highways england

Lower Thames Crossing

Post-Consultation Scheme Assessment Report

Volume 3: Identification of Routes and Public Consultation

Volume 3

Lower Thames Crossing | 2017

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1.1 Structure of Post-Consultation Scheme Assessment Report

1.1.1 The Post-Consultation Scheme Assessment Report (SAR):

- Reports on the appraisal of the route options for a new Lower Thames Crossing (LTC), including the engineering, safety, operational, traffic, economic, social and environmental appraisals.
- Reports on the public consultation of options.
- Presents a Recommended Preferred Route.

1.1.2 Highways England is making a recommendation to the Secretary of State (SoS), following consideration and analysis of the consultation feedback, on which route option Highways England considers should be selected as the Preferred Route. The SoS will consider the recommendation and then decide which route option will form the Preferred Route. That decision will be published in a 'preferred route announcement'. The Preferred Route will then be developed in more detail, with further consultation, before an application is made for a Development Consent Order (DCO).

1.1.3 A Pre-Consultation SAR was published in January 2016 and was made available at public consultation; the Pre-Consultation SAR was made up of seven volumes. Each volume has been updated in the Post-Consultation SAR to include revised and additional information where required. The Post-Consultation SAR also reports on the consultation, response to consultation findings and the Recommended Preferred Route.

1.1.4 An outline of what is included in each volume of the Post-Consultation SAR is set out below:

- Volume 1 – provides an Executive Summary of the SAR.
- Volume 2 – describes the scheme background, including previous studies undertaken, existing traffic, physical and environmental conditions, the future conditions without an improvement, the need for improvement and the scheme objectives.
- **Volume 3 (this volume)** – describes the option identification and selection process. It summarises the consultation process, the consultation findings and the Highways England response to those findings. It describes the routes reported in the Post-Consultation SAR (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 Post-Consultation Appraisal Routes against the scheme objectives and describes the Recommended Preferred Route. It also describes the next steps including further work that will be undertaken in the development of the scheme.

1.2 Structure of this Volume

1.2.1 The structure of this volume is as follows:

- Section 2 sets out the scheme study area and the key stages in the option identification and selection.
- Section 3 outlines all route options considered, the rationale for the selection of the shortlist routes to undergo more detailed appraisal, and the rationale for the selection of the routes then presented in the public consultation on options.
- Section 4 sets out the approach to pre-consultation stakeholder engagement and the bodies consulted.
- Section 5 describes the public consultation process and summarises the findings from the consultation.
- Section 6 sets out Highways England's response to the public consultation findings.
- Section 7 provides the rationale for the selection of the Post-Consultation Appraisal Routes and describes the Post-Consultation Appraisal Routes.
- Section 8 lists other documentation referred to in this report.

2 Option Identification and Selection

2.1 Options Considered in Previous DfT Studies

2.1.1 Five location options were investigated as part of the 2009 Department for Transport (DfT) study into ways to address capacity constraints at the Dartford-Thurrock River Crossing. The study concluded that three options (A, B and C) offered the greatest benefits in terms of relieving congestion at the existing crossing and should be assessed further.

2.1.2 The DfT commenced a further study in 2012 to investigate the three options (A, B and C). Following this assessment and public consultation, the DfT announced in December 2013 that there were sufficient grounds to disregard Option B. (Refer also to Volume 2 of this Post-Consultation SAR for further details).

2.1.3 The appraisal of options B, D and E has been reviewed against the current scheme objectives to confirm that the decision not to take these options forward remains valid. This review is summarised in **Appendix 3.1** and confirms that the decision not to take these options forward does remain valid.

2.1.4 The Secretary of State for Transport announced on 15 July 2014 the Government's response to the May 2013 consultation for a new Lower Thames Crossing. The response confirmed that there is a need for a new crossing, that there is currently no clear preference on its location and that further work would be carried out to develop and appraise route options for both Location A and C before choosing where to site a new crossing. Location A is at or close to the existing crossing and Location C is a new route connecting the A2/ M2 near Gravesend with the A13 and M25 north of the River Thames. C Variant, an improvement of the A229 connection between the M20 Junction 6 and the M2 Junction 3 south of the River Thames, was also included.

2.1.5 In May 2014, DfT handed over the scheme to the Highways Agency (now Highways England) to develop the scheme through the options phase, including identification and appraisal of route options at Locations A and C (including C Variant), and development of a proposed scheme.

2.2 Study Area for Locations A and C

2.2.1 The Study Area for the identification and appraisal of options at Locations A and C is shown in **Figure 2.1.**

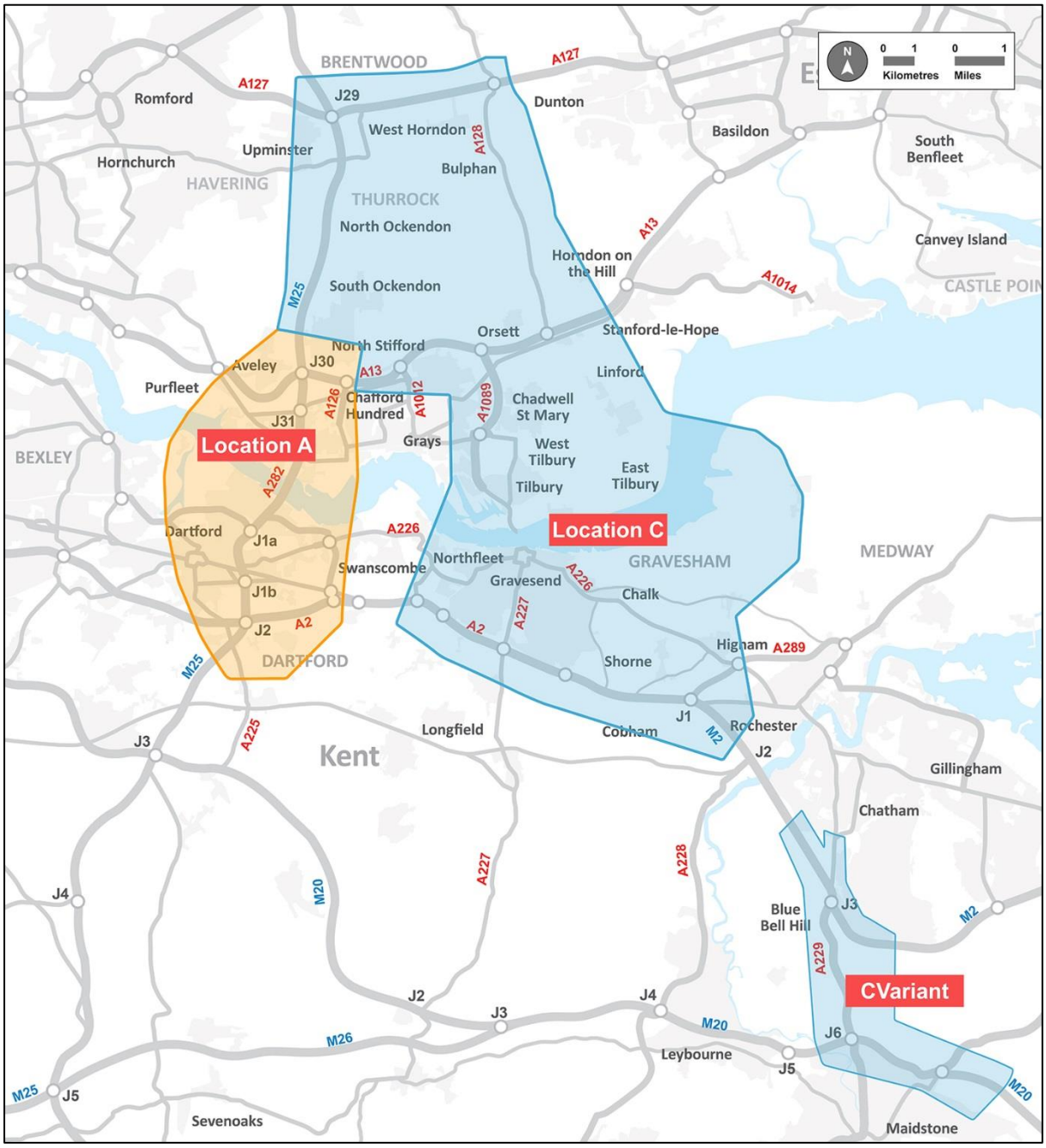

FIGURE 2.1 - STUDY AREA

2.3 Option Identification and Selection

2.3.1 The approach taken to the options Identification and selection process on Lower Thames Crossing is shown in **Figure 2.2** below.

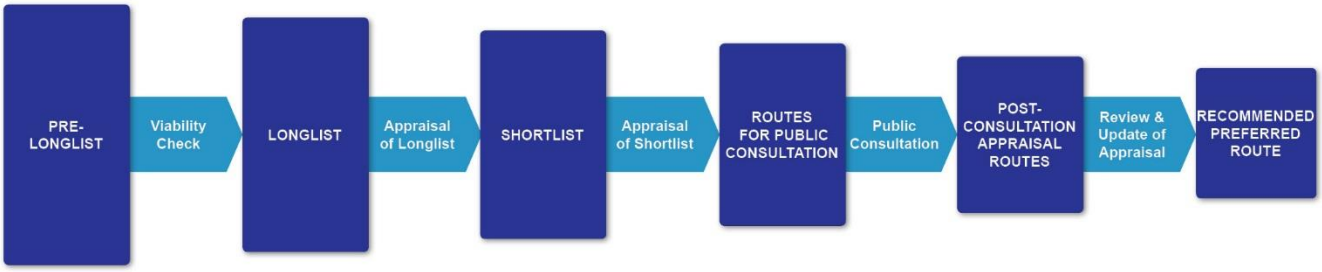

FIGURE 2.2 - OVERVIEW OF OPTIONS IDENTIFICATION AND SELECTION PROCESS

2.3.2 The key stages in the appraisal are set out below. These stages are briefly described in Section 3.

a) **Viability Check.** An initial list of route options (the pre-longlist, refer to **Figures 3.1, 3.2 and 3.3**) was developed for Locations A and C. Route options which performed poorly against the scheme objectives (refer to Section 2.4 for details of the scheme objectives) or were considered unviable (e.g. due to not being technically viable or having unacceptable environmental impacts) were not selected for the longlist.

b) **Appraisal of longlist.** The longlist options (refer to paragraph 3.2.2) were appraised. The appraisal of the longlist options was undertaken in two stages (refer to Section 3.3) and the analysis of those options not selected for the shortlist is summarised in **Appendix 3.2**. The result of this appraisal was the shortlist of options.

c) **Appraisal of shortlist.** A detailed appraisal of the shortlist routes was undertaken and is described in Volumes 4 (Engineering, safety, construction impacts, operations and maintenance, risk and cost), 5 (Traffic, economics and social impacts) and 6 (Environmental) of the Pre-Consultation SAR. Based on the detailed appraisal of the shortlist routes those that performed satisfactorily against the scheme objectives and were considered deliverable were identified and proposed for public consultation. This included the proposed scheme, being the route that Highways England considered at that stage to perform best overall. The appraisal was reported in Volume 7 of the Pre-Consultation SAR.

d) **Public Consultation on options and proposed scheme.** The proposed scheme and those shortlist routes that performed satisfactorily against the scheme objectives and were considered viable, were presented at the non-statutory public consultation which was held between January and March 2016. The consultation also included information on those routes that were not considered viable and the reasons for those conclusions, together with the opportunity to comment on these issues and to propose other solutions.

e) **Review and update of appraisal of Post-Consultation Appraisal Routes and Recommended Preferred Route.** Following public consultation the appraisal of a number of the routes (the Post-

Consultation Appraisal Routes) has been reviewed and updated taking account of the feedback from the consultation and using new or revised information (as set out in Volumes 4, 5 and 6 of this Post-Consultation SAR) where appropriate. The selection of the routes for the review and update of appraisal also takes account of the findings of the public consultation (refer to Sections 5 and 7). The updated appraisal of the Post-Consultation Appraisal Routes is described in Volumes 4 (Engineering, safety, construction impacts, operations and maintenance, risk and cost), 5 (Traffic, economics and social impacts) and 6 (Environmental) of this Post-Consultation SAR. The updated appraisal of the Post-Consultation Appraisal Routes is summarised in Volume 7 which also sets out the Recommended Preferred Route. This recommendation has been determined taking account of the feedback from the public consultation (refer to Sections 5 and 6) and the review and update of the appraisal.

2.4 Scheme Objectives

2.4.1 The scheme objectives are set out in **Table 2.1**.

TABLE 2.1 - SCHEME OBJECTIVES

Scheme Objectives		
Transport	Tr1	To relieve the congested Dartford Crossing and approach roads and improve their performance by providing free-flowing north-south capacity.
	Tr2	To improve resilience of the Thames crossings and major road network.
	Tr3	To improve safety.
Economic	Ec1	To support sustainable local development and regional economic growth in the medium to long term.
	Ec2	To be affordable to Government and users.
	Ec3	To achieve value for money.
Environment and Community	En1	To minimise adverse impacts on health and the environment.

3 Overview of Option Appraisal Process

3.1 Route Options Considered

3.1.1 For both Location A and Location C a number of route options were developed to a sufficient level to determine a route in terms of their technical feasibility. This initial development of routes also took account of the environmental and physical constraints, including known planned development where such data was available. Information received through the engagement with stakeholders (refer to Section 4) was also taken into consideration in the development and appraisal of the route options at each stage of the process.

3.1.2 A design speed and cross-section were assumed for a route and the alignment was then developed taking account of the constraints: environmental, physical (including known planned development), junctions and what impacts these could have on the geometry and crossing locations. The alignments, junctions and cross-sectional designs were carried out in accordance with the relevant Design Manual for Roads and Bridges (DMRB) standards.

3.1.3 The majority of routes were designed as dual two lane all-purpose carriageways with a design speed of 120kph (70mph) and grade-separated junctions. However, options at Location A close to the existing crossing which involved widening or improvement of the existing A282 had a design speed of 85kph (50mph). This is due to the constraints of the existing site including the highway geometry and the closely spaced junctions. This design speed matches the design speed and speed limit of the existing road. Lane provision and junction layouts were determined from predicted traffic flows from the traffic modelling undertaken to support the development and appraisal of route options (refer to Volume 5 for more details).

3.1.4 There has been a staged appraisal in order to develop and appraise route options and identify the Recommended Preferred Route. The stages were the pre-longlist, longlist, shortlist, routes for public consultation and post-consultation appraisal routes (refer to **Figure 2.2**).

3.1.5 At the pre-longlist stage sixteen route options were considered within Location A (refer to **Figure 3.1)**, six main options within Location C (refer to **Figure 3.2**) and four options within C Variant (refer to **Figure 3.3**). At Location C there were also thirteen “combination options” (C7 to C19 - refer to **Table 3.1**) which involved combining sections from the main options (refer to **Appendix 3.2** for more details).

3.1.6 The routes not selected for the shortlist are described in **Appendix 3.2**. The shortlist routes are described in detail in Section 5 of Volume 3 of the Pre-Consultation SAR and the Post-Consultation Appraisal Routes are described in detail in Section 7 of this Volume 3 of the Post-Consultation SAR.

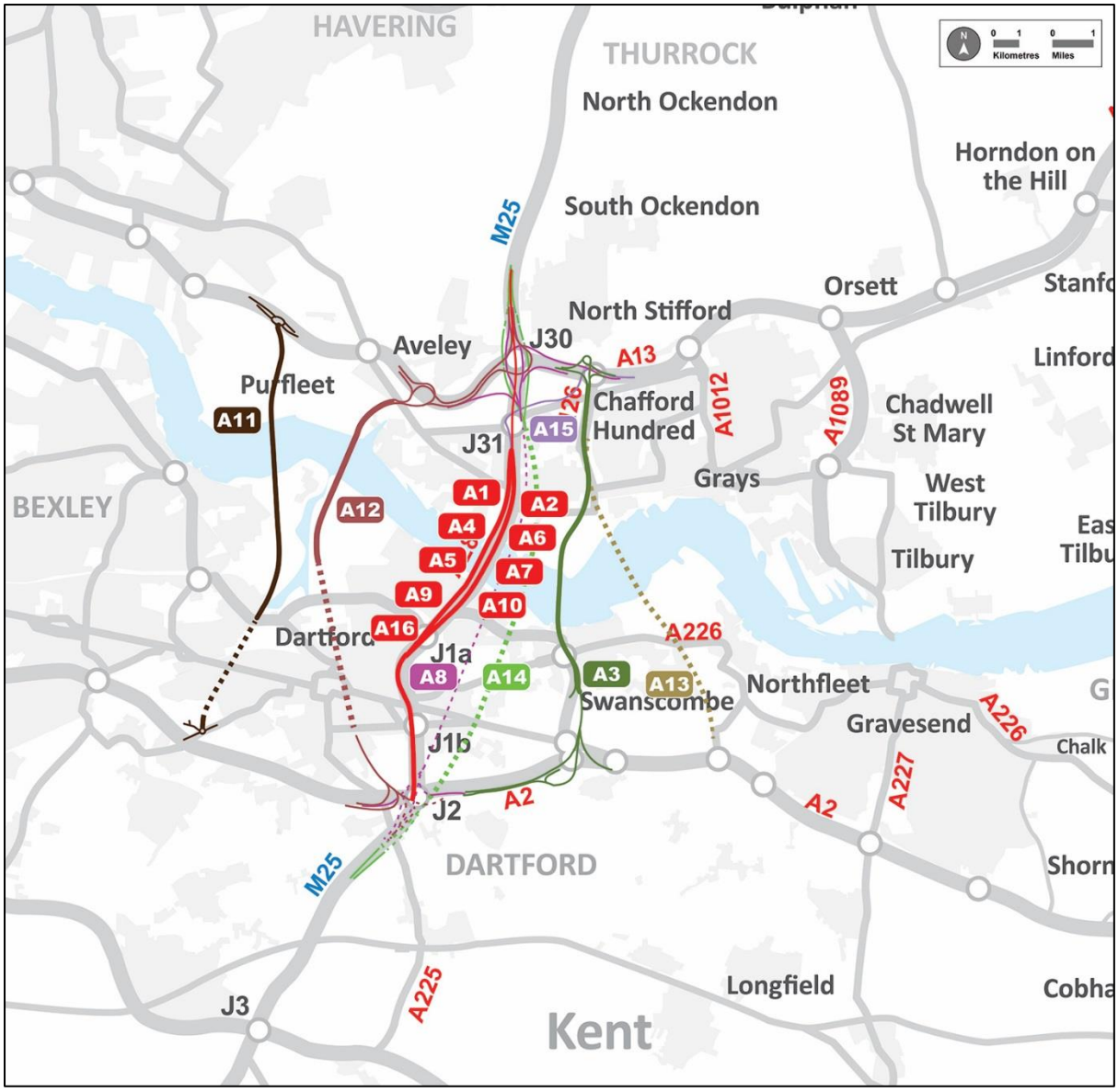

FIGURE 3.1 - LOCATION A - ALL ROUTE OPTIONS – PRE-LONGLIST

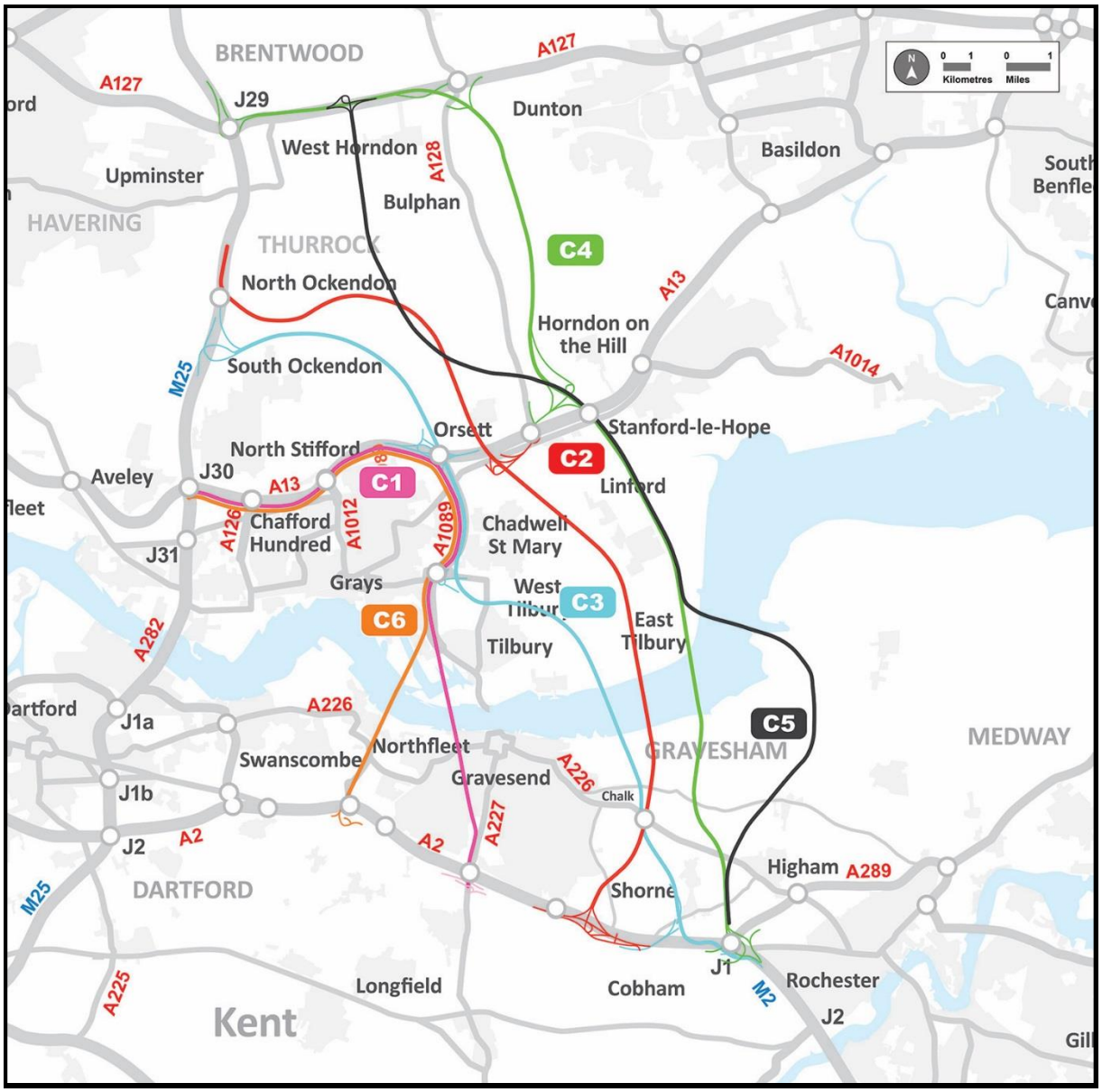

FIGURE 3.2 - LOCATION C - MAIN ROUTE OPTIONS – PRE-LONGLIST

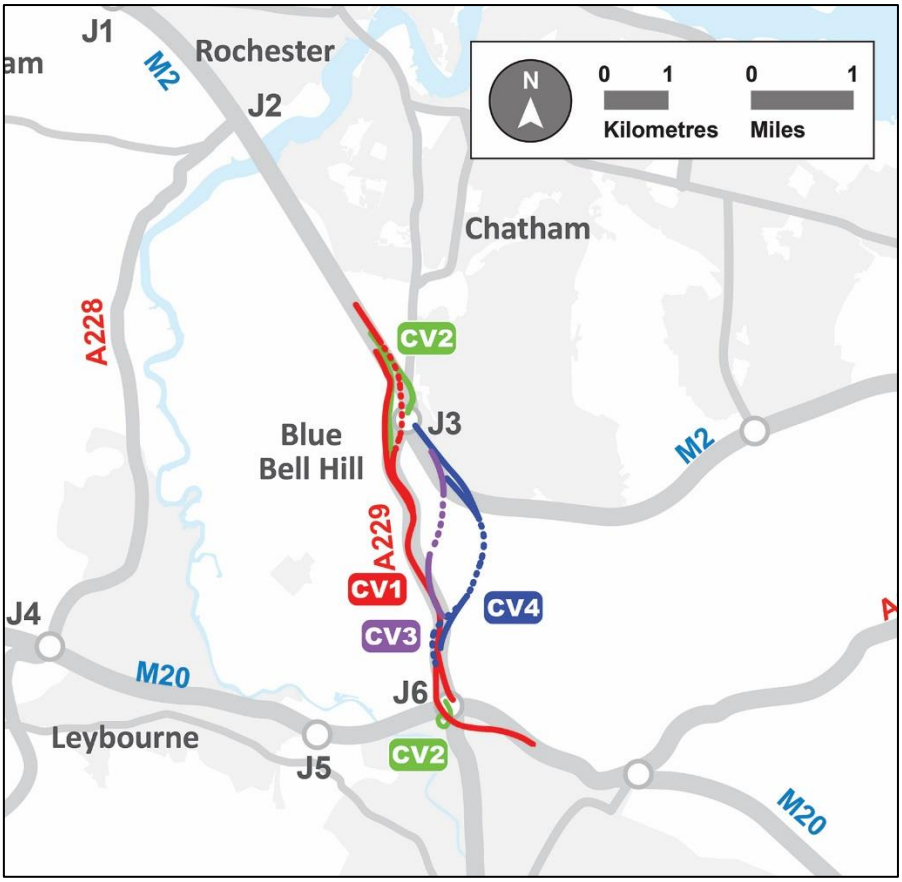

FIGURE 3.3 - C VARIANT - ALL ROUTE OPTIONS – PRE-LONGLIST

TABLE 3.1 - LOCATION C - COMBINATION OPTIONS

Route Reference	Route 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
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

3.2 Routes not Selected for Longlist

3.2.1 As part of the pre-longlist appraisal, initially a wide range of route options within Locations A, C and C Variant were considered, and an initial viability check undertaken considering technical feasibility and a high level appraisal against the scheme objectives. This resulted in the recommendation that eleven options should not be considered further and not included in the longlist as shown in **Table 3.2**. A more detailed justification for this recommendation is set out in **Appendix 3.2**.

TABLE 3.2 - ROUTE OPTIONS NOT SELECTED FOR LONGLIST

Route Option	Key Reason for Decision
A3 - Bluewater/ Lakeside corridor	High cost and complexity of construction directly impacting access to Bluewater and Lakeside shopping centres, and impact on new Eastern Quarry housing development
A5 - Double deck tunnel	Technical non-viability; insufficient space to create effective connections to existing roads
A6 – Two-lane bored tunnels east and west of existing crossing	Significant impact on existing development north and south of the river east of existing crossing
A7- Bored tunnel east	Significant impact on existing development north and south of the river east of existing crossing
A10 - Immersed tube tunnel east	Significant impact on existing development north and south of the river east of existing crossing
A11 - A2/ A13 connection (west)	Doesn't solve strategic traffic problem, too far from Dartford and too close to proposed TfL Belvedere crossing
A13 - Swanscombe Peninsular (east)	Impact on new development (London Resort Company Holdings site and Ebbsfleet Garden City)
C5 - East route	Significant environmental impacts on protected ecological sites (Ramsar, Special Protection Area (SPA)) and Cliffe Pools (RSPB)
C6 - Ebbsfleet junction connection.	Technical non-viability due to insufficient space to effectively connect to A2 and impact on new development (Ebbsfleet Garden City)
Cv3 – Bored tunnel and viaducts at M2 J3	Impact on Blue Bell Hill village and construction impact at M2 Junction 3
Cv4 – Two bored tunnels at M2 J3	Significant environmental impact and high cost of tunnels

3.2.2 Following the pre-longlist appraisal the longlist options were:

- A1, A2, A4, A8, A9, A12, A14, A15 and A16
- C1, C2, C3, C4 and their associated combination options
- Cv1 and Cv2

3.3 Routes not Selected for Shortlist

3.3.1 Following the pre-longlist viability check, the longlist comprised nine options at Location A, four at Location C and two for C Variant. These are shown in

Figure 3.4. The “combination options” referred to in paragraph 3.1.5 were also included in the longlist but are not shown in **Figure 3.4** for clarity.

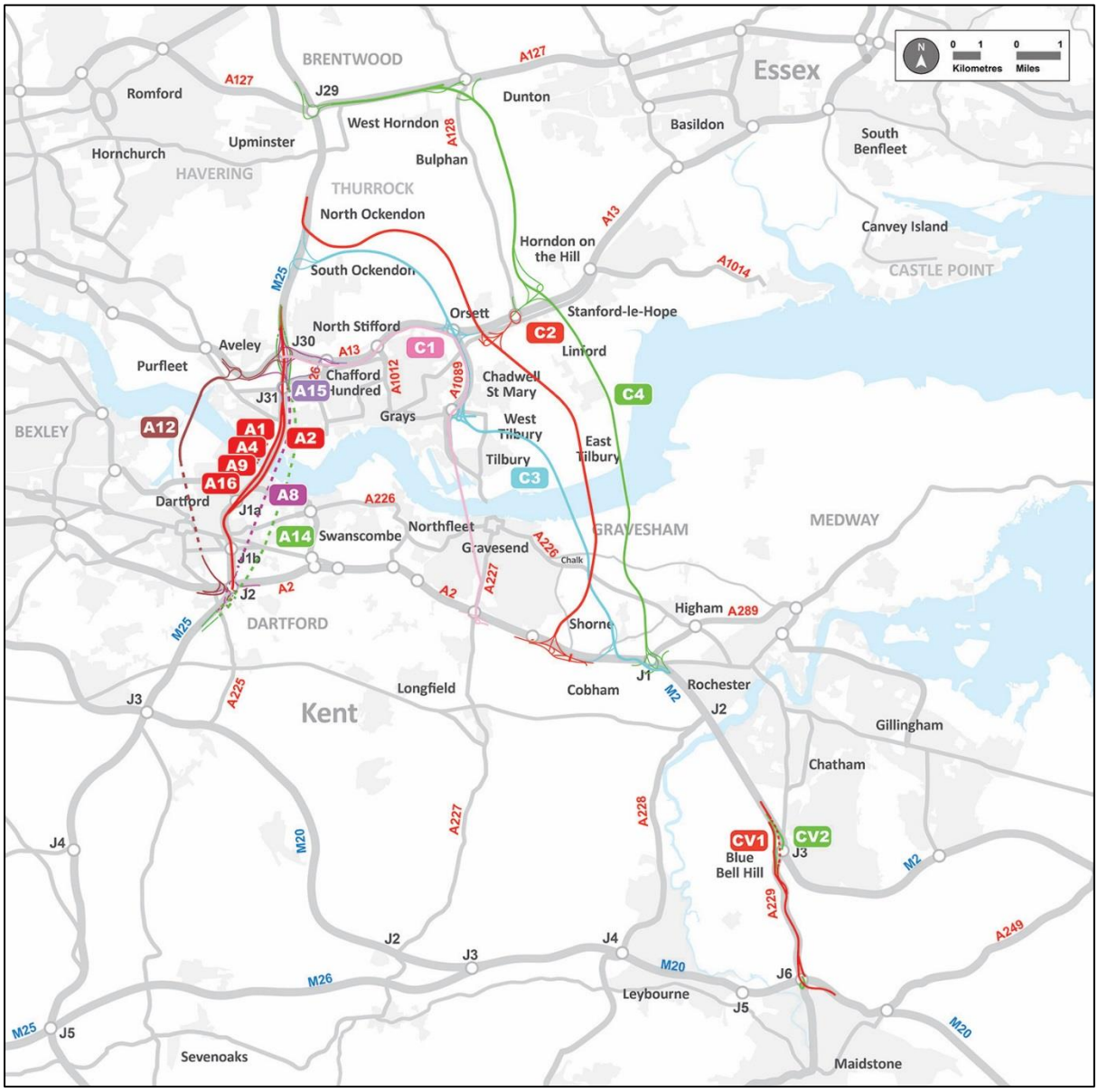

FIGURE 3.4 - PLAN OF LONGLIST ROUTES

3.3.2 The traffic model used for the appraisal of the longlist options was the LTC Version 1, as described in Volume 5 of the Post-Consultation SAR.

