

Lower Thames Crossing

Post-Consultation Scheme Assessment Report

Volume 1: Executive Summary

Volume 1

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1 Introduction

1.1 Background

- 1.1.1 The Dartford Crossing is one of the most strategically important pieces of road network in the UK, carrying traffic of international and national importance, as well as catering for regional and local movements. It is the only river crossing on the Strategic Road Network to the east of London. The existing crossing suffers from severe congestion, affecting strategic and local road users, which constrains economic growth in the region.
- 1.1.2 In May 2014 the Department for Transport (DfT) commissioned Highways England to evaluate options at two crossing locations for a new Lower Thames Crossing (LTC). A Pre-Consultation Scheme Assessment Report was published in January 2016, which reported on the appraisal of options, and described Highways England's proposed scheme. This formed part of the consultation documents for the non-statutory public consultation, which was held between January and March 2016.
- 1.1.3 Following consultation, further appraisal work has been undertaken, taking account of feedback from the public consultation. The Post-Consultation Scheme Assessment Report (SAR) reports on the consultation, the appraisal of the route options, and recommends Highways England's Preferred Route.
- 1.1.4 The Secretary of State for Transport will consider Highways England's recommendation and then decide which route option will form the Preferred Route. That decision will be published in the form of a Preferred Route Announcement (PRA). The Preferred Route will then be developed and assessed in more detail, with further consultation, before an application is made for a Development Consent Order (DCO).

1.2 Structure of the Post-Consultation SAR

- 1.2.1 The Post-Consultation SAR is structured in 7 volumes, as follows:
- **Volume 1 (this volume)** – provides an Executive Summary of the Post-Consultation SAR.
 - Volume 2 – describes the scheme background, previous studies undertaken, existing conditions, future conditions without an improvement, the need for improvement and the scheme objectives.
 - Volume 3 – describes the option identification and selection process. It summarises the consultation process, the consultation findings and Highways England's response to those findings. It describes the Post-Consultation Appraisal Routes.
 - Volume 4 – describes the engineering, safety and cost appraisal of the Post-Consultation Appraisal Routes.
 - Volume 5 – describes the traffic and economic appraisal of the Post-Consultation Appraisal Routes.
 - Volume 6 – describes the environmental appraisal of the Post-Consultation Appraisal Routes.

- Volume 7 – summarises the appraisal of the routes post-consultation against the scheme objectives, and describes the Recommended Preferred Route and the next steps in the development of the scheme.

2 The Need for Improvement

2.1 Existing problems at Dartford

- 2.1.1 This section provides an overview of the existing problems with the existing crossing; a more detailed assessment can be found in Volume 2 of the SAR.
- 2.1.2 The Dartford Crossing provides a vital link on the road network for local, regional and national journeys. The high levels of commercial traffic and long distance movements demonstrate that the crossing is of strategic national importance and has a significant effect on the economic productivity of the UK. For over 50 years, it has provided the only road crossing of the Thames Estuary east of London, situated over 15 miles east of the next closest crossing at Blackwall.
- 2.1.3 The crossing connects communities and businesses and provides a vital link between the Channel Ports, London and the rest of the UK. It is essential for the provision of services and goods, enabling local businesses to operate effectively, and local residents to access housing, jobs, leisure and retail facilities north and south of the river.
- 2.1.4 The existing crossing consists of two bored tunnels for northbound traffic and a bridge for southbound traffic. The first of the two tunnels (the west tunnel) was opened in 1963. The second tunnel (the east tunnel) opened in 1980. The QE II Bridge opened in 1991, at which time the traffic regime was changed so that, in normal operations, the tunnels are used for northbound traffic and the bridge for southbound traffic. Users are charged to use the crossing with payment collected electronically.
- 2.1.5 **Figure 2.1** shows how traffic volumes have increased over time as the capacity of the crossing has been increased. There was a steady increase in traffic until 1999 when traffic began to be constrained by the current capacity. Following the opening of the QEII Bridge, when capacity was effectively doubled, it only took seven years until traffic growth was again constrained.

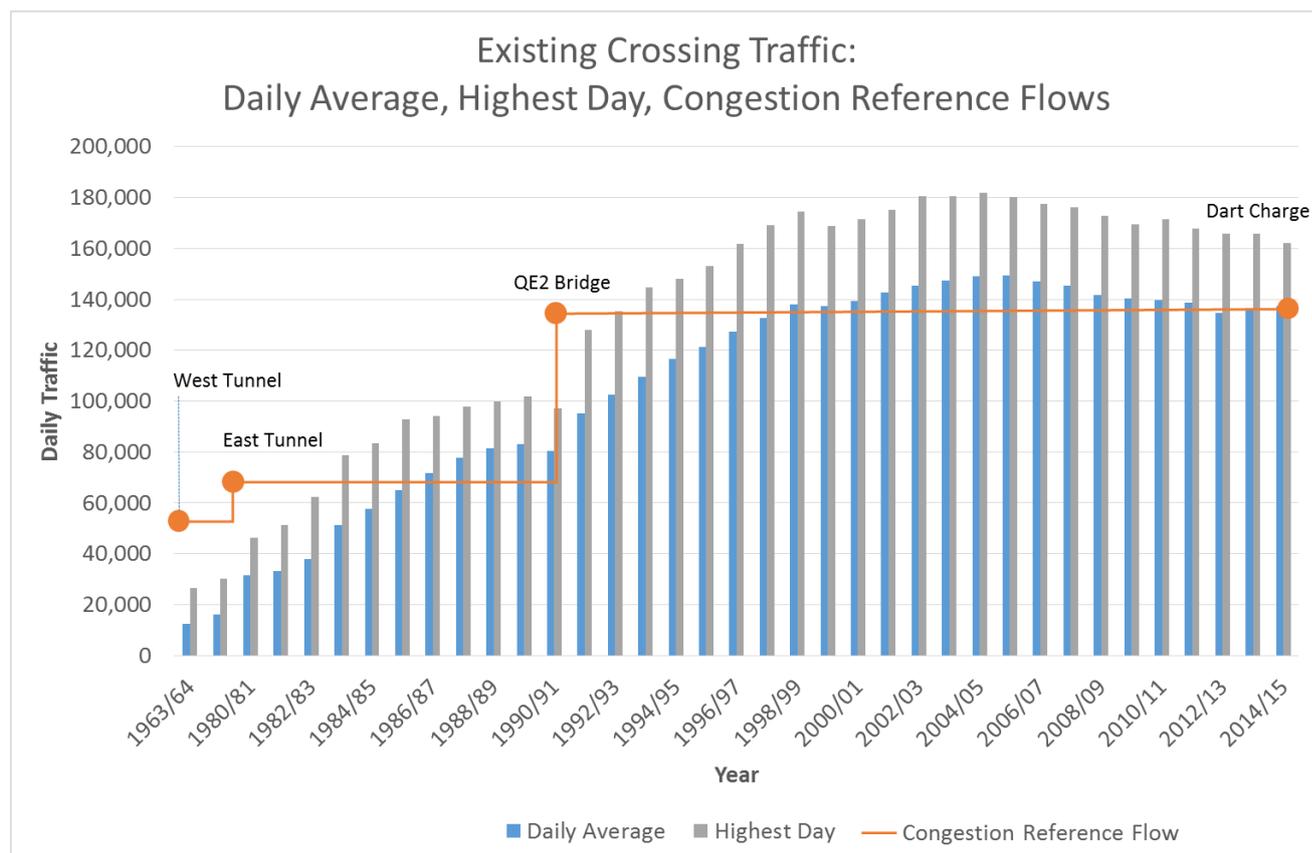


FIGURE 2.1 - DAILY TRAFFIC FLOWS AT THE DARTFORD CROSSING SINCE OPENING IN 1963 (2-WAY TRAFFIC)

- 2.1.6 In November 2014 a system of free-flow electronic payment (Dart Charge) was introduced, payment booths were removed and the approach roads realigned to improve traffic flow. This change has significantly improved journey times. Traffic volumes have also increased by 11% demonstrating a high level of suppressed demand. With the exception of Dart Charge, there have been no major improvements in the capacity of the existing crossing for nearly 25 years. During this time there have been significant developments in the area such the opening of Lakeside (1990) and Bluewater (1999) shopping centres.
- 2.1.7 Given its unique nature and its location, the existing crossing serves as a critical local, regional and national route on the Strategic Road Network (SRN). As a consequence of this, and the intersection of the approach roads with major arterial and local roads, traffic in this location is highly concentrated. Analysis of traffic origins and destinations shows that whilst 38% of trips start or finish in the local area north and south of the crossing, only 6% are local-to-local trips, and half of trips have an origin or destination in the wider Kent or Essex regional area.
- 2.1.8 50% of trips over the crossing are long distance journeys between Kent, Essex and national destinations. Heavy Goods Vehicles (HGVs) account for approximately 18% of total traffic which equates to 28,000 HGVs per day; this percentage increases to 31% if 2-axle goods vehicles are also included. These proportions of commercial traffic are almost double the levels on other

parts of the SRN, indicating the importance of the crossing to commercial traffic and to UK productivity.

- 2.1.9 The existing crossing has many problems because of the volume of traffic and the physical constraints of the existing infrastructure. These constraints have a severe effect on operations and limit the capacity of the crossing. When incidents occur, congestion quickly increases and users typically have no alternative to waiting in slow or stationary traffic.

Problems with the existing infrastructure

- 2.1.10 The existing infrastructure imposes many constraints leading to very high levels of congestion, frequent closures and highly variable journey times. When incidents occur, journey times are increased substantially causing knock-on congestion on other roads and long delays for local, regional or national road users. Key issues with the existing infrastructure include:
- Headroom and speed constraints of the existing tunnels – The west tunnel has a headroom of 4.8m, which is less than the standard headroom requirements. Taller vehicles must use the east tunnel and cross traffic lanes to do so which increases weaving, congestion and incidents. Both tunnels and their approaches are subject to a 50mph speed limit due to geometry and clearance restrictions inside the tunnels.
 - Restrictions on Dangerous Good Vehicles – All northbound Dangerous Goods Vehicles (DGVs) are required to report to the marshalling area prior to being escorted through the tunnel in convoys. This activity is carried out close to the tunnel portals which adds to congestion and increases the risk of incidents. Other traffic must be held back while the convoys transit the tunnel contributing further to the congestion and queues. Approximately 400 restricted vehicles use the crossing per day so that there are up to 70 escorted convoys per day. Each escort requires closure of the western tunnel for 2-3 minutes. With up to four escorts per hour this effectively requires closure of the west tunnel for up to 12 minutes every hour reducing capacity by 20%.
 - Closely Spaced Junctions - The closely spaced junctions (less than 1 mile apart) north and south of the crossing cause extensive weaving as vehicles enter/ exit the route and prepare to use the crossing. This reduces the flow and increases the likelihood of incidents. When incidents occur, traffic is halted and queues form as traffic cannot be allowed to stand inside the tunnels for safety reasons.
 - Vulnerability to weather - When the crosswind speeds exceed 60 mph or the headwind speed exceeds 70 mph, the QEII Bridge is closed to all traffic for safety reasons. Southbound traffic is then routed through the east tunnel causing congestion and delays to both northbound and southbound traffic. In these circumstances conveying of DGVs takes place in both directions with a 4.8m height restriction northbound and a 5.0m height restriction southbound.

