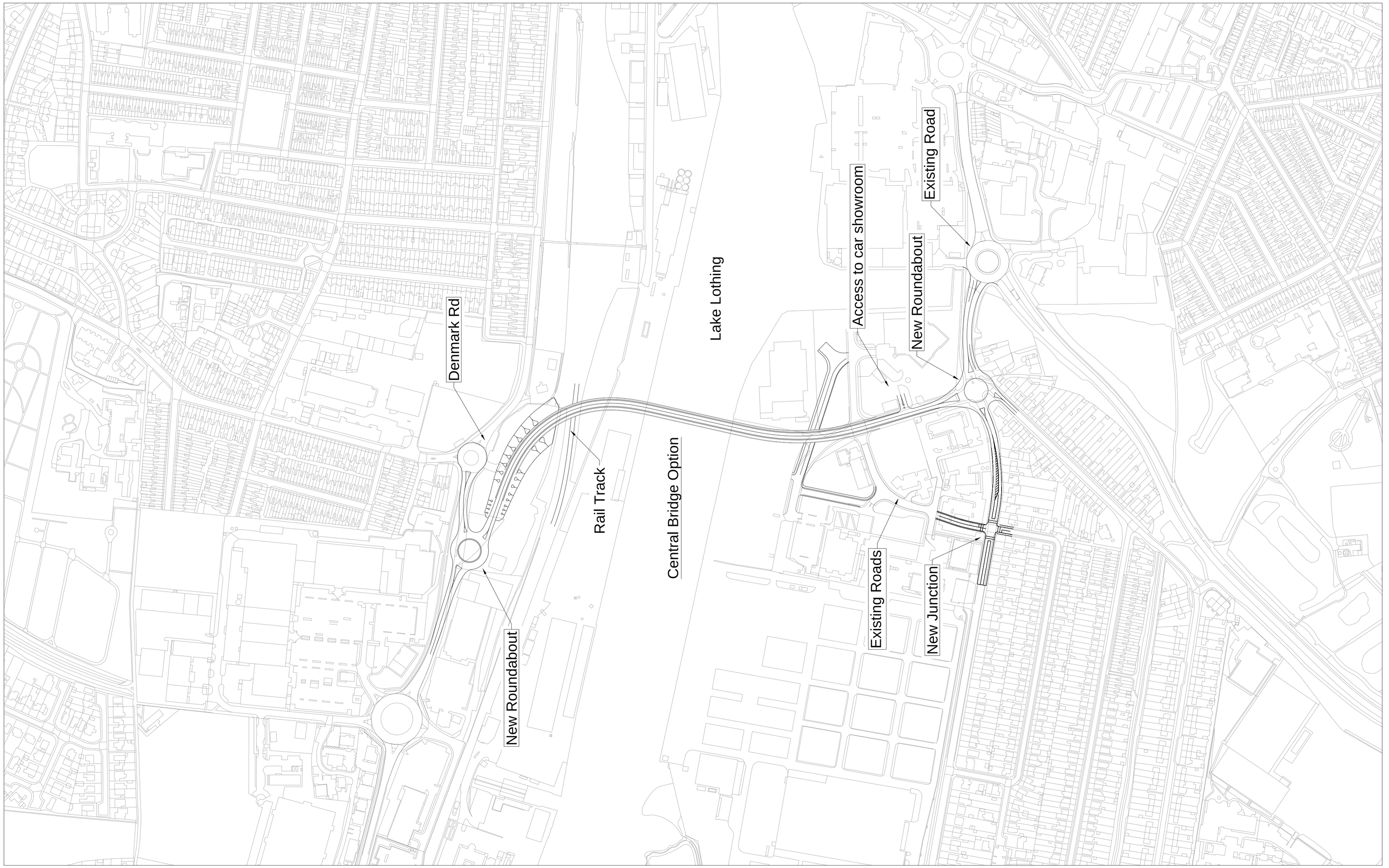
Client: Suffolk County Council

Contract: Lake Lothing Third Crossing

Title: Western Bridge Option

Scale (A1): 1:2500

Drawing No.	Issue
1069948-OPT-W4-001	A



Notes:

1. Unless shown otherwise or indicated in the Specification, whichever is the more onerous, dimensional tolerance is to be in accordance with Tables 1 and 2 of BS 5606.
2. All dimensions are in millimetres (mm) unless noted otherwise. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY.
3. This drawing is to be read in conjunction with the Specification and any Specialist drawings.
4. UNLESS THE REVISION OF THIS DRAWING IS DENOTED BY THE PREFIX C THEN THIS DRAWING IS NOT FOR CONSTRUCTION.