3.3.3 The longlist appraisal was carried out in two stages. The first stage involved appraisal against the following criteria:

- Value for money (cost against economic benefit).
- Significant environmental impact.
- Other significant impacts (e.g. congestion, network resilience, impact on planned or existing developments).

The above criteria were based on the scheme objectives (refer to Section 2.4 for references). The first criterion included objectives Ec2 and Ec3, the

second criterion was objective En1 and the third criterion included objectives Tr1, Tr2 and Ec1.

3.3.4 Following this first stage appraisal three route options (A8, A12 and A14) were not considered to be viable and the section of Route Option C3 south of the River Thames through Shorne Country Park was also not considered viable. This also resulted in combination options C11 to C14 not being selected as they included this section of Option C3. **Table 3.3** shows the route options and the key reasons for these conclusions. For more details of reasons for not selecting these options refer to **Appendix 3.2**.

3.3.5 Following the decision not to select the southern section of Route Option C3 through Shorne Country Park the route was modified to retain the same alignment north of the River Thames and include the same southern alignment and A2 junction as Route Option C2 (refer to **Figure 3.4** where Route Option C2 is shown in red). However, the designation of the option was kept as Route Option C3. This modified version of Route Option C3 was subsequently shortlisted (refer to paragraph 3.3.9).

TABLE 3.3 - LONGLIST ROUTE OPTIONS NOT SELECTED, FIRST STAGE APPRAISAL

Route Option	Key Reason for Decision
A8 - Long tunnel Junction 2 to Junction 30	Cost approximately more than twice A1. Very complex junctions required to connect A2 and A13 traffic with significant impact on existing property.
A12 - Western Route Junction 2 to Junction 30 tunnel under Dartford with bridge over river	Cost approximately three times A1. Poor economic benefits, significant impact on planned development at Purfleet. Potential impact on a Site of Special Scientific Interest (SSSI).
A14 - Long tunnel south of Junction 2 to north of Junction 30	Cost approximately more than twice A1. Poor level of economic benefit due to limited attraction of traffic.
C3 (southern section through Shorne Country Park)	Environmental impact on Shorne Country Park, affecting Area of Outstanding Natural Beauty (AONB), SSSI and ancient woodland. Reasonably practicable alternative available (southern section of C2).

3.3.6 The remaining route options could not be differentiated on the basis of the limited criteria set out in paragraph 3.3.3. A second stage of appraisal of the longlist was therefore carried out. This involved appraisal of the remaining route options against criteria considered to be significant in making the choice between these route options as set out in **Table 3.4**. The third column in **Table 3.4** shows which of the scheme objectives as set out in Section 2.4 each criterion relates to.

TABLE 3.4 - LONGLIST SECOND STAGE APPRAISAL CRITERIA

Main Criteria	Sub-Criteria	Scheme objective
Strategic	Fit with wider transport & government objectives	Ec1
	Fit with other (regional) objectives	
Economic	Travel time savings	Tr1 & Tr2
	Congestion	Tr1 & Tr2

Main Criteria	Sub-Criteria	Scheme objective
	Resilience	Tr2
	Accident benefits	Tr3
	Wider economic benefits	Ec1
	Impact on current/ planned infrastructure	Ec1
Environmental	Carbon emissions	En1
	Historic environment	
	Biodiversity	
	Landscape & townscape	
	Air quality	
	Noise	
	Water environment	
	Construction disruption	
Management	Implementation timetable	Ec3
	Practical feasibility	
Financial	Capital cost	Ec2 & Ec3
	Operation and maintenance cost	
Commercial	Revenue costs	Ec2

3.3.7 **Table 3.5** shows the route options that were not selected following the second stage of the longlist appraisal. In this table the most significant criteria from **Table 3.4** are noted in brackets after the reasons for the decision.

TABLE 3.5 - LONGLIST ROUTE OPTIONS NOT SELECTED, SECOND STAGE APPRAISAL

Route Option	Key Reason for Decision
A2 - Bridge east	Low value for money (limited benefits from travel time savings or congestion relief compared to capital cost). Significant impact on commercial property north and south of the river east of existing crossing (impact on current/ planned infrastructure). Impact on SSSI (biodiversity).
A9 - Immersed tube west	High technical risks, significantly more difficult to construct than other options (practical feasibility). Impact on river/ jetty operations unlikely to be acceptable to owners/ operators or Port of London Authority (PLA) (impact on current/ planned infrastructure & construction disruption).
A15 – Alternative Junction 30 improvement	Significant impact on commercial property around Junction 31 (impact on current/ planned infrastructure). Major high voltage overhead cable diversions required (construction disruption and implementation timetable).
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 (high capital cost and limited benefits from travel time savings or congestion relief).

Route Option	Key Reason for Decision
C1 – A2 junction south of Gravesend to M25 Junction 30. Long tunnel under Gravesend and Tilbury docks. Widening of A13.	Low value for money (high capital cost, low benefits from travel time savings). Poor resilience due to use of A13 (resilience). Potential impacts on Tilbury Docks from tunnelling under existing structures (impact on current/ planned infrastructure).
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	High cost (capital cost). Impact on scheduled monuments (historic environment). There are better, lower cost options available.
C Variant with A or C Option	C Variant has negligible effect in transferring M20 traffic from existing Dartford Crossing onto a new crossing at Location C. Significant impact on AONB (biodiversity and landscape). High capital cost (capital cost). Does not bring traffic and economic benefits that materially add value to the Lower Thames Crossing scheme. Further detail on non-selection of C Variant is provided in Section 3.4.

3.3.8 The element of Option C4 that resulted in its high cost and impact on the historic environment was the very long tunnel under the Ramsar site emerging close to Coalhouse Fort. The southern section of this option connecting to Junction1 of the M2 and the northern section running parallel to the A128 and then joining and widening the A127 were recognised as the reason that Option C4 had the highest economic benefits of all the Location C options. These sections were included in combination options C9 and C19 which were therefore included in the shortlist.

3.3.9 As a result of Options C1 and C4 not being included in the shortlist, combination options C7, C15, C16, C17 and C18 were not selected as they included parts of these main options. 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 combination options C8 and C10 (which include parts of Options C2 and C3) became redundant.

3.3.10 The appraisal of the longlist options is summarised in **Appendix 3.2**, which provides more detailed information on the reasons for selecting the shortlist. The options taken forward to the shortlist were: A1, A4, C2, C3, C9 and C19.

3.4 C Variant

3.4.1 C Variant would be an online widening of the A229, including significant junction improvements at M2 Junction 3 and M20 Junction 6, as shown in **Figure 3.5**. It could be combined with any C option but was appraised in combination with Option C2 with a bored tunnel crossing. This option was chosen as it was the option giving the highest benefits at the time of the appraisal. As C Variant was an incremental improvement its impact on the performance of any Location C option would have been similar. The additional capital cost of C Variant at out-turn would be £450m.

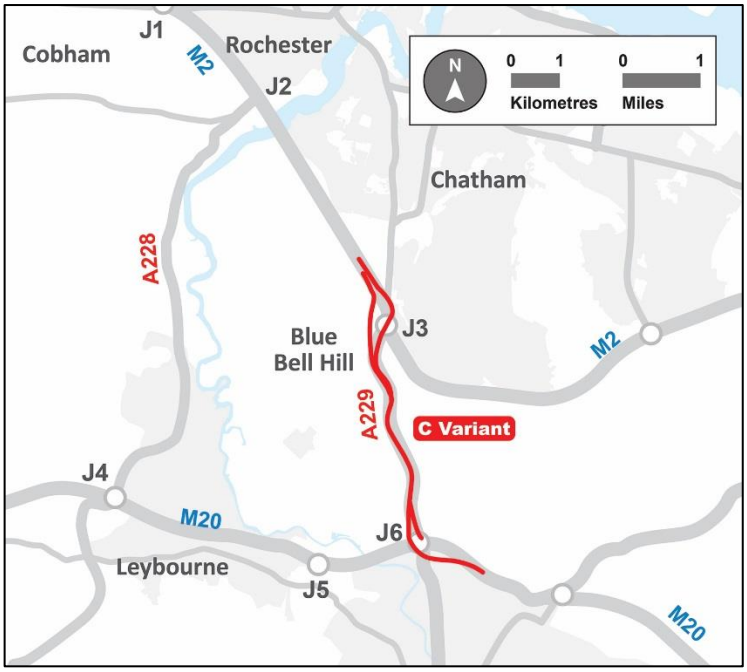

FIGURE 3.5 - C VARIANT

Traffic Appraisal

3.4.1 **Table 3.6** compares predicted flows in 2025 at the existing Dartford Crossing for Option C2 with and without C Variant. The traffic model used for the appraisal reported in this section was the LTC Version 1, as described in Volume 5 of the Post-Consultation SAR.

TABLE 3.6 - FLOWS AT EXISTING DARTFORD CROSSING (PASSENGER CAR UNIT (PCU)) IN 2025

		C2	C2 with C Variant
2025	AM Peak NB	5400	5400
	AM Peak SB	5300	5300
	PM Peak NB	5600	5600
	PM Peak SB	5200	5200

3.4.2 It can be seen that Option C2 combined with C Variant has no impact on reducing flows at the existing crossing over and above Option C2.

3.4.3 **Table 3.7** compares flows on the A229 in 2025 on the highest trafficked A229 link. With Option C2, flows on the A229 increase by up to 38%, compared to the Without Scheme scenario. The highest flow is 3400 in the PM peak (northbound).

TABLE 3.7 - FLOWS ON A229 (PCU) IN 2025

	Without Scheme	C2	C2 with C Variant
AM Peak NB	2400	3300	4800
AM Peak SB	2600	3300	4700
PM Peak NB	3400	3400	4900
PM Peak SB	2900	3000	4500

3.4.4 C Variant combined with C2 increases flows on the A229 by up to 100%, with a maximum flow of 4900 in the PM peak (northbound). Widening of the A229 would lead to significant additional traffic on the A229 link itself, but this would not help to transfer traffic from the existing Dartford crossing on to a new route at Location C. There is therefore not a compelling reason to widen the A229 as part of the Lower Thames Crossing scheme.

Environmental Appraisal

3.4.5 The key environmental impact associated with C Variant would be that on landscape. It requires the widening of the existing A229, which lies predominantly within a rural landscape and is almost entirely located within the nationally important Kent Downs Area of Outstanding Natural Beauty (AONB). The requirements of the NPSNN are relevant in considering the significance of the impact.

3.4.6 The NPSNN requires that for development proposed within nationally designated areas *"Great weight should be given to conserving landscape and scenic beauty in nationally designated areas. National Parks, the Broads and AONBs have the highest status of protection in relation to landscape and scenic beauty*

The Secretary of State should refuse development consent in these areas except in exceptional circumstances and where it can be demonstrated that it is in the public interest. Consideration of such applications should include an assessment of:

- *the need for the development, including in terms of any national considerations, and the impact of consenting, or not consenting it, upon the local economy*
- *the cost of, and scope for, developing elsewhere, outside the designated area, or meeting the need for it in some other way*
- *any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated*

There is a strong presumption against any significant road widening or the building of new roads and strategic rail freight interchanges in….AONBs, unless it can be shown there are compelling reasons for the new or enhanced capacity and with any benefits outweighing the costs very significantly. Planning of the Strategic Road Network should encourage routes that avoid National Parks, the Broads and Areas of Outstanding Natural Beauty.

3.4.7 It is therefore evident that not only would C Variant have a significant impact on a protected landscape but from a planning/ acceptability perspective the scheme carried a significant risk of refusal unless it met certain criteria. Other significant environmental factors are considered below.

3.4.8 The new junction arrangement at the northern connection with the M2 would have a major direct impact on the nationally important Bridge Woods ancient woodland. The existing A229 is located close to the Wouldham to Detling Escarpment Site of Special Scientific Interest (SSSI) which could be directly impacted by bridge expansion works. In addition, the internationally

important North Downs Woodlands Special Area of Conservation could be indirectly impacted due to decrease in air quality through increased traffic flow and it is already identified as a site that is very sensitive to nitrogen deposition. This has been raised as an issue in correspondence with Natural England.

3.4.9 This option could also have setting impacts on three nationally important scheduled monuments; Kit's Coty House Long Barrow, Little Kit's Coty House Megalithic Tomb and White Horse Stone. There could also be setting impacts on two nationally important Grade II Listed Buildings at Sandling and Tyland Farmhouse on Chatham Road.

Summary

3.4.10 Overall, C Variant does not help to transfer traffic from the existing Dartford Crossing on to the new route at Location C, and has substantial impacts on the Kent Downs AONB; there is no compelling reason for this widening, and in accordance with the NPSNN there is a strong presumption against such widening. As a result, C Variant does not meet the LTC scheme objectives, particularly the transport and environment and community objectives, and was not selected for the shortlist.

C Variant combined with an option at Location A

3.4.11 Whilst C Variant was primarily intended to be combined with an option at Location C it would also be possible to combine it with an option at Location A. A high level appraisal of C Variant combined with Option A1 or A4 was carried out and this showed that it would provide no additional benefit compared to the A option without C Variant. This option would have a high additional cost of £450m compared to Option A1 or A4. The widening of the A229 has substantial impacts on the Kent Downs AONB; there is no compelling reason for this widening, and in accordance with the NPSNN there is a strong presumption against such widening. As a result, C Variant combined with an option at Location A was not selected for the shortlist.

3.5 Shortlist Routes

3.5.1 Following shortlisting the routes were renamed for clarity and for the purpose of the remainder of this report route options will be referred to using the references set out in **Table 3.8** below. **Figure 3.6** shows the shortlist route options.

TABLE 3.8 - SHORTLIST ROUTES

Shortlist Route	Shortlist Reference	Previous Reference
Route 1 with Bridge	Route 1 (BR)	A1
Route 1 with Bored Tunnel	Route 1 (BT)	A4
Route 2 with WSL and Bridge	Route 2 WSL (BR)	C3 (BR)
Route 2 with WSL and Bored Tunnel	Route 2 WSL (BT)	C3 (BT)
Route 2 with WSL and Immersed Tunnel	Route 2 WSL (IT)	C3 (IT)
Route 2 with ESL and Bridge	Route 2 ESL (BR)	C3 (BR) and C19

Shortlist Route	Shortlist Reference	Previous Reference
Route 2 with ESL and Bored Tunnel	Route 2 ESL (BT)	C3 (BT) and C19
Route 2 with ESL and Immersed Tunnel	Route 2 ESL (IT)	C3 (IT) and C19
Route 3 with WSL and Bridge	Route 3 WSL (BR)	C2 (BR)
Route 3 with WSL and Bored Tunnel	Route 3 WSL (BT)	C2 (BT)
Route 3 with WSL and Immersed Tunnel	Route 3 WSL (IT)	C2 (IT)
Route 3 with ESL and Bridge	Route 3 ESL (BR)	C2 (BR) and C19
Route 3 with ESL and Bored Tunnel	Route 3 ESL (BT)	C2 (BT) and C19
Route 3 with ESL and Immersed Tunnel	Route 3 ESL (IT)	C2 (IT) and C19
Route 4 with WSL and Bridge	Route 4 WSL (BR)	C9 (BR)
Route 4 with WSL and Bored Tunnel	Route 4 WSL (BT)	C9 (BT)
Route 4 with WSL and Immersed Tunnel	Route 4 WSL (IT)	C9 (IT)
Route 4 with ESL and Bridge	Route 4 ESL (BR)	C9 (BR) and C19
Route 4 with ESL and Bored Tunnel	Route 4 ESL (BT)	C9 (BT) and C19
Route 4 with ESL and Immersed Tunnel	Route 4 ESL (IT)	C9 (IT) and C19

3.5.2 Following the shortlisting summarised in Section 3.4, the shortlist routes were further developed and refined. This development and refinement was a result of the receipt of further more detailed information, discussion with stakeholders (e.g. the statutory environmental bodies) and the provision of greater detail required for the detailed appraisals (e.g. land take boundaries). As a result of this work a number of refinements were made to the routes and these are described in Section 5.1 of Volume 3 of the Pre-Consultation SAR.

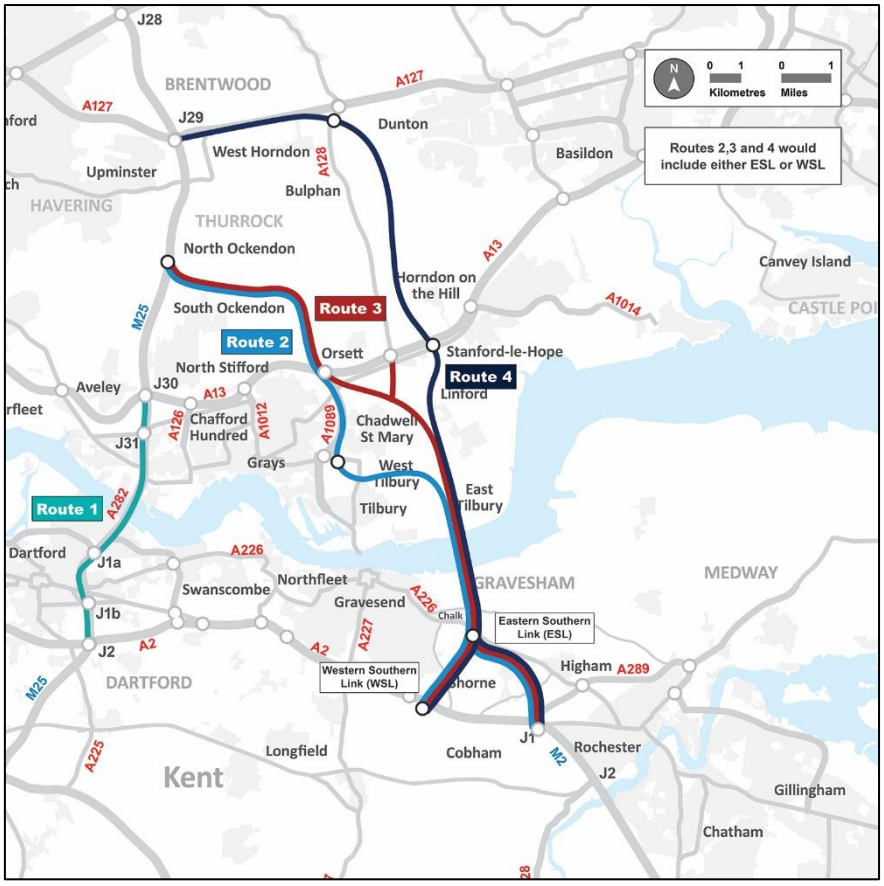

FIGURE 3.6 - SHORTLIST ROUTES

3.5.3 There were four principal shortlist routes, one at Location A and three at Location C. Each of these routes had a number of possible alternatives or sub-options, specifically the crossing type for all options and two southern link options with alternative A2/ M2 junction locations for the options at Location C.

3.5.4 The crossing types considered were:

- Bridge (all routes)
- Bored tunnel (all routes)
- Immersed Tunnel (Routes 2, 3 and 4. The immersed tunnel at Location A (Option A9) was not selected for the shortlist – refer to **Table 3.5**)

3.5.5 For shortlist Routes 2, 3 and 4 there were two possible junctions with the A2/ M2 with associated alignments south of the river. The first is to the east of Gravesend and the second is further east at A2/ M2 Junction 1. For the remainder of this report the two junctions and associated alignments south of the river are referred to as:

- Western Southern Link (WSL) (junction east of Gravesend)
- Eastern Southern Link (ESL) (A2/ M2 Junction 1)

3.5.6 The full list of 20 possible alternatives that were considered for the four shortlist routes is shown in **Table 3.8**.

3.6 Routes for Public Consultation

3.6.1 As a result of the appraisal reported in the Pre-Consultation SAR the 14 route option alternatives set out in **Table 3.9** were considered not to be viable and therefore were not included in the proposed route options at the 2016 public consultation. These are presented in **Table 3.9** along with the key reasons for the decisions not to select them. The reasons for the decisions are discussed and set out in more detail in Volume 7 of the Pre-Consultation SAR.

TABLE 3.9 - ROUTE OPTIONS NOT PROPOSED

Shortlist Route	Key Reason for Decisions
Route 1 (BR)	Performs poorly against the traffic related scheme objectives. Does not provide alternative route Would take at least six years to construct with significant delay and disruption Completed scheme would still be subject to 50mph speed limit Offers lower value for money than Location C options Performs poorly against other scheme objectives including safety, noise and air quality
Route 1 (BT)	
Route 2 WSL (BR)	There would be risk of significant effects to European Sites with both bridge and immersed tube solutions. The bored tunnel is therefore the only viable crossing alternative at Location C as it meets the scheme objectives and is the least environmentally damaging alternative.
Route 2 WSL (IT)	
Route 2 ESL (BR)	
Route 2 ESL (IT)	
Route 3 WSL (BR)	
Route 3 WSL (IT)	
Route 3 ESL (BR)	
Route 3 ESL (IT)	
Route 4 WSL (BR)	
Route 4 WSL (IT)	
Route 4 ESL (BR)	
Route 4 ESL (IT)	

3.6.2 The routes taken to public consultation were therefore Routes 2, 3 and 4 each with a bored tunnel river crossing and either the WSL or ESL as shown in **Figure 3.7** and set out in **Table 3.10**.

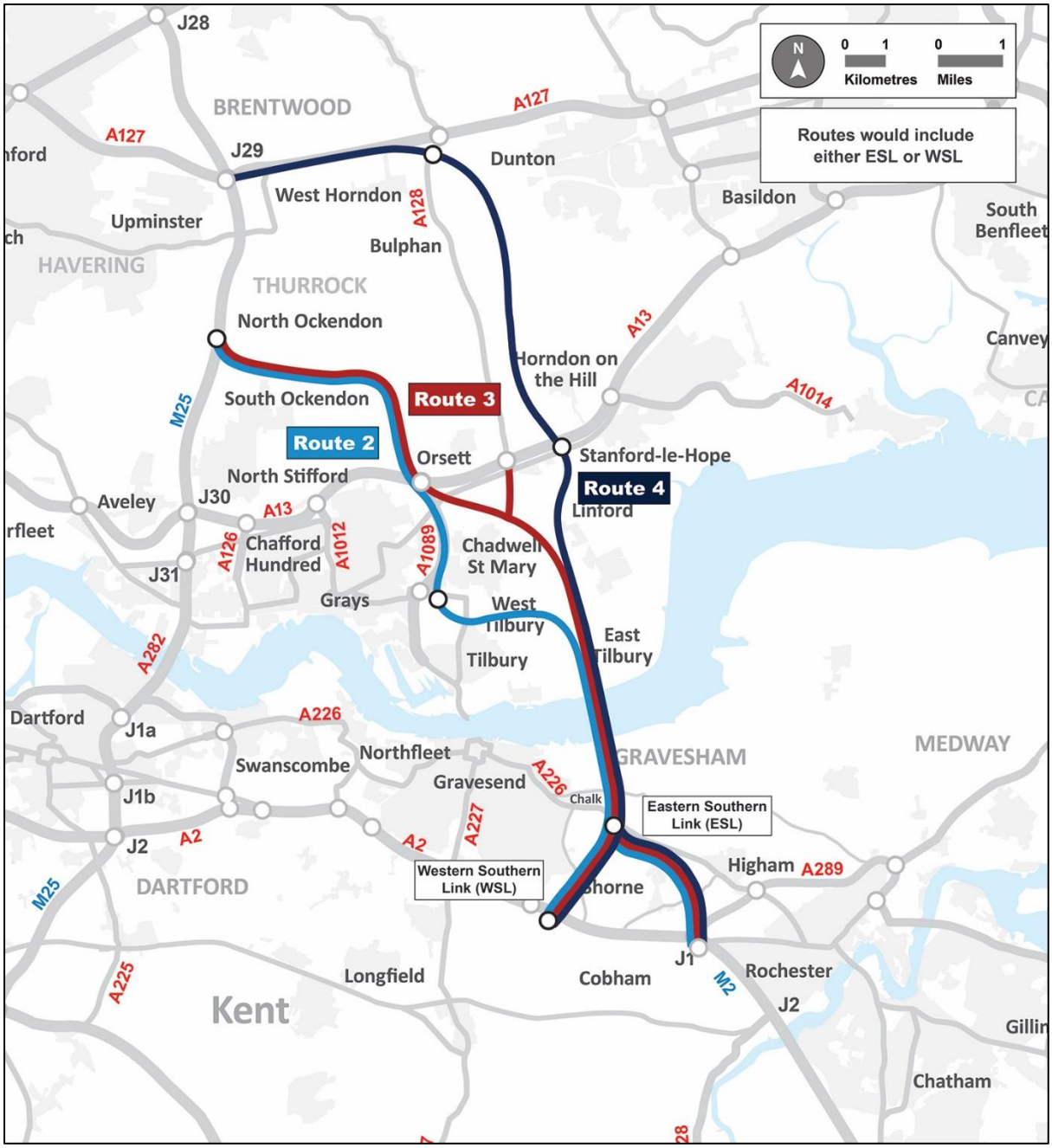

FIGURE 3.7 - PROPOSED ROUTE OPTIONS AT PUBLIC CONSULTATION

TABLE 3.10 - PROPOSED ROUTE OPTIONS AT PUBLIC CONSULTATION

Public Consultation Route	Shortlist Reference
Route 2 with WSL and Bored Tunnel	Route 2 WSL (BT)
Route 2 with ESL and Bored Tunnel	Route 2 ESL (BT)
Route 3 with WSL and Bored Tunnel	Route 3 WSL (BT)
Route 3 with ESL and Bored Tunnel	Route 3 ESL (BT)
Route 4 with WSL and Bored Tunnel	Route 4 WSL (BT)
Route 4 with ESL and Bored Tunnel	Route 4 ESL (BT)

3.6.3 The Highways England proposed scheme for public consultation was Route 3 with the ESL as shown in **Figure 3.8**. The detailed reasons for selecting this option as the proposed scheme are set out in Section 7 of Volume 7 of the Pre-Consultation SAR.

3.6.4 In summary the proposal was made on the grounds that this option:

- Provided the best economic benefits of all the shortlist routes evaluated.
- Reduced traffic at Dartford and therefore reduced congestion.
- Could be constructed largely off-line avoiding the disruption which would be caused by online works at Location A or on the A1089 with Route 2 and A127 with Route 4.
- Provided network resilience through a second independent crossing of the Thames.
- Provided a “motorway-to-motorway” experience for drivers.
- Reduced the air and noise pollution along the existing A282 corridor at Dartford, whilst recognising that there were environmental impacts in the vicinity of the new scheme, including noise and air quality on communities alongside the proposed scheme.
- Would provide a new strategic link to the local, regional and strategic road network, increasing resilience and addressing future increases in traffic demand.