Traffic Congestion

- 2.1.11 The existing crossing is heavily congested. As shown in **Figure 2.1** the maximum observed daily throughput is over 180,000 vehicles; this only occurs on the rare occasions when all other routes are flowing freely and there are no incidents at or close to the crossing. Average daily two-way traffic flows are typically about 155,000 vehicles and flows frequently exceed the design capacity of the crossing at peak periods. Queues on the northbound approach typically consist of around 1,000 vehicles moving slowly towards the tunnels on both the strategic and local road networks. Delays of over 20 minutes on the crossing approach are common and can be even longer for users joining from the local road network.
- 2.1.12 Congestion and incidents at the crossing cause slow and unreliable journeys for a high number of vehicles for long periods of every day. Queuing traffic causes long delays on the crossing approaches and on local roads. This has severe economic, safety and environmental impacts on users and local communities.

Incidents and resilience

- 2.1.13 The problems arising from high volumes of traffic are made worse when incidents (breakdowns, collisions and obstructions) occur. The average duration of lane closures following incidents during the first 8 months of 2016 was approximately 20 minutes which is typical. With an average of four incidents involving lane closures a day, typically lanes are closed for about 1.5 hours every day. The consequential queues can take between 3 and 5 hours to clear. Furthermore, on average once every week, there is a more serious incident which takes over an hour to clear. In the event of major closures there are limited options available to manage the impact using those elements of the crossing which remain available. Each response requires time to implement and further reduces the total crossing capacity leading to substantial delays. When this happens, the strategic and local networks are badly affected and “gridlock” usually occurs. In many cases the network doesn’t recover for the rest of the day and only returns to normal overnight.
- 2.1.14 During significant incidents involving full or partial closure of the crossing, users have few alternatives. They can either abandon their journeys, sit out the congestion, travel up to an additional 100 miles around the M25, or drive through London to the Blackwall Tunnel. All of these typically add at least 40 minutes to journeys.
- 2.1.15 The problems with the existing crossing, as highlighted above, have a wide range of impacts.

Economic Impacts

- 2.1.16 The disruption caused by the congestion on the Dartford Crossing affects not only the 54 million users of the crossing but also the millions who use the adjacent local road network and the arterial routes in and out of London.
- 2.1.17 Local stakeholders confirm that congestion and delays at the crossing are adversely affecting economic growth. Impacts of congestion and lack of resilience in turn reduce business productivity and ultimately produce an

adverse impact on the national economy. Current traffic problems at the crossing are seen to limit growth in national productivity, output, investment and employment. In particular, the poor connectivity between north and south of the river impedes the movement of labour, goods and services thereby constraining productivity and growth.

- 2.1.18 The traffic appraisal indicates substantial suppressed demand in the area. Road users are deterred from making economically worthwhile journeys, as is evidenced by the recent growth in traffic after the introduction of Dart Charge, which improved journey times.

Environmental Impacts

- 2.1.19 As a result of traffic congestion, people living close to the crossing and its approach roads are exposed to high levels of vehicle emissions. These levels are expected to get worse as congestion increases, despite future improvements to vehicle emission standards, as standing or slow moving traffic is worse for air quality than free flowing traffic.
- 2.1.20 Air Quality Management Areas (AQMA) have been designated by both Dartford Borough Council and Thurrock Council. AQMA are designated where levels of nitrogen dioxide (NO₂) and/ or particulate matter smaller than 10 microns (PM₁₀) exceed the air quality strategy objectives (AQSO). The high levels of traffic and congestion at the crossing are considered to be the key causes of exceedance of the AQSO. The impact on local people is worse because properties are close to the road.
- 2.1.21 There are Noise Important Areas (NIAs) located close to the crossing. In these areas 1% of the population are subjected to the highest noise levels permitted for major roads. Levels of noise are directly related to the volumes of traffic on the network, and future increases in traffic volumes and lengthening of traffic peak periods would increase noise levels and enlarge the NIAs.

Journey time and reliability

- 2.1.22 Under free flow conditions the journey time on the M25 between Junction 2 south of the River Thames and Junction 30 north of the River Thames is approximately 6 minutes, which equates to an average speed of about 50mph. However, during peak periods northbound speeds can drop as low as 10mph on sections of the crossing approaches and travel times between Junctions 2 and 30 can more than double.

Safety

- 2.1.23 With the high numbers of incidents at the crossing, the safety record close to the crossing is substantially worse than elsewhere on the SRN. **Table 2.1** shows the fatalities and weighted injuries (FWI) per billion vehicle km calculated over the 5 year period 2009 – 2013 compared to the national average rate for this type of road. In addition, Junctions 1a and Junction 2 are amongst the worst junctions in the country in terms of safety performance.

TABLE 2.1 - SAFETY AT EXISTING CROSSING

Existing crossing section	FWI rate compared to national average
Junction 1b - Junction 2	404% higher
Junction 2 - Junction 3	87% higher
Junction 1a - Junction 31 (crossing)	45% higher
Junction 1a - Junction 1b	42% lower
Junction 31 - Junction 30	30% higher
Junction 30 - Junction 29	7% higher

2.2 Future conditions without an improvement

- 2.2.1 The opportunities to improve the situation at the existing crossing are very limited because of the physical constraints and the layout of the local road network. The existing problems will get worse with increasing traffic levels. Traffic growth in response to previous increases in cross-river road capacity indicates the extent to which demand is suppressed in an area where levels of prosperity compare poorly to areas better served by road connections.
- 2.2.2 The success of Dart Charge in creating additional capacity and the consequent further growth in traffic volumes has demonstrated the extent of the suppressed demand to cross the river. Failure to create new cross river road capacity will stifle future UK economic growth and limit the prosperity of the region. Without additional road capacity, the transport, economic and environmental problems will continue to worsen.
- 2.2.3 Forecast traffic growth is expected to result in an increase in traffic volume of 23% by 2025. Speeds would fall from 22 mph to 18 mph (a fall of nearly 20%) between 2016 and 2025. Air quality and noise would get worse. Speeds would continue to fall to 15 mph by 2041 (a further fall of over 15%).

3 Appraisal of Options and Public Consultation

3.1 Previous Studies

- 3.1.1 In 2009 the DfT examined five locations where an additional crossing could be built. The most easterly of these (Locations D and E) were found to be too far from the existing crossing to ease the problems at Dartford and were eliminated from further consideration.
- 3.1.2 In 2013 further analysis was undertaken of the three remaining options at Locations A, B and C. This included C Variant, an improvement of the A229 between the M2 and M20 south of the River Thames, which could be an additional element with potential to provide greater connectivity to the ports and the Channel Tunnel with any scheme at Location C.
- 3.1.3 In 2013 the DfT held a public consultation on the need for a new crossing and invited views on:
- Location A (at the existing crossing)
 - Location B (connecting the A2 and the Swanscombe Peninsula with the A1089)
 - Location C (east of Gravesend and Tilbury)
 - C Variant
- 3.1.4 Later that year the Government announced its decision not to proceed with Location B due to limited public support, the potential impact on local development plans and limited transport benefits.
- 3.1.5 In 2014, the Government published its response to the 2013 consultation, confirming the need for an additional crossing between Kent and Essex. The response acknowledged that there was no preference at that stage on location, and that further work would be carried out to develop and appraise route options for both Location A and Location C (including C Variant) before choosing where to site a new crossing. DfT then instructed Highways Agency (now Highways England) to identify and appraise route options at Locations A and C.

3.2 Scheme Objectives

- 3.2.1 The objectives for a new Lower Thames Crossing were agreed between DfT and Highways England and are recorded in the Client Scheme Requirements (CSR, Version 2.8). The scheme objectives, as shown in **Table 3.1**, were included in the material provided to the public in the 2016 consultation. All route options have been appraised against these scheme objectives, which are presented in three principal categories – transport, economic, and environment and community.

TABLE 3.1 - SCHEME OBJECTIVES

Scheme Objectives	
Transport	<ul style="list-style-type: none"> To relieve the congested Dartford Crossing and approach roads and improve their performance by providing free flowing north-south capacity To improve resilience of the Thames crossings and major road network To improve safety
Economic	<ul style="list-style-type: none"> To support sustainable local development and regional economic growth in the medium to long-term To be affordable to Government and users To achieve value for money
Environment & Community	<ul style="list-style-type: none"> To minimise adverse impacts on health and the environment

3.3 Appraisal Assumptions

3.3.1 In order to appraise the options against the scheme objectives on a comparable basis a number of key assumptions have been made, which are summarised in **Table 3.2**.

TABLE 3.2 - KEY ASSUMPTIONS IN APPRAISAL OF OPTIONS

Assumption	
User Charges	In the traffic modelling, user charges equal to existing charges were applied at Location A and C crossings, so that options could be assessed on a like for like basis. Charges are assumed to remain constant in real terms.
Traffic and revenue forecasts	All traffic forecasts, unless stated otherwise, are based on a core growth traffic scenario, as defined by WebTAG guidance. WebTAG is DfT's web-based multi-modal guidance on appraising transport projects and proposals.
Programme	The scheme development timetable assumes authorisation by way of the DCO process and delivery using a design and build model with public funding.

3.4 Study Area

3.4.1 The Study Area for the identification and appraisal of options at Locations A and C, including C Variant, is shown in **Figure 3.1**. The extent of the Study Area was determined ensuring that all possible options within Locations A and C were identified, whilst not encroaching within locations that had been eliminated in previous DfT studies, i.e. Locations B, D and E.

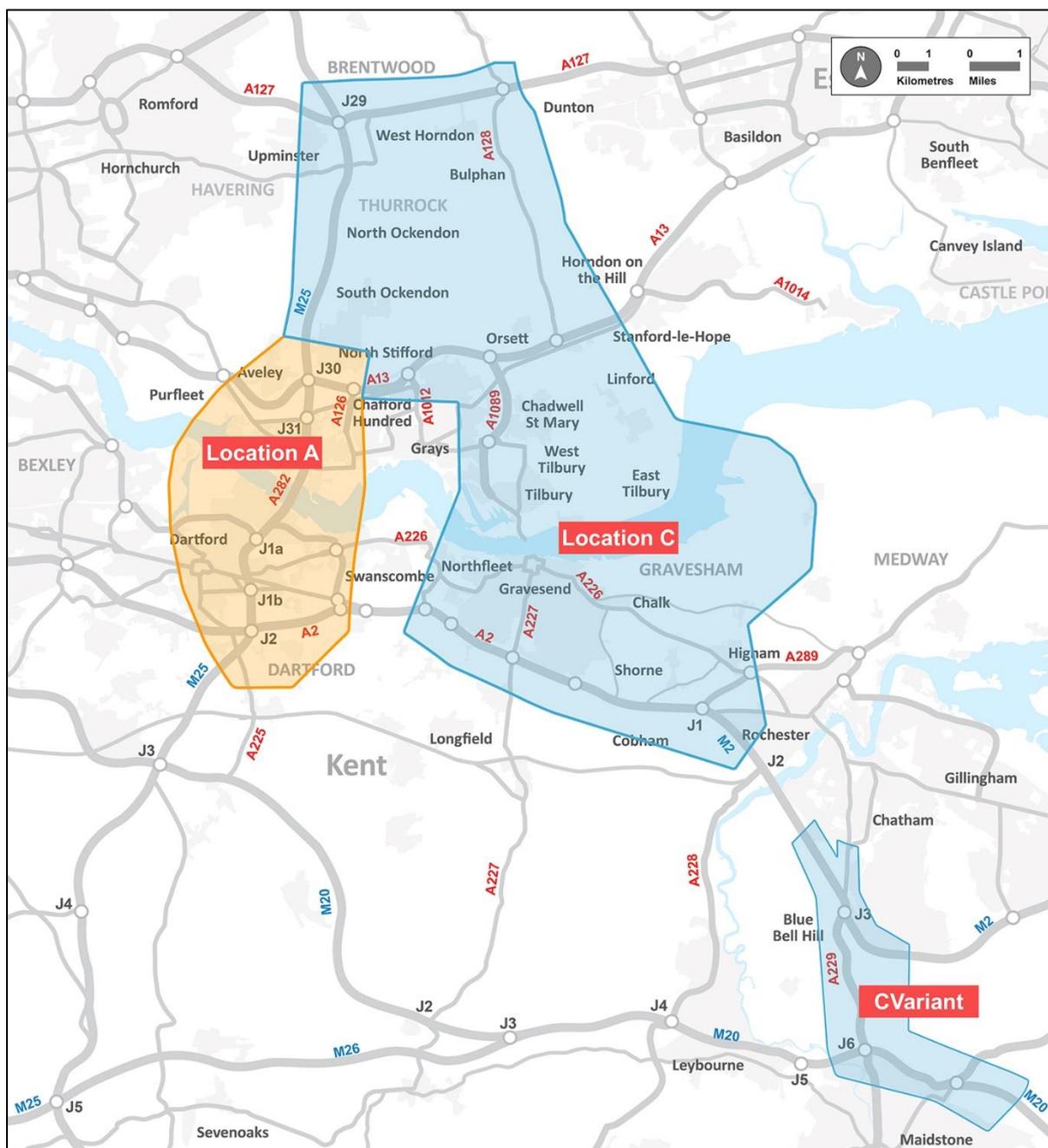


FIGURE 3.1 - STUDY AREA

3.5 Option Identification and Selection Process

3.5.1 The approach taken to identifying, developing and selecting the Recommended Preferred Route is shown in **Figure 3.2** below.