F01	03/12/15	Issued for Information.	TDN	SE	CF

Issue codes:-
F - Feasibility | T - Tender | P- Preliminary | C - Construction | AB - As built

Drawing status: NOT FOR CONSTRUCTION

mouchel
Mouchel Consulting
Knights House, Sutton Coldfield, West Midlands B72 1PH
Tel : 0121 3558949
www.mouchel.com
Part of the Kier Group

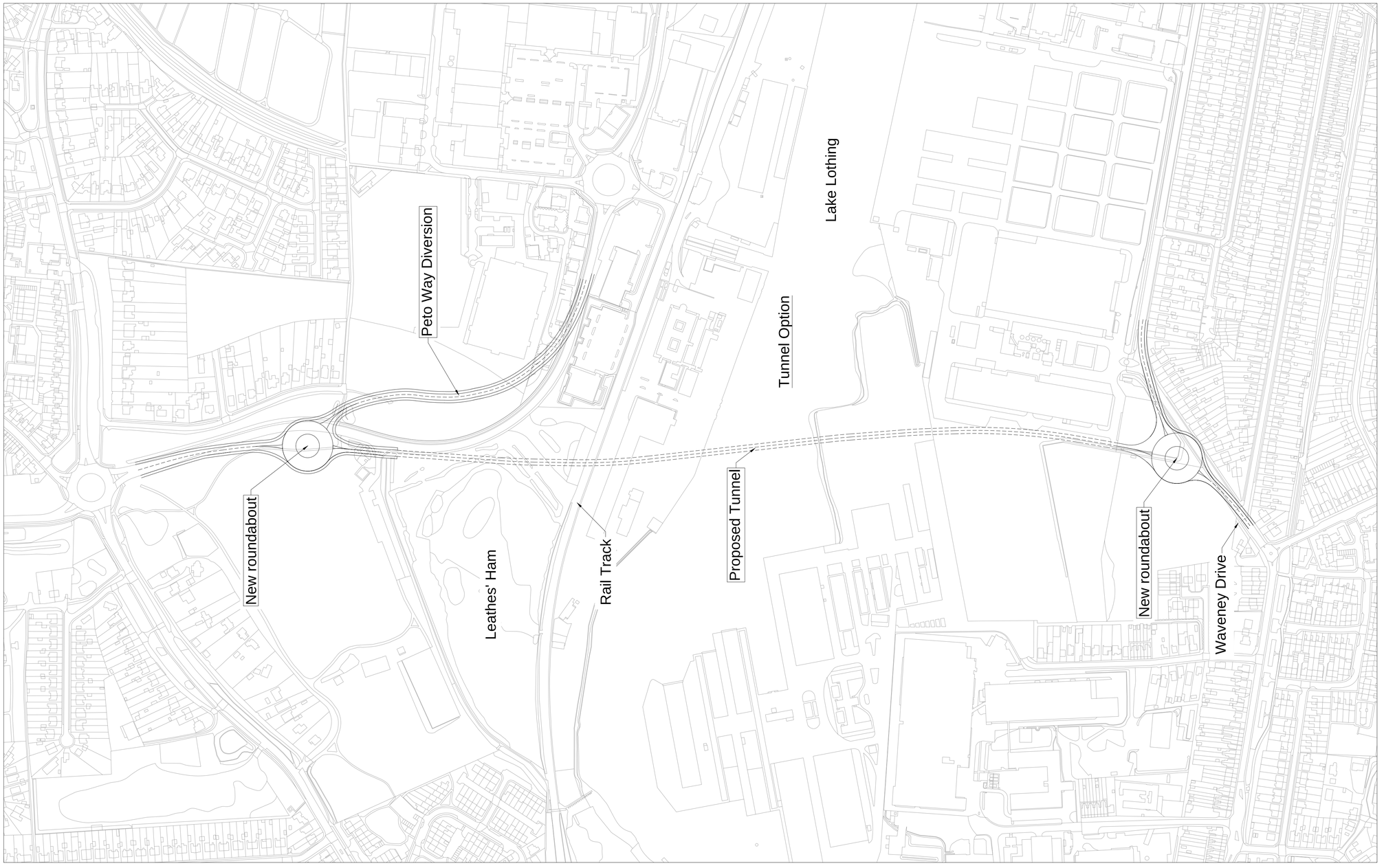
Client: Suffolk County Council

Contract: Lake Lothing Third Crossing

Title: Central Bridge Option

Scale (A1): 1:2500

Drawing No.	Issue
1069948-OPT-C11-001	A



Notes:

1. Unless shown otherwise or indicated in the Specification, whichever is the more onerous, dimensional tolerance is to be in accordance with Tables 1 and 2 of BS 5606.
2. All dimensions are in millimetres (mm) unless noted otherwise. DO NOT SCALE FROM THIS DRAWING, USE FIGURED DIMENSIONS ONLY.
3. This drawing is to be read in conjunction with the Specification and any Specialist drawings.
4. UNLESS THE REVISION OF THIS DRAWING IS DENOTED BY THE PREFIX C THEN THIS DRAWING IS NOT FOR CONSTRUCTION.

F01	03/12/15	Issued for Information.	TDN	SE	CF

Issue codes:-
F - Feasibility | T - Tender | P- Preliminary | C - Construction | AS - As built

Drawing status: NOT FOR CONSTRUCTION

Mouchel Consulting
Knights House, Sutton Coldfield, West Midlands B72 1PH
Tel : 0121 3558949
www.mouchel.com
Part of the Kier Group

Client: Suffolk County Council

Contract: Lake Lothing Third Crossing

Title: Tunnel Option

Scale (A1): 1:2500

Drawing No.	Issue
1069948-OPT-T3-001	A