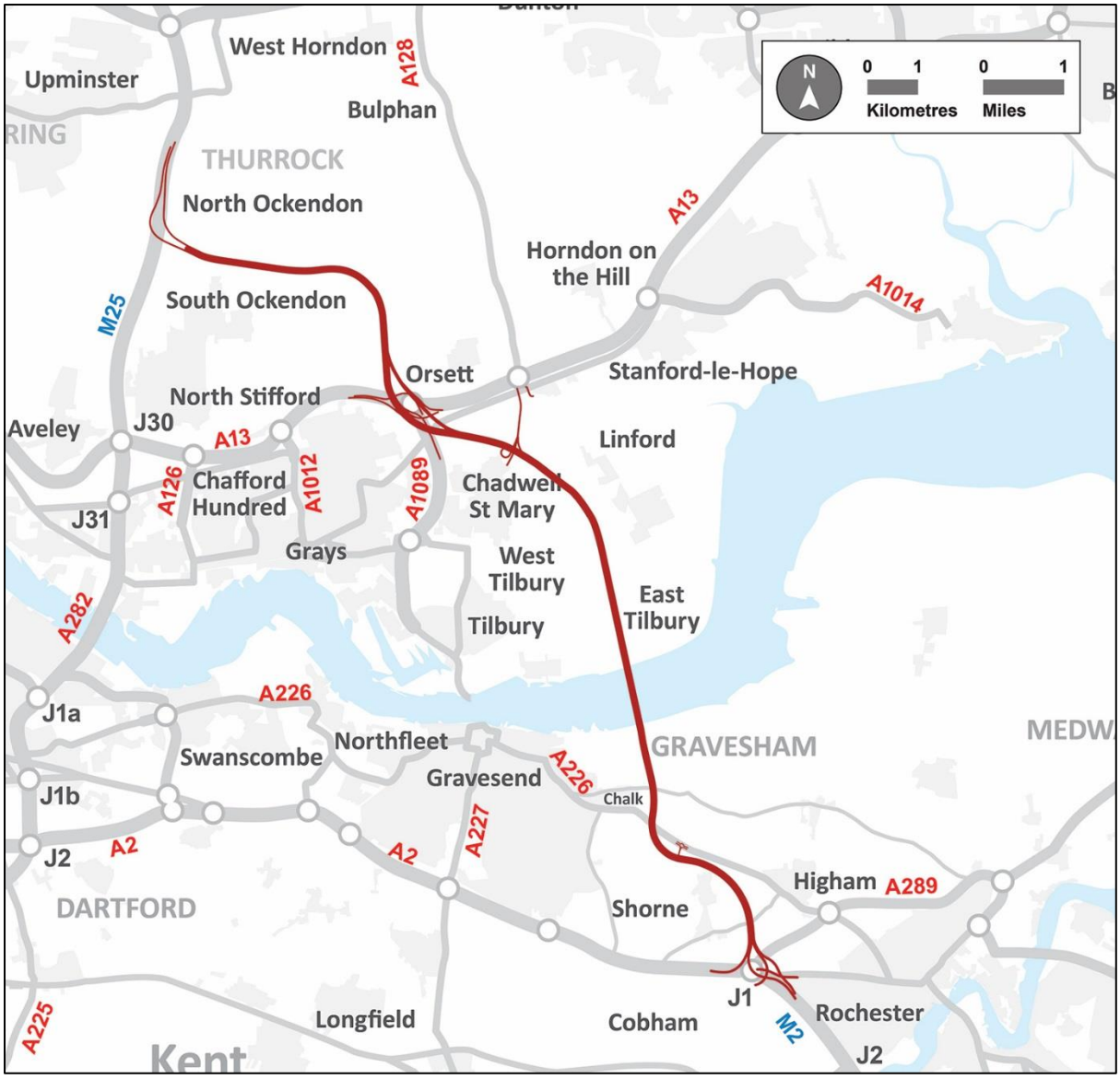

FIGURE 3.8 - HIGHWAYS ENGLAND'S PROPOSED SCHEME AT PUBLIC CONSULTATION

4 Pre-Consultation Stakeholder Engagement

4.1 Approach to Engagement

4.1.1 The project undertook early engagement starting in September 2014 to determine constraints and priorities which would affect the identification and development of feasible options for a new Lower Thames Crossing. A planned and focused approach to engagement has been adopted to ensure high quality and meaningful engagement. This provided opportunities for sharing complex and technical information and facilitated relationship building with opportunities for further engagement. Key stakeholders for this purpose were local authorities, statutory and environmental bodies, statutory undertakers (utilities) and businesses which might be affected. The public and stakeholders had the opportunity to share their views on the options through the public consultation that took place in early 2016. The public consultation is summarised in Sections 5 and 6 of this Volume 3.

4.2 Stakeholder Advisory Panel

4.2.1 The Stakeholder Advisory Panel (SAP) was originally convened by the Department for Transport (DfT). It was reconvened for the options phase of the project with the first meeting held in December 2014. The purpose of the SAP is to help Highways England draw upon local knowledge and understand stakeholders' needs, priorities and opinions with respect to a new crossing of the Lower Thames. The panel meets at key stages in the project and is designed to be a consultative and advisory group, currently comprising officers of the organisations listed in **Table 4.1** below:

TABLE 4.1 - STAKEHOLDER ADVISORY PANEL MEMBERS

SAP Members	
Basildon Borough Council	Maidstone Borough Council
Brentwood Borough Council	Medway Council
Dartford Borough Council	South East Local Economic Partnership (SELEP)
Ebbsfleet Development Corporation	Southend Borough Council
Essex County Council	Thames Gateway Kent Partnership
Gravesham Borough Council	Thames Gateway South Essex Partnership (TGSEP)
Kent County Council	Thurrock Council
London Borough of Bexley	Tonbridge and Malling Borough Council
London Borough of Havering	Transport for London

4.2.2 Bilateral meetings were also held with officers and representatives of SAP member organisations to obtain information on existing highway networks, development plans, information to feed into the traffic model and any other constraints that could potentially affect route option selection.

4.2.3 During the options phase SAP meetings were held at key stages in the project to share and discuss the emerging findings of the options

development and appraisal work. The project team explained the staged approach to appraisal and criteria for each stage of the options phase, seeking feedback on the process through the post-SAP bilateral meetings.

4.2.4 As the project moved through the options phase, SAP members were given the opportunity to provide feedback on the proposed routes at key stages including the emerging longlist, longlisted routes, emerging shortlist, shortlisted routes and the proposed approach to consultation. The views of SAP members have been considered throughout the options phase.

4.2.5 The project has also sought to engage council leaders and MPs in directly affected and neighbouring areas.

4.3 Statutory and Environmental Bodies

4.3.1 Throughout the options phase, the project has engaged with statutory and environmental bodies to share the emerging findings of the options process and provide an overview of the approach to the environmental appraisal of the routes. These bodies comprise the Environment Agency (EA), Historic England, Natural England and the Marine Management Organisation; with involvement from the Kent Downs Area of Outstanding Natural Beauty, Essex and Kent County Archaeologists and the Greater London Archaeology Advisory Service who have been engaged through bilateral meetings. Meetings have also been held with the Royal Society for the Protection of Birds and ornithological data has been obtained from the British Trust for Ornithology.

4.3.2 Through this engagement the project has gained a detailed understanding of the environmental constraints associated with each of the route options. Discussions held covered issues including ecological impact, flood risk, hydrodynamic impact and potential mitigation. The approach to the Habitats Regulations Assessment was also discussed.

4.4 Industry and Utilities

4.4.1 Key major industry stakeholders have been identified to seek important technical information including constraints associated with existing assets and future development plans. Organisations approached included Port of London Authority, London Gateway Port, Network Rail, HS1, RWE npower, National Grid, UK Power Networks, Tilbury Docks, Lafarge-Tarmac, Hanson, Peel Ports, C.RO Ports, Vopak, London Resort Company Holdings and the Port of Dover.

4.4.2 The project has also engaged with wider industry stakeholders comprising prominent local businesses from the ports, logistics and retail sectors, along with the Kent and Essex Chambers of Commerce. Briefing sessions have been held to inform small to medium sized enterprises on the aims of the project and bilateral meetings have been used to raise awareness and to obtain valuable insight on the needs of the business community. Information obtained in these meetings has informed the refinement of the route options.

4.4.3 Preliminary enquiries have been made to utility companies about the locations of their assets to assist with understanding the impact of these assets on the proposed route options. Follow up discussions have been held

with the owners of assets potentially significantly impacted by the proposed routes to understand possible diversion costs and lead times.

5 Public Consultation Process and Summary of Findings

5.1 Route Consultation 2016

5.1.1 The consultation started on Tuesday 26 January 2016 and closed at 23:45 on Thursday 24 March 2016. The consultation aimed to inform as many people as possible about the scheme and obtain feedback on the proposals, to inform further detailed work and to make a recommendation on a preferred route to the Secretary of State for Transport.

5.1.2 The 2016 consultation was a non-statutory consultation. This means that there was no statutory basis or requirement for the consultation, and consequently there were no rules or requirements under legislation that the consultation had to meet. Instead, in carrying out the consultation Highways England was guided by Government guidance on consultation, best practice and lessons learned from other major consultations, and the principles for a lawful consultation that have been established by the courts. For further details of the approach to consultation, refer to **Appendix 3.3**.

5.2 What was Consulted on

5.2.1 This consultation specifically invited views on the proposals below using a questionnaire with 21 questions (including personal details etc.). The questions including numbers are summarised below. A copy of the questionnaire is included in **Appendix 3.3**.

- A crossing at Location C (question 5). This question also included the opportunity to comment on other routes that people might favour, thus providing an opportunity to state a preference for options at Location A or elsewhere.
- Routes north of the river - three route options were identified north of the river connecting a crossing at Location C with the M25 (Routes 2, 3 and 4) (questions 6 and 7).
- Routes south of the river - two route options were identified south of the river, connecting a crossing at Location C with the A2/ M2 (ESL and WSL) (questions 8 and 9).
- Highways England's proposed scheme – Route 3 with a bored tunnel at Location C and the ESL (question 10).
- Additional junctions – whether additional junctions with the existing road network would be beneficial (question 11).
- Any other comments on the proposals (question 12).
- Feedback on the consultation itself (questions 13 and 14).

5.2.2 The routes consulted on are shown in **Figure 5.1**.

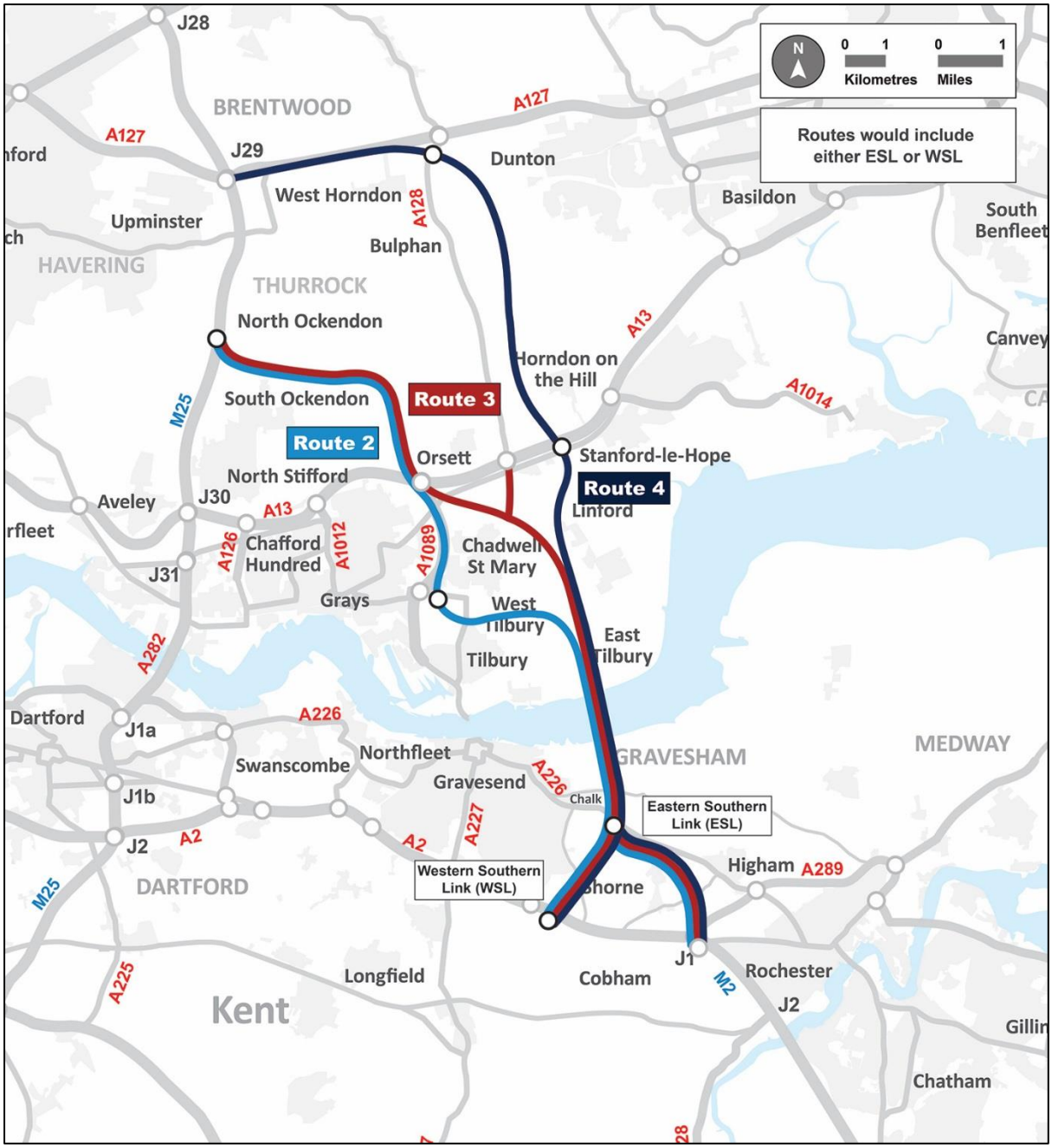

FIGURE 5.1 - CONSULTATION ROUTES

5.3 Methods and Materials used in Consultation

5.3.1 A variety of material was made available, digitally and in hard copy form, to ensure the public had access to the information needed to consider the options presented and respond to the consultation accordingly. A summary of methods and materials used in consultation is included in this section, for further details refer to **Appendix 3.3**.

5.3.2 **Online** - The primary means of accessing consultation material was online via the Citizen Space consultation platform, linked from the Highways England website (www.lower-thames-crossing.co.uk).

5.3.3 **Hard copies of consultation material** - Consultation materials were made available at a series of deposit locations as identified in **Figure 5.2** below. Materials were restocked throughout the consultation period.

5.3.4 **Public information events (PIEs)** - Highways England held a total of 24 PIEs in 20 locations over a six-week period in Kent, Essex and the London Boroughs of Bexley and Havering, as shown in **Figure 5.3**. Almost 13,000 people attended the PIEs over the consultation period.

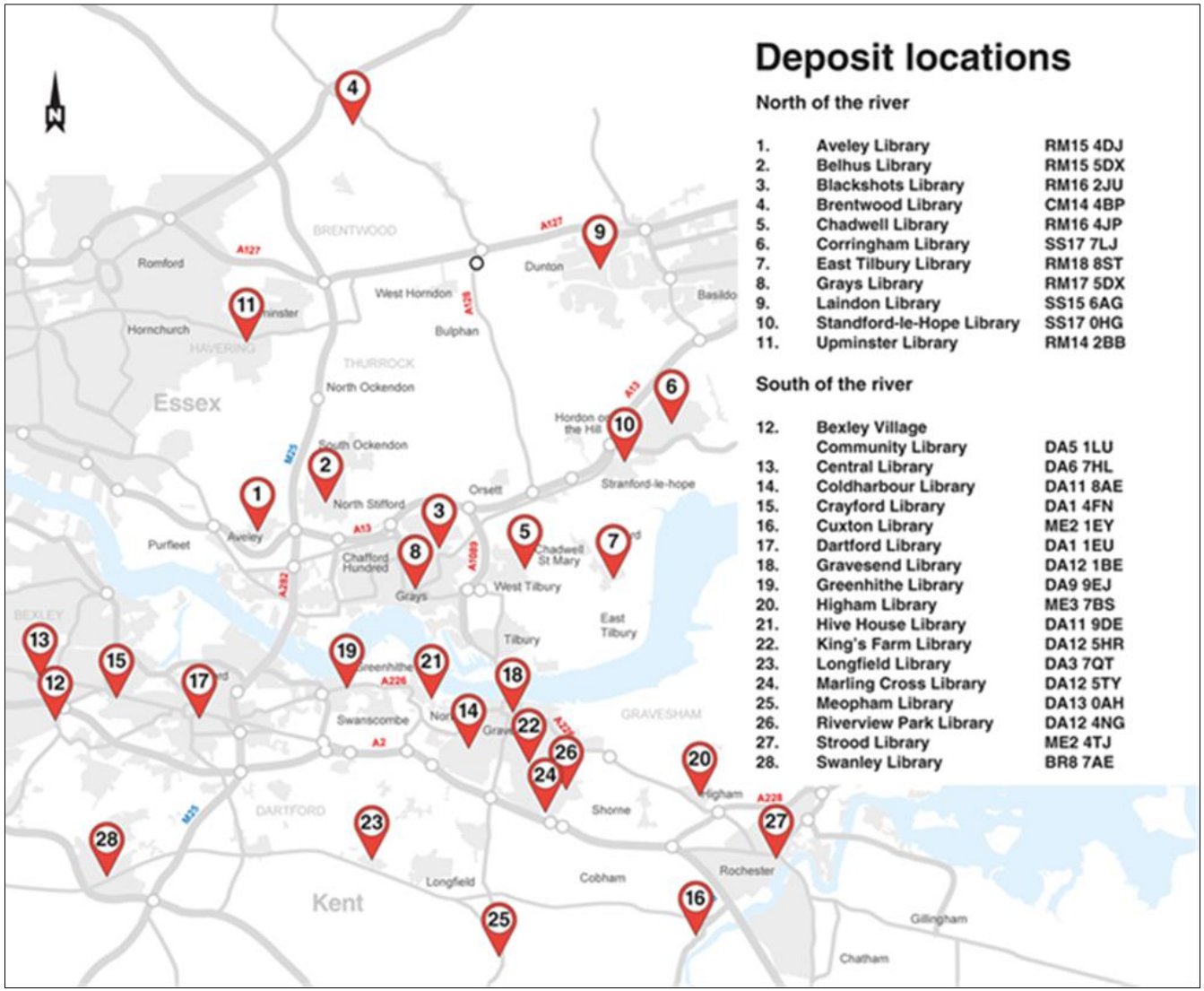

FIGURE 5.2 - DEPOSIT LOCATIONS

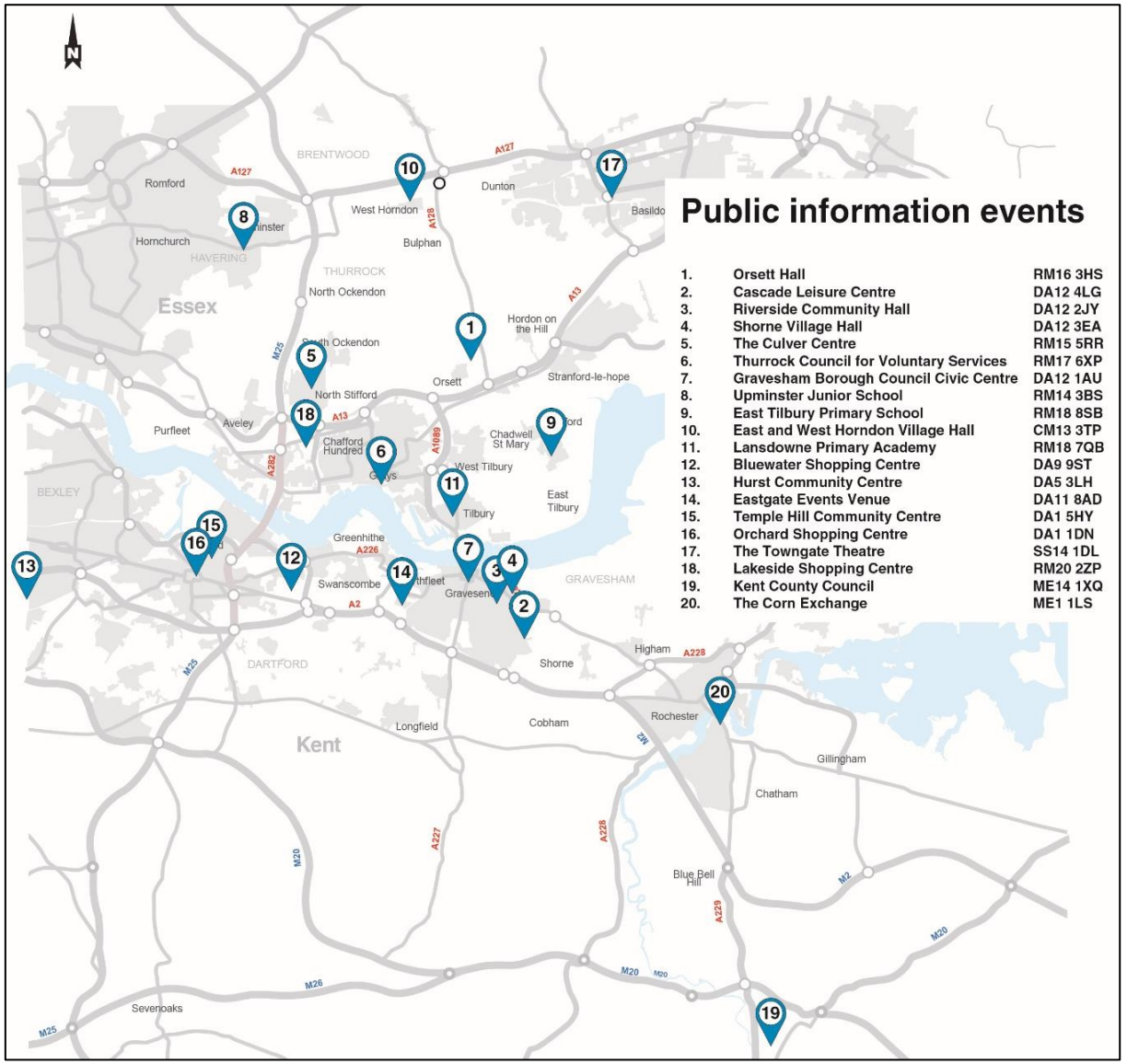

FIGURE 5.3 - LOCATION OF PUBLIC INFORMATION EVENTS

5.3.5 **Accessibility adapted events** - In response to a request from British Sign Language (BSL), Highways England held a special consultation event translated into BSL on 1 March 2016, 7:00 pm – 9:00 pm at the Towngate Theatre, Basildon (Essex).

5.3.6 **Advertising** - A mix of hard copy and digital advertising was used. Further information can be found in **Appendix 3.3**.

5.3.7 **Local media** - Local and regional media was used across Kent and Essex to publicise the consultation.

5.3.8 **Posters** - Bus stop and roadside posters were distributed in locations around Dartford, Gravesham and Thurrock. Digital posters were also placed in 10 petrol station forecourts.

5.3.9 **Leaflets** - Leaflets were distributed via two door-drop distributions to households and businesses in post codes within at least two kilometres from the proposed routes at Locations C and A. Additional post codes were added to capture areas affected by the C Variant proposal. In total the leaflet distribution comprised over 240,000 targeted door-drop distributions to residential properties and over 10,000 businesses.

5.3.10 **Letters to Landowners -** A total of 385 letters were sent to landowners or businesses potentially directly affected by the proposals.

5.3.11 **Dart Charge Account Holders -** Emails were sent to over 900,000 Dart Charge Account Holders (supplemented by 2,463 letters to account holders who requested postal contact only) and over 11,500 subscribers (via GOV.UK website) of LTC scheme updates.

5.3.12 **Social media -** Over 3,500 tweets mentioned LTC in some way during the consultation.

5.3.13 **Customer Contact Centre** - Over 1,300 telephone and email queries were received during the consultation period.

5.4 Process for Capturing Consultation Responses

5.4.1 Highways England appointed Ipsos MORI Social Research Institute, a wholly independent research and analysis organisation, to undertake analysis of responses. As part of their independent assurance, the consultation questionnaire was reviewed by Ipsos MORI to ensure questions were impartial and not leading.

5.4.2 The independent analysis of the consultation responses is contained in the Ipsos MORI report *Lower Thames Crossing Consultation: Analysis of findings report.*

5.4.3 In line with the Government Digital Strategy, Highways England directed respondents to the Citizen Space online consultation platform. This platform contained links to the consultation material and a link to the secure online survey.

5.4.4 Once the questionnaire was completed and submitted, respondents received an automatically generated response reference ID. If the respondent provided their email address, he or she could elect to receive a copy of their response via email. This process allowed Highways England to comply with

the Data Protection Act and Government standards for handling personal data.

5.4.5 In some instances respondents could not, or chose not to, respond via Citizen Space. In this situation, a hard copy version of the questionnaire, printed with unique serial numbers, and accompanying freepost envelope were made available.

5.4.6 Respondents were not limited to using the questionnaire. People responding to the consultation were also able to send their own written response via the freepost address or by email directly to Ipsos MORI. These were also analysed to identify the issues raised.

5.4.7 The ways in which people could respond to the consultation were heavily publicised and made clear in the consultation material. If these channels were not used during the consultation period it could not be guaranteed that the response would be included in the independent consultation analysis report.

5.4.8 Responses sent to other organisations such as the DfT or to the Prime Minister could not be guaranteed to be included in the analysis. As many of these responses as possible have been collected to include them in the consultation response analysis.

5.5 Response to Consultation

5.5.1 47,034 people and organisations responded to the Lower Thames Crossing consultation, making it the largest ever public consultation for a UK road project. The number of responses to the consultation received through each channel are set out in **Table 5.1**.

TABLE 5.1 - TABLE OF CONSULTATION RESPONSES

Respondent Type	Response Method	Total
Members of the public	Online questionnaire	29,516
	Paper questionnaire	2,792
	Letters and emails	916
Campaigns	Online questionnaire	0
	Paper questionnaire	942
	Letters and emails	12,342
Organisations and groups[1]		523
Petitions		3
Consultation Total		**47,034**

[1] The number of responses by organisations and groups is the total across all channels: online questionnaire, paper questionnaire, letters and emails

5.5.2 46,511 responses were received from people who classified themselves as members of the public and 523 responses from those who classified themselves as an organisation or group.

5.5.3 Organisations or groups who responded to the consultation include elected representatives, action groups, transport groups, community groups, local authorities, public bodies and businesses. These respondents have particular relevant specialist knowledge (such as local authorities or environmental organisations), represent the interests of a large group of people or represent organisations for whom the continuous smooth functioning of the road network is important to the operation of their business. A full list of these stakeholders is provided in Appendix C of the Ipsos MORI *Analysis of findings report*.

5.5.4 13,284 responses were received from 14 different campaigns. A campaign response is an identically worded response that has been received from a group of people. These responses are included in the overall number of responses that were received but are summarised separately from those responses received from members of the public or organisations using the questionnaire. Three petitions were received with a combined total of 188 signatories.

5.5.5 The geographic spread of public responses has been analysed based on respondents' postcodes, which were supplied in 97% of questionnaire responses. These responses were plotted on a map of the country to show their geographical spread, as shown in **Figure 5.4.** Not only does the map show the concentration of responses from the directly affected areas of south Essex and north Kent but it also shows the wide distribution of responses from across the country, reflecting the national importance of the project.

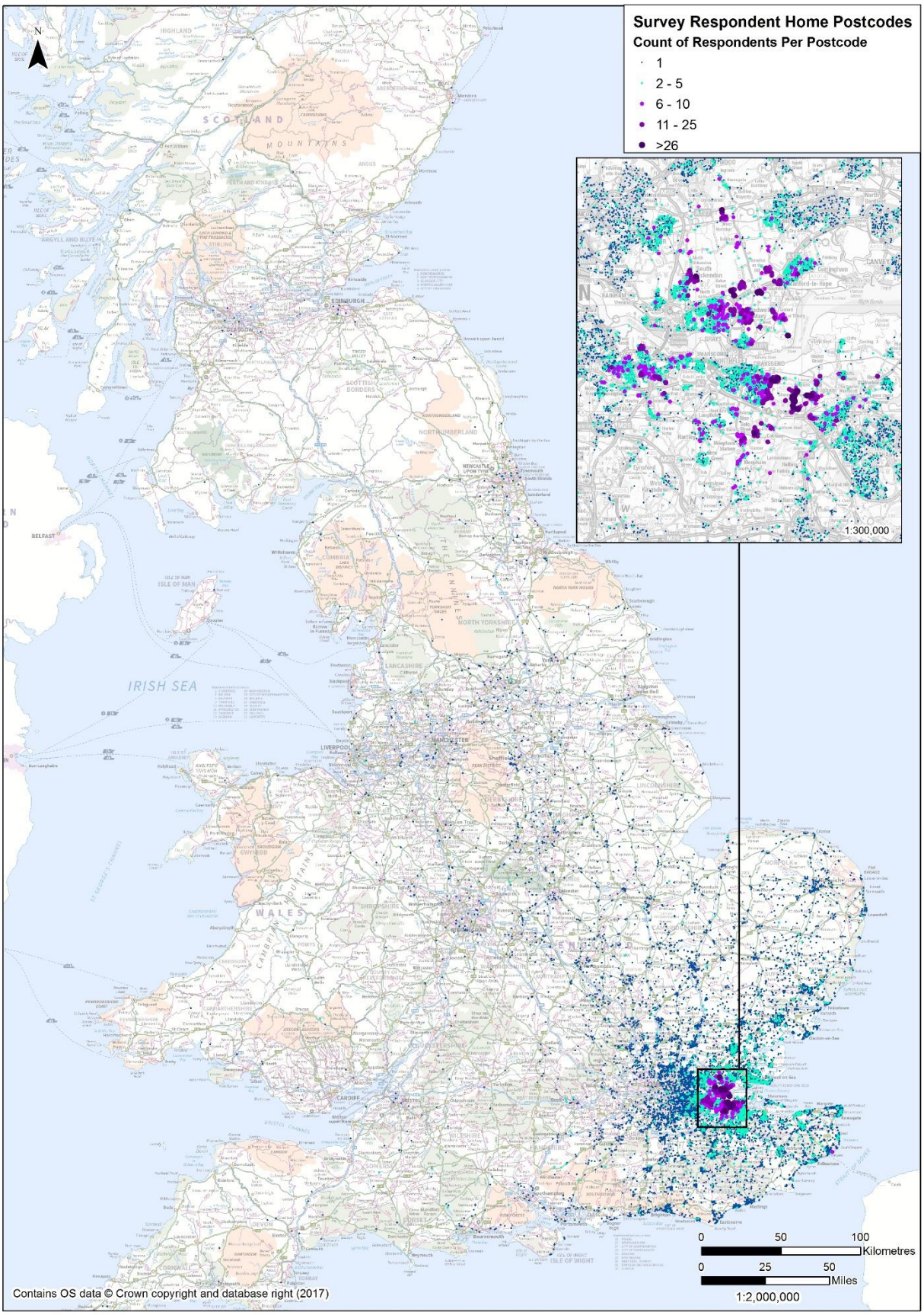

FIGURE 5.4 - DISTRIBUTION OF PUBLIC RESPONSES

5.6 Summary of Consultation Responses and Findings

5.6.1 Extensive analysis of the responses to consultation has been undertaken to consider the large number of responses received and to identify the comments and issues raised that have emerged from the consultation.