FIGURE 3.2 - OPTION IDENTIFICATION AND SELECTION PROCESS

3.5.2 The key stages in the process are set out below.

- **Viability Check.** An initial list of route options (the pre-longlist) was developed for Locations A and C. Route options which did not meet the scheme objectives or were considered unviable were not selected for the longlist.
- **Appraisal of longlist.** Those routes which performed poorly against the scheme objectives in the appraisal of the longlist were not taken forward; the remaining routes formed the shortlist of options.
- **Appraisal of shortlist.** A detailed appraisal of the shortlist routes was undertaken, as described in the Pre-Consultation SAR.
- **Public Consultation on options.** Those shortlist routes that performed satisfactorily against the scheme objectives and were considered to be viable, were presented at public consultation. This included a proposed scheme, being the route that Highways England considered to perform best overall based on the pre-consultation appraisal.
- **Review and update of appraisal.** Taking account of the feedback from the public consultation the appraisal of a number of the routes has been reviewed and updated. These routes are referred to as the Post-Consultation Appraisal Routes and are appraised and reported in Volumes 4 to 6 of the SAR. The updated appraisal of these routes is summarised in Volume 7 where the Recommended Preferred Route is also presented. This recommendation has been determined taking account of the public consultation responses and the appraisal of the options.

3.6 Longlist Routes

3.6.1 As part of the pre-longlist appraisal, a wide range of route options within Locations A, C and C Variant were considered, and an initial viability check was undertaken to consider the technical feasibility. A high level appraisal against the scheme objectives was also undertaken. This resulted in a number of options not being considered further. These options were not included in the longlist, as described in Volume 3 of the SAR.

3.6.2 The longlist options at Locations A, C and C Variant are shown in **Figure 3.3**. These are:

- Options A1, A2, A4, A8, A9, A12, A14, A15, A16
- Options C1, C2, C3, C4

- Options CV1, CV2

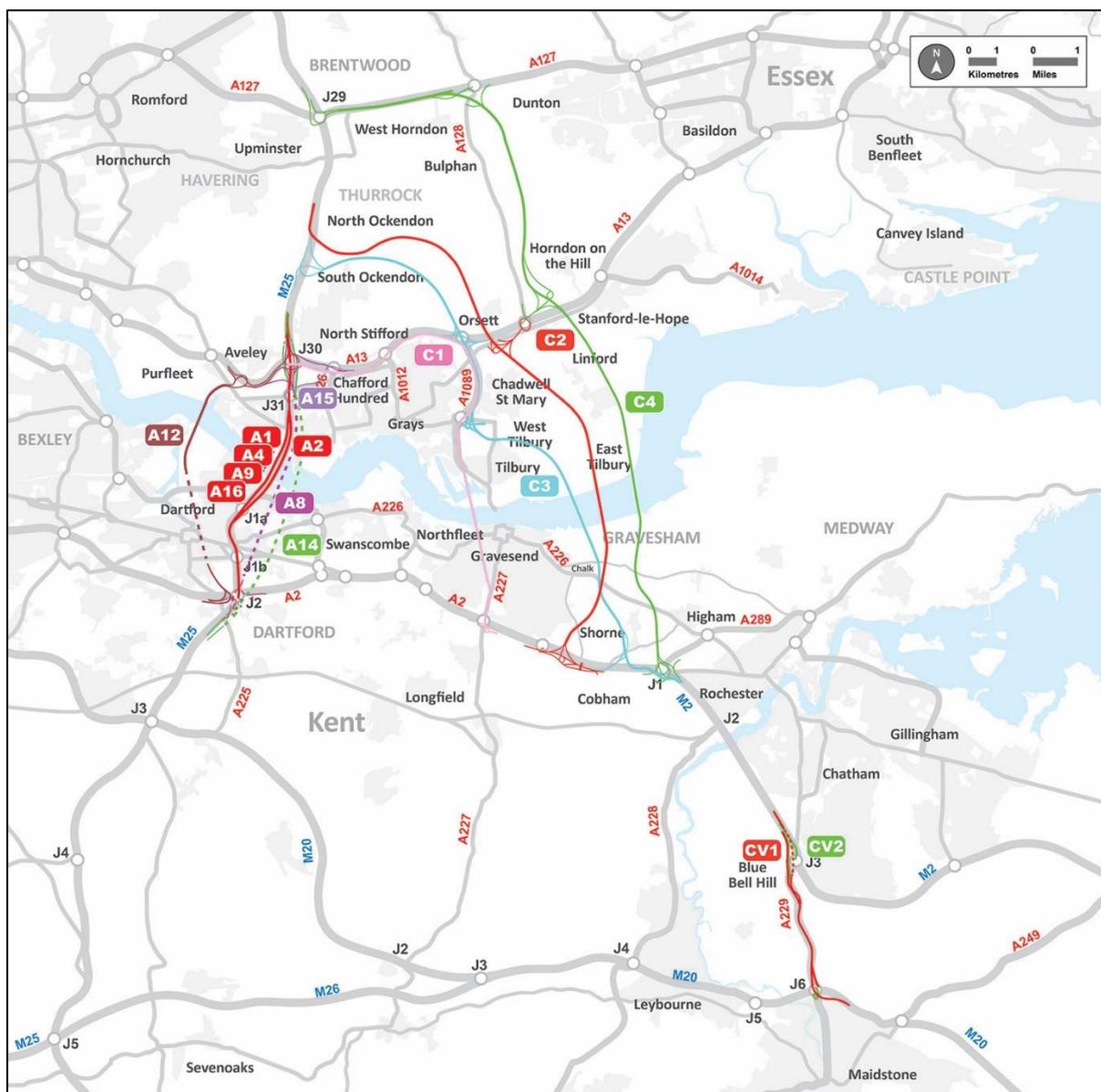


FIGURE 3.3 - LONGLIST ROUTES

3.6.3 The longlist also included a number of combination options at Location C (Options C7 to C19) which involved combining sections of the main options, as shown in **Table 3.3**.

TABLE 3.3 - LOCATION C COMBINATION OPTIONS

Combination Option	Description
C7	Southern section of C1 connecting to C3 west of Chadwell St Mary
C8	Southern section of C2 connecting to C3 south of Chalk
C9	Southern section of C2 connecting to C4 north west of East Tilbury
C10	Southern section of C2 connecting to C3 north west of Orsett
C11	Southern section of C3 connecting to C2 south east of Chalk

Combination Option	Description
C12	Southern section of C3 connecting to C1 existing A13 junction
C13	Southern section of C3 connecting to C2 south east of Chalk and then connecting back to C3 north west of Orsett
C14	Southern section of C3 connecting to C2 south east of Chalk and then connecting to C4 south west of East Tilbury
C15	Southern section of C4 connecting to C3 south east of Chalk
C16	Southern section of C4 connecting to C3 south east of Chalk and then connecting to C1 at the existing A13 junction
C17	Southern section of C4 connecting to C2 east of Chalk
C18	Southern section of C4 connecting to C2 north of Orsett and then connecting to C3 South Ockendon
C19	Southern section of C4 connecting to C2, C3 or C9 east of Chalk

3.6.4 Following the appraisal of the longlist, a number of these options were not considered viable and were not taken forward, as shown in **Table 3.4**.

TABLE 3.4 - LONGLIST ROUTES NOT TAKEN FORWARD

Route Option	Key Reason for Decision
A2 - Bridge east	Significant impact on commercial property north and south of the river east of existing crossing. Low value for money due to limited benefits from travel time savings or congestion relief compared to capital cost. Impact on a Site of Special Scientific Interest (SSSI).
A8 - Long tunnel Junction 2 to Junction 30	Very complex junctions required to connect A2 and A13 traffic with significant impact on existing property. Cost more than twice that of option A1.
A9 - Immersed tube west	High technical risks, significantly more difficult to construct than other options. Impact on river/ jetty operations unlikely to be acceptable to owners/ operators of Port of London Authority.
A12 - Western Route Junction 2 to Junction 30 tunnel under Dartford with bridge over river	Cost approximately three times option A1. Poor economic benefits, significant impact on planned development at Purfleet. Impact on a SSSI.
A14 - Long tunnel south of Junction 2 to north of Junction 30	Cost approximately twice that of option A1. Poor level of economic benefit due to limited attraction of traffic.
A15 - Alternative Junction 30 improvement	Significant impact on commercial property around Junction 31. Significant utility diversions.
A16 - Any C option combined with a 2 lane northbound tunnel at Dartford	Reduces value for money compared to the C option on its own. High cost solution with limited additional economic benefits.
C1 - A2 junction south of Gravesend to M25 Junction 30. Long tunnel under Gravesend and Tilbury docks. Widening of A13.	Potential impacts on Tilbury Docks from tunnelling under existing structures. Low value for money due to high capital cost/ low benefits from travel time savings. Poor resilience due to use of A13.

Route Option	Key Reason for Decision
C3 (southern section through Shorne Country Park)	The southern section of Option C3 was not taken forward due to environmental impact on Shorne Country Park, affecting an Area of Outstanding Natural Beauty (AONB), SSSI and ancient woodland. The layout of Option C3 was as a result modified to incorporate the southern section of Option C2.
C4 - A2/ M2 Junction 1 to M25 Junction 29. Long tunnel under Ramsar site and Coalhouse fort, north west of East Tilbury then parallel to A128 and along A127 to Junction 29	Impact on historic environment, scheduled monuments. High capital cost due to the very long tunnel under the Ramsar site emerging close to Coalhouse Fort.
CV1/ CV2 - C Variant	C Variant has negligible effect in transferring M20 traffic from existing Dartford Crossing onto a new crossing at Location C. Significant impact on AONB. High capital cost. Does not bring traffic and economic benefits that materially add value to the Lower Thames Crossing scheme.