5.6.2 Ipsos MORI undertook an independent analysis of the consultation responses. Closed question responses from members of the public and groups and organisations using the questionnaire (e.g. multiple choice "tick box" format) were counted up and totalled. The open question responses (which contained the free text comments) were each analysed to identify the themes emerging from the consultation.

5.6.3 Highways England worked alongside Ipsos MORI to consider the large number of responses received. A code frame was developed to capture free-text comments, answers and responses and to match these against standard codes. This allowed systematic statistical and tabular analysis of the responses.

5.6.4 In parallel, the detailed responses were analysed and reviewed by Highways England to identify the consultation themes arising. The issues identified in the responses were checked, challenged and validated against the code frame. Consultation themes were identified qualitatively from a range of factors including:

- Frequency of response
- Potential traffic/ highways implications
- Potential environmental and community impacts
- Strategic importance
- Relevance to route selection
- Importance to the DCO application

5.6.5 The consultation themes identified from the analysis described above were considered in the updated appraisal of the Post-Consultation Appraisal Routes and in making the recommendation to Government on the preferred route. They will also be considered during the further development of the scheme. The themes and Highways England's responses to the issues raised in those themes are set out in Section 6.

5.6.6 A range of feedback on the proposals was received in response to the consultation, including supportive and neutral comments as well as objections, issues and concerns. Ipsos MORI's analysis of the consultation responses is contained in their report *Lower Thames Crossing Consultation: Analysis of findings report.* A summary of the consultation feedback is provided in the sections that follow. Details of the questions referred to are given in paragraph 5.2.1

5.7 Location and Crossing Type

5.7.1 There were 32,872 members of the public who answered question 5a about the proposal for a crossing at Location C. Their responses are shown in **Figure 5.5**. In total, 60% of those who responded to this question (19,729)

agreed with a crossing at Location C, compared with 36% who responded (11,998) who did not.

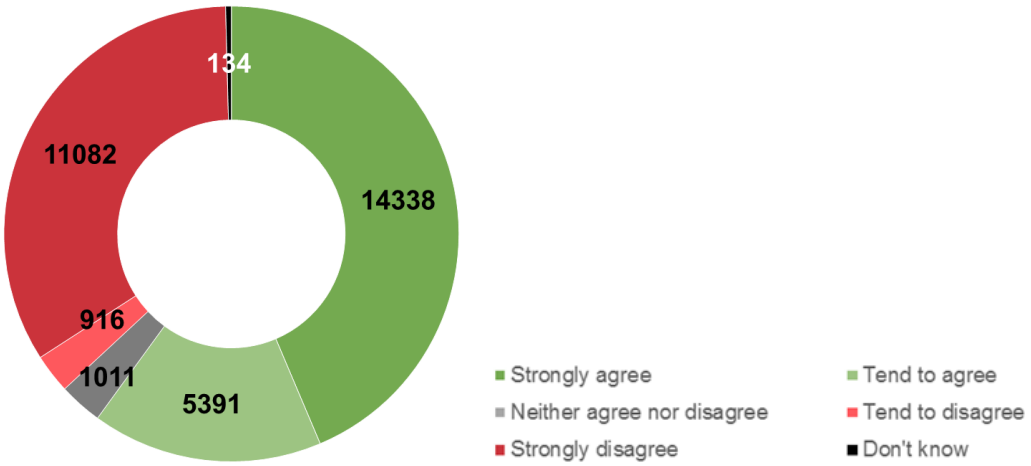

FIGURE 5.5 - PUBLIC RESPONSE ON CROSSING AT LOCATION C

5.7.2 Opposition to the proposed crossing location primarily stemmed from the potentially affected communities in Thurrock and Gravesham.

5.7.3 The consultation questionnaire also included the opportunity to comment on other routes that people might favour, thus providing an opportunity to state a preference for options at Location A or elsewhere. Comments on options at Location A could be based on the information included in the consultation materials. This included information in the Pre-Consultation SAR on the appraisal carried out, to the same level of detail as that for the Location C options, and the reasons for not presenting these options in the public consultation. Responses were received from 1,760 members of the public in response to Question 5b explicitly supporting a new crossing at Location A with 1,165 explicitly opposed. Nearly 14,000 people made a comment in favour of Location C with 10,000 statements in opposition.

5.7.4 Two of the directly affected local authorities, Gravesham Borough Council and London Borough of Havering, supported a crossing at Location A and opposed a crossing at Location C. During the PIEs the provision of a crossing at Location A was frequently raised in discussions.

5.7.5 A total of 447 groups and organisations answered question 5a about the location of the crossing. Their responses are shown in **Figure 5.6**. Again, the balance of opinion amongst groups and organisations towards Location C was more supportive than critical.

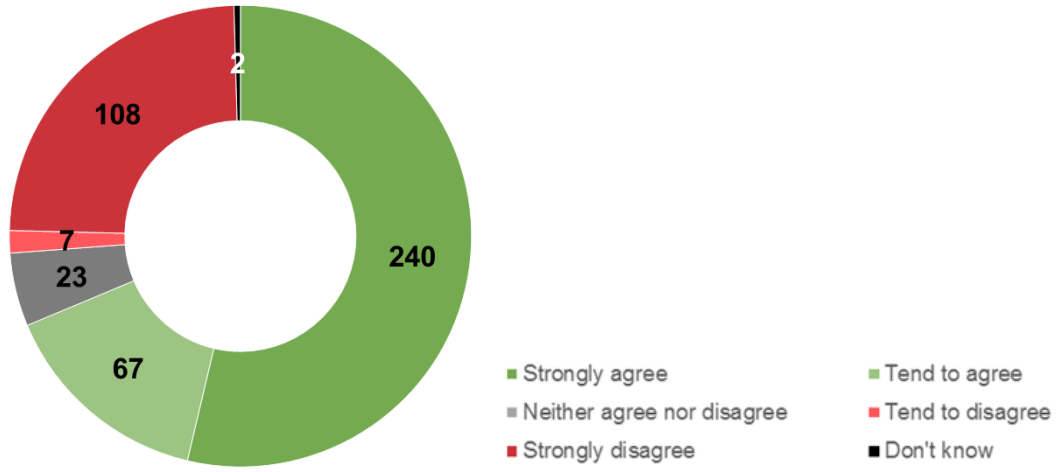

FIGURE 5.6 - GROUP AND ORGANISATION RESPONSE ON CROSSING AT LOCATION C

5.7.6 Local authorities, businesses and regional forums recognised the benefits of improved connections and the potential to relieve congestion at the Dartford Crossing. The County Councils of Essex and Kent along with Dartford Borough Council strongly supported Location C. Some supporters from this group stated that their support was conditional on the effective reduction of the possible effects of noise and pollution that could result from the construction of the new road.

5.7.7 A clear majority of business respondents supported Location C. Issues raised by the business community in support of a new crossing at Location C related to the unreliability of the existing crossing, the impact it has on their business operations and the resilience that a new crossing would bring. The business community also commented that a crossing at Location C would open up new opportunities, improve commuting times and stimulate growth in Essex and Kent.

5.7.8 Thurrock Council and Gravesham Borough Council along with Shorne Parish Council and the London Borough of Havering opposed Location C. Concerns were expressed about the ability of a route at Location C to reduce traffic on the existing Dartford Crossing over the long term. There were also concerns over the potential effect to the local road networks in their areas and the environmental impact of the proposed crossing, particularly the noise and air quality effects on local communities in those areas.

5.7.9 Thurrock Council's key objections were that the consultation process was flawed, the environmental harm that would be caused is not outweighed by the benefits, case tests have not been met regarding the rationale for the scheme, traffic movement data is out-of-date and that Highways England's proposed scheme is in conflict with Thurrock's strategic growth plan.

5.7.10 Gravesham Borough Council's key objections were that the consultation process was flawed and the objectives of alleviating traffic, noise and air quality problems from the current Dartford Crossing would not be met. The Council was also concerned over the major environmental and social impacts it would have on the community. The Council asked that options at Location A should be reconsidered, particularly those involving long tunnels.

5.7.11 The London Borough of Havering strongly supported Location A as it would be the most deliverable and least costly option, avoid Green Belt, have less impact on conservation areas and have the potential to support and facilitate growth in the London Riverside area. However, the Council recognised that Location A may not be viable and therefore reluctantly suggested that Routes 2 and 3 should be the subject of further appraisal rather than Route 4.

5.7.12 Special interest and environmental organisations were also concerned over the loss of green space and the potential effects on ancient woodland and marshland as well as animal and insect species.

5.7.13 The proposal for a tunnel generated little reaction in consultation. In terms of specific stakeholders, the EA agreed with the bored tunnel proposal. Natural England agreed that the bored tunnel would be the least environmentally damaging river crossing option and the Port of London Authority supported a bored tunnel crossing.

5.8 Route North of the River

5.8.1 There were 32,381 members of the public who answered question 6a about the routes north of the river on the questionnaire. Their responses are shown in **Figure 5.7**. Route 3 was the most favoured route, with respondents least likely of all to choose Route 2.

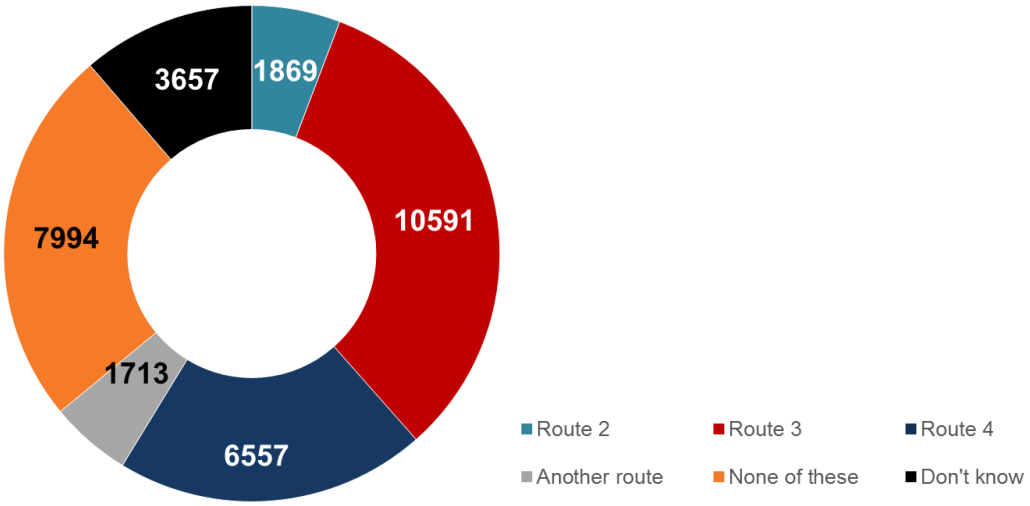

FIGURE 5.7 - PUBLIC RESPONSE ON ROUTE NORTH OF RIVER

5.8.2 The three route options north of the river would directly affect Thurrock and this was reflected in the fact that over half of the responses from members of the public from Thurrock said “None of these” rather than nominating one of the routes offered in the consultation.

5.8.3 A total of 432 groups and organisations answered question 6a about the routes north of the river. Their responses are shown in **Figure 5.8**. Route 3 was the most popular option for a route north of the River Thames, followed by Route 4 and then Route 2.

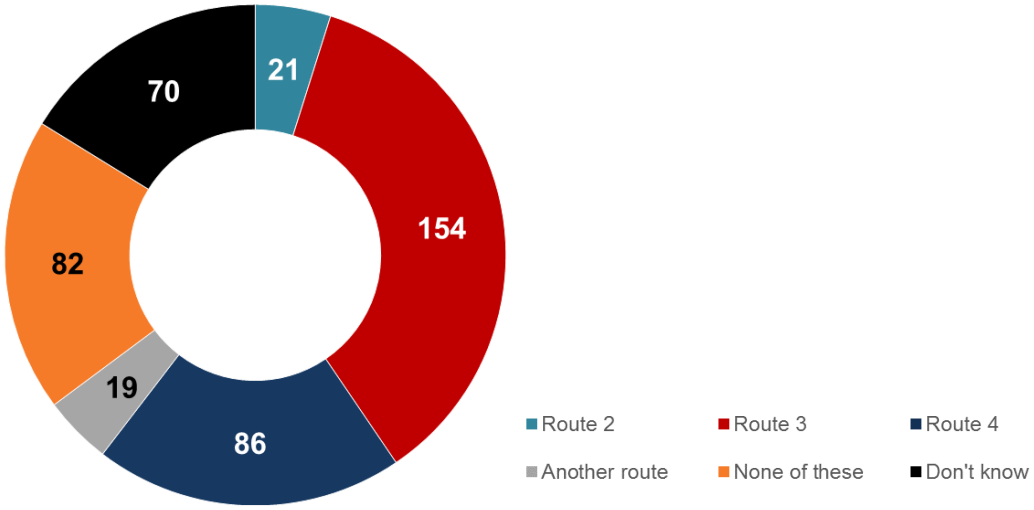

FIGURE 5.8 - GROUP AND ORGANISATION RESPONSE ON ROUTE NORTH OF RIVER

5.8.4 Only 6% (1,869) of members of the public and 5% (21) of groups and organisations who responded to question 6a favoured Route 2. Those opposed to Route 2 most often stated that it would not reduce congestion and may instead increase it. Closely linked to this is opposition because of the potential effect this route would have on communities such as those in developed or residential areas generally or specific places such as South Ockendon. Other objections to Route 2 were because of its effect on access and freedom of travel. Respondents were also critical for environmental reasons and amongst these the most common reason was because they thought it would increase air pollution and the level of noise. Stakeholder organisations were also critical of Route 2 due to concerns about its proximity to local communities and the disruption it could cause. Reasons stated in support of Route 2 included that it would cause the least disruption to developed and residential areas as well as the least effect on the countryside. Some business responses preferred Route 2 as it was seen to provide good access to Tilbury Docks and would minimise the loss of undeveloped land due to the fact that the route uses existing roads.

5.8.5 Reasons stated in support of Route 3 included that it would improve access to the area and would be the shortest route with the least impact on the local area. Opposition to Route 3 highlighted concerns about the effects of congestion on local roads and on local communities. Nearly half of the business responses preferred Route 3, highlighting the fact it would be the shortest and most direct route. The benefits of lower cost and quicker journey times were often mentioned. It is therefore suggested that Route 3 would be the most attractive route to drivers. Businesses in support of Route 3 also stated that it would be further away from the built-up areas that could be affected by Route 2 and less harmful to the environment than Route 4. The Port of London supported Route 3 on the condition that it includes a junction for the Port of Tilbury, a request that was also raised by other business groups.

5.8.6 Reasons stated in support of Route 4 included that it would improve connectivity, the positive effects it would have on the M25, A13 and A127 and the potential to improve existing congestion on the M25 and Dartford Crossing. Another reason given in support of the route was the limited effect

it was thought to have on local communities. Opposition to Route 4 came from the fact that it would be the longest route and that it would potentially increase congestion on the A127. Route 4 was the second-most preferred route amongst the business community, with the distance from the M25 seen as a benefit. The fact that it would be the longest route was mentioned as a disadvantage as was the fact that it would impact undeveloped land, with potential effects on the environment.

5.8.7 Thurrock Council is opposed to a Lower Thames Crossing at the proposed location and therefore to all of the routes north of the river.

5.9 Route South of the River

5.9.1 There were 32,259 members of the public who answered question 8a about the routes south of the river. Their responses are shown in **Figure 5.9**. The ESL had significantly more support than the WSL. 38% of those who responded to the question (12,304) supported the ESL, compared with 18% (5,889) who favoured the WSL.

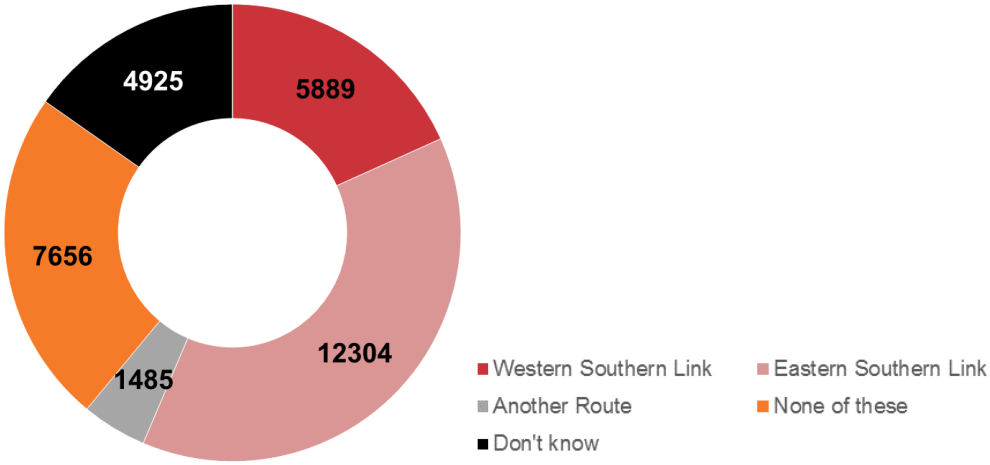

FIGURE 5.9 - PUBLIC RESPONSE ON ROUTE SOUTH OF RIVER

5.9.2 Locally, both the ESL and WSL were very unpopular. Support in the Gravesham area (which includes responses from Shorne and Higham) for the ESL was 640 and 391 for the WSL, while 3,088 of the 4,605 respondents who responded using the questionnaire did not want either option.

5.9.3 Support for the ESL was high in the rest of Kent (2,388 favouring ESL out of the 3,750 who responded using the questionnaire) and the rest of the UK (3,209 favouring ESL out of the 6,564 who responded using the questionnaire).

5.9.4 Of over 8,500 comments made by members of the public about the ESL in response to question 8b in support of their answer to question 8a, 7,826 were positive with key reasons being access to destinations, freedom of travel and improved connections to motorways and ports, and improved traffic flow and relief of the A2 and Dartford crossings. Positive comments about the WSL related to minimising impacts to the environment and communities. A summary of the comments received in response to question 8b relating to the ESL and WSL is provided in **Table 5.2**.

TABLE 5.2 - SUMMARY OF QUESTION 8B RESPONSES ON SOUTHERN LINK

	WSL	ESL
In support	• Least impact on environment, in particular on protected natural areas, countryside and landscape • Improved access to destinations and freedom of travel. In particular improved access to M25 and WSL is shorter route • Would benefit communities and individuals, in particular least effect on developed residential areas and local towns/ villages such as Shorne	• Would improve access to destinations and freedom of travel, in particular better connection between motorways, improved access to channel ports and ESL is shorter route • Improved flow of traffic/ would ease congestion, in particular on A2 and at the Dartford Crossing or roads to and from Channel ports • Would benefit communities and individuals, in particular would benefit them personally and least effect on developed residential areas • Would have limited effect on environment • Anticipated economic benefits
In opposition	• Would not reduce or actually increase congestion (most commonly specified on A2) • Would not improve connections to destinations or be the slower route because of speed restrictions • Would impact on environment, in particular local air quality • Would not be beneficial for communities or individuals	• Would impact on environment, in particular on protected natural areas, green spaces and landscape • Would impact on communities and individuals (village of Shorne mentioned most often) • Would not improve or actually increase congestion (at Dartford Crossing and on M2 Junction 1 mentioned most often)

5.9.5 A total of 433 groups and organisations answered question 8a about the routes south of the river. Their responses are shown in **Figure 5.10**. The ESL had significantly more support with 42% (181) preferring this link, compared with 17% (74) who favoured the WSL.

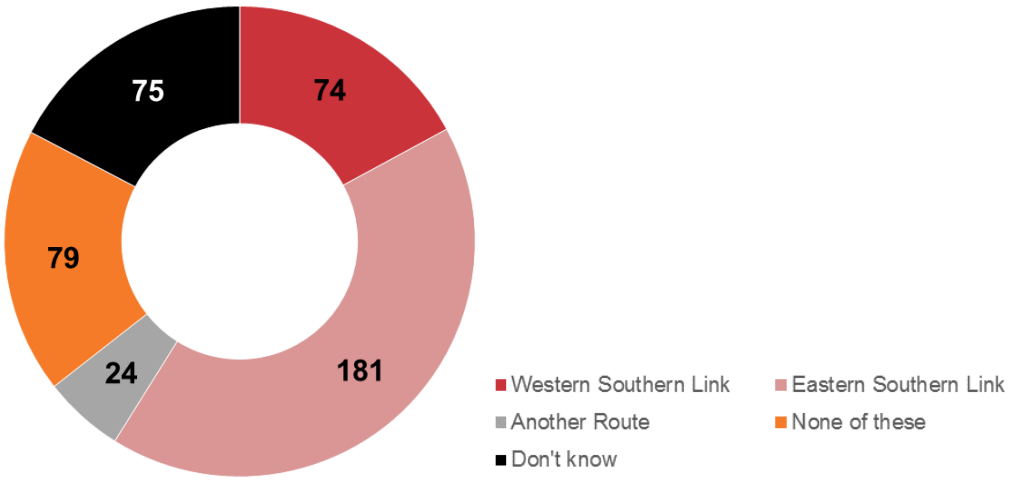

FIGURE 5.10 - GROUP AND ORGANISATION RESPONSE ON ROUTE SOUTH OF RIVER

5.9.6 Gravesham Borough Council stated its opposition to a route east of Gravesend, considering that it would have significant detrimental impacts including threatening areas of outstanding natural beauty and internationally significant nature conservation areas, this threatening the biodiversity that

their status seeks to protect. The Council considered that all communities in Gravesham would potentially suffer air quality issues as congestion on local roads would be exacerbated as drivers sought to avoid problems elsewhere on the highway network.

5.9.7 139 of the 262 businesses who responded using the questionnaire favoured the ESL over the WSL (56). National Grid also preferred the ESL because of the potential impacts on its assets of the WSL.

5.9.8 The Royal Society for the Protection of Birds was concerned about the potential impacts of both southern route options on their reserve at Shorne Marshes. They noted that a full Habitats Regulations Assessment (HRA) would be required in the next phase and that careful consideration of any potential tunnel portal would be required. Natural England advised that the ESL was potentially environmentally damaging to a SSSI, ancient woodland and the Kent Downs AONB. They stated that the WSL would have less impact but noted that there would still be significant impacts on another area of ancient woodland and the AONB.

5.9.9 Other environmental and community bodies saw the WSL as having a lower impact on valued environmental features than the ESL. Kent County Council opposed the ESL for similar reasons.

5.9.10 Kent County Council's support for the scheme was stated to be conditional on the WSL. Essex County Council also supported the WSL.

5.10 Additional Junctions

5.10.1 The consultation materials explained that junctions were proposed with the M2/ A2, A226, A13 and M25. The questionnaire gave people the opportunity to comment on this and asked whether additional junctions would be beneficial.

5.10.2 While not all comments refer to specific junctions, those most mentioned were the following:

- Concerns raised about congestion on the M25 as a result of Route 3 connecting between Junctions 29 and 30.
- Concerns raised with the proposed A13 junctions and the impact on the Orsett Cock junction. Some organisations, including businesses, were also concerned about the proposed layouts and congestion.
- M2/ A2: concern about access from A289.
- Concerns were raised in consultation responses and at the public information events over the proposed new junction with the A226 and the potential for congestion on this road, especially during school pick up and drop off hours.

5.10.3 Responses from local authorities, elected representatives and businesses made many requests for improvements to specific roads and junctions based on their local knowledge and experience of the road network.

5.11 Other Comments on the Scheme

5.11.1 The questionnaire gave people the opportunity to provide any other comments about the scheme. While those people who supported the proposals urged that the scheme be progressed quickly, those who opposed the scheme reiterated their concerns about the environment, potential effects on local communities and local traffic flows.

Scheme objectives

5.11.2 Some respondents raised the issue that the scheme objectives had changed since the 2013 consultation and that this biased the scheme appraisal and steered the project in a specific direction.

Groundwater and flood risk

5.11.3 Concerns were raised over the potential impacts of the construction on the groundwater of the areas concerned and the location of the tunnel in relation to the tidal flood plains. Some respondents questioned whether the scheme could accommodate the worse-case sea level rise scenario.

Other transport solutions

5.11.4 A range of alternative transport solutions were suggested during the consultation. Some suggested that a complete re-think was needed and that instead of a road, a new rail link for passengers and freight should be looked at in more detail. Others suggested that a combined road/ rail link should be built or that a new ferry service could be pursued. The need to take full account of pedestrians, cyclists and all ‘non-motorised users’ was also raised.

National policy

5.11.5 Some respondents highlighted the fact that there is no mention of the need for the LTC in the NPSNN. They state that the outcome of the consultation would establish the need for the scheme without full and proper justification.

Relationship with the existing crossing

5.11.6 People suggested that the charges at the new crossing should be aligned with those of the existing Dartford Crossing. Others suggested that the charges should be less than for the existing crossing or that the new crossing should not have charges at all.

Programme and completion

5.11.7 Some respondents suggested that an opening year of 2025 is too late and that the problems with the existing crossing are only getting worse. Many people at the public information events said that something else besides the introduction of the Dart Charge system needed to be put in place to address the existing mounting problems with the Dartford Crossing.

5.12 Feedback on the Consultation

5.12.1 The questionnaire invited feedback on the consultation itself (questions 13 and 14). Respondents were asked to indicate how they heard about the consultation. The results of the response analysis, as shown in **Figure 5.11**,

were used to assess the effectiveness of the publicity surrounding the consultation.

5.12.2 Over 19,000 people responding to the consultation had received an email, with approximately half of those specifying that they received it as a Dart Charge Account Holder. Subscribers who had signed up for updates on the proposals via the gov.uk website were also emailed.

5.12.3 Over 7,600 individuals indicated that they had received a letter drawing their attention to the consultation. This underlines the significance and widespread nature of direct contact with road users and with potentially affected households or businesses.

5.12.4 The combined print media and online publicity was highlighted in over 8,000 responses with “word of mouth” accounting for approximately 5,000 of these.

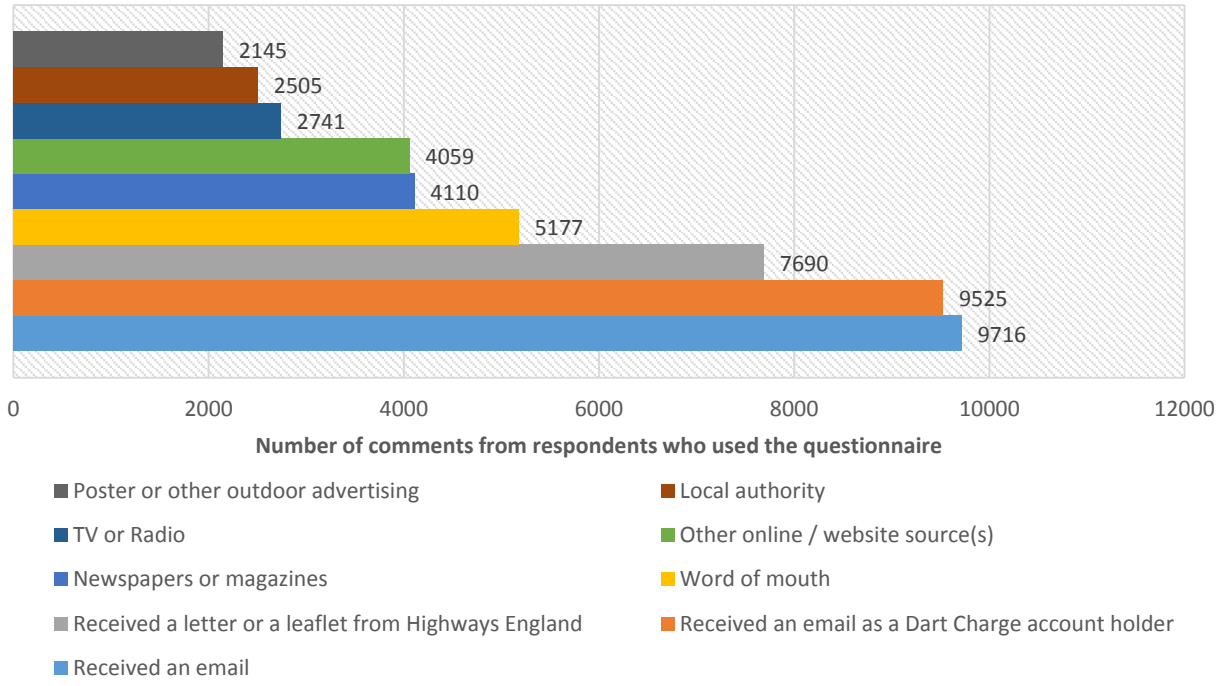

FIGURE 5.11 - HOW RESPONDENTS HEARD ABOUT THE CONSULTATION

5.12.5 People had the opportunity to provide comments on the consultation, including the events that were held, the information provided and the way the consultation was advertised. For further details of the comments on the consultation, refer to **Appendix 3.3**.

5.12.6 A total of 2,070 respondents gave positive comments about the consultation. 242 respondents felt the consultation was good, helpful or useful; and 219 felt it was well thought out, thorough or comprehensive.

5.12.7 A total of 4,948 respondents gave negative views about the consultation, the most frequently cited reason being perceived bias, the results being a ‘done deal’ or already decided (1,369 responses). 1,479 respondents gave negative comments about the publicity, with 1,144 commenting that there was a lack of advance notice, publicity or advertising about the consultation.

A lack of options being presented at consultation was a reason cited by 767 respondents. Some also mentioned that the eight week consultation period was too short and that the consultation relied too much on the use of the internet.

5.12.8 Respondents who disagreed with the proposed scheme were more likely to provide negative feedback on the consultation than those who agreed with the proposed scheme.

5.13 Consultation Process

5.13.1 Of the total 47,034 responses received to the consultation, 29,516 were public responses received online via the online questionnaire. Almost 20,000 respondents said they found out about the consultation via email from Highways England, highlighting the importance of the online accessibility of the consultation. The public information events, which provided for face-to-face engagement with project experts, were well attended by nearly 13,000 members of the public. The consultation was also reported extensively by local and regional media.

5.14 How the Consultation Responses have been used

5.14.1 The over-riding aim of the consultation was to engage with all those affected by the issues with the existing crossing and all those potentially affected by the proposals, to inform them of the proposals and give them an opportunity to have their say and contribute to the route selection process.

5.14.2 The main themes that came out of the consultation responses are set out in Section 6, together with Highways England's responses to the issues raised.

5.14.3 Highways England has carefully evaluated the consultation feedback which has been very helpful in providing new technical information on the social, economic and environmental effects of each of the options, including constraints associated with existing assets and conditions and information on the local effects of the proposed scheme at consultation.

5.14.4 The consultation responses have been taken into account in making a recommendation to Government about the choice of a Preferred Route to be taken forward to the next stage of development. Refer to Volume 7 of this Post-Consultation SAR for further details.

5.14.5 Many of the comments received will help inform detailed design refinements as the scheme is developed in more detail in the next stages.

5.14.6 Some feedback identified lessons which have been learned when planning future consultations, such as the scheduling of events (locations and times), adding an online form for requesting further copies of materials and the need to provide advance publicity prior to the start of the consultation.

6 Response to Consultation Findings

6.1 Identification of Consultation Themes

6.1.1 This section describes the themes which have emerged from the consultation and Highways England's response to those themes. This analysis concentrates on the key strategic issues and challenges which have been raised during consultation in written responses (questionnaire, e-mail and letter formats) and at public meetings and exhibitions.

6.1.2 The consultation themes identified are listed in **Table 6.1**, and Highways England's responses to the themes are set out in Sections 6.2 to 6.21 which follow.

TABLE 6.1 - THEMES AND HEADLINE ISSUES RAISED BY RESPONDENTS

Consultation Theme	Section
Consultation Process	6.2
Need and consistency with National Policy	6.3
The traffic problem at the existing Dartford Crossing	6.4
Traffic Modelling	6.5
Scheme Objectives	6.6
Environmental Impacts	6.7
Construction Impacts	6.8
Other Options	6.9
Options to mitigate impacts of Scheme	6.10
Other modal solutions	6.11
Junction strategy	6.12
Provision for non-motorised users	6.13
Wider network impacts	6.14
Economic benefits and costs	6.15
Land and property	6.16
Futureproofing	6.17
Integrated Asset Delivery	6.18
Equality Diversity and Inclusion	6.19
Legacy Opportunities	6.20
Future programme	6.21

6.2 Consultation Process

Consultation Theme	Highways England's Response
Some respondents considered that the consultation was misleading and flawed, with inadequate comparative material, and inadequate venue capacity. Some raised the issue of conflicting and insufficient information being provided which did not allow respondents to fully assess the options	The first event at Orsett Hall on Wednesday 03 February and the second at Cascade Leisure Centre on Thursday 04 February, 2016 had an unexpected number of attendees. In recognition of the number of attendees, the event at Orsett Hall remained open later than advertised to accommodate the number of people who wished to meet the project team. The capacity at the remaining venues proved to be adequate. A suite of consultation documents and materials were developed and provided to respondents through the methods set out in Section 5.3 of this volume. These provided information on the various crossing and route options assessed and an analysis of each of these together with various technical reports. Together these formed a comprehensive report detailing the studies that Highways England had undertaken and allowed respondents to fully assess the options.
Some respondents raised the issue that the 8-week timeframe was insufficient. The events finished too early and should have been extended to venues in places such as Higham and Chalk. In contrast consultation was extended to Dart Charge holders, many of whom do not live in the area.	In accordance with the overarching guidance for consultation set out in the Government's Consultation Principles document published in November 2013, Highways England considers that the timeframe adopted for consultation was proportionate and reasonable. Wherever possible, Highways England sought to hold the PIEs between 11am and 7pm. For those people who could not attend their local event during the week, alternative events were scheduled on four of the five weekends during the six week period in town centres and two major regional shopping centres. Criteria including health and safety checks, suitability and accessibility to public transport were used to assess venues and plan for the PIEs. Highways England considers that holding 24 events over a 6 week period was a proportionate measure and that meaningful engagement took place. This is evidenced by the number of attendees at PIEs and by the 47,034 consultation responses received. Whilst Highways England did not hold a PIE in Higham, following a specific request, it did agree to attend a community event in the area on 12 March 2016. Highways England contacted registered Dart Charge account holders to ensure all users of the road network who are likely to be affected by, or have an interest in, the proposals had an equal opportunity to respond to the public consultation.

Consultation Theme	Highways England's Response
Some respondents raised the issue that the consultation material was incorrect and information was presented in a confusing and manipulative manner. Further issues raised included that information was not easily accessible, requests for hard copy materials were processed too slowly and consultation was publicised with relatively short notice. Some respondents stated that there was confusion over information appearing on the internet before the official start of the consultation and that there were significant gaps in the documentation and engagement process.	In preparing the consultation material, Highways England took into account principles set in policy and best practice and designed the consultation to ensure that the materials had an appropriate mix of concise and well-presented plain English summaries, supplemented by technical reports providing a greater level of detail. Taken together, the materials provided all of the information necessary to respond to the consultation. Official information about consultation and the suite of materials were available online from the launch day of the consultation. As well as online, information was made available at the PIEs and at deposit locations in the areas affected by the scheme. The Highways England Customer Contact Centre (CCC) operates on a 24 hour basis, seven days per week. This facility was used as a method for members of the public (especially those without internet access) to ask for more information about consultation events, deposit locations and to request copies of consultation materials, which were prioritised and processed as quickly as possible by Highways England. Over the whole consultation period, the CCC handled over 1,300 telephone and email queries about the LTC consultation. The consultation had a high profile in the regional print, broadcast and online media from the launch day of consultation. Highways England press office recorded 387 separate pieces of print and broadcast coverage, with a combined reach of 24 million people. In addition, publicity activity included; a press release, newspaper, poster and digital advertising, local authority channels, a notification letter and follow up leaflet drop to over 250,000 local resident/business owners in postcodes potentially affected by the proposals, along with a bespoke land and property notification letter to alert potentially affected landowners. An LTC email was issued to over 950,000 current Dart Charge account holders to find out their views on the scheme. In addition, a series of videos were produced and available online. The consultation was designed as an early stage route options consultation and there will be a further round of consultation. There will be opportunity to engage further with the project and participate in a statutory consultation as required in accordance with the Planning Act 2008 prior to the application

Consultation Theme	Highways England's Response
	for a Development Consent Order being submitted. Details of this will be announced at a later date.
Some respondents raised the issue that there was confusion at the heart of the consultation over Route 1 (Location A). Concerns were raised that the consultation was presented as though only Location C was viable and that Location A was reintroduced after the start of the consultation but no like for like assessment of Location A was provided. Some felt that the consultation process was fundamentally flawed as there was no mention or opportunity to give Option A as the preferred choice and there was also confusion over the respective roles of Highways England and the Department for Transport.	Prior to the consultation, Highways England undertook a thorough assessment of locations for the crossing, routes and junctions. This work concluded that Location A performed poorly against the traffic and economic scheme objectives for Lower Thames Crossing. These findings were included in the consultation materials, and a full appraisal of Location A against the scheme objectives was made available in the Pre-Consultation SAR. Location A was not reintroduced into Highways England's consultation on its proposed scheme after the start of consultation. The consultation material explained why a crossing location was being proposed at Location C, and not at Location A, and provided the opportunity for respondents to comment on this in the free text questions in the consultation questionnaire. The consultation booklet provides a clear narrative around the commissioning of the LTC Route Consultation 2016, next steps in the development process and engagement between Highways England, the Department for Transport and central Government.
Some respondents raised the issue that a compelling case for compulsory acquisition of land has not been made and should have been consulted on earlier.	A misunderstanding arose as a result of Highways England writing to landowners potentially affected by the options to draw the consultation to their attention. The letters did not initiate the compulsory purchase process and the only purpose of the letters was to alert these landowners that their property was potentially affected by one of the proposals and shown as such in the consultation materials. Throughout the future scheme development and before the submission of a DCO application, there will be ongoing engagement with affected landowners. A statutory consultation will also be held prior to making the application in which directly affected landowners will be statutory consultees. Highways England is satisfied that a compelling case for compulsory purchase can be made in view of the national significance and need for the scheme. This will be put forward in detail in the Development Consent Order application.
Some respondents raised the issue that consultation has been discriminatory against older and non-IT literate people in contravention of the Equality Act 2010.	When designing the consultation Highways England was guided by the principles set out in the Equality Act 2010 with regards to the need to eliminate unlawful discrimination against a group of people who share a protected characteristic (e.g. age). In compliance with these, consultation materials were

Consultation Theme	Highways England's Response
	made available to respondents without internet access at a series of deposit locations (local libraries) distributed throughout the area affected by the proposed scheme. An alternative print questionnaire option was available at the public information events and deposit locations for those not on line.
Some respondents raised the issue that the consultation was biased and engineered to produce a predetermined result.	The development of the proposals and assessment of the options, and appraisal of the shortlist was clearly set out in the consultation booklet. The process has been open and transparent. Location C was proposed because it offered far greater benefits than Location A. Information on all the options (including the detailed reasoning for the conclusion that Location C offered far greater benefits than Location C) was available in the booklet, questionnaire and Pre-Consultation SAR and the consultation questionnaire provided the opportunity to comment on them and to provide other suggestions. Responses to the consultation have been independently analysed by Ipsos MORI and will be part of a suite of material used to inform the Government's decision on the Recommended Preferred Route.

6.3 Need and Consistency with National Policy

Consultation Theme	Highways England's Response
Some respondents raised the issue that there is no compelling case of national need and no specific scheme support in the National Policy Statement for National Networks (NPSNN) or in Highways England's Delivery Plan. The outcome of the consultation process would therefore have the effect of establishing a national policy position in favour of this specific scheme without full and proper justification. Some respondents stated that the proposals are not consistent with national planning policy because of impacts on designated Greenbelt, Area of Outstanding Natural Beauty (AONB), Sites of Special Scientific Interest (SSSI) and ancient woodland.	The case for the scheme has been clearly established and is set out in Volume 2 of the Post-Consultation SAR. The Government Response to Consultation: Options for a New Lower Thames Crossing, DfT July 2014, concluded (para. 3.20) that "*there is a need for an additional crossing between Essex and Kent that ties in effectively with the surrounding road network to address the lack of capacity and resilience at the existing crossing, the approach road and junctions with east-west routes….it is therefore important to build a new crossing that meets the government's objectives for this part of the strategic road network and supports economic growth across South East England"*. The DfT's first '*Road Investment Strategy'* (RIS) (2014) sets out the Department's longer term investment and planning, outlining how it will invest in the SRN between 2015/ 16 and 2020/ 21. The RIS underlines the importance of the SRN to British businesses and the successful functioning of the economy, though it also acknowledges that capacity

Consultation Theme	Highways England's Response
	has become a major issue in recent years, with parts of the network becoming increasingly congested. In response, Highways England has published its first 'Strategic Business Plan 2015-2020' setting out how the newly established company will deliver the performance requirements set by the Government and progress delivery of the Investment Strategy in line with the timescales proposed. The Business Plan states its '*support for regional and local growth by addressing a number of specific bottlenecks and heavily congested routes across the country*.' This includes consulting '*the public on options for a much needed further Lower Thames Crossing in early 2016, which subject to the necessary planning consents and funding mechanisms, will start construction by 2021*.' The NPSNN recognises the critical need to improve the national networks to address road congestion, to facilitate safe and reliable journeys, and to provide a transport network that is capable of stimulating and supporting economic growth. It also identifies an equally important need to ensure improvements have minimal impact on the environment, are well designed and improve safety. Section 2 of the NPSNN sets out the Government's vision, strategic objectives and need for development of the national networks. Paragraph 2.10 states that "*The Government has therefore concluded that at a strategic level there is a compelling need for development of the national networks – both as individual networks and as an integrated system. The Examining Authority and the Secretary of State should therefore start their assessment of applications for infrastructure covered by this NPS on that basis."* The compelling national need for the project should be accorded considerable weight in the planning balance when considering the impacts on national policy designations. Highways England has considered the various tests in the NPSNN in the appraisal of options and is satisfied that the proposed scheme is able to meet the relevant policy tests. Further work on mitigation at designated sites will be undertaken as part of the development of the scheme design, to ensure that relevant policies are fully complied with. (See also section 6.7 below).

6.4 The Traffic Problem at the existing Dartford Crossing

Consultation Theme	Highways England's Response
Relief at Dartford Some respondents raised the issue that the proposed scheme would not provide sufficient relief at Dartford.	The proposed scheme at Location C would provide a high quality, safe transport solution with a 70 mph road providing improved journey times for traffic using the new crossing and also providing significant traffic relief to the existing Dartford Crossing, with heavy goods vehicle movements predicted to reduce by 29% in 2025. The proposed scheme would provide significant improvements in journey times. In 2025, journey speeds between M25 J3 and M25 J28 across the existing Dartford Crossing would increase from 43mph to 51mph with a 3 minute time saving, whilst journey speeds between M2 J4 and M25 J28 would increase from 47mph to 56mph with an 8 minute time saving. The proposed scheme would substantially improve the resilience of the strategic road network east of London. Importantly, it would provide a high standard diversionary route when incidents occur on the existing A282 Dartford Crossing and would also ensure that the strategic road network in the vicinity of the crossings operates at lower traffic volumes in relation to capacity, compared to the situation without the Scheme.

6.5 Traffic Modelling

Consultation Theme	Highways England's Response
Age of data used in traffic model Some respondents raised the issue that the demand data used in the LTC v2 traffic model is old and may not reflect current traffic levels and patterns, as well as recently planned developments. This may call into question the robustness of the traffic forecasts used in the LTC shortlist appraisal.	The traffic model used for the appraisal of the shortlist options is considered to be suitable for the appraisal of options. It has a validated base year of 2009. The model incorporates updated information about land development planning and highway schemes in the area collected from stakeholders during 2014 and 2015, including the proposed Ebbsfleet Garden City development. It also includes updated data from the Transport for London (TfL) traffic model used for the appraisal of TfL river crossings, and incorporates improved coding of the road network inside and outside the M25. A revalidation of the critical area around the existing Dartford Crossing (the M25 and main east-west corridors) was also undertaken which demonstrated good model performance in this critical area. Since consultation, the model has been further enhanced for use in the appraisal of

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	the Post-Consultation Appraisal Routes, as described in Volume 5 of the Post-Consultation SAR. The enhanced model (Version 2.1) takes account of updated data following the opening of Dart Charge, improvements to highway network representation and future patterns of local development in Kent and Essex, and new values of time issued by DfT. A Version 3 traffic model (LTC v3) will be used for the Development Consent Order (DCO) phase of the LTC project which will be based on updated demand data.
Allowance has not been made for London Resort Company Holdings' proposals Some respondents raised the issue that allowance has not been made in the traffic model for the significant future development proposed by London Resort Company Holdings on the Swanscombe Peninsula.	London Resort Company Holdings (LRCH) proposes to create the UK's largest entertainment resort on a site at Swanscombe Peninsula, potentially providing facilities for up to 50,000 visitors per day and creating up to 33,000 jobs. It is recognised that this development could have major traffic and transport impacts in the vicinity of the proposed LTC. To date, in accordance with WebTAG requirements, the traffic and transport impacts of this development have not been included in the appraisal of the LTC options. This is due to the uncertainty over the details of the proposed development and the developers' access proposals, as no planning application has yet been submitted and this is not expected until later in 2017. Although this development has not been considered explicitly, traffic and economic sensitivity tests have been undertaken looking at high and low growth scenarios which reflect uncertainty regarding future levels of development. Part of that development uncertainty relates to developments such as the one proposed by LRCH. During the next phase of the development of the LTC, the traffic and transport implications of this entertainment resort will be considered in more detail, as the developers' proposals are more firmly defined through the planning application process. If there is an appropriate level of certainty regarding the proposals, details of LRCH's development will be incorporated in the updated traffic model (LTC v3) which is being developed. This will incorporate revised travel demand data, as well as details of recent new developments and committed proposed developments.

6.6 Scheme Objectives

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Some respondents raised the issue that the scheme objectives have changed since the 2013 consultation, without explanation, and this has biased the scheme appraisal.	The development of the scheme objectives can be split into two distinct phases; prior to July 2014 where the project was led by the Department for Transport (DfT); and post July 2014 when the leadership transitioned to Highways England. As part of transitioning the project to Highways England, the Secretary of State for Transport (SoS) stated in the Government Response to Consultation Options (para 4.9) dated July 2014 that "*All the route options and types of crossing will need to be appraised against a single set of objectives in the context of government's and stakeholders' aspirations for economic growth. The objectives will build upon and amplify the government's existing objectives for a new LTC"*. Accordingly a refreshed set of scheme objectives and requirements were developed. These were developed from the 2013 objectives, the SoS announcement in July 2014, the DfT's Client Scheme Requirements approved in February 2015 as well as the Highways England published Strategic Outcomes. The refreshed objectives are expressed differently but are consistent with the earlier objectives and wider transport policy and have not prejudiced the overall appraisal outcomes Options which have not been taken forward in previous phases of the project have been checked against the current scheme objectives to ensure that the decision not to progress them remains valid and the conclusions remain the same. Refer to **Appendix 3.1** for details of this appraisal.

6.7 Environmental Impacts

Consultation Theme	Highways England's Response
Air Quality	
Impacts on People and Communities Concerns were expressed over air quality impacts on people and communities, especially vulnerable receptors – e.g. schools. Concerns were raised that additional traffic will increase pollution in areas which are already subject to high levels.	Volume 6 Environmental Appraisal Section 10 Appendices include a drawing 'Air and Noise Constraints and Air Quality Modelling Receptor Locations which identifies Air Quality Management Areas and also monitoring data for 2014. This data demonstrates Highways England's understanding of existing air quality issues. For the Pre-Consultation SAR air quality assessment, annual mean nitrogen dioxide (NO_2)

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	concentrations were predicted at 89 worse case receptors e.g. houses (receptors which are likely to have the largest impacts as a result of the options). The Pre-Consultation SAR only presented the results of the assessment for those receptors which are predicted to exceed the Air Quality Strategy (AQS) Objective annual mean NO_2 of greater than 40 µg/m^3 and those that are at risk of exceeding it i.e. are predicted to experience levels greater than 36 µg/m^3. As a result of the consultation feedback and concerns about other vulnerable receptors, analysis has been undertaken for an additional ten receptors. Based on the modelling of additional receptors, the conclusion remains that based upon the assessment work undertaken to date, with the exception of receptors located in the Dartford Crossing corridor, properties within the vicinity of Routes 2, 3 or 4 (with either the WSL or the ESL) would not exceed or be at risk of exceeding the AQS Objective of 40 µg/m^3 for NO_2. Further detail about the additional air quality assessment is presented in Volume 6 of the Post-Consultation SAR.
Compliance with the EU Directive on Ambient Air Quality and Carbon Dioxide Emissions Some respondents raised the issue that no part of the South East meets the standard for the ambient air quality directive. The Climate Change Act requires a reduction in CO2 emissions and the LTC will make it difficult to meet international obligations.	During the options appraisal the impact of the options on both ambient air quality and carbon dioxide emissions have been assessed. In relation to ambient air quality Defra is responsible for reporting to the European Commission on compliance with the EU Directive on ambient air quality. The UK is split into 43 zones for the purpose of reporting against the Directive and a combination of modelling and monitoring is used to assess whether a zone is compliant with the Directive. The date that Defra report to the Commission that the zone is compliant is the date where Defra has determined that everywhere in the zone will be compliant with the Directive (i.e. below the EU Limit Value for each of the pollutants which are assessed, NO_2 and PM_{10} being the pollutants which are the most difficult to achieve compliance). The scheme is located in the South East and Eastern zones which are predicted to be compliant with the Directive in 2020 (for NO_2, for all other pollutants the zone is reported as being compliant).

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	In relation to Environmental Impact Assessment (EIA), and in accordance with the NPS NN, the DCO application will set out whether the project would lead to a significant impact on air quality. Should a significant impact be assessed a scheme air quality action plan would be included in the assessment which would identify mitigation measures to reduce the impact of the scheme on air quality. Significance would be determined by the impact of the scheme on both compliance and the impacts of the scheme at sensitive receptors. In addition to ambient air quality the impact of the scheme on emissions of carbon dioxide would need to be assessed as required in the NPSNN. The NPSNN states that it is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets. It also states that increases in carbon emissions is not a reason to refuse development consent, unless the increase in carbon emissions resulting from the proposed scheme are so significant that it would have a material impact on the ability of Government to meet its carbon reduction targets. The carbon plan sets out the Governments vision that all vehicles will be Ultra Low Emission Vehicles (ULEV) by 2050, individual road schemes would not impact on the plans which would lead to significant reductions in carbon dioxide emissions.
Comments on Air Quality Assessment: Respondents raised the following issues: • Need to consider other pollutants (e.g. PM_{10}/$PM_{2.5}$) given the evidence of long term impacts on health. • Unclear how there could be an improvement in air quality in the vicinity of Location C compared to the "without" route levels. • A significant worsening of air quality where there was no previous source of air pollution cannot be justified purely by saying that it will not lead to an exceedance. • 2001 traffic data is unreliable in determining air quality impacts	The approach to the air quality appraisal is outlined above and is documented in Volume 6 of the Pre Consultation SAR. The appraisal considered NO_2 as road schemes generally lead to very small changes in other pollutants such as PM_{10} and $PM_{2.5}$. The Pre Consultation SAR does not state that there would be an improvement in air quality at Location C. It states in paragraph 4.6.14 of Volume 6 that "*Routes 2, 3 and 4 would lead to improvements in air quality at the A282 where exceedances of EU limits currently occur. Properties within the vicinity of Routes 2, 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within EU limits in the With Scheme scenario*". The Pre Consultation SAR does not report a significant impact on air quality with Routes 2, 3 and 4. The Volume 6 of the Post-Consultation SAR

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	presents further air quality results that do not show a significant impact. As described in Section 6.5, the traffic model is considered to be suitable for use in the appraisal of options, including the air quality assessment. As part of the Environmental Impact Assessment for the Preferred Route, it will be necessary to undertake a detailed air quality assessment in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 1 HA 207/07. The assessment will use an updated Base Year, additional air quality monitoring data and a dispersion model (ADMS Roads). The air quality assessment will consider the impact of the scheme on particulates (PM_{10}) as well as NO_2. In addition to the assessment of pollutant concentrations at receptors an assessment of the change in emissions as a result of the scheme will also be undertaken. The assessment will use traffic data from the Version 3 model. The air quality assessment method will be discussed and agreed with relevant bodies to ensure that the air quality assessment is robust and that where mitigation is required it is designed to manage the air quality impacts. To determine compliance of the Preferred Route with the NPSNN it will be necessary to determine whether the scheme has a significant impact on air quality. This will be undertaken through the use of the guidance in Highways England's Interim Advice Note 174/13 "Evaluation of Significant Local Air Quality Effects" and will form part of the assessment presented in the Air Quality chapter of the EIA and Interim Advice Note 175/13 which provides updated air quality advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans.
Noise and Vibration	
Increased Noise and Vibration Concerns were expressed that the scheme would result in increased noise for many people, and destroy communities and rural tranquillity. Some respondents thought that there would be negative impacts on children's health, wellbeing and learning as a consequence of increased noise and pollution caused by an increased volume of traffic.	The Pre Consultation SAR noise and vibration appraisal (Volume 6) followed a WebTAG methodology which is an industry recognised and robust approach to options appraisal. The appraisal demonstrated that for Routes 2, 3 and 4 when comparing each route with the Without Scheme scenario there would be an overall improvement in noise (a greater number of properties would benefit than dis-benefit) on the existing road network. This would be due to Routes

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Some thought that Location C would do little to alleviate the existing high levels of noise and pollution at Dartford or Thurrock.	2, 3 and 4 reducing traffic flows along the M25 and the A2. However, there would be increases in noise levels for receptors within close proximity of Routes 2, 3 and 4, which would be mitigated to acceptable levels through the use of measures such as low noise surfacing and barriers/ bunds. This mitigation would also reduce effects on receptors such as schools. A crossing at Location C through the provision of Routes 2, 3 or 4 would alleviate congestion at Dartford through a reduction in traffic flows. For Route 1, there would be an overall worsening of noise (a greater number of properties would dis-benefit than benefit) as the traffic flows on the existing road network along the A282, M25 and A2 would increase and therefore the noise level would increase. Further measures will be considered during the next stage of scheme development to reduce and mitigate noise effects, as described below.
Comments on Noise Appraisal Some respondents raised the following issues: • Noise impacts have not been considered beyond a narrow zone close to the road. However, in open countryside fast moving traffic on the new road will be audible as a continuous noise from the surrounding fields and footpaths for a considerable distance. The wider noise impacts are not considered in the environmental appraisal, yet noise has a major impact on the rural character of the countryside. The zone of effect can be up to 1000m on either side of the carriageway. • There is no indication in the published documents as to whether any detailed examination has been made into the feasibility of mitigation such as an engineering or barrier solutions to reduce noise exposure in the existing crossing area or removal of sensitive receptors. • No commentary is made of these routes being in relatively quiet locations and the effects of a large	To undertake the WebTAG appraisal, a preliminary noise model was constructed to undertake road traffic noise calculations accounting for horizontal alignment, screening from buildings and traffic composition, speed and flows. For all of the roads considered, properties within 600m were modelled to determine whether there would be an improvement or a deterioration in noise level - this is termed the calculation area. This approach is robust and appropriate and complies with the recommended WebTAG methodology. The consideration of properties within 600m is also consistent with advice presented in the Design Manual for Roads and Bridges (DMRB) which recognises that beyond 600m other factors will influence the noise environment. A qualitative appraisal is only appropriate for receptors beyond the calculation area. The noise and vibration assessment will provide predictions for both construction and operational effects. It will outline potential mitigation measures that will be integrated into the scheme design and will set out, in environmental documentation such as in a Construction Environmental Management Plan, mitigation measures to be complied with. These could include: • Modifying the horizontal alignment of the scheme in relation to its proximity to sensitive

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increase in noise which will be experienced in more rural areas compared to the very small reduction in noise predicted to be experienced by people living along the A282 on the Location A route. The assessment needs to consider updates in the baseline.	receptors (recognising other engineering and environmental factors that influence the scheme design). • Modifying the vertical alignment of the scheme to keep it as low as possible within the natural topography to exploit any natural screening and through the use of cutting. • Using environmental barriers in the form of earth mounding or acoustic barriers or potentially a combination of both. • Using low noise surfacing These mitigation options have not yet been included within the noise model but they will be considered as part of the EIA and also the engineering design during the development phase to reduce noise levels as far as possible and to within acceptable limits. As part of the Environmental Impact Assessment (EIA) for the Preferred Route, a detailed noise and vibration assessment in accordance with the NPSNN and DMRB Volume 11, Section 3, Part 7, HD 213/11 will be undertaken. The assessment will also consider potential impacts of the scheme in accordance with current national and local legislation and policy, including: the Noise Policy Statement for England, the National Planning Policy Framework, Environmental Protection Act 1990, Control of Pollution Act 1974 and Noise Directive 2002/49/EC. Highways England's preliminary noise assessment of options suggests that relevant policy and standards will be met with the inclusion of appropriate mitigation such as acoustic barriers. Baseline noise monitoring will also be carried out to understand the existing noise environment and to validate the levels predicted within the noise model. The details of the baseline survey will be agreed with the relevant local authorities and then undertaken at appropriate residential receptors. The sensitive receptors considered in the noise assessment will include: dwellings, hospitals, schools, community facilities, designated sites and public rights of way. The study area for the noise assessment will be defined in accordance with the DMRB and agreed through the EIA scoping process with consultees. The operational noise model will be further developed to take account of changes in the road network, composition, flow and speed of vehicles, as well as building a 3-D topographical data. This

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	will ensure an accurate real world model of the Preferred Route option.
Landscape/ townscape (including visual)	
Some respondents were concerned that the proposed scheme would be an unnatural, man-made feature that will detract from the natural landscape, including the Thames Estuary marshes and other designated and valued local landscapes and features. There was also some concern that the physical scale of grade separated junctions and the effects of traffic, lighting and other road infrastructure would have negative landscape and visual impacts. Respondents were also concerned that both of the southern links would involve land take within the Kent Downs Area of Outstanding Natural Beauty (AONB) as well as affecting its setting. The setting of the Kent Downs AONB is of great value and was a main reason behind the designation of the AONB; the Kent Downs was designated in part because of the views beyond it into its setting and these views have remained critical to its value and to public enjoyment ever since. Objectors do not believe that it is possible to adequately mitigate the impact of either of the links and state that it will be essential for significant investment to be put into exceptional mitigation to minimise impacts as far as possible. This is in accordance with policy SD12 of the AONB Management Plan which requires that essential transport schemes are to be mitigated by sympathetic landscape and design measures. Stakeholders also highlighted the need for maintenance of existing green infrastructure and that there should be a presumption against any development which would damage or threaten an ecological network or Living Landscape. Concerns have also been raised in relation to the effects of the scheme	A WebTAG appraisal was completed of the effects of the proposed scheme on landscape and townscape of each route option. This is a recognised and robust methodology for comparing and appraising options and their townscape/ landscape effects. This approach was agreed with Natural England during the options phase as being an appropriate methodology. Highways England's preferred option of the bored tunnel crossing reduces the effects of the scheme on the River Thames corridor and the level of visual impact of the scheme in this location. However, there are other potentially significant effects on the landscape and townscape that would require mitigation. Once the Preferred Route has been announced a detailed Landscape and Visual Impact Assessment (LVIA) will be completed. This will assess the effects of the Preferred Route on the physical characteristics or components of the landscape which form its character e.g. landform, vegetation and buildings and an assessment of the visual impacts on residents or users of community facilities or Public Rights of Way. The assessment will consider all aspects of the Preferred Route including noise and light pollution, as well as effects on local amenity and tranquillity. Developing mitigation will be an intrinsic part of the assessment process and may lead to the modification of the design of the Preferred Route where possible to avoid or reduce landscape and/or visual impacts. The use of planting and barriers, the types of boundary treatment, levels of signage/ gantry provision and lighting (recognising highways design standards) and treatment of verges will also be considered. Nationally designated landscapes have the highest status of protection in the NPSNN and national policy. It is recognised that a key issue of the proposed scheme is the effect on the Kent Downs AONB and its setting associated with the WSL and ESL. Highways England considers that a suitable Southern Link route can be developed which will meet the relevant policy tests, taking into account the potential mitigation measures available and the national need for the scheme. The approach to design and visual quality is discussed in section 2.11 of Volume 4 of the Post-

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on visual amenity of residents near to the scheme.	Consultation SAR. In the Road Investment Strategy the Government has made new commitments to environmental standards and to design, including establishing a Design Panel, which will provide support and guidance in the development of the design of the preferred solution. This will further contribute to a reduction in landscape and visual effects.
Community Impacts and Severance	
A number of concerns were raised about the effects on community facilities and severance of access to them including local footpaths and facilities such as the Shorne Woods Country Park. Particular issues raised were: i) The ESL would divide Shorne Parish ii) Both proposed routes for the southern link would cut off Chalk Church from its community iii) Severance of communities and effects on cohesion either side of the road. iv) Loss of access to green spaces, open spaces and impacts on recreational facilities v) Impacts on important areas of countryside that are a vital 'green lung' to urban areas vi) Potential impact on Thurrock's Local Development Plans by severing and blighting large areas of potential development land from the A1089 corridor through to East Tilbury, and north of the A13 vii) Disruption to farm operations. viii) Efforts should be made to ensure the continued connectivity of the Public Rights of Way network. ix) Impact on homes and schools	The Pre-Consultation SAR identified where community facilities would be directly impacted or severed by route options. For the Preferred Route the design will be developed further to minimise impacts on community facilities and to identify appropriate mitigation measures such as modifications to route alignments or provision of alternative facilities in line with NPSNN requirements. The detailed design of the Southern Link will consider measures to reduce severance at Chalk. Effects on people and communities will be assessed as part of the EIA for the Preferred Route. The scope of this will include analysis of socio-economic impacts and effects on agricultural land and farms, community facilities, open spaces, private property and development land and communities. The assessment of severance will consider impacts caused directly by the Preferred Route as well as the implications of traffic impacts on primary access routes and linkages between communities.
Ecology	
Some respondents raised the issue that the major ecological impact would be on the Ramsar/ Special Protection Area (SPA) that covers the marshes in North Kent and South Essex as well as a range of other potential impacts on nationally and locally protected and managed sites.	The potential risks to the Thames Estuary and Marshes Ramsar Site and Special Protection Area were recognised during the options appraisal, as set out in Volume 6 of the Pre-Consultation SAR. As identified in Volume 7 of the Pre-Consultation SAR the bored tunnel at Location C was put forward as Highways England's proposed solution. In particular the reasons for this are that Highways

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Respondents stated that the scheme would also have the potential to affect areas of nationally important ancient woodland, Local Wildlife Sites and protected species and a comprehensive and effective mitigation package would be required to address damage arising from the development.	England feels that this is the option that best meets the scheme objectives, whilst also providing a more practical array of implementable mitigation measures that would increase the scheme's compliance with the Habitats Directive. Other options such as a bridge or an immersed tunnel would have involved direct habitat loss within the Ramsar site and so would have been more likely to have significant effects thereby posing a risk to compliance with the Habitats Directive. Highways England recognises that there may be other potential effects on the Ramsar and SPA with the bored tunnel and understands that the ecological interest features may also be reliant upon areas of land outwith the site boundary (areas known as functionally linked land) and that changes to hydrological processes could also impact the sites. A comprehensive suite of surveys, for example ornithological (wintering, summer and autumn passage) will be completed to understand bird movements and usage of land within the Thames Estuary and in locations affected by the scheme. Invertebrate and botanical surveys will also be undertaken within the boundary of the Ramsar Site. This survey information as well as engineering design details will be used to assess effects on the sites and then develop appropriate mitigation measures. A Habitats Regulations Assessment will be undertaken for the Preferred Route that will report potential effects and mitigation on the European Sites. Volume 7 of the Pre-Consultation SAR also identifies that the proposed scheme may affect other nationally designated ecological sites including SSSI's and a Recommended Marine Conservation Zone, as well as areas of ancient woodland. Nationally designated ecological sites are afforded a high level of protection in the NPSNN. It states that where an adverse effect on a SSSI is likely an exception should be made only where the benefits of the development at that site clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest, and any broader impacts on the national network of SSSIs. Ancient woodland is recognised in the NPSNN as being irreplaceable and is afforded a very similar level of protection to SSSIs as a matter of policy. Highways England is satisfied that these NPSNN tests could be met in the detailed design of both the scheme in the light of the national need for the scheme and the inclusion of suitable mitigation measures.