- 3.6.5 The southern section of Option C3 was modified during the course of the longlist appraisal to include the southern section of Option C2, due to the significant environmental impacts of the original route through Shorne Country Park, as shown in **Table 3.4**.
- 3.6.6 As a result of Options C1, C4 and the southern section of C3 not being selected, the combination Options C7, C11, C12, C13, C14, C15, C16, C17 and C18 were not selected. The design of the Location C routes taken forward to the shortlist was based on a single river crossing location, taking account of community, environmental and other physical constraints. As a result the combination Options C8 and C10, which included parts of Options C2 and C3, became redundant.
- 3.6.7 Whilst Option C4 was not selected as a result of the river crossing location and the long tunnel required, the southern section of C4 and the northern section of C4 to the north west of East Tilbury were included in combination Options C9 and C19, which were included in the shortlist.
- 3.6.8 The routes selected for the shortlist, together with their revised shortlist references, are shown in **Table 3.5**.

TABLE 3.5 - ROUTES SELECTED FOR SHORTLIST

Location	Longlist Ref	Shortlist Ref	River Crossing Options
A	A1, A4	Route 1	Bored tunnel, bridge
C	C3	Route 2 with Western Southern Link (WSL)	Bored tunnel, immersed tunnel, bridge
	C2	Route 3 with WSL	Bored tunnel, immersed tunnel, bridge
	C9	Route 4 with WSL	Bored tunnel, immersed tunnel, bridge

Location	Longlist Ref	Shortlist Ref	River Crossing Options
	C19	Routes 2, 3, and 4 with an alternative Eastern Southern Link (ESL)	Bored tunnel, immersed tunnel, bridge

3.7 Shortlist Routes and Proposed Route Options for Consultation

3.7.1 The shortlist routes are shown in **Figure 3.4**. The shortlist comprised four principal routes:

- At Location A, Route 1 with a bridge or bored tunnel crossing option.
- At Location C, Route 2, Route 3 and Route 4, with two southern link options, and three river crossing options.

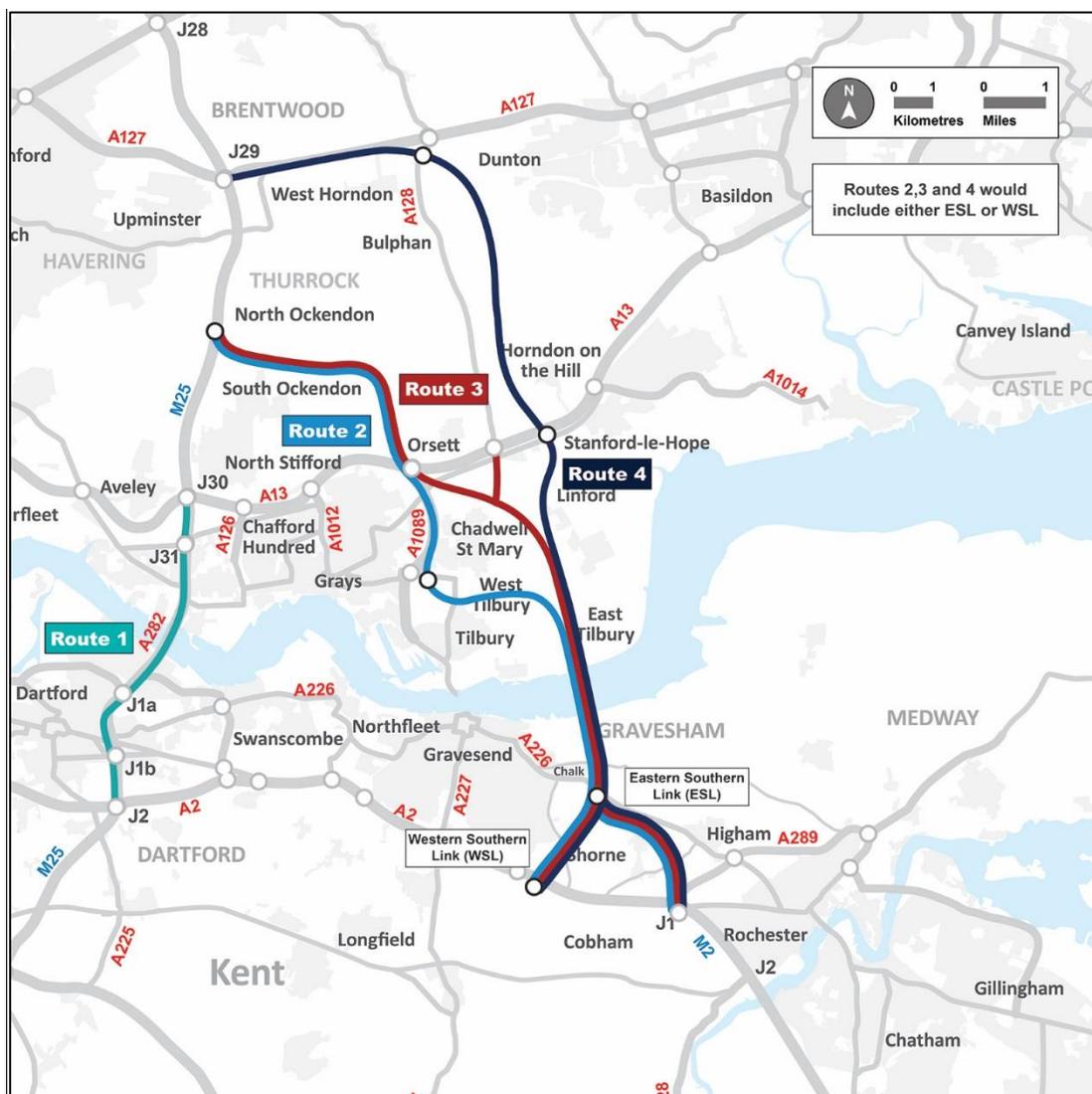


FIGURE 3.4 - SHORTLIST ROUTES

3.7.2 Volume 7 of the Pre-Consultation Scheme Assessment Report provides a summary of the appraisal of the shortlist routes against the LTC scheme

objectives. Following completion of the appraisal, the following route options were considered by Highways England to be viable, and were presented in the public consultation in 2016:

- i) Location of crossing - Location C, east of Gravesend and Tilbury
- ii) North of the River Thames - Route 2, Route 3 and Route 4
- iii) South of the River Thames - WSL and ESL

3.7.3 Highways England's proposed scheme presented at public consultation was Route 3 with the ESL, and a bored tunnel river crossing. This was selected on the basis that it would provide the shortest connection between the M2 and M25, creating a 70mph motorway-to-motorway connection, and would offer the best economic benefits and the best value for money. The proposed scheme would:

- Provide additional north-south river crossing capacity, reducing congestion and delays at Dartford crossing and on the approach roads including the A2 and A13.
- Provide a safer, faster and more reliable road improving journeys for road users.
- Improve transport connections, supporting businesses and local and regional development.
- Improve network resilience by providing a second strategic road crossing of the River Thames.
- Minimise the environmental impact on sensitive and valuable habitats along the river by adopting a bored tunnel solution.
- Reduce congestion at the existing crossing thereby improving air quality and reducing noise, although there would be some adverse impacts close to the new route.

3.8 Public Consultation

3.8.1 A public consultation was held between January and March 2016. The consultation aimed to inform as many people as possible about the scheme, and obtain feedback on the proposals. This would in turn inform further detailed work and a recommendation on a preferred route to the Secretary of State for Transport.

3.8.2 Various channels were used to raise awareness of the consultation, encourage high levels of participation and to invite feedback on the proposals, including:

- A dedicated Lower Thames Crossing website.
- Press advertisements.
- Letters and leaflets sent to households and businesses within a 2km area of Locations A and C.
- Letters sent to landowners or occupiers of properties potentially affected by the proposals.
- Email notifications sent to Dart Charge account holders.

- 3.8.3 24 public information events were held across the project area, attended by almost 13,000 people. The project team also attended over 20 public forums to explain the proposals and answer questions.
- 3.8.4 Ipsos MORI, an independent analysis company, was appointed to capture and analyse responses to the consultation and to prepare an independent report of the findings.
- 3.8.5 During the consultation a series of questions were asked about the extent to which people agreed or disagreed with the proposals using tick boxes. Open questions, which allowed respondents to feedback their views and comments in their own words, were also included.
- 3.8.6 Responses were analysed, coded and matched against a series of themes. Each of these codes represented a discrete issue or viewpoint raised by a number of respondents in their verbatim responses. Responses were appraised in order to inform the development of the project and shape the scheme.
- 3.8.7 47,034 responses to consultation were received. Responses were received from across the UK, with the largest proportion from south Essex, north Kent and the adjoining London boroughs. The vast majority of responses were received from individual members of the public. More than 500 responses were received on behalf of organisations and groups. 13,284 responses were received from 14 different campaigns, and 3 petitions were received. There were 300,000 visits to the project website during the course of the consultation. The Highways England correspondence team also handled requests for more information through letters and emails.

3.9 Post-Consultation Appraisal

- 3.9.1 The appraisal of the shortlist routes was reported in the Pre-Consultation SAR. Following public consultation the appraisal of the routes has been reviewed and updated taking account of the feedback from the consultation and using new or revised information where appropriate. Each route has been appraised to determine the extent to which it meets the scheme objectives. Appraisal of the routes has included:
- Development of engineering designs of feasible crossing types.
 - Design of horizontal and vertical alignments for highways and junctions.
 - Estimating construction and operation and maintenance costs.
 - Traffic forecasting using the V2.1 LTC (SATURN) traffic model, taking into account planned housing and commercial developments.
 - Undertaking economic appraisal of each option in accordance with WebTAG guidance using outputs from the V2.1 LTC traffic model, using DfT's updated October 2015 consultation values of time.
 - Assessing the impact on people and property.
 - Appraisal of the environmental impacts both long term and during construction.

3.9.2 In undertaking this work, the route options subject to updated appraisal, the Post-Consultation Appraisal Routes were:

- Route 1 with a bridge crossing.
- Route 3 with a bored tunnel crossing and either the WSL or ESL.
- Route 4 with a bored tunnel crossing and either the WSL or ESL.

3.9.3 Route 2 has not been included in the Post-Consultation Appraisal for the following reasons:

- Popularity - it is the least popular of the Location C route options north of the river. Of 32,381 members of the public who answered the consultation question about the route north of the river only 6% (1,869) favoured Route 2. Of 432 groups and organisations that answered the same question only 5% (21) favoured Route 2.
- Disruption during construction - compared to Routes 3 and 4 it would create greater disruption during construction to communities and existing road infrastructure. Route 2 would be closer than Routes 3 and 4 to more densely populated urban areas including Tilbury, Chadwell St Mary and Grays.
- Safety issues - Route 2 would incorporate the existing A1089 which is the access road to the Port of Tilbury and heavily used by heavy goods vehicles. The A1089 has a very poor safety record with a Fatal and Weighted Injury (FWI) collision rate for 2009 to 2013 241% higher than the national average for this type of road. Whilst improvements would be made to this route as part of the Route 2 scheme, some of the underlying safety issues associated with this route section would not be improved and therefore safety concerns would remain.
- Environmental concerns - a number of members of the public and organisations who specifically made comments in opposition to Route 2 did so on environmental grounds. The most cited reason was increased air pollution and the level of noise. Communities raised concerns about increased air pollution and noise as the route uses existing road infrastructure and is close to existing communities. As noted above Route 2 would be closer to the more densely populated urban areas of Tilbury, Chadwell St Mary and Grays than Routes 3 and 4 and makes use of the existing A1089.
- Property impacts - for the reasons noted above it is closer to a greater number of properties than Routes 3 and 4. Nearly a third of the members of the public who responded opposing Route 2 did so because of the effect the route would have on communities such as those in developed or residential areas. Stakeholder organisations were also critical of Route 2 due to concerns about its close proximity to local communities and the disruption it could cause.
- Heritage and environmental impacts - it has potential environmental impacts around West Tilbury, particularly direct permanent impacts on

two conservation areas, a scheduled monument and two listed buildings. These features would not be affected by Routes 3 or 4.

- Flooding impacts - the Environment Agency (EA) expressed concerns about the potential impact on the Tilbury flood storage area which is not affected by either Route 3 or 4. In their consultation response the EA specifically state “We have serious concerns with the section of Route 2 which passes through the Tilbury Flood Storage Area (FSA). This is because it could be very difficult to find additional storage volume to negate any losses resulting from the construction of a road embankment.”

3.10 Options at Location A

Route 1

- 3.10.1 The options identification and selection work has looked at many options at Location A, as described in Section 3.6 above. Of these options, Route 1 was selected for detailed appraisal in the shortlist routes.
- 3.10.2 The Pre-Consultation SAR concluded that Route 1 would not meet the transport and economic scheme objectives, hence it was not one of the route options proposed at public consultation. However, there was still significant interest in this route at consultation and it was specifically supported by two of the directly affected local authorities, Gravesham Borough Council and the London Borough of Havering. Route 1 has therefore been included in the Post-Consultation Appraisal Routes.
- 3.10.3 In the previous appraisal of Route 1 the bridge crossing option was shown to have lower construction costs and better value for money compared to the bored tunnel crossing option at that location. It also had safety benefits compared to a tunnel option. This is because the tunnel option would require northbound traffic to be segregated in three separate tunnels, leading to weaving difficulties and complex signing arrangements. The updated appraisal of Route 1 has therefore been based on the bridge crossing option only.

Transport Scheme Objectives

- 3.10.4 Route 1 does not meet the transport scheme objectives for LTC. As a result of constructing additional capacity at the existing crossing, traffic would be attracted to the M25/ A282 corridor, partly as a result of releasing additional suppressed traffic which has been constrained by the existing crossing capacity for a number of years. By 2025 traffic at the crossing would increase by 24%, with a 14% increase in HGVs. These increases would rise by 2041 to 40% and 28% respectively. There would be increased traffic flows at junctions along the M25/ A282 corridor, some of which are already close to or at capacity. Attracting more traffic into the existing corridor also increases congestion on key east-west approach roads to the crossing, such as the A2 and A13.
- 3.10.5 The route could not be transformed into a free-flowing 70 mph solution. The crossing and approaches would be restricted to a 50mph speed limit, due to constraints imposed by the layout of the existing crossing structures, junctions and existing development along the route.

- 3.10.6 It would not improve the resilience of the wider road network. Traffic would still be funnelled through the existing M25/ A282 corridor between Junction 2 and Junction 30. It does not provide an independent alternative river crossing route for traffic to use when incidents occur, which would still lead to long delays and severe congestion.
- 3.10.7 Construction of Route 1 would take approximately 6½ years. During this time traffic would be restricted to a 40mph speed limit, with complex traffic management arrangements. The capacity at the existing crossing would be reduced during construction, imposing delays on existing users and increased unreliability of journey times.
- 3.10.8 The existing M25/ A282 corridor has a poor safety record, and with the significant increase in traffic along the corridor with Route 1, it is likely to continue to perform poorly compared with national average rates. With an additional crossing point the driving environment would be more complex requiring substantial weaving movements as a result of the split of traffic between the two bridges and two tunnels, combined with the proximity of Junctions 1a and 31.

Economic Objectives

- 3.10.9 Building more capacity at Dartford would reinforce existing patterns of development rather than provide new journey opportunities, and would not connect new communities to the network. As a result, the economic benefits of Route 1 would be considerably lower than a solution at Location C. The estimated direct benefits generated by Route 1 are £1.0bn, with estimated Wider Impact benefits and reliability benefits of £0.7bn. In comparison, Route 3 with the WSL would generate direct and Wider Impact benefits and reliability benefits of £2.3bn and £1.5bn respectively.
- 3.10.10 It is estimated that Route 1 would require an investment in the range of £3.4bn to £4.9bn (most likely to P90 estimates). In comparison, it is estimated that Route 3 with WSL would require an investment in the range of £4.1bn to £5.8bn.
- 3.10.11 The Adjusted Benefit Cost Ratio (BCR) of Route 1, including Wider Impact benefits, is estimated to be 1.1 which represents low value for money. In comparison, Route 3 with the WSL has an estimated Adjusted BCR of 2.0, which represents high value for money.

Environment and Community Objectives

- 3.10.12 Existing air quality problems along the M25/ A282 corridor would be exacerbated with Route 1. Air quality would get worse for most of the route because more traffic would be attracted to the existing road corridor. In many locations this would lead to further exceedances of the NO₂ AQSO.
- 3.10.13 During the construction period, as a result of additional congestion resulting from traffic management, temporary speed limits and contraflow working, air quality would worsen and there would be additional exceedances of the air quality strategy objective.
- 3.10.14 There would be an overall noise disbenefit with Route 1 compared to the Without Scheme scenario, because of the additional traffic through the existing corridor.

- 3.10.15 Route 1 could have landscape impacts on the setting of the Mardyke Valley, and impacts on features associated with the internationally important Ramsar and Special Protection Area sites including impacts due to land take on functionally linked land. It would also require land take in local wildlife sites, ancient woodland areas and a recommended Marine Conservation Zone.
- 3.10.16 In conclusion, Route 1 would not meet key scheme objectives and performs poorly against other scheme objectives. It is recommended that it should not be taken forward.

Long Tunnel Alternative at Location A

- 3.10.17 Some consultees suggested that a long tunnel at Location A from south of M25 Junction 2 to north of M25 Junction 30 would be a better solution. This option was examined as part of the longlist appraisal, as Option A14, and was not taken forward for further consideration at that stage because it would not meet the traffic objectives for the scheme. There would be no connections with Junction 2, Junction 1b, Junction 1a, Junction 31, and Junction 30 along the M25/ A282 corridor. Whilst the new tunnel would have a capacity of around 8,000 vehicles/hr, the maximum peak hourly two-way traffic flow predicted in 2025 would be only 3,700 vehicles/ hour, as the tunnel would only carry long distance traffic. As a result, high flow levels would remain on the existing M25/ A282 corridor between Junction 2 and Junction 30. The cost of the tunnel would be twice that of Route 1, whilst the economic benefits would be approximately 6% lower than Route 1. The Initial BCR, excluding Wider Impact benefits, would be 0.4, and therefore would provide poor value for money. Overall this option does not meet the scheme objectives and would be poor value for money, and it is recommended that it should not be taken forward.

3.11 Location C Northern Link Options

- 3.11.1 Of the two northern link options, Route 3 is the shortest route and would provide an entirely new route for traffic between the A2/ M2 south of the river and the M25 north of the river. Overall Route 3 best meets the transport objectives of providing free-flowing north-south capacity, improving network resilience and improving road user safety.
- 3.11.2 Route 3 has the lowest capital cost, and offers the best value for money, with the highest BCR, calculated using DfT's WebTAG guidance. It would also have lower overall environmental impacts than Route 4. From the consultation responses, Route 3 had greater support from members of the public and groups and organisations than Route 4.
- 3.11.3 The recommended northern link route is Route 3, as shown in **Figure 3.5**.

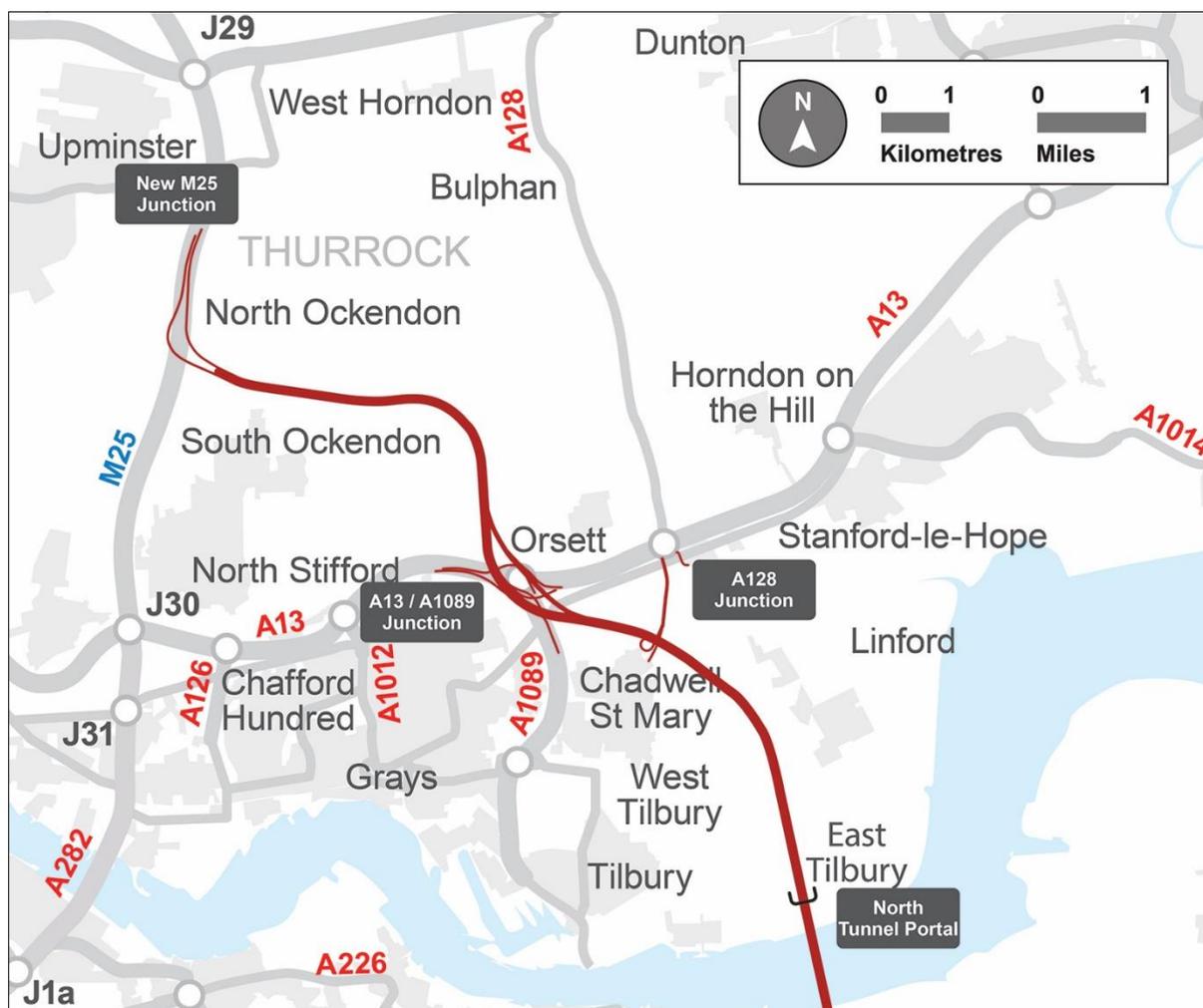


FIGURE 3.5 - RECOMMENDED NORTHERN LINK ROUTE

3.12 Location C Crossing

3.12.1 Possible locations for a crossing of the River Thames at Location C are limited to a narrow corridor approximately 800m wide bounded by the conurbation of Gravesend on the south-western side and environmentally sensitive designated sites to the east. The area includes the Thames Estuary and Marshes Ramsar site and Thames Estuary and Marshes SPA. These are sites of European and international value and are given the highest level of protection in UK law under the Habitats Regulations. The protection of these sites is due to a number of sensitive habitats and species, including a complex of brackish floodplain grazing marsh ditches, saline lagoons and intertidal saltmarsh and mudflats. These habitats together support internationally important numbers of wintering waterfowl, diverse wetland plants and invertebrates. Location C routes have the potential to affect both the Ramsar and the SPA sites.