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	In relation to other potential ecological effects a comprehensive suite of surveys will be undertaken including an extended Phase 1 habitat survey, National Vegetation Classification surveys and arboricultural assessment, as well as protected species surveys such as water voles, badgers, bats, dormice, great crested newts, invertebrates and otters. The assessment of ecological effects will consider these survey results, the design of the scheme and the risks to ecological features as a result of direct and indirect effects such as noise, impact of lighting and changes to drainage and air quality. The assessment will then be used to inform the design of the Preferred Route and inclusion of appropriate ecological mitigation measures that may comprise: modifications to the route alignment to avoid or minimise impacts, for example severance of areas of woodland, review of the scheme drainage, ensuring that new structures have appropriate provision for wildlife, replacement planting, translocation and provision of new habitat. The Ecological Impact Assessment produced will meet the EIA requirements of paragraphs 5.22 and 5.23 of the NPSNN. The assessment will be informed by engagement with statutory and non-statutory environmental bodies and will be in accordance with the Highways England Biodiversity Plan 'Our Plan to Protect and Increase Biodiversity' (June 2015).
Historic Environment	
Some respondents raised the issue that a number of heritage assets would be potentially affected either by a physical or setting impact including Scheduled Monuments, Listed Buildings, Conservation Areas and Registered Parks and Gardens. They stated that there would be a high likelihood of impacting highly significant buried heritage assets including Palaeolithic archaeology and that there would also be historic landscape impacts.	The Pre-Consultation SAR Volume 6 identified the potential effects on designated heritage assets (Scheduled Monuments, Listed Buildings, Registered Parks and Gardens and Conservation Areas) and it is acknowledged that each Route would affect a number of heritage assets. The potential for buried heritage assets to be impacted was also identified. The NPSNN states that given that heritage assets are irreplaceable, harm or loss affecting any designated heritage asset should require clear and convincing justification. Substantial harm to or loss of heritage assets should be exceptional, or wholly exceptional for designated assets of the highest significance. Highways England is satisfied that these NPSNN tests could be met in the detailed design of these sections of the scheme in the light of the national need for the scheme and the inclusion of suitable mitigation measures.

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	The scope and proposed methods of assessment for heritage assets in the EIA will be developed in consultation with Historic England, Kent and Essex County Councils and other stakeholders as appropriate and will meet the requirements of the NPSNN. Appropriate mitigation based on assessment and evaluation of the heritage resources will be developed. Whilst this is likely to involve investigation and evaluation of assets, for effects on the setting of features such as Listed Buildings and Conservation Areas this mitigation may comprise, route alignment modifications or appropriate bunding or screening to lessen visual intrusion or noise impacts.
Green Belt	
Some respondents raised the issue that the Location C routes run entirely through the Green Belt, north and south of the river. Protection of Green Belts is given significant weight in national planning policy. They stated that for there to be "very special circumstances" justifying inappropriate development, such as this scheme, a number of tests would need to be satisfied and it is not clear from the analysis presented that those tests and the implications of the Green Belt have been consistently and rigorously considered.	Volume 6 of the Pre-Consultation SAR does recognise that all of the Route options would affect the Green Belt. Highways England does acknowledge that as major new infrastructure the proposed scheme would impact on the openness of the Metropolitan Green Belt and may comprise inappropriate development in the Green Belt in terms of national policy. The NPSNN advises that there is a presumption against inappropriate development in the Green Belt except in very special circumstances. Very special circumstances would not exist unless the potential harm to the Green Belt by reason of inappropriateness, and any other harm, is clearly outweighed by other considerations. Highways England has given these issues careful consideration. The proposed scheme is a linear scheme which is designed to connect to the wider road network, much of which is already in the Green Belt (e.g. M25 and M2/ A2). There is a clear national need for the LTC and it would not be reasonably possible to avoid the Green Belt whilst still meeting the scheme objectives. Highways England is satisfied that the potential harm to the Green Belt by reason of inappropriateness and any other harm is outweighed by the need for the scheme and that this constitutes very special circumstances for the purposes of the NPSNN.
Land Use	
Some respondents raised the issue that all route options would result in loss of agricultural land and severance of farm holdings. This is particularly notable for the routes in Essex, where most of the land is high	It is not feasible to avoid the loss of at least some farmland, given the need to minimise impacts on other environmental and community assets. Wherever possible areas of poorer quality land will be used in preference to that of a higher quality. This will be looked at in detail during the next stage

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quality. Soil is a finite resource that fulfils many important functions and services (ecosystem services) and should be protected and used in a sustainable manner. Some respondents were concerned that whichever route option is chosen, infill development will be encouraged and facilitated, leading to the erosion of the Green Belt and eventual complete disappearance of valued green spaces. Other respondents were concerned about the scheme's potential impact on a number of landfill sites, particularly: • The Veolia South Ockendon landfill. • The East Tilbury Marshes landfill, which includes hazardous liquid waste.	of scheme development and mitigation measures in the form of re-use and conservation of soils and farm access accommodation works measures will be considered. Green Belt issues are dealt with above and the detailed route alignment will seek to minimise impacts on the functions of the Green Belt. The route per se will not affect the planning policy presumption against infill and encroachment in the Green Belt; these matters are under the control of the relevant local authorities. An extensive preliminary geotechnical risk assessment for the scheme has been carried out, which is reported in Volume 4 of the Post-Consultation SAR. The proposed route does pass through a landfill site located to the north of South Ockendon and this is expected to reopen to accept waste in the next five to ten years. A number of alternative engineering solutions will be looked at in greater detail in the next stage of design, including excavation and replacement of the landfill, ground treatment, structural solutions, and local modification of the alignment of the route. This further work will include geotechnical investigation to assess levels of landfill gas, leachate and ground movements. There are also a number of former and active waste disposal sites in the East Tilbury area. The site known as East Tilbury Marshes, which contains hazardous waste, is some distance from the road alignment. However, the route does affect a number of other landfill sites, including Goshems Farm, which is still active, and Tilbury Ash Disposal site. Highways England will undertake further ground investigations during detailed scheme development and are confident that a suitable engineering solution can be found for any issues posed by these sites, although there may be cost and environmental implications.
Concerns were raised that the proposed scheme would directly affect two Golf Courses.	Route 3 north of the river would affect the edge of one golf course (Orsett) but would not affect any holes. Route 4 north of the river would affect 2 golf courses (Orsett and Dunton Hills). The WSL would run through the central part of the Southern Valley golf course causing severance and resulting in the direct loss of land. The NPSNN states that "The Secretary of State should not grant consent for development on existing open space, sports and recreational buildings and land, including playing fields, unless an assessment has been undertaken either by the

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	local authority or independently, which has shown the open space or the buildings and land to be surplus to requirements, or the Secretary of State determines that the benefits of the project (including need) outweigh the potential loss of such facilities, taking into account any positive proposals made by the applicant to provide new, improved or compensatory land or facilities." Highways England is satisfied that these NPSNN tests could be met in the detailed design of the scheme in the light of the national need for the scheme and the inclusion of suitable mitigation measures.
National Grid has identified that all route options would cross a number of their Electricity Transmission overhead lines (400kv and 275kv). All route options also cross high pressure gas distribution pipelines.	The potential impact on electricity and gas transmission assets could have significant cost and programme implications and will be given careful consideration and consultation with National Grid in the detailed design stage to ensure that a detailed strategy is developed for any required relocation of facilities and associated mitigation measures.
Groundwater	
Concerns were raised regarding the impacts that construction and dewatering may have on groundwater resources and ecology	An initial Part One Habitats Regulations Appropriate Assessment has been undertaken and is reported in Volume 6 of the Pre-Consultation SAR. This identifies the potential for hydrogeological changes to affect the ecology of the protected European Sites. This issue will be examined in further detail in the full Habitats Regulations Assessment to accompany the DCO application to ensure any effects are understood and mitigated. Highways England has also had initial discussions on the potential impacts on groundwater resources with the EA and this issue too will be assessed in detail as part of the Environmental Impact Assessment.
Flood Risk	
Some respondents have raised concerns about: i) The location of the Kent tunnel portals and their distance from the tidal flood plains. ii) The ability of the flood plain to accommodate a worse-case sea level rise scenario with LTC. iii) The EA have serious concerns about the section of Route 2 which passes through the Tilbury Flood Storage Area.	To date Highways England has: • Identified areas at risk of flooding and flood defences. • Held discussions with the EA and on the basis of those discussions selected a proposed scheme that would not impact the Tilbury Flood Storage Area. • Considered how options could integrate or avoid compromising TE2100 River Thames flood defence plans (including any defences along the Mardyke).

Consultation Theme	Highways England's Response
	• Considered the possible effects of the options on flood risk and taken them into account when developing and appraising the options.
Some respondents also stated that the construction of the WSL would provide an opportunity to enhance flood defences.	At the next stage of scheme development Highways England will continue engagement with the EA and prepare a Flood Risk Assessment (FRA) to accompany the DCO application. The design will take into account the findings of the FRA to ensure flood risk and future plans are accommodated, and opportunities realized wherever possible. The DCO application will comply with the tests in the NPSNN and the FRA will "*identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account*".

6.8 Construction Impacts

Consultation Theme	Highways England's Response
Some respondents were concerned about the impacts of construction on surrounding areas and communities, including land required for construction, impact during construction on the emergency services and how excavated materials would be removed.	In the next stage of scheme development, the design development work will include a detailed appraisal of construction impacts of the scheme, including the requirements for temporary land needed to construct the scheme. Where effects are identified mitigation measures will be proposed and these will be contained in a variety of management plans to be submitted with the DCO application, such as a draft Construction Environmental Management Plan (CEMP) or Code of Construction Practice (CoCP). The appointed contractor will be responsible for enforcing the requirements of the management plan during the construction phase. In developing the draft management plan discussions will be held with a range of organisations including local authorities, emergency services and statutory environmental bodies such as Natural England, the EA and English Heritage. Agreement to the measures would be secured with these organisations through protective provisions (i.e. commitments to implement the agreed measures) in the DCO or other forms of agreement.
Some respondents raised the issue that the Kent Minerals and Waste Local Plan shows the area of the tunnel cutting and portal at Chalk as a site for the potential extraction of	Policies CSM5 and DM9 of the Kent Minerals and Waste Local Plan are relevant to LTC as they are both concerned with safeguarding mineral resources from development. The appraisal that will be carried out in the next stage of scheme

Consultation Theme	Highways England's Response
sands and gravel. Within the plan policies CSM5 (safeguarding) and DM9 (prior extraction of minerals in advance of surface development) are relevant, implying an assessment of the resource and its extraction if economic, before any tunnel is constructed.	development will include necessary work to demonstrate compliance with these policies.
Some respondents requested details of how the excavated materials will be removed.	This is a complex issue, the details of which have not yet been fully established. Further work will be carried out on this aspect and the DCO application will be accompanied by a Waste Management Strategy which will describe the approach to be followed for waste management, including the removal of excavated materials.
Some respondents have questioned whether the construction timeline and predicted opening date has taken any potential legal challenges into account.	Highways England is striving to develop the project in a robust and fair way, so that it is able to withstand scrutiny such that the programme would not be affected should any legal challenge be made.

6.9 Other Options

Consultation Theme	Highways England's Response
A number of respondents put forward or made the case for alternative options to the proposed scheme at consultation (i.e. options other than Route 3 with ESL and bored tunnel) to address the scheme objectives. These included options presented in the consultation, as well as options which had been considered and discounted in the past. These alternatives are summarised below, together with Highways England's response.	
Location C - Southern Link A range of feedback was received on our proposals for the Southern Link, including supportive and neutral comments and objections, issues and concerns. The key themes relating to the Southern Links which emerged from consultation were as follows: • The impact on the protected areas SSSI, Kent Downs AONB, Ancient Woodland and Green Belt • The impact on communities e.g. severance, air quality, noise impacts (especially around Shorne) • The visual impact of the junction with the M2/A2 • The connectivity to the Medway towns including integration of the Wainscott bypass	The ESL would have a greater impact on nationally important landscape, nature conservation, ancient woodland sites and Green Belt than the WSL. There are strong policy tests which must be satisfied in the NPSNN relating to the loss of such assets. Consequently, and following the 2016 consultation, Highways England has undertaken further work on the southern link options. The outcome of this work and the response to this consultation theme is reported in Volume 7 of this Post-Consultation SAR.

Consultation Theme	Highways England's Response
• The improvement of the 'compact' junction with the A2 • Removal of the junctions with the A226	
Location C – Route 2 Responses in support of Route 2 north of the river are described below. **Traffic** - would facilitate better provision of junctions to serve the local area which would provide maximum economic benefit to the Thurrock area, and the planned expansion of Tilbury - would provide the quickest, most direct route to the M25 which would reduce journey times - would provide a useful interchange with the A1089	For part of its length 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. The quality of the solution is constrained as a result, and would not be the same standard of high quality route as provided by Route 3. It would also disrupt the A1089 during construction, affecting HGV traffic to the port.
Impact on communities - less disruptive and have less impact on residential areas - closest to the urban area, which would create less space for infill development	Route 2 would have greater noise and air quality impacts than Route 3 as it is closer to existing communities, particularly the more densely populated urban areas of Tilbury, Chadwell St Mary and Grays.
Economic development - would be most cost effective	The capital cost of Route 2 is similar to that of Route 3. The economic benefits generated by Route 2 are similar to those of Route 3.
Environment - less disruptive and have less impact on the countryside	Route 2 would have a significant impact on the EA flood compensation area north of Tilbury. It also has greater heritage impacts than Route 3, particularly around West Tilbury, with direct permanent impacts on two conservation areas, a scheduled monument and two listed buildings. Further details of the appraisal of Route 2 are provided in the Pre-Consultation SAR Volumes 4, 5, 6 and 7.

Consultation Theme	Highways England's Response
Location C Route 4 Responses in support of Route 4 north of the river are described below. **Traffic** - reduces congestion on Thurrock road network - avoids increased HGV traffic on A128 - would connect to the M25 further north, helping to relieve congestion at the existing crossing - provides access to the A13 further to the east taking traffic further away from London	Route 4 is a longer route than Route 3 and would require widening of the A127, a county road, for part of its length. As a result it does not perform as well as Route 3 in meeting the transport objectives of providing free-flowing north-south capacity, improving network resilience and improving road user safety. The new junction with the A13 would require the closure of Orsett Cock east facing slip roads. This is due to the close proximity of the existing junctions at Orsett Cock and Manor Way. North of the A13 Route 3 would carry around 20% more traffic than Route 4, providing greater relief to traffic on existing roads.
Impact on communities - reduces impact on communities which are affected by congestion at the Dartford crossing, particularly with respect to air quality impacts - takes HGV traffic away from Tilbury Town and from the A128 onto the new road, helping to relieve nuisance to residents	Route 4 would have similar impacts on air quality as Route 3. Properties within the vicinity of both routes would not experience exceedances or a risk of exceedances as they are predicted to be well within EU limits. All properties which are predicted to exceed or are at risk of exceeding the EU limits in the vicinity of the Dartford crossing would experience an improvement in air quality with both routes compared with the Without Scheme situation. Overall the noise impact on properties is lower with Route 4 than Route 3.
Economic development - opens up east of Thurrock for residential and business development, in the east of the borough, where there is more potential - offers the future potential to extend across to the M11 further reducing pressure on the M25	Route 4 would conflict with Brentwood's proposals for the Dunton Garden Suburb development, situated to the south east of the A127/ A128 junction. Whilst Route 4 generates similar economic benefits to Route 3, it has a higher capital cost; the additional outturn cost of Route 4 is £340m.
Environment - avoids Orsett scheduled crop-mark.	Route 4 would affect ancient woodland and a registered park and garden. Overall Route 4 has a greater impact on historic environment and biodiversity than Route 3, but lesser impact on the water environment. Further details of the appraisal of Route 4 are provided in the Post-Consultation SAR Volume 7.

Consultation Theme	Highways England's Response
Route 1 at Location A Some respondents have expressed an opinion that Location A is a better solution than Location C. They stated that the consultation documents include some limited information on Route 1 (Location A), but not in a consistent or comprehensive manner compared with the other routes and that this does not enable a meaningful comparison to be made on a consistent basis.	The appraisal of Route 1 was reported in detail in the *Pre-Consultation SAR*. This appraisal was carried out to the same level of detail as for the routes at Location C. Due the significant interest at consultation, Route 1 has been included in the Post Consultation Appraisal Routes, the results of which are reported in Volumes 4-7 of this Post-Consultation SAR.
Long tunnel at Location A Some respondents raised the issue that a twin bore Dual 2 lane 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 in the appraisal of the longlist options, as Option A14, summarised in **Appendix 3.2**. Option A14 is a dual 2-lane twin bore tunnel, with 2 lanes in each direction, connecting the M25 from south of Junction 2 to north of Junction 30. The results of the appraisal of the Option A14 tunnel demonstrated that it would carry relatively low levels of traffic, as it would not have connections with M25/A282 junctions between Junction 2 and Junction 30, i.e. there would be no connection with Junction 2, Junction 1b, Junction 1a, Junction 31, and Junction 30. Whilst the new tunnel would have a capacity of around 8000 vehs/hr, the maximum peak hourly two-way traffic flow predicted in the Opening Year (2025) was 3700 vehs/ hour, as the long 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 economic benefits provided were approximately 6% lower than Option 1, whilst most likely outturn capital cost was around twice the cost of Route 1. This option therefore represents very poor value for money. Further more detailed appraisal of Option A14 together with other selected Location A options not selected for the shortlist, including Option A8 the tunnel connecting J2 to J30, has been carried out and is reported in **Appendix 3.4**. Overall, the long tunnel option at Location A performs poorly against the traffic and economic scheme objectives.
Wind shielding at Location A Some respondents suggested that wind shielding should be provided on the existing QEII Bridge at Dartford	Between November 2009 and January 2015 the existing bridge was closed on average 2.5 times a year due to high winds with the average duration of a closure being about 6 hours. The installation of

Consultation Theme	Highways England's Response
	wind shielding on the existing bridge would potentially reduce the closures in high winds. To add wind shielding to the existing Dartford Crossing would involve major structural work to strengthen the deck to support the shielding. Traffic management would be used whilst construction work is being carried out which would require lane and speed restrictions which would reduce the flow capacity during this period. This proposed option would not solve the existing problems of congestion, unreliability of journey times and lack of resilience at the existing crossing. However, during the next stage of scheme development the possibility of installing wind shielding on the QEII Bridge will be considered further.
Improved lane signage at Location A A suggestion was made that better advance signage should be provided at to direct unsuitable traffic away from the crossing coming north	Improved lane and advanced signage could marginally improve flow capacity for traffic travelling northbound by reducing the use of the Traffic Management Cell. This proposed option would not solve the existing problems of congestion, unreliability of journey times and lack of resilience at the existing crossing. However, during the next stage of scheme development potential improvements to the lane signage on the approach to the existing crossing will be considered further.
Segregation of long haul and short haul traffic at Location A using concrete barriers Some respondents suggested that long haul and short haul traffic at the existing Dartford Crossing should be segregated using concrete barriers	Segregation of long and short haul traffic was considered as part of the longlist options, linked to a new bridge or tunnel to the east of the existing crossing (Option A2 – refer to **Table 3.5** and **Appendices 3.2** and **3.4**). It was found that there wasn't enough short haul traffic to benefit such a scheme resulting in lower economic benefits than Options A1 and A4 with the new crossing to the west of the existing crossing and no segregation of long and short haul traffic.
Increase the speed limit at the existing crossing at Location A Some respondents suggested that the speed limit at the existing Dartford Crossing should be increased from the current 50mph	The speed limit along the existing A282 corridor at Dartford is restricted to 50mph. This is due to constraints imposed by the existing horizontal and vertical alignment, including the existing tunnels and the QEII bridge, together with the location and spacing of existing junctions. It would not be

Consultation Theme	Highways England's Response
	possible to safely increase the speed limit along the existing route.
Blocking of hatched areas at roundabouts on the existing road network at Location A (e.g. on A13) Some respondents suggested that there should be better enforcement of the hatched areas at roundabouts on the existing local road network	Whilst blocking of hatched areas at roundabouts may cause increased congestion, this is a local enforcement issue. As part of the development of the design of the Preferred Route, operational assessments of junctions will be carried out, and measures included to optimise the traffic performance at junctions. However such local measures would not solve the existing problems of congestion, unreliability of journey times and lack of resilience at the existing crossing.
Build a dedicated tanker/ hazardous loads tunnel at the existing Dartford Crossing at Location A Some respondents suggested that a dedicated new tunnel for tankers and hazardous loads should be built at the existing Dartford Crossing	This would be a very expensive solution which would involve substantial disruption to traffic during construction. The dedicated tunnel would take a very small proportion of the total traffic (no more than 1,000 vehicles per day) and it would therefore not solve the existing problems of congestion, unreliability of journey times and lack of resilience at the existing crossing.
Build more than one crossing Some respondents suggested that more than one new crossing should be built, one at Location A and one at Location C	An option (Option A16) was appraised during the longlist appraisal stage which included a combination of a solution at Location C and an additional two lane northbound tunnel at Location A. The option had a high cost and provided little additional benefit and was not taken forward (refer to **Table 3.5** and **Appendix 3.2**).
C Variant Some respondents have requested the inclusion of C Variant to maximize the benefits to LTC and to improve the wider network. C Variant connects the A2/M2 with the A13 and the M25 between Junctions 29 and 30, and includes widening the existing A229 dual carriageway between the M2 and the M20 in Kent (Blue Bell Hill) and improving M2 Junction 3 and M20 Junction 6.	Highways England has undertaken an assessment of C Variant, the results of which show that the improvement to the A229 would have negligible impact (a maximum of 1%) on further reducing flows at the existing Dartford crossing, over and above options at Location C and would not be a necessary part of a new crossing. Moreover, it would have substantial environmental impacts particularly on the Kent Downs AONB. C Variant would have a high cost, around £450m, and would generate around £700m of benefits, including wider economic benefits. Overall, the C Variant

Consultation Theme	Highways England's Response
C Variant was included in the SoS July 2014 announcement as an option requiring further assessment to establish whether improvement of the A229 would help to transfer traffic from the existing Dartford Crossing on to the new route at Location C, and provide greater connectivity for the ports of Dover and Folkestone, and the Channel Tunnel.	Option would perform poorly against the scheme objectives and would not meet the tests in the NPSNN. Refer also to Section 3.4 of this Post-Consultation SAR Volume 3. There will be further consideration of this link as well as other wider M20/ M2 network issues as part of Highways England's ongoing regional route planning.
Location D A number of respondents proposed a solution at Location D.	Location D is further downstream from the existing Crossing than Location C connecting M2 Junction 1 to the A130 east of Pitsea and north of Canvey Island. It has no direct connection to the M25. This option was considered and not taken forward following the Dartford River Crossing Study, prepared by Parsons Brinckerhoff, January 2009 for the Department for Transport (the 2009 Study). The 2009 Study concluded that a solution at Location D would only reduce traffic at the existing Dartford crossing by 3%, and the existing crossing would therefore still be operating with demand in excess of capacity, with consequential queuing and delays. A solution at Location D would also have a significantly higher capital cost than options at Location A and C; the cost would be around 40% higher than a solution at Location C. **Appendix 3.1** to this volume provides further details of the appraisal of Option D against the current scheme objectives. The option performs poorly against the scheme objectives, it would have a high cost and represent poor value for money, it would carry a limited amount of new traffic and provide limited relief at the existing Dartford crossing.
A Lower Thames Pool at Location D which integrates new flood defences with energy storage and a multi-modal tunnel A suggestion was made that a Lower Thames Crossing at Location D with a multi-modal tunnel could be combined with a Lower Thames Pool integrating new flood defences with energy storage	A scheme objective is to relieve congestion at the existing Dartford Crossing. The further a new crossing is located downstream from Dartford the less the transfer of traffic and relief to the traffic congestion. As noted above the 2009 Study showed that Location D did not provide enough relief to the existing crossing to be considered to meet the scheme objectives. Other modal solutions are discussed in Section 6.11.

Consultation Theme	Highways England's Response
The plans take no account of future autonomy in cars. In only a few years all cars will have systems that greatly increase the capacity of roads, effectively turning large traffic jams into enormous 'road trains' Some respondents commented that the plans did not take account of future developments such as autonomous cars which could make the scheme unnecessary	The integration of connected vehicles into the network is likely to increase over the next 15 years with automated vehicles and potential platooning fleets coming onto the network. Connected vehicles are expected to improve safety to the road user by using technology to maintain a safe distance between vehicles. It is unlikely that the introduction of connected vehicles will have a significant impact in relieving congestion at the existing crossing. The design development of the Preferred Route will consider changes required to support future technological developments.

6.10 Options to Mitigate Impacts of Scheme

Consultation Theme	Highways England's Response
Some respondents have expressed the view that a longer tunnel south of the river at Location C could mitigate some environmental impacts of the scheme and reduce the severance between Chalk Church and Chalk.	A longer tunnel south of the river to mitigate environmental and community impacts will be considered as part of the next stage of scheme development.
Some respondents have commented that the scheme needs to be subject to a great deal more environmental mitigation if negative impacts are to be managed to an acceptable level.	The development of mitigation measures will be an integral part of the Preferred Route design process. The Preferred Route will be subject to EIA which will assess the significant effects of the route and identify measures to mitigate those effects. The EIA will be prepared in line with the prevailing best practice guidance and Planning Inspectorate Advice Notes. The scope of the EIA will be agreed with statutory consultees and engagement with stakeholders will continue to agree methods of assessment and mitigation measures. As outlined in Section 3.7, there are a number of different types of mitigation measures that could be considered for different environmental effects and all will be considered as appropriate through the scheme development process.