3.12.2 The UK is required to comply with the terms of the EU Habitats Directive and the Wild Birds Directive. The UK also has to meet its obligations under the Ramsar Convention. The protection given by the Habitats Directive and the Wild Birds Directive is transposed into UK legislation through the Habitats Regulations. Regulation 61 of the Habitats Regulations requires that where a

project is likely to have a significant effect on a European site (either alone or in combination with another project) and is not directly connected with or necessary to the management of that site, the competent authority must make an 'Appropriate Assessment' of the implications for that site, in view of its conservation objectives, before deciding to give consent.

- 3.12.3 In the light of the conclusions of the assessment, the competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site. In the case of LTC, the competent authority will be the Secretary of State for Transport as the application for consent will be made through the Planning Act 2008, as LTC is a Nationally Significant Infrastructure Project (NSIP).
- 3.12.4 Given the presence of the Thames Estuary and Marshes Ramsar and SPA sites and the proposed proximity of a crossing at Location C this was a fundamental consideration to the selection of the crossing structure.
- 3.12.5 The appraisal undertaken has demonstrated that there are risks of significant adverse effects on the sites as a result of all alternative crossing structures at Location C, but they are greater with a bridge or immersed tunnel and can be mitigated more effectively with a bored tunnel.
- 3.12.6 A bored tunnel crossing is the only option that does not directly affect the Thames Estuary and Marshes Ramsar site. Both a bridge and immersed tunnel would result in direct loss of habitat at the southern portal and on the approaches to the crossing.
- 3.12.7 The recommended solution for the river crossing at Location C is a bored tunnel. It is the least environmentally damaging option and represents the only viable alternative that meets the scheme objectives, and for which there is an array of measures that could be implemented to mitigate adverse impacts.

3.13 Location C Southern Link Options

- 3.13.1 Highways England's proposed scheme presented at public consultation was Route 3 and the ESL. This was selected on the basis that it would provide the best transport alternative by providing the shortest connection between the M2 and M25, creating a 70mph motorway-to-motorway connection. It also offered the best value for money when costs and benefits were taken into account.
- 3.13.2 The responses from the public consultation showed that whilst there was greater support for the ESL in terms of the numbers of responses received, some stakeholders, including directly affected local authorities and statutory environmental bodies, favoured the WSL. These stakeholders highlighted the National Policy Statement for National Networks (NPSNN) policy tests which would need to be met in terms of potential impacts on nationally designated landscapes, habitats, Green Belt and ancient woodland if the ESL option were to be pursued.
- 3.13.3 In response to environmental and community concerns regarding the impact of the ESL raised in the consultation, further design and appraisal work was undertaken on the southern link proposals. This included examination of the following:

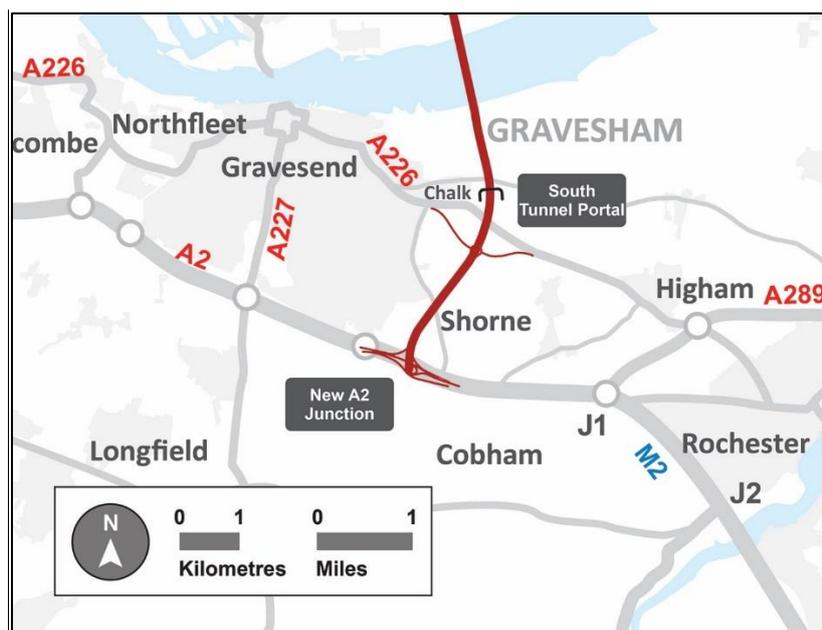
- Improvements to the design of the junction between the WSL and the A2 to provide an unrestricted free-flowing junction to the same standard as that provided where the ESL meets the M2 Junction 1. The WSL junction presented at consultation was of “compact” design with consequent speed restrictions.
- The extent to which the impact of the ESL on both the protected sites and the community could be mitigated.

3.13.4 The further work undertaken since consultation has shown that:

- There is very limited opportunity with the ESL to reduce the community and environmental impacts on the AONB, SSSI and ancient woodland. The NPSNN provides significant protection to these nationally important sites.
- It is possible to improve the performance of the WSL and provide a full standard free-flowing junction solution at the new A2 junction. This option could be achieved without significantly increasing impacts on nationally important environmental sites (AONB, SSSI and ancient woodland).

3.13.5 On the basis of the consultation responses and the work undertaken since consultation, it is now concluded that the WSL would best meet the scheme objectives. The WSL would achieve the transport objectives and provide a high quality solution. It would offer high value for money and would fully support wider regeneration and economic objectives, whilst having a materially lower impact than the ESL on the environment and local communities.

3.13.6 In a change to the proposed scheme presented in the 2016 consultation, the recommended southern link route is now the WSL, as shown in **Figure 3.6**.



NOTE: THIS DRAWING IS BASED ON THE ROUTE PRESENTED AT PUBLIC CONSULTATION. THE INCLUSION OF A LOCAL JUNCTION WITH THE A226 WILL BE EXAMINED IN THE NEXT STAGE OF SCHEME DEVELOPMENT

FIGURE 3.6 - RECOMMENDED SOUTHERN LINK ROUTE

4 Recommended Preferred Route

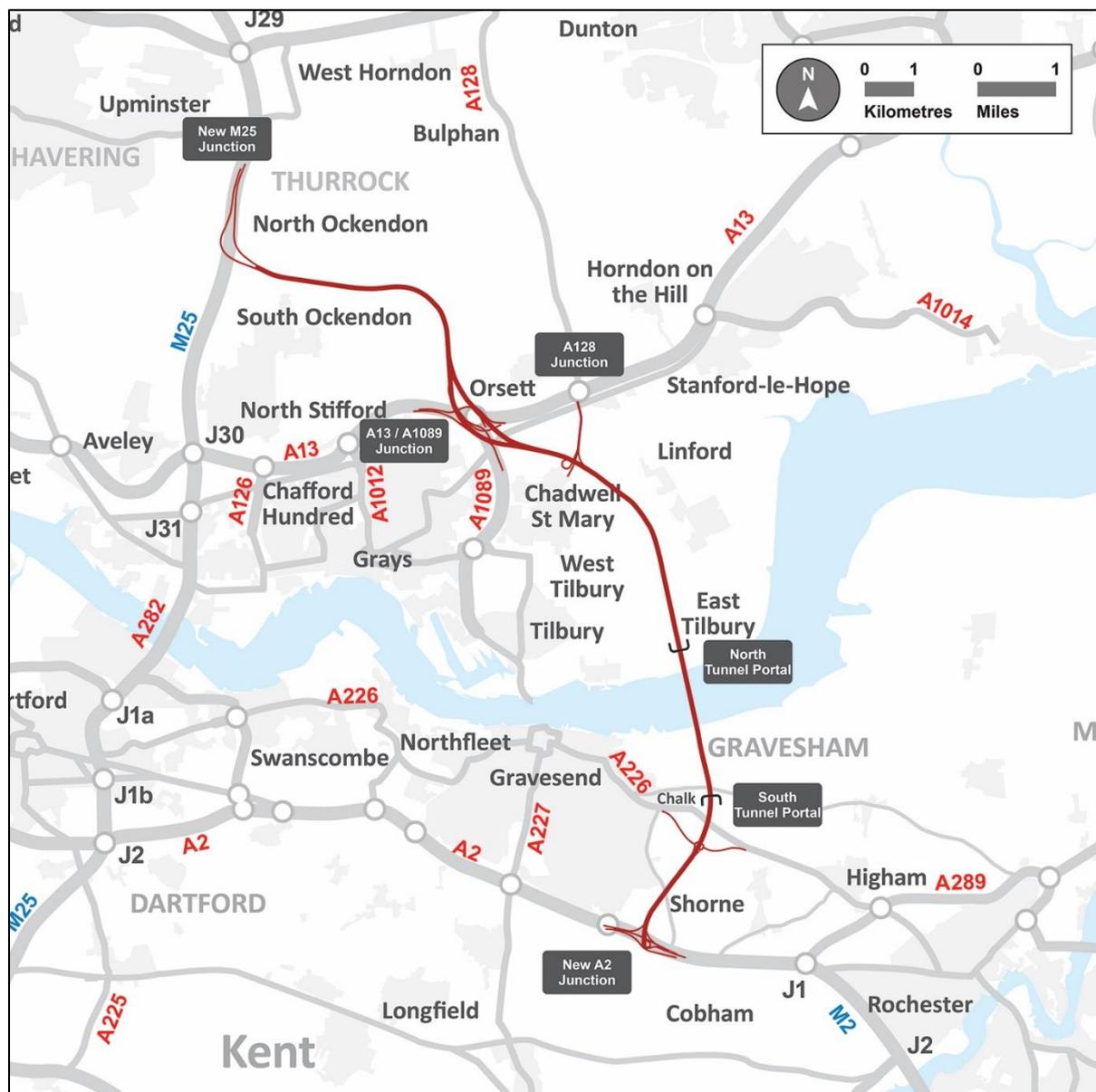
4.1 Strategic considerations in the selection of the Recommended Preferred Route

4.1.1 The strategic considerations which have led to the selection of the Recommended Preferred Route are as follows:

- Of the two locations considered, only a new crossing at Location C satisfies the transport scheme objectives, particularly in regard to resilience. Options at Location A did not meet the strategic objectives of the scheme.
- A new crossing at location C opens up new opportunities for development and would strongly support the regional economic growth objectives.
- A bored tunnel provides the best opportunity to mitigate adverse impacts on the Thames Estuary and Marshes Ramsar and SPA sites, which are international and European designations.
- Route 3 provides the most direct route with the lowest environmental and community impacts north of the river.
- The WSL is the recommended route south of the river. This would achieve the transport and economic objectives and provide a high quality solution, whilst having a materially lower impact than the ESL on the environment and local communities.

4.2 Description of Recommended Preferred Route

4.2.1 The Recommended Preferred Route, as shown in **Figure 4.1**, is Route 3 north of the River Thames with the WSL south of the River Thames, and a bored tunnel river crossing.



NOTE: THIS DRAWING IS BASED ON THE ROUTE PRESENTED AT PUBLIC CONSULTATION. THE INCLUSION OF LOCAL JUNCTIONS AT TILBURY AND WITH THE A226 WILL BE EXAMINED IN THE NEXT STAGE OF SCHEME DEVELOPMENT

FIGURE 4.1 - RECOMMENDED PREFERRED ROUTE

4.2.2 The recommended scheme would provide a new 70 mph route to expressway standards between the M25 in Essex and the A2 in Kent. It would include the following junctions:

- A new free-flow junction with north-facing slip roads on the M25 between Junctions 29 and 30.
- A modified junction with the A13/ A1089 in Essex, including a spur to the Orsett Cock junction, incorporating an improvement to the A128.
- A new free-flow junction with the A2 to the east of Gravesend.

4.2.3 Further work will be undertaken in the next stage of scheme development to determine whether new local junctions should be provided with the A226 south of the river and at Tilbury north of the river.

4.2.4 It is proposed that the route would be a dual two-lane carriageway. However, further work will be undertaken in the next stage of scheme development to examine whether a dual three-lane solution should be provided for all or part of the route. The recommended scheme includes twin bored tunnels large enough to accommodate a dual three lane carriageway, in order to provide a future-proofed solution. The new tunnels would accommodate all vehicles and would not be restricted by size or load type, unlike the northbound tunnels at the existing crossing.

4.3 Performance against Scheme Objectives

4.3.1 **Table 4.1** summarises the performance of the Recommended Preferred Route against the scheme objectives. This is described in more detail in the remainder of this section.

TABLE 4.1 - PERFORMANCE OF RECOMMENDED PREFERRED ROUTE AGAINST SCHEME OBJECTIVES

Scheme Objectives	Performance of Recommended Preferred Route
Transport	<ul style="list-style-type: none"> • Reduces congestion and delays at the existing crossing, on local roads and on the approach roads including the A2 and A13. Heavy goods vehicle movements are predicted to reduce at the existing crossing by 29% in 2025 reducing congestion and reducing the risk of incidents and the impact of conveying hazardous goods northbound. • Provides a faster route with improved journey times for users of the new and the existing crossings. • Provides a more reliable road improving journeys for all road users. • Provides more than 70% additional north-south capacity on opening, and an alternative river crossing to the existing crossing, which will improve the resilience of one of the least reliable sections of the SRN. • Provides a safer route, as a result of a new high quality expressway route and reduced congestion along the existing A282 corridor which has a poor safety record.
Economic	<ul style="list-style-type: none"> • Drives economic benefit by unlocking constraints on economic growth and stimulating local and regional development, as well as supporting national growth. • Improves transport connections at a critical part of the SRN supporting businesses and improving productivity. • Connects communities in Kent and Essex and provides better access to jobs, housing, leisure and retail facilities either side of the river. • Opens up new opportunities for investment, regeneration and housing. • Creates jobs, apprenticeships and training opportunities during construction and in the longer term. • Would require an investment in the range of £4.1bn to £5.8bn and generate £2.35bn of direct economic benefits and £1.53bn of Wider Impact and reliability benefits. Adjusted BCR is 2.0, which represents high value for money.
Environment & Community	<ul style="list-style-type: none"> • Minimises the environmental impact on sensitive and valuable habitats close to the river by adopting a bored tunnel solution. • Reduces congestion at the existing crossing thereby improving air quality along the A282 corridor, where exceedances of the NO2 AQSO currently occur. • Reduces congestion at the existing crossing reducing noise, although there will be some adverse noise impacts close to the new route.

- 4.3.2 The Recommended Preferred Route would provide the best solution in meeting the transport, economic, and environment and community scheme objectives.

Transport objectives

- 4.3.3 The preferred scheme would reduce congestion and delays at the existing crossing and on the approach roads including the A2 and A13. Heavy goods vehicle movements are predicted to reduce at the existing crossing by 29% in 2025.
- 4.3.4 It would provide a faster route with improved journey times for users of the existing Dartford crossing and the new crossing. On opening of the new crossing, under typical morning peak conditions, for northbound journeys between M25 Junction 3 and M25 Junction 28 across the existing Dartford Crossing, journey speeds would increase by 7mph from 44mph to 51mph with a 3 minute time saving. Average journey speeds between the M2 Junction 4 and M25 Junction 28 would increase by 9mph from 47mph to 56mph with a journey time saving of 8 minutes via the new crossing.
- 4.3.5 It would provide an additional 70% north-south capacity on opening, enabling a significant increase in cross-river journeys to be made which are currently not possible due to the lack of capacity.
- 4.3.6 It would provide an alternative river crossing to the existing crossing, which would improve the resilience of one of the least reliable sections of the SRN, and provide a more reliable road improving journeys for all road users. The existing route is prone to frequent incidents which increase the likelihood of congestion, not only at the crossing but also on the wider road network. With increasing congestion in the future, the likelihood of incidents will lead to greater unreliability. The scheme will substantially improve the resilience of the SRN east of London, by providing a high quality diversionary route when incidents occur on the existing crossing.
- 4.3.7 The scheme would provide a safer route, as a result of a new high quality expressway route and reduced congestion along the existing A282 corridor which has a poor safety record.

Economic objectives

- 4.3.8 The preferred scheme would drive economic benefit by unlocking constraints on economic growth and stimulating local and regional development, as well as supporting national growth.
- 4.3.9 It would improve transport connections at a critical part of the SRN supporting businesses, through increased cross-river capacity and by providing more reliable and quicker journey times and reduced operating costs.
- 4.3.10 It would connect communities in Kent and Essex and improve connectivity with Europe providing better access to jobs, housing, leisure and retail facilities either side of the river. It would provide improved connections between major centres of economic activity, including Tilbury Port and London Gateway Port, Medway Ports, the Port of Dover and the Channel Tunnel.

- 4.3.11 Through improving connectivity, it would open up new opportunities for investment, regeneration and housing. Planned developments in the area could lead to an increase of up to 92,000 new homes and 122,000 new jobs by 2041, which include a 21st century garden city at Ebbsfleet. In addition, the Thames Estuary 2050 Growth Commission, which has been established to develop an ambitious vision and delivery plan for North Kent, South Essex and East London up to 2050, is expected to explore the development of high productivity clusters in specific locations, looking at future regeneration and planned infrastructure projects.
- 4.3.12 It could create jobs, apprenticeships and training opportunities during construction and in the longer term. The lack of a reliable cross river connection has restricted movement of labour; only 2% of workers commute between Dartford and Thurrock compared with 10% who commute the same distance between Dartford and Gravesend.
- 4.3.13 The preferred scheme would generate estimated direct economic benefits of £2.35bn, with estimated Wider Impact benefits and reliability benefits of £1.53bn. The Adjusted BCR would be 2.0, which represents high value for money. The discounted scheme costs, benefits and Initial and Adjusted BCRs are presented in **Table 4.2**, based on the core traffic growth scenario and the most likely capital costs.

TABLE 4.2 - PRESENT VALUE OF COSTS, BENEFITS AND BENEFIT COST RATIOS (2010 PRICES DISCOUNTED TO 2010)

	Value
Present Value Costs (£bn)	1.93
Present Value Direct Benefits (£bn)	2.35
Present Value Wider Impact benefits and Reliability benefits (£bn)	1.53
Initial BCR	1.2
Adjusted BCR	2.0 (High value for money)

- 4.3.14 A complementary appraisal of wider economic benefits has also been carried out alongside the conventional WebTAG analysis which was the basis for Wider Impact benefits reported in **Table 4.2**. The objective of this analysis was to capture the “transformational” nature of the project. This used “Spatial Computable General Equilibrium” on a similar basis to that used for the Airports Commission economic appraisal. This approach is widely used by Government departments including HM Treasury and HMRC. This assessment indicates that the scheme could add over £8bn cumulatively to the economy in terms of GDP by stimulating investment and business opportunities, and create over 6,000 new long-term jobs nationally by 2050.
- 4.3.15 The preferred scheme would require an estimated investment in the range of £4.1bn to £5.8bn.
- 4.3.16 Users of the existing crossing are currently required to make a user payment via the Dart Charge system. It is anticipated that these charges will continue

to be applied in the future and that user charges would also be applied to the new crossing in line with current Government policy.

Environment and community objectives

- 4.3.17 The preferred scheme would reduce congestion at the existing crossing thereby improving air quality along the A282 corridor, where exceedances of the NO₂ AQSO currently occur. Properties within the vicinity of the recommended scheme are not expected to experience exceedances and levels are predicted to be well within AQSO limits.
- 4.3.18 It would reduce congestion at the existing crossing, thereby reducing noise at properties along the A282. There would be increases in noise levels for properties close to the new route but, based on the predicted traffic flows and with the incorporation of mitigation measures, levels at properties are expected to be within appropriate standards.
- 4.3.19 It would minimise the environmental impact on sensitive and valuable habitats along the river by adopting a bored tunnel solution. The main impacts would be during the construction phase and there is potential for hydrogeological changes because of the dewatering required. The bored tunnel would avoid direct loss of habitat from the Ramsar site. On completion, the tunnel would not impact the marine environment and the coastal/ terrestrial impacts would be much less than for a bridge or immersed tunnel.
- 4.3.20 The selection of the WSL, in preference to the ESL, would help to minimise impacts on ecology, protected habitats, and protected landscapes.
- 4.3.21 The scheme would provide a new road corridor and would impact on the openness of the Metropolitan Green Belt. There is an overriding national need for the scheme, which constitutes very special circumstances for the purposes of Green Belt policy.

4.4 Next Steps

- 4.4.1 Following the Preferred Route Announcement by the Secretary of State for Transport, the next steps in the development of the scheme will involve:
- Environmental, geotechnical and topographical surveys.
 - Preparation of the preliminary design of the route.
 - Environmental, traffic, and economic assessment.
 - Engagement and consultation with stakeholders.
 - Subject to the outcome of consultation, the submission of a Development Consent Order (DCO) application to the Planning Inspectorate.
- 4.4.2 Survey work will include a comprehensive suite of ecological surveys to further understand bird movements and usage of land in the internationally protected sites. These surveys will also support the development of appropriate mitigation measures to ensure that there are no adverse impacts on the integrity of the sites, and that wider impacts elsewhere are minimised during construction and once the scheme is in operation.

- 4.4.3 In developing the preliminary design, further detailed consideration will be undertaken regarding:
- Whether a dual three lane solution should be provided for all or part of the route.
 - Whether new local junctions should be provided with the A226 south of the river and at Tilbury north of the river.
 - Whether tunnelling should continue further south of the river to mitigate the impacts of the scheme.
 - Development of the junction arrangements with the A2, A13 and M25 to reduce their impacts on the community and the environment.
 - Alternative alignments for the route where it passes through the landfill site north of South Ockendon.
 - Further assessment of the impacts of the preferred route on the wider road network. This work will form part of Highways England's ongoing route strategy planning.
- 4.4.4 An environmental assessment of the local environment will be undertaken to ensure that local conditions are fully understood. This will include a Habitats Regulations Assessment to understand the impacts on European protected sites and further assessment of the effects on nationally protected landscapes, ancient woodland and ecological sites.
- 4.4.5 A detailed air quality assessment will be undertaken in the next stage of scheme development. This will use updated data and will consider changes in emissions as a result of the scheme, to ensure that air quality effects are minimised as far as possible.
- 4.4.6 A detailed noise and vibration assessment will be undertaken, considering potential impacts of the scheme in accordance with the NPSNN and the National Planning Policy Framework. The noise and vibration assessment will consider construction and operational effects at individual receptors, as well as appropriate mitigation measures such as low-noise surfacing, bunds or acoustic barriers to reduce noise levels at sensitive receptors.
- 4.4.7 The environmental assessment will also consider potential impacts of the preferred scheme on:
- The historic environment, including listed buildings, scheduled monuments, scheduled areas and conservation areas.
 - The water environment, including flood risk and hydrogeological changes during dewatering of the bored tunnel construction.
 - Community facilities including Open Access Land, golf courses, footpaths, bridleways and local cycle routes.
 - Private and commercial property, agricultural land and farms.
- 4.4.8 The LTC traffic model will be developed to include updated travel demand data and to reflect the latest information on committed planned developments. Future significant developments in the area include Ebbsfleet Garden City, and expansion of London Gateway Port and Tilbury Port, as

well as proposals for an entertainment resort in the Swanscombe peninsular. There will also be engagement with the Thames Estuary 2050 Growth Commission, which is looking at future growth up to 2050 in North Kent, South Essex and East London.