6.11 Other Modal Solutions

Consultation Theme	Highways England's Response
Some respondents raised the issue that there has been no serious consideration of any alternative strategy for relieving congestion and meeting both passenger and freight travel demands through other modal solutions. There is a lack of alternative public transport and this is stated to be the reason most people use the car for travel from Kent and Essex to other counties. In particular, the need to travel into London, interchange and then travel out again on the train to travel between Kent and Essex is seen as a major deterrent to rail use. Bus services using the Dartford Crossing are also minimal. If road traffic is encouraged to increase as a result of schemes of this nature, the UK will fail to abide by its international commitments (air, noise, climate change etc). A range of alternative modal solutions have been suggested including: • A complete re-think of transport provision with no more road building and more public transport including a new rail link for passengers and freight (which could be on a different alignment) and enhanced bus services across the existing Dartford Crossing, reducing car demand. • A combined road/ rail link (for passengers and freight) rather than a road only solution. • More priority for bus services on any new crossing and the provision of more services linking towns in Essex and Kent. • New ferry services across the Thames linking Essex and Kent. • A revised national Ports strategy Whilst some of the suggestions are intended to be a replacement for a new road crossing, others would entail a combined road/ rail crossing or act as complementary to a new road crossing. The issues raised would	An initial assessment of alternative modes was carried out as part of the 2009 Dartford River Crossing Study undertaken by Parsons Brinckerhoff for the Department of Transport (DfT). This concluded that rail passenger and freight did not provide a viable alternative to a new road crossing for the Thames and that there was no advantage in considering a combined road and rail crossing. These conclusions have been updated and re-examined by Highways England to ensure that they are robust. This updated assessment of possible alternative modes followed the guidelines set out in Highways England's Traffic Appraisal Modelling and Economics (TAME) Advice Note 2 v1.0 published in July 2015. Road and rail public transport solutions have been examined and it is clear from this analysis that whilst some of the alternative modes could be complementary to a new Lower Thames road crossing, none have the capability of solving the identified problem and meeting LTC objectives. There is no practical alternative that would provide 75% relief of the identified problem for the first 15 years (this equates to the occupants of 34,000 cars and more than 8,000 heavy goods vehicles in 2025) or which could return the flow to the capacity of the existing crossing in 2041. Whilst the new crossing should ensure that there is adequate provision for non-motorised users and road-based public transport, these modes do not in themselves provide an alternative. Future developments in the rail network and inter-modal terminals may help to reduce the demand for freight by road but the percentage that would be diverted form the Dartford/ Lower Thames Crossing would not be sufficient to eliminate the need for a new road crossing, given the predicted increase in demands and existing congestion. Alternative modes would therefore be complementary to a new crossing and not a replacement for it. Highways England will seek to work with Network Rail, public transport providers and the relevant local authorities to provide as many alternatives by public transport as possible. Whilst not providing a direct replacement for the LTC, road and rail public transport, ferries and rail freight would provide alternatives which would reduce the rate of growth in road traffic and increase the longevity of the infrastructure.

Consultation Theme	Highways England's Response
therefore affect the need for the crossing, the type of crossing (road and/ or rail) and the resultant size of any crossing.	

6.12 Junction Strategy

Consultation Theme	Highways England's Response
M25 Junction Concerns have been raised about congestion on the M25 as a result of connecting Route 3 to the M25 between Junctions 30 and 29.	An analysis has been undertaken of the capacity of M25 link between the new LTC junction and Junction 29. This work demonstrates that traffic flows on both northbound and southbound carriageways would be below the congestion reference flow. Refer to **Appendix 3.5** for more details of the results of this analysis. Further detailed work will be undertaken in the next stage of scheme development of the Preferred Route to optimise the junction arrangement, including the development of measures to mitigate community and environmental impacts of the scheme.
A13 Junctions Concerns have been raised regarding the impact of the proposed scheme on the A13, in particular: i) The new junction with the A13 and ii) The impact of the scheme on Orsett Cock junction, particularly queuing traffic on the A13 diverge slip roads.	Route 3 would intersect the A13 at the existing A1089/ A13 junction. In order to reduce the impacts of the proposed scheme at this junction, the proposals include the utilisation of the existing Orsett Cock Junction and Brentwood Road (upgraded to a dual carriageway) to provide the following turning movements: • A13 westbound vehicles onto LTC southbound • LTC northbound vehicles onto the eastbound A13 Further assessment work has been undertaken of the Orsett Cock junction which indicates that improvements to the junction would be required, which are likely to include signalisation. Further work will be undertaken in the next stage of scheme development to refine this analysis. This will include working with Thurrock Council who are developing the A13 Widening Scheme from Orsett Cock to Manor Way. Since the publication of the Pre-Consultation SAR, information has been received on a planning application for a recycling centre to be located in the south west corner of the existing Orsett Cock junction. The implications of this development on

Consultation Theme	Highways England's Response
	the proposals to widen Brentwood Road will also be considered in the next stage of scheme development.
New local junction north of the river Some respondents raised the issue that a local all-movement junction north of the river could be located between the northern portal and the proposed junction with the A13. Providing a junction in this location would bring benefits to Tilbury Port, other businesses and local residents in the area with the potential to provide economic growth opportunities, journey time savings as a result of greater connectivity with the new scheme and the wider motorway network.	Currently there are no significant roads in the area between Tilbury and East Tilbury to which LTC could connect. The provision of a new local junction will be considered in the next stage of scheme design, recognising the potentially significant regeneration and economic benefits that could flow from it. This work will include engagement with all relevant stakeholders.

6.13 Provision for Non-Motorised Users (NMUs)

Consultation Theme	Highways England's Response
Some respondents raised the issue that the scheme needs to take full account of the travel needs of pedestrians, cyclists and all non-motorised users (NMU) and to encourage safer and more attractive provision wherever possible. Other respondents also raised the issue that if the WSL is chosen it would affect National Cycle route N177, which runs alongside the A2 linking Dover to London.	During the design development of the shortlist routes existing public-rights of-ways (including footpaths and bridleways) and cycleways have been identified. If the route option affected a NMU route then an analysis has been undertaken of the measures which would be required to ensure that the route could remain open, by provision of under or overbridges or diversions. This analysis is reported in Volume 4 of the Pre-Consultation SAR, and Volume 3 Appendices contains plan and profile drawings which identify the NMU routes. For the purposes of the detailed appraisal of the shortlist routes, no provision has been included for NMUs at the new crossing. This aspect will be considered further as part of the next stage of the scheme's development, recognising that there are issues to consider in providing for NMUs in tunnels due to the enclosed space and requirements for separation for reasons of safety. Highways England will also engage with local authorities, NMU user groups and other stakeholders to ensure that their needs are understood.
Some respondents have suggested that an immersed tunnel be constructed to cater for cycle movements at the Crossing	An immersed tunnel would have unacceptable environmental impacts on the internationally designated ecological sites (Ramsar and SPA), and is not a viable option to take forward.

6.14 Wider Network Impacts

Consultation Theme	Highways England's Response
Some respondents have requested additional information to demonstrate the likely impacts of LTC on the wider road network. For the purposes of Highways England's response to this issue the impact of Route 3 with ESL as Highways England's proposed scheme at public consultation is considered. Where there are significant differences for Route 3 with the WSL these are also considered.	
A2 between M25 and LTC	Route 3 would result in a significant decrease in traffic on the A2 in both directions between the M25 and LTC. This is due to the transfer of traffic away from the existing Dartford Crossing on to the new LTC route.
A2 and M2 between LTC and M2 Junction 3	Route 3 with either ESL or WSL would result in an increase of traffic on the M2 between J1 and J3. With the WSL, there would also be an increase in traffic on the section of A2 between the new LTC junction and M2 J1. A congestion reference flow (CRF) analysis has been undertaken which shows that there is sufficient lane capacity on the A2 and M2 to accommodate the additional traffic. Refer to **Appendix 3.5** for more details of the results of this analysis. During the next stage of scheme development further detailed assessment will be undertaken to consider the impacts of the scheme on the A2 and M2. This work will include new traffic surveys to collect updated traffic data.
A229 (Blue Bell Hill), M2 Junction 3 and M20 Junction 6	i) **A229** - There would be an increase in traffic in both directions on the A229, as a result of transfer of some traffic between the M20 and the M2. An appraisal has been undertaken which has shown that there is sufficient lane capacity on the A229 to accommodate the additional traffic. Refer to **Appendix 3.5** for more details of the results of this appraisal. ii) **M2 Junction 3** - There would be increased traffic on the two roundabouts joining the M2 Junction 3 to the A229. The predominant change is on the M2 southbound off slip road and on the circulatory carriageways of the roundabouts. This increase in traffic will create longer queuing particularly at peak times. Possible improvements that could be implemented at this junction include reviewing traffic signal times, and local widening of the slip roads and circulatory carriageway. During the next stage of the scheme development more detailed assessment of the junction layout will be carried out to establish the need for any necessary improvement measures and determine appropriate solutions.

Consultation Theme	Highways England's Response
	This work will include new traffic surveys to collect updated traffic data. iii) **M20 Junction 6** - There would be some increase of traffic on the M20 westbound diverge slip road. Possible improvements that could be implemented at this junction include changing the layout of the diverge slip, link roads and local improvements to the connecting roundabouts. During the next stage of the scheme development more detailed assessment of the junction layout will be carried out to establish the need for any necessary improvement measures and determine appropriate solutions. This work will include new traffic surveys to collect updated traffic data.
A127 between M25 Junction 29 and A127/A130 Junction	Route 3 would result in a reduction of traffic on the A127 between M25 Junction 29 and the A128 junction. On the A127 from the A128 junction to the A130 junction there would be little change in traffic flows as a result of the proposed scheme.
A12 between M25 Junction 28 and A12/A130 Junction	There would be little change in traffic flows on the A12 as a result of the proposed scheme.
M25 Junction 30 - Junction 26	Route 3 would connect to the M25 via a new junction between M25 Junction 30 and Junction 29. To the south of the new junction, there would be a reduction in traffic on the M25, due to transfer of traffic onto LTC. To the north of the new junction, there would be an increase in traffic on the M25. An appraisal has been undertaken which has shown that there is sufficient lane capacity on the M25 between the new junction and M25 J26 to accommodate the additional traffic. Refer to **Appendix 3.5** for more detail of the appraisal results. During the next stage of scheme development a more detailed assessment will be undertaken of the performance of the M25 north of the new LTC junction. This work will include new traffic surveys to collect updated traffic data.
M25 Junction 2	More detailed modelling work has shown that there would generally be an improvement in traffic conditions at M25 Junction 2 as a result of the proposed scheme. However this work has shown that there would be an increase in queuing on the Junction 1b to Junction 2 southbound connector road. Possible improvements that could be implemented at this

Consultation Theme	Highways England's Response
	junction include reviewing traffic signal times, and local widening of the slip roads and circulatory carriageway. During the next stage of the scheme development more detailed assessment of the junction layout will be carried out to establish the need for any necessary improvement measures and determine appropriate solutions. This work will include new traffic surveys to collect updated traffic data.
M25 Junction 30	More detailed modelling work has shown that there would generally be an improvement in traffic conditions at M25 Junction 30 as a result of the proposed scheme. However, this work has shown that there would be increased queuing on the northbound Junction 31 to Junction 30 connector road. Possible improvements that could be implemented at this junction include reviewing traffic signal times, and local widening of the slip roads and circulatory carriageway. During the next stage of the scheme development more detailed assessment of the junction layout will be carried out to establish the need for any necessary improvement measures and determine appropriate solutions. This work will include new traffic surveys to collect updated traffic data.
M25 Junction 29	Route 3 would result in an increase in some traffic movements at Junction 29. Possible improvements that could be implemented at this junction include reviewing traffic signal times, and local widening of the slip roads and circulatory carriageway. During the next stage of the scheme development more detailed assessment of the junction layout will be carried out to establish the need for any necessary improvement measures and determine appropriate solutions. This work will include new traffic surveys to collect updated traffic data.
M25 Junction 28	Route 3 would result in an increase in some traffic movements at Junction 28. Possible improvements that could be implemented at this junction include reviewing traffic signal times, and local widening of the slip roads and circulatory carriageway. During the next stage of the scheme development more detailed assessment of the junction layout will be carried out to establish the need for any necessary improvement measures and determine appropriate solutions. This work will include new traffic surveys to collect updated traffic data.

Consultation Theme	Highways England's Response
A13 Orsett Cock Junction	The proposed scheme would result in an increase in traffic movements in both directions between A13 and A128 Brentwood Road at Orsett Cock Junction. Possible improvements that could be implemented at this junction include of the addition of signaling to the junction, and local widening of the slip roads and circulatory carriageway. During the next stage of the scheme development more detailed assessment of the junction layout will be carried out to establish the need for any necessary improvement measures and determine appropriate solutions. This work will include new traffic surveys to collect updated traffic data.

6.15 Economic Benefits and Costs

Consultation Theme	Highways England's Response
Some respondents raised the following issues: • There is limited information on the extent of economic benefits that would accrue to the local area, including benefits for local businesses. • The scheme will encourage further warehouse development whereas it is high skilled and professional jobs which are needed. • Future housing growth will stimulate demand for further schools, hospitals and other public services which are already at or near capacity, leading to a deterioration in quality of life for existing residents.	As part of the options development work, the project team has assessed the economic impact unlocked by the new crossing. The Post-Consultation SAR, Volume 5: Traffic and Economics Appraisal outlines the basis of the economic appraisal. This was undertaken in line with DfT WebTAG guidance to understand the direct economic impacts, the wider economic impacts and environmental impacts. This was based on a central estimate of national economic growth and future land use developments in the area around the LTC crossing locations that were viewed as 'near certain' and 'more than likely' to proceed. Separately, a "complementary appraisal" was also carried out to capture the "transformational" nature of the project. This has been done using "Spatial Computable General Equilibrium" and econometrics, on a similar basis to that used for the recent Airports Commission economic appraisal. This assessment indicated that the proposed scheme could add over £7bn cumulatively to the economy by stimulating investment and business opportunities, and create over 5,000 new jobs nationally. The graphical representation of the relative GDP impact by region from the new crossing at Location C was included in the Summary Business Case included in the 2016 consultation materials. In the next stage of development of the Preferred Route, the traffic model and economic appraisal will be updated with new demand data, to reflect

Consultation Theme	Highways England's Response
	updates to the economic growth, local growth strategies and future land-use developments. It is anticipated that this will bring a focus on the regional impacts, including the incremental housing developments that may occur as a result of the new crossing. This work will be undertaken to reflect the further development of the route alignment and how the new route would connect with the existing transport network. Improved accessibility from a new crossing would improve the attractiveness of the area to residential developers and to a wide range of potential businesses, such as LPER. This offers the potential to support a fresh strategic approach to development in North Kent and South Essex. The Lower Thames has been a priority regeneration area for at least 20 years and all parties recognise that public services provision needs to keep pace with demographic changes and future population growth. This is outside the scope of Highway's England responsibilities but Highways England will work with public sector agencies to help them understand the implications of improved accessibility which LTC will bring and to maximise the regeneration potential it offers. The Thames Estuary 2050 Growth Commission is examining potential economic opportunities throughout the Thames Gateway and Highways England are working closely with the Commission to ensure that economic opportunities from LTC are maximised. Highways England will also develop a LTC Legacy Plan to maximise the potential economic and other benefits of the scheme.
Stakeholders have questioned the increase in costs for the Location A option since the DfT May 2013 consultation	The Location A option reported in the *Review of Lower Thames Crossing Options: Final Review Report* published in May 2013 incorporated a new crossing alongside the existing crossing. The Most Likely cost of this option was £1,200m - £1,600m. The *Government Response to Consultation, Options for a New Lower Thames Crossing* published in July 2014 indicated that a new crossing at Location A would require substantial improvements to the A282/ M25 corridor and junctions on both sides of the river; this option was referred to as Option A+. With the inclusion of these additional improvements the P50 cost estimate of Option A+ increased to £1,950 - £2,900m, depending on the solution adopted. The work carried out by Highways England to develop and appraise route options for both

<table>
<tr><th>Consultation Theme</th><th>Highways England's Response</th></tr>
<tr><td></td><td>Location A and C is described in the Pre-Consultation SAR.

Route 1 at Location A was included in the options shortlist, following the appraisal of a number of longlist routes. Route 1 includes either a bridge or bored tunnel to the west of the existing crossing, and includes improvements to the existing M25/ A282 corridor north and south of the river. The P50 cost estimate of Route 1 was £3,365m - £3,560m. The detailed appraisal undertaken demonstrated that construction of Route 1 would take around 6½ years, including a 20 month advanced works stage. The principal reasons for the higher Route 1 costs compared to Option A+ resulted from the longer construction duration, together with higher costs of land, utility and other third party works, programme risk and VAT. The estimated most likely out-turn costs for Option A, Option A+ and Route 1 are shown in Table 6.2.

TABLE 6.2 - LOCATION A COSTS
<table><tr><th></th><th>Most likely out-turn cost (£m)</th></tr><tr><td>Option A (May 13)</td><td>1,200-1,600</td></tr><tr><td>Option A+ (July 14)</td><td>1,950-2,900</td></tr><tr><td>Route 1 (SAR)</td><td>3,365-3,560</td></tr></table></td></tr>
<tr><td>Stakeholders have questioned the increase in benefits for an option at Location C since the DfT 2013 consultation</td><td>The calculation of scheme benefits has been undertaken following the guidance set out in the DfT WebTAG (Web-based transport analysis guidance). WebTAG defines the technical standards to be followed in respect of traffic forecasting and appraisal of economic benefits.

In calculating the Benefit Cost Ratio (BCR) costs and benefits over a 60 year appraisal period are discounted to a common base year for comparison purposes. This is termed Net Present Value.

Two BCRs are calculated. The Initial BCR consists of direct benefits made up of user and provider benefits (from travel time savings, vehicle operating cost savings, user charges and construction delays) plus accident, noise and greenhouse gas benefits. The Adjusted BCR builds on the initial BCR but includes Wider Impact benefits and journey time reliability benefits.

Table 6.3 shows a comparison between the benefits with Location C from the 2013 consultation with Route 3 ESL or WSL, as reported in Volume 5 of the Post-Consultation SAR. It is noted that the benefits reported in the Pre-Consultation SAR at the time of the consultation were higher than those</td></tr>
</table>

Consultation Theme	Highways England's Response

shown in **Table 6.3;** the benefits have reduced as a result of the updated appraisal reported in Volume 5 of the Post-Consultation SAR.

TABLE 6.3 - 2013 AND 2016 BENEFITS FOR ROUTE 3 AT LOCATION C

Principal Benefit Component	**Benefit £m**		
	2013 Location C Option	**2016 R3 WSL Option**	**2016 R3 ESL Option**
Total Direct Benefits, PVB (for Initial BCR)	**2,132**	**2,346**	**2,817**
Wider Impact Benefits	1,162	1,392	1,611
Reliability Benefit	Not assessed	138	141
Total PVB (for adjusted BCR)	**3,294**	**3,876**	**4,569**

Route 3 WSL, with a new junction on the A2, is the option that has the greatest similarity to the 2013 study Location C option.

Time Savings and Agglomeration Benefits

Changes in direct benefits are a function of the improved journey times (and hence reduced journey costs) when the scheme is implemented compared with the Without Scheme scenario. There has been considerable changes to both the Location C options and traffic model since 2013, which have led to improved option performance in terms of reducing journey times.

Key changes to the Location C option are as follows:

- Increasing the speed in the bored tunnel crossing of the Thames from 50 mph to 70 mph.
- Inclusion of the Dartford Crossing traffic management cell in the Without Scheme scenario.
- Inclusion of the M25 Junction 30 congestion relieving scheme – this provides free flow lanes between A13 (westbound) to M25 (northbound) and M25 (northbound) to A13 (eastbound).
- Updated 50mph speed limits on the A282 south of M25 Junction 31.
- Introduction of the A13 Orsett Cock to Manor Way improvement in the Without Scheme scenario. This eliminated a significant constraint on traffic between the new crossing and the A13.

Consultation Theme	Highways England's Response
	• Improved junction between LTC and the A13. Key changes to the traffic model are as follows: • Greater road network detail in the vicinity of the Location C options and the inclusion of new road schemes that were not included in the 2013 model. • Incorporation of the TfL London traffic model (LoHAM) for the area within the M25 orbital motorway. This significantly improved the modelling of traffic flows in and around London and provided a better representation of travel choices and travel costs between the orbital motorway and London roads. • More detailed disaggregation of the travel demand into a finer zone system for use in the model. This provided better representation of where journeys would start and finish on the network and meant that the local traffic flows adjacent to the proposed crossings were better represented. • More up-to-date information on the future changes to land use in the area. There are plans for considerable development in the area around the proposed crossing locations which affects the forecasts of future trip making. Revised development estimates of housing and employment were collected from local authorities to revise future year trip forecasts. • Incorporation of the impact of the Dart Charge network changes, with the removal of the toll barriers, including its effect on traffic capacities • Amendment to the application of the national trip end model forecasts to better reflect anticipated patterns of local development in Kent and Essex • Use of the new DfT 'consultation' Values of Time. Cumulatively, all of these enhancements have changed the forecast benefits for the Location C options east of Gravesend. In addition, reliability benefits have now been monetized. **Changes in TUBA** There have been some changes in the way that benefits are calculated using the TUBA programme with changes to the RPI base, values of time, fuel consumption factors, and carbon values. **Summary** A solution at Location C provides congestion relief both for north-south and east-west traffic flows.

Consultation Theme	Highways England's Response
	Changes in economic benefits from the previous 2013 study are as a result of scheme development, improvements to the traffic model and incorporation of updated development plans in the future forecasts, which have been applied consistently in the appraisal of options at Location A and Location C.

6.16 Land and Property

Consultation Theme	Highways England's Response
Some respondents raised the issue that it is essential that property owners, who have already been blighted by the proposed routes, are fully compensated for the loss of property value and inability to now sell if they need or want to move. Others noted that the 2016 consultation had caused considerable distress in the local community and a swift decision on the Preferred Route must be taken by Government following the consultation so as to minimise the uncertainty around the potential routes through the community.	The number of properties affected by each route is analysed in Volume 4 of the Post-Consultation SAR. The route alignments have been developed to minimise the impact on property whilst meeting the scheme objectives. At junctions this can be difficult as the layout has to allow for the tie-ins with existing roads which in some cases are constrained. The designs are illustrative at this stage and there is potential for change during the next stage of scheme development. At or shortly after the preferred route announcement, the route will be safeguarded, which is the process of protecting the land required for the preferred route during its development phase and before the formal acquisition of land. Following safeguarding of the route, homeowners on, or close to, the line of the proposed scheme can ask Highways England to consider buying their homes under blight provisions. Each case would be assessed individually and property owners would need to demonstrate that they have been unable to sell their property or land other than at a reduced value due to the impact of the preferred route. If there is an urgent need to move, for example for medical reasons, and the owner has been unable to do so except at a significant loss due to the effects of the scheme, there may be scope to apply to Highways England under its discretionary purchase policies. Following the announcement of a preferred route Highways England will liaise with homeowners and the local community to fully understand the impacts of the scheme and look at ways these impacts can be mitigated. In developing the scheme design Highways England will seek to avoid and mitigate property impacts wherever possible in line with the requirements of the NPSNN and wider government policy.

Consultation Theme	Highways England's Response
	Following completion of the scheme construction other compensation may be available under the provisions of the Land Compensation Act 1973 and other relevant legislation.

6.17 Future-proofing

Consultation Theme	Highways England's Response
Some respondents raised the issue that three lanes should be built each way from the outset for future-proofing purposes, which would be more cost effective in the long run.	The shortlist routes at Location C were assessed on the basis of a dual 2 lane solution. Consideration was also given to the need for a dual 3 lane solution, by carrying out a CRF analysis, as described in Section 8 of Volume 4 of the Pre-Consultation SAR. The CRF is the Annual Average Daily Traffic (AADT) flow at which the carriageway would be congested in the peak period. This work showed that the traffic forecasts did not justify a dual 3 lane solution, although southbound evening peak hour flows on the river crossing section would be more than the CRF in 2041 (it is noted that this was a sensitivity test as the standard requires the number of lanes to be based on the flows in the opening year (assumed as 2025)). An updated traffic model will be developed for the next stage of scheme development. In updating the traffic model, further testing will be undertaken of dual 3 lane provision for LTC in so far as desirable for future-proofing against changes in demand in the longer term. As described in Section 7 below, the Location C routes include a tunnel section large enough to accommodate a dual 3 lane carriageway in the future, in order to provide a future-proofed solution for this critical piece of infrastructure.

6.18 Integrated Asset Delivery

Consultation Theme	Highways England's Response
Some respondents raised the issue that the charges at the new crossing and existing crossing at Dartford should be aligned to provide optimal efficiency and traffic management.	Users of the existing Dartford 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. It is proposed that user charges would also be applied to the new crossing in line with current Government policy. Further analysis and modelling work on this element will be undertaken during the next stage of scheme development. This will look

Consultation Theme	Highways England's Response
	at both the existing and new crossing to provide opportunities to effectively manage traffic across both crossings and provide customers with a common payment system.
Some respondents raised the issue that future operation of the new crossing and existing crossing at Dartford should be well integrated with that of the future crossings within Greater London	Highways England will continue to work closely with TfL in the development of the design and operational requirements for the LTC scheme, to ensure an integrated approach to the delivery of LTC and future river crossings within Greater London. This will be implemented through both bi-lateral meetings that will be held with TfL and other local authorities, as well as continuing the joint working group between Highways England, TfL and other local authority stakeholders which was set up by Highways England at the commencement of the options work.

6.19 Equality Diversity and Inclusion

Consultation Theme	Highways England's Response
Some respondents raised the issue that the proposal could have significant impacts on people and their communities and stated that the final route decision needs to be informed by a full equality analysis on the potential / likely impact of the proposed changes on people with protected characteristics and socio-economic groups.	A distributional impact appraisal has been undertaken for the shortlisted options. This considered impacts of the routes on vulnerable social groups, in accordance with the Department for Transport's WebTAG guidance. This work has demonstrated that the impact of the options on vulnerable social groups is not a significant factor in the choice of the preferred solution. More detailed appraisal will be undertaken in the next stage of scheme development on the impacts of the Preferred Route on vulnerable social groups.

6.20 Legacy Opportunities

Consultation Theme	Highways England's Response
Some respondents are keen to see legacy benefits arising out of LTC, including: • Various aspirational projects to enhance the river and the valley corridor for biodiversity in the Mardyke valley. • The need for wider regeneration in the Thames Gateway. • Use of the Thames for transport of spoil and materials. • Provision for public transport and non-motorised users.	The LTC scheme provides significant legacy and benefits opportunities which will be developed further during the next stage of scheme development.

6.21 Future Programme

Consultation Theme	Highways England's Response
Some respondents have expressed a desire to be involved in the future development of the scheme and have requested 'a seat at the table'. Some respondents seek clarification on the activities undertaken during the development stage, future engagement and consultation.	Highways England is committed to working cooperatively with stakeholders throughout the scheme development phase. As a Nationally Significant Infrastructure Project (NSIP), the scheme will be submitted to the Planning Inspectorate by means of a DCO application. Close working with stakeholders will be an essential component of a successful DCO application. A Consultation Strategy and Statement of Community Consultation will be developed early in the development stage and this will map out in greater detail how this will occur.
Some respondents raised the issue that the anticipated opening year of 2025 is unacceptable and too late since serious capacity, congestion and environmental problems are an issue at Dartford today. Early delivery is essential.	The project programme through to road opening is largely defined by the need to collect and analyse sufficient environmental and geotechnical information, undertake scheme design, carry out statutory consultation, the DCO application processes under the Planning Act 2008, and the detailed design and construction. This work cannot be commenced until there is certainty about the proposed route. Some of the environmental work will require at least two years survey data linked to the protected areas the scheme would affect. The construction is expected to take 4.5 to 5 years to complete. Highways England is committed to delivering the benefits that the Lower Thames Crossing will provide at the earliest opportunity and will continue to work with stakeholders to look at ways of achieving this.

7 Post-Consultation Appraisal Routes

7.1 Selection of Routes and Basis of Appraisal

7.1.1 Following the 2016 public consultation the number of routes subject to the review and update of appraisal has been reduced taking account of the feedback from the public consultation discussed in Sections 5 and 6.

7.1.2 Fifteen of the shortlist alternatives are not subject to the review and update of appraisal as shown in **Table 7.1**. The reasons for not selecting these options are described in paragraphs 7.1.3 to 7.1.5.

TABLE 7.1 - SHORTLIST ROUTES NOT SUBJECT TO REVIEW AND UPDATE OF APPRAISAL

Shortlist Route	Shortlist Reference
Route 1 with Bored Tunnel	Route 1 (BT)
Route 2 with WSL and Bridge	Route 2 WSL (BR)
Route 2 with WSL and Bored Tunnel	Route 2 WSL (BT)
Route 2 with WSL and Immersed Tunnel	Route 2 WSL (IT)
Route 2 with ESL and Bridge	Route 2 ESL (BR)
Route 2 with ESL and Bored Tunnel	Route 2 ESL (BT)
Route 2 with ESL and Immersed Tunnel	Route 2 ESL (IT)
Route 3 with WSL and Bridge	Route 3 WSL (BR)
Route 3 with WSL and Immersed Tunnel	Route 3 WSL (IT)
Route 3 with ESL and Bridge	Route 3 ESL (BR)
Route 3 with ESL and Immersed Tunnel	Route 3 ESL (IT)
Route 4 with WSL and Bridge	Route 4 WSL (BR)
Route 4 with WSL and Immersed Tunnel	Route 4 WSL (IT)
Route 4 with ESL and Bridge	Route 4 ESL (BR)
Route 4 with ESL and Immersed Tunnel	Route 4 ESL (IT)

Route 1

7.1.3 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 (refer to Section 3 of Volume 7 of the Pre-Consultation SAR and Section 3.6). 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 London Borough of Havering (refer to paragraphs 5.7.3 and 5.7.4). Route 1 has therefore been included in the Post-Consultation Appraisal Routes and re-appraised more extensively to assess whether the previous conclusions reached are robust and still valid.

7.1.4 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 the same location. It also had safety benefits compared to a tunnel option which would require northbound traffic to be segregated in three separate tunnels. This would lead to weaving difficulties with closely spaced junctions at Junction 1a and Junction 31 and complex signing arrangements. The Route 1 bridge option has therefore been included in the routes subject to review and update of the appraisal. The bored tunnel option has not been selected.