- 4.4.9 There will be further engagement and consultation with local communities, local authorities, environmental bodies, businesses, landowners, homeowners, utility providers and other interest groups. Statutory consultation will be undertaken before the DCO application is made. This consultation will provide stakeholders and the community with further opportunities to contribute to the development of the scheme. A Statement of Community Consultation will be prepared setting out how local communities in the vicinity of the scheme will be consulted. A Consultation Report will be prepared to accompany the DCO application to record consultations undertaken, views received and how respondents' views have been considered. Statements of Common Ground will be prepared with stakeholders to agree positions on subjects such as assessment methods and design and mitigation measures, in advance of the examination of the proposals submitted in the DCO application.

5 Abbreviations and Glossary

Abbreviation	Description
AONB	Area of Outstanding Natural Beauty: Statutory designation intended to conserve and enhance the ecology, natural heritage and landscape value of an area of countryside.
AQMA	Air Quality Management Area: an area, declared by a local authority, where air quality monitoring does not meet Defra's national air quality objectives.
AQS	Air Quality Strategy
AQSO	Air Quality Strategy Objective, set by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland to improve air quality in the UK in the medium term. Objectives are focused on the main air pollutants to protect health.
Benefit Cost Ratio (BCR)	The net benefit of a scheme divided by the net cost to Government. The ratio of present value of benefits (PVB) to present value of costs (PVC), an indication of value for money.
Birds Directive	Council Directive 2009/147/EC on the conservation of wild birds is a European Union directive. It replaces Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds and aims to protect all European wild birds and the habitats of listed species, in particular through the designation of Special Protection Areas (SPAs).
CSR	Client Scheme Requirements, the formal means by which the DfT instruct Highways England to develop a scheme and define the scope of a project.
Dart Charge	The Dartford Crossing free-flow electronic number plate recognition charging system (operates between 0600 and 2200).
DCO	Development Consent Order
DfT	Department for Transport: the government department responsible for the English transport network and a limited number of transport matters in Scotland, Wales and Northern Ireland that have not been devolved.
DGV	Dangerous goods vehicle. DGVs are subject to restrictions under the ADR Regulations (Accord Dangereux Routier, European regulations concerning the international transport of dangerous goods by road). The passage of Dangerous Goods Vehicles through the Dartford Tunnels is determined according to the procedure described in the Dartford Dangerous Goods Listing. The Dartford tunnels are a category C tunnel according to the categories defined in the ADR regulations. Vehicles with Tunnel Restriction Codes A, B, and C are prevented from using the tunnels (with some minor exceptions for vehicle Tunnel Restriction Code C). Vehicles with Tunnel Restriction Codes D and E are subject to conveying or 'check and allow' using the procedures describe in the Dartford Dangerous Goods Listing.
EA	Environment Agency: The Environment Agency was established under the Environment Act 1995, and is a Non-Departmental Public Body of Defra. The Environment Agency is the leading public body for protecting and improving the environment in England and Wales. The organisation is responsible for wide-ranging matters, including the management of all forms of flood risk, water resources, water quality, waste regulation, pollution control, inland fisheries, recreation, conservation and navigation of inland waterways.
Eastern Southern Link (ESL)	The Eastern Southern Link (ESL) is an alternative for Routes 3 and 4 to the south of the River Thames. The route would connect into Junction 1 of the M2 and would pass to the east of Shorne and then northwest towards Church Lane and Lower Higham Road. This route could connect into either of the Routes 3 and 4 north of the river utilising all of the crossing options for these route options.
FSA	Flood Storage Area: a natural or man-made area basin that temporarily fills with water during periods of high river levels.
FWI	Fatalities and Weighted Injuries: a statistical measurement of all non-fatal injuries added-up using a weighting factor to produce a total number of 'fatality equivalents'.
Habitats Directive	The Habitats Directive (the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) is a European Union directive adopted in 1992 as an EU response to the Berne Convention. It is one of the EU's two directives in relation to wildlife and nature conservation, the other being the Birds Directive; it aims to protect some 220 habitats and approximately 1,000 species listed in the directive's Annexes.
Habitats Regulations	The Conservation of Habitats and Species Regulations 2010 (as amended) are the principal means by which Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the "Habitats Directive") and the Birds Directives Council Directive 2009/147/EC are transposed into English law.
HGV	Heavy Goods Vehicle

Abbreviation	Description
HHJV	Halcrow Hyder Joint Venture: a joint venture between Halcrow Group Limited and Hyder Consulting Limited appointed as technical adviser by Highways England in June 2014.
Ipsos MORI	A UK market research organisation appointed by Highways England to analyse and report on the responses to the LTC public consultation.
Location A	The location for LTC route options close to the existing Dartford crossing.
Location B	The location for a new crossing in the vicinity of the Swanscombe peninsula. It would connect the A2 to the south in the vicinity of Dartford to the A1089 to the north in the vicinity of Tilbury Docks. This route would cross the Eastern Quarry development site and the Swanscombe Peninsular.
Location C	The location for LTC route options connecting the A2/ M2 east of Gravesend with the A13 and M25 (between Junctions 29 and 30) north of the River Thames.
Location C Variant	As for options at Locations C and A with additional widening of the A229 between the M2 and the M20.
Locations D and E	The two most easterly of five locations originally examined by the DfT for the proposed Lower Thames Crossing, both were eliminated from further consideration.
London Gateway Port	A new deep-water port, able to handle the biggest container ships in the world, and part of the London Gateway development on the north bank of the River Thames in Thurrock, Essex, 20 miles (32 km) east of central London.
LTC	Lower Thames Crossing: a proposed new crossing of the Thames estuary linking the county of Kent with the county of Essex, at or east of the existing Dartford Crossing.
Mardyke	A small river, mainly in Thurrock, that flows into the River Thames at Purfleet, close to the QEII Bridge.
Marine Conservation Zones (MCZs)	A Marine Conservation Zone (MCZ) is a type of marine nature reserve in UK waters. They were established under the Marine and Coastal Access Act (2009) and are areas designated with the aim to protect nationally important, rare or threatened habitats and species.
NO ₂	Nitrogen dioxide
Noise-important area (NIA)	Defra published noise maps for England's roads in 2008, with the noise action plans following 2 years later in 2010. The action plans set out a framework for managing noise, rather than propose specific mitigation measures, and were designed to identify 'Important Areas' that are impacted by noise from major sources and therefore must be investigated. NIAs are where the 1% of the population that are affected by the highest noise levels from major roads are located, according to the results of Defra's strategic noise maps.
NPSNN	National Policy Statement for National Networks: The NPSNN sets out the need for, and Government's policies to deliver, development of nationally significant infrastructure projects on the national road and rail networks in England. It provides planning guidance for promoters of nationally significant infrastructure projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.
NSIP	Nationally significant infrastructure project: major infrastructure developments in England and Wales, such as proposals for power plants, large renewable energy projects, new airports and airport extensions, major road projects etc.
PM ₁₀	Particulate matter (in this example, particulates smaller than 10µm that can cause health problems).
Post-Consultation Appraisal Routes	The routes appraised, following the public consultation, using updated version of the LTC traffic model (v2.1), which takes account of updated data following the opening of Dart Charge, enhancements to improve highway network representation and future patterns of local development in Kent and Essex, and new values of time issued by DfT.
PRA	Preferred Route Announcement
QEII Bridge	Queen Elizabeth II Bridge, part of the Dartford-Thurrock crossing.
Ramsar site	A wetland of international importance, designated under the Ramsar convention.
Recommended Preferred Route	The preferred route of the Lower Thames Crossing as recommended by Highways England in the Post-Consultation SAR.
Route 1 (Post-Consultation Appraisal Route)	A new trunk road connecting M25 Junction 2 to M25 Junction 30, with a new 4 lane bridge crossing to the west of Dartford crossing, with significant improvements to Junctions 30 and 31. Smart Motorway Technology is to be implemented from Junction 2 to 1b (with no widening) and Junction 1b to 1a (with widening to dual 5 lanes).
Route 2 (shortlist route)	A new trunk road connecting A2 (2 km east of Gravesend) to M25 between Junctions 29 and 30, using A1089 (upgrading), with dual 2 lane crossing option of a bridge/ twin-bored tunnel/ immersed tunnel. See also Eastern Southern Link and Western Southern Link.
Route 3 (Post-	A new trunk road connecting the A2 (2 km east of Gravesend) to the M25 (between Junctions 29 and 30), with dual 2 lane crossing of a twin-bored tunnel river crossing large enough to accommodate a

Abbreviation	Description
Consultation Appraisal Route)	future dual 3 lane carriageway. Junction with the A13 at the existing junction with the A13 and A1089 and a junction with Brentwood Road, with Brentwood Road upgraded to dual 2 lane to Orsett Cock interchange. See also Eastern Southern Link and Western Southern Link.
Route 4 (Post-Consultation Appraisal Route)	A new trunk road connecting the A2 (2 km east of Gravesend) to the M25 (between Junctions 29 and 30), with dual 2 lane twin-bored tunnel river crossing large enough to accommodate a future dual 3 lane carriageway. Junction with A13 between Orsett Cock (A128) and Manor Way (A1014) junctions. Single carriageway road provided from B186 to A128 parallel with the A127. See also Eastern Southern Link and Western Southern Link.
SAR	Scheme Assessment Report, on the Lower Thames Crossing. The Pre-Consultation SAR was issued in January 2016, prior to the public consultation; the Post-Consultation SAR is a new report that reports on the consultation, response to consultation findings and presents Highways England's Recommended Preferred Route.
SPA	Special Protection Area: A designation under the European Union Directive on the Conservation of Wild Birds.
SRN	Strategic Road Network, the core road network, managed in England by Highways England.
SSSI	Site of Special Scientific Interest: A conservation designation denoting an area of particular ecological or geological importance.
Thames Estuary 2050 Growth Commission	The Thames Estuary 2050 Growth Commission, announced in March 2016, is tasked with developing an ambitious vision and delivery plan for North Kent, South Essex and East London up to 2050.
WebTAG	Department for Transport's web-based multi-modal guidance on appraising transport projects and proposals.
Western Southern Link	The Western Southern Link (WSL) is an alternative for Post-Consultation Appraisal Routes 3 and 4 to the south of the River Thames. The route would connect into the A2 to the east of Gravesend and would go to the west of Thong and Shorne and east of Chalk towards Church Lane and Lower Higham Road. This route could connect into either of the Routes 3 and 4 north of the river utilising all of the crossing options for these route options.
Wider Impacts (WI)	Land use-related economic consequences of transport interventions, not directly related to impacts on users of the transport network, such as increased productivity.

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