Route 2

7.1.5 Route 2 has not been included in the updated appraisal for the following reasons:

- Popularity - it is the least popular of the 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, particularly the A1089 affecting HGV traffic to the Port of Tilbury. 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 EA have 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”.

Location C Crossing

7.1.6 The appraisal of the crossing options at Location C concluded that the bored tunnel was the only viable alternative as it met the scheme objectives and was the least environmentally damaging alternative (refer to Section 5 of Volume 7 of the Pre-Consultation SAR). The bored tunnel crossing was therefore the option proposed by Highways England in the 2016 consultation for the Location C routes. Taking account of the responses to consultation, that conclusion has not changed and so the bridge and immersed tunnel crossing options for Routes 3 and 4 have not been selected for the review and update of the appraisal.

7.1.7 The five routes subject to review and update of appraisal in the Post-Consultation SAR are shown in **Table 7.2** and in **Figure 7.1**.

TABLE 7.2 - POST-CONSULTATION APPRAISAL ROUTES

Post-Consultation Appraisal Route	Shortlist Reference
Route 1 with Bridge	Route 1 (BR)
Route 3 with WSL and Bored Tunnel	Route 3 WSL (BT)
Route 3 with ESL and Bored Tunnel	Route 3 ESL (BT)
Route 4 with WSL and Bored Tunnel	Route 4 WSL (BT)
Route 4 with ESL and Bored Tunnel	Route 4 ESL (BT)

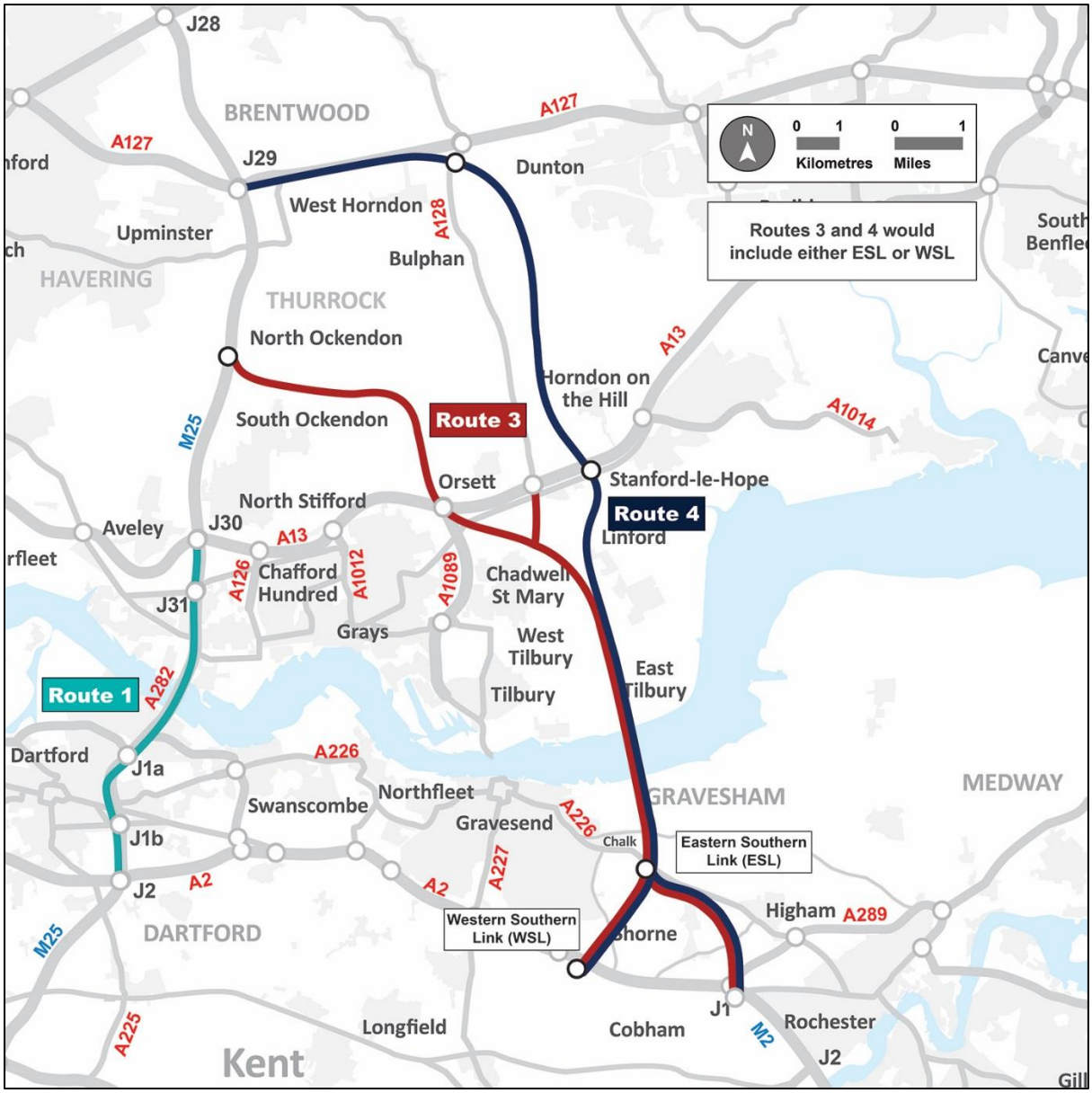

FIGURE 7.1 - POST-CONSULTATION APPRAISAL ROUTES

7.1.8 The appraisal of the Post-Consultation Appraisal Routes has been updated from the appraisal of these routes reported in the Pre-Consultation SAR to include the following:

- New network and alternative trip end methodology (LTC v2.1 traffic model)
- New values of time issued in October 2015. The traffic modelling and appraisal results presented in the Pre-Consultation SAR were based on the WebTAG hourly values of time that were current when it was published in January 2016. In October 2015 DfT began a public consultation on new values of time. These October 2015 consultation values of time are the basis for the traffic modelling and appraisal results presented in the Post-Consultation SAR.

7.1.9 More details of the updated appraisal and the results are reported in Volumes 5 and 6 of this Post-Consultation SAR.

7.1.10 For the updated appraisal of Routes 3 and 4 a bored tunnel crossing structure is included. This is a tunnel with space for a future third traffic lane although initially it is proposed to operate the tunnel as a dual two lane carriageway. Section 8 of Volume 4 of the Pre-Consultation SAR reported the results of a capacity test using CRFs. The CRF of a link is an estimate of the Annual Average Daily Traffic (AADT) flow at which the carriageway is likely to be congested in the peak periods on an average day. This demonstrated that whilst a dual two lane solution would generally perform satisfactorily, southbound evening peak hour flows on the river crossing section would be more than the CRF in 2041. The inclusion of a larger tunnel section as part of the scheme will provide a future-proofed solution for this critical piece of infrastructure. This is considered to be a better value solution than building a new tunnel at a later date, which would be the only alternative in order to provide extra capacity.

7.1.11 The capacity test using CRFs referred to in paragraph 7.1.10 above has been updated using the flows predicted in the LTC v2.1 traffic model as reported in Volume 5 of this Post-Consultation SAR. The results of this test are given in **Appendix 3.5** and again show that southbound evening peak hour flows on the river crossing section would be more than the CRF in 2041. However, the results also show that in 2025 the southbound evening peak hour flows on the river crossing section would be close to the CRF. This indicates that the requirement for dual three lane provision on the river crossing section needs more detailed consideration. This will be carried out as part of the development of the Preferred Route during the next stage of scheme development.

7.1.12 The future-proofed bored tunnel is described in Section 7.3. The estimated construction costs reported in Section 7 of Volume 4 include the larger tunnel as do the economic results reported in Volume 5.

7.1.13 The key assumptions made to appraise the routes subject to review and update of appraisal against the scheme objectives are summarised in **Table 7.3**.

TABLE 7.3 - KEY ASSUMPTIONS IN REVIEW AND UPDATE OF APPRAISAL

Assumption	
User Charges	In the traffic modelling, user charges equal to existing charges are applied at Location A and C crossings to allow for comparison on an equal basis. For the purpose of the detailed appraisal presented here, charges are assumed to remain constant in real terms with no change in vehicle classification.
Oversize crossing structure at Location C	In order to allow for future expansion from a dual-two lane road to dual three lane, an oversized structure would be constructed at Location C. Capital costs quoted reflect this assumption.
Traffic and revenue forecasts	All traffic forecasts, unless stated otherwise, are based on a core growth traffic scenario, as defined by WebTAG guidance.

Assumption	
Programme	The scheme development timetable assumes authorisation by way of the DCO process and delivery using a design and build model with public funding.

7.1.14 The routes were subject to detailed engineering, safety, operation and maintenance, traffic, economic, social and environmental appraisals described in Volumes 4, 5 and 6 of this Post-Consultation SAR. The cost estimates and appraisal of risk are described in Sections 6 and 7 of Volume 4 of this Post-Consultation SAR.

7.1.15 The designs of the routes have been developed for the detailed appraisal of options as part of the study and may be subject to change in later stages of the scheme development.

7.1.16 Provision for non-motorised users (NMUs) at the crossing and along the new route will be considered further as part of the next stage of the scheme's development. Where existing NMU routes including footpaths, bridleways and cycleways would be affected or severed by the proposed routes the designs include alternative provision such as overbridges or underpasses or diversion of the affected routes. This is discussed in more detail as part of the engineering appraisal of the routes discussed in Volume 4 of this Post-Consultation SAR.

7.1.17 All locations and features referred to in the descriptions of the routes below are shown in Appendix 2.2 to Volume 2.

7.2 Route 1

(Refer to **Appendix 3.6** for Plan and Profile drawings and **Appendix 3.7** for Typical Cross Section drawings)

7.2.1 The Post-Consultation Appraisal Route at Location A, known as Route 1, is a route with a bridge to the west of the existing crossing. This route is shown in **Figure 7.2**. Controlled motorway technology would be implemented between Junction 2 and Junction 30.

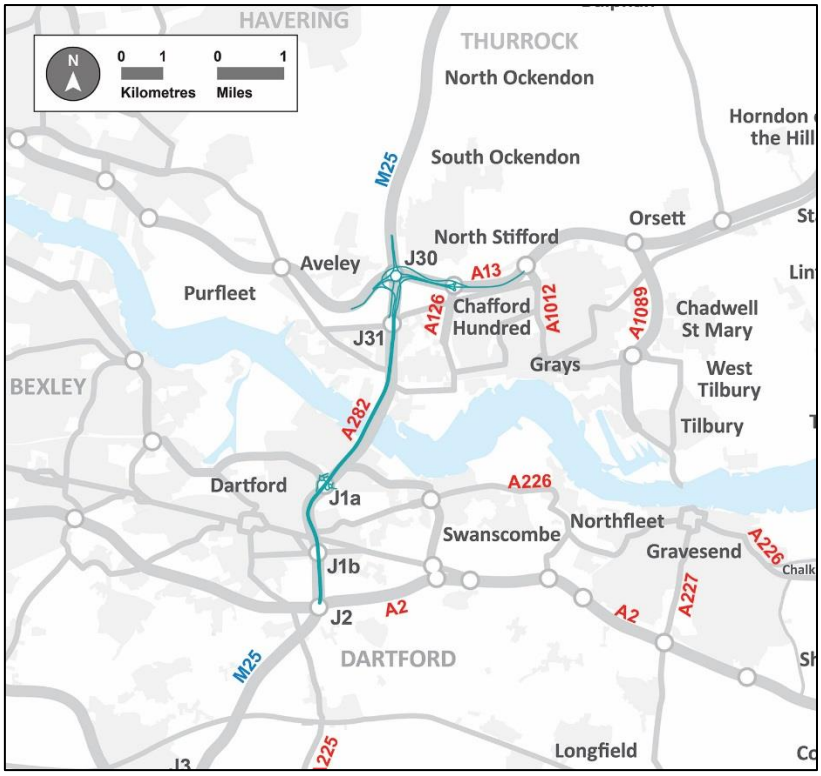

FIGURE 7.2 - ROUTE 1

7.2.2 Works would include the following:

- Local widening to Junction 2 southbound off-slip.
- Junction 2 - 1b no widening.
- Junction 1b -1a widening to dual five lanes by conversion of existing hard shoulder.
- Improvements to Junction 1a.
- Proposed bridge crossing the River Thames.
- Improvements to Junctions 31 and 30 and free-flow links to/ from the A13.

7.2.3 The comparison of the number of existing lanes and those provided by Route 1 are shown in **Table 7.4** and illustrated in **Figure 7.3**.

TABLE 7.4 - COMPARISON OF NUMBER OF EXISTING LANES AND ROUTE 1

M25/A282 section	Without Scheme		Route 1		
	Northbound	Southbound	Northbound	Southbound	Comments
Junction 3 to 2	4	4	4	4	No additional widening
Junction 2 to 1b	3 (4 Lanes after A2 on-slip)	4 (3 Lanes after B260 overbridge)	3 (4 Lanes after A2 on-slip)	4 (4 Lanes after B260 overbridge)	Local widening at southbound off-slip to A2 (after B260 overbridge)
Junction 1b to 1a	4	4	5	5	1 additional lane in each direction
Junction 1a to 31	4	4	6	6	4 additional lanes provided at River Thames crossing
Junction 31 to 30	3	3	5	5	Northbound 3 Lanes after new A13 Link Southbound 3 Lanes before new A13 Link
Junction 30 to 29	4	4	4	4	No additional widening

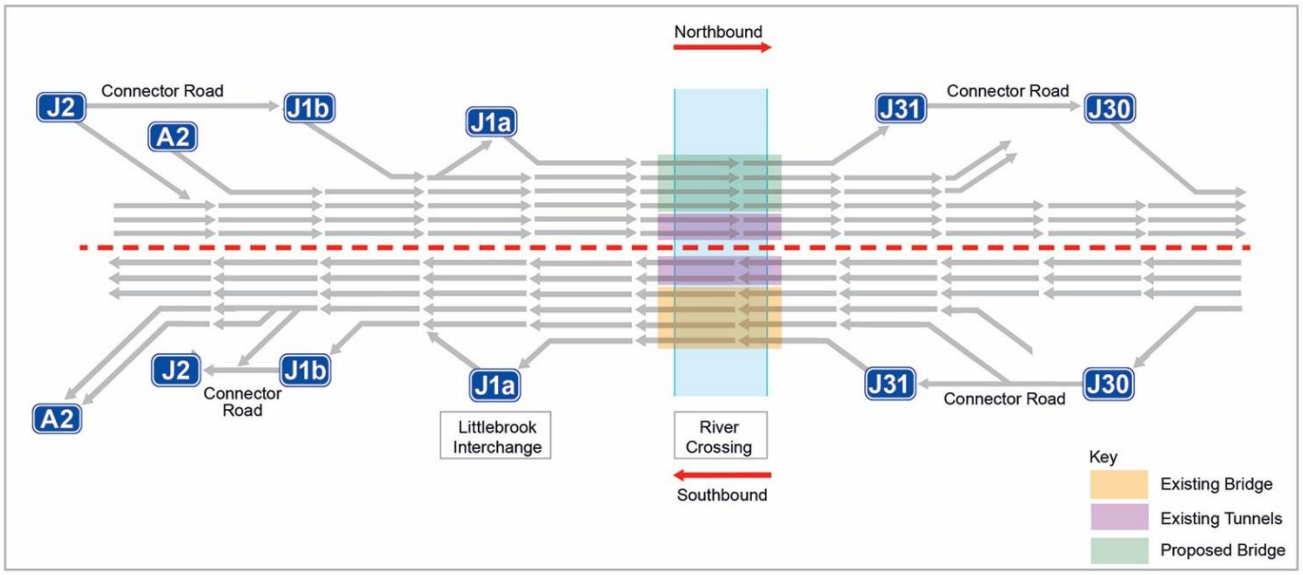

FIGURE 7.3 - ROUTE 1 SCHEMATIC LANE LAYOUT

Route Alignment (horizontal)

7.2.4 The horizontal route alignment has been designed in accordance with DMRB TD 9/93 and the junctions to TD 22/06, based on an Urban All Purpose road classification with a design speed of 85kph (50mph) (refer to paragraph 3.1.3).

Junction 2

7.2.5 Local widening of the southbound off-slip to accommodate traffic flows predicted by the traffic modelling.

Junction 1b

7.2.6 No works would be required at Junction 1b.

Junction 1b to 1a

7.2.7 Widening of existing carriageway from dual four-lane to dual five-lane by the conversion of the existing hard shoulder to a running lane except at the structures which would need to be widened.

Junction 1a

7.2.8 The existing A282 Junction 1a would require significant upgrading to accommodate traffic flows predicted by the traffic modelling and to provide a suitable connection with the new crossing. This would involve the following works:

- Replacement overbridge directly south of the existing A206 overbridge, which would be demolished.
- Alterations to the west roundabout to accommodate the relocation of the bridge.
- Removal of the existing northbound loop on-slip road to the A282.
- New two-lane northbound on-slip road from west roundabout to the new river crossings. The existing west tunnel would not be accessible from this slip road.

The roundabout to the east would be improved and all existing movements would be maintained. An additional lane would be provided on both main carriageways through this junction.

Route Alignment (horizontal – crossing)

7.2.9 There would be a total of 6 lanes northbound and southbound at the River Thames crossing. The existing west tunnel would take lanes 5 and 6 northbound and the flow in the existing east tunnel would be reversed to take lanes 5 and 6 southbound. To accommodate this new Traffic Management Cell arrangements would be required, including arrangements for controlling access by restricted vehicles to southbound lanes 5 and 6 in the existing east tunnel. The restrictions and Traffic Management Cell arrangements would be similar to those currently in place at the existing crossing as described in Section 3.4 of Post-Consultation SAR Volume 2.

7.2.10 The 5 northbound lanes from Junction 1a would separate immediately after passing under the A206 overbridge. The 2 eastern lanes would tie-in to the

existing west tunnel, whilst 3 lanes would split and merge with a single lane from Junction 1a northbound on-slip with 4 lanes over the new bridge. The 2 southbound lanes from the east tunnel would continue through Junction 1a. The 4 southbound lanes from the bridge would have a lane drop with 3 lanes continuing through Junction 1a to merge with lanes from the east tunnel. At the lane drop there would be southbound off-slip road to the A206.

7.2.11 The mainline would pass above the existing Fastrack bus route and continue north where National Grid overhead cables would require diverting.

7.2.12 The route across the River Thames would take the alignment close to the existing ventilation building whilst providing sufficient clearance between the bridge foundations for the towers and piers and the existing west road tunnel and the Dartford Cable Tunnel.

7.2.13 The bridge would cross jetties north and south of the river which would affect their use during construction and potential future operation.

7.2.14 North of the River Thames the alignment would continue through the site of an aggregate and cement works to enable it to merge with the existing A282. The alignment has been designed to mitigate against the impact on this site by keeping as far east as feasibly possible.

7.2.15 North of this site lie two existing railways; HS1, and the London Tilbury Southend (LTS) line which are a key constraint in this location. The two railways are in close proximity with HS1 on a viaduct and the LTS line in a shallow cutting.

7.2.16 The bridge would tie-in to existing road levels south of Junction 31 and the road layout would provide an off-slip to Junction 31 before merging with the two lanes from the existing Dartford west tunnel. These lanes would not be able to access Junction 31. The off-slip would require additional land take and a retaining wall to limit the effect on adjacent property to allow for the existing highway to be widened.

7.2.17 The five lanes would continue northbound until a two lane drop is required for the link road to the A13 at Junction 30. Three lanes and a hard shoulder would continue north to tie-in to the existing highway layout prior to the Mardyke bridge at Junction 30.

Route Alignment (vertical)

7.2.18 The new bridge would follow existing highway levels before connecting to the southern approach viaduct where the road rises at a gradient of 4%.

7.2.19 The gradient of the southern viaduct would continue for about 1000m before connecting to the new bridge.

7.2.20 The vertical alignment of the approach viaduct would allow for sufficient clearance under the structure to enable the Traffic Management cell to operate as existing in the long-term. Control areas would be resited and accessed under the approach viaducts.

7.2.21 The vertical alignment would provide significant clearance of about 15m above the Fastrack bus route.

7.2.22 The new bridge is assumed to continue for a length of 810m spanning the River Thames. Navigational clearances are assumed to be the same as the existing bridge.

7.2.23 The northern viaduct would have a flatter gradient of 3.5% and descend for a length of about 1370m and tie-in to the existing ground levels. Where it passes over HS1 a vertical clearance of about 11m would be maintained whilst also providing 26m above the LTS railway line.

Highway Structures – Junction 2 to 1a

7.2.24 The opportunity to widen the A282 route between Junctions 2, 1b and 1a is largely constrained by the existing retaining walls. It is considered impracticable, in terms of cost, traffic disruption, and potential land take to provide new retaining walls outside the existing highway boundary. So the widening would be limited to north of the A226 London Road overbridge. This would avoid the need to demolish and reconstruct the A226 and B2500 Watling Street overbridges.

7.2.25 The proposed additional lane southbound under the B260 overbridge would require construction of a new bridge and a realignment of the B260. Between Junctions 1b and 1a there would be a need to widen the carriageway which is constrained by the Bow Arrow rail underbridge. The existing northbound structure would be widened on the outside of the bend to allow for an additional lane and appropriate stopping sight envelope. This would also require a length of new retaining wall on the approach to the bridge. The existing southbound structure would be replaced by a wider structure which would provide the necessary headroom to the existing Dartford to Gravesend railway. The adjacent footbridges would also be replaced.

7.2.26 In summary the new and replacement structures between Junctions 2 and 1a would be:

- Replacement B260 overbridge.
- Widening of northbound Bow Arrow rail underbridge including new retaining wall on the southern approach.
- Replacement of southbound Bow Arrow rail underbridge.
- Replacement of footbridges adjacent to Bow Arrow rail underbridge.

Junctions 31 and 30

7.2.27 The modified Junction 30 would provide a free-flow link from the A282 north of Junction 31 to the A13 this would diverge and then split into two two-lane links, one for eastbound and one for westbound traffic.

7.2.28 The new northbound link from Junction 31 to Junction 30 would run parallel and to the west of the existing northbound link between Junction 31 and 30.

7.2.29 The new A13 eastbound free-flow link would pass beneath the new northbound link from Junction 31 to Junction 30 and underneath the westbound A13 main carriageway and Junction 30/ A13 westbound on-slip. The link would then continue east over the M25 mainline and M25/ A13 eastbound off-slip passing beneath the existing railway to tie-in to the existing A13 east of the A126 junction.

7.2.30 The new westbound 2 lane free-flow link would be provided and diverge from the new A13 eastbound free-flow link and tie in to the A13 after Ship Lane overbridge.

7.2.31 A new free-flow link from the A13 westbound to A282 southbound would replace the existing off slip to Junction 30 and diverge from the A13 to A282, between the A126 dumbbell and existing Junction 30. This free-flow link would have a two lane fork, one movement would provide the westbound off-slip to Junction 30 and the other would provide free-flow A13 west to A282 southbound movement. The link would merge with the southbound A282 as close as possible to Junction 30, with a lane gain merge.

7.2.32 A new southbound link from Junction 30 to Junction 31 would replace and run parallel and to the east of the existing southbound link. The new southbound link would split, one movement would provide access to Junction 31 and Thurrock services and the other would merge with the A282 south of Junction 31, with a lane gain merge. The southbound on slip from Junction 31 would merge with the A282 further south with another lane gain merge. There would be no access from Junction 31 to the existing east tunnel.

Highway Structures – Junction 1a

7.2.33 The existing A282 Junction 1a would be upgraded with a proposed replacement overbridge directly south of the existing A206 overbridge, which would be demolished. The construction of the new overbridge would be carried out off-line, to minimise traffic disruption.

Highway Structures – Junction 1a to 31

7.2.34 North of the river, the new A282 alignment would require embankments and retaining walls due to the limited width available at the merging location. The bridges for the M25 over Junction 31 would require widening, using the same form of construction as the existing bridges.

Highway Structures – Junction 30

7.2.35 Junction 30 would include 12 new structures on the new links and crossings of the Mardyke, A13 and M25 as listed below:

- 6 viaducts
- 3 overbridges
- 2 underpasses (one under the A13 and west facing slip roads west of Junction 30 and one under the railway line east of the A126)
- 1 footbridge

7.2.36 For the locations of these structures refer to drawing Route 1 Junctions 30 and 31 General Plan Layout in **Appendix 3.6**.

Additional Junction Improvements

7.2.37 More detailed modelling work carried out as part of the appraisal showed that if Route 1 was to be taken forward further improvements to those described above would be required at Junction 2, Junction 1a and Junction 30.

River Crossing - Location

7.2.38 The height and span of the bridge crossing would be determined by the clearances required for river navigation. A clearance for shipping between the river water level and underside of the bridge (air-draft) of 57.5m has been adopted matching that of the existing bridge and as discussed with the PLA.

7.2.39 The bridge impacts on the site of an aggregate and cement works on the north side of the river and avoiding this was not found to be possible.

7.2.40 On the south bank of the river, the route alignment passes through the area where the Dartford Control Centre, TM cell and other crossing operational facilities for the existing crossing are located. In order to accommodate the new route, it is proposed that these facilities would be demolished and replaced elsewhere in a phased manner. It is envisaged that both the existing and new crossings would be controlled from an integrated traffic control centre. This, along with other crossing operational facilities, would require land outside the existing highway.

River Crossing

(Refer to **Appendix 3.8** for Bridge General Arrangement Drawing)

7.2.41 A 450m span cable-stayed bridge has been considered to match the existing QEII Bridge and to provide clear spans for navigation that would meet the PLA requirements for shipping at the existing bridge.

7.2.42 The total length of the bridge would be 3180m. The suspended spans would be 810m long with 1000m and 1370m long southern and northern approach viaducts respectively. The bridge configuration is shown in **Figure 7.4**:

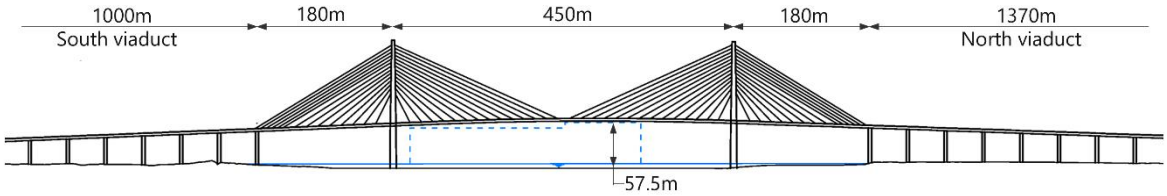

FIGURE 7.4 - BRIDGE CONFIGURATION AT LOCATION A

7.2.43 The new bridge is assumed to carry an all-purpose road with a design speed of 85kph (50mph) in accordance with TD 27/05 with four 3.65m lanes northbound, 1.0m hard strips (no allowance for hard shoulders) and 0.6m verges.

7.2.44 To reduce the risk of any damage to the existing west road tunnel during construction, a clear lateral distance not less than 50m between the new bridge and the west tunnel has been allowed, similar to the distance between the foundations of the existing bridge and the existing west tunnel.

7.2.45 The new bridge would be located to provide similar clearances from the existing road tunnels as the QEII Bridge whilst maximising the clearance to the Dartford Cable Tunnel which is located upstream of the existing west tunnel. The minimum clearance between the foundations of the new bridge and the existing west tunnel would be about 40m and the clearance from the Dartford Cable Tunnel would vary between about 25m and 80m.

7.2.46 With a main span of 450m, a cable-stayed bridge with a steel-concrete composite deck is considered to be the most appropriate bridge form, matching the existing crossing. The bridge deck section is shown in **Figure 7.5**. Arch or suspension bridge solutions are dismissed as unlikely to be economic or reasonable solutions at this location. The span is too long for deep girders or other structural forms to be feasible.

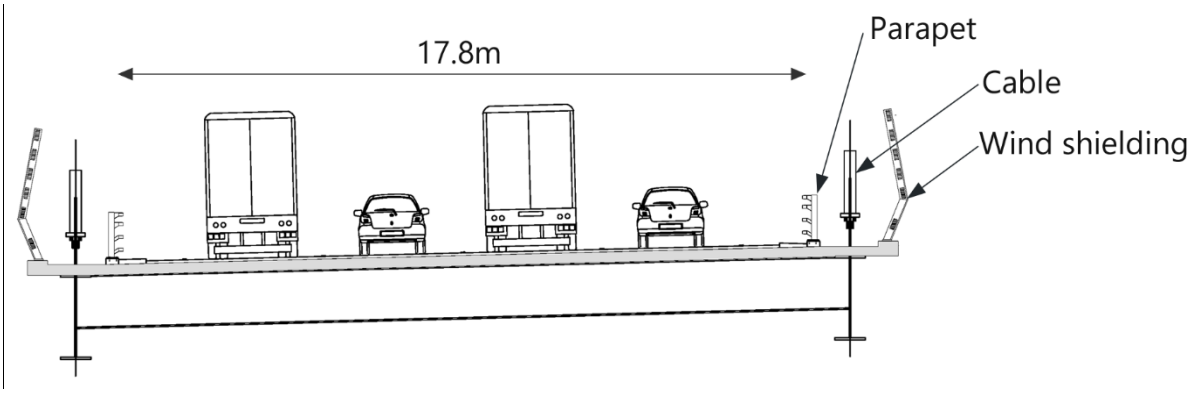

FIGURE 7.5 - BRIDGE CROSS SECTION AT LOCATION A

7.2.47 The concrete deck slab would allow standard thin surfacing to be applied over the suspended spans such as stone mastic asphalt. This has the benefit that it can be machine laid by readily available equipment.

7.2.48 The approach viaducts would comprise repetitive spans that are assumed to have spans in the range of 50-80m. It is likely that concrete or steel concrete composite decks would be supported on reinforced concrete piers which in turn would be supported by spread or piled foundations.

7.2.49 Design quality is an important consideration in the development of the options. Bridges are an important component of the built environment, they are highly visible forms that have a significant impact on their locality and on the people who live there. The sketch included as **Figure 7.6** shows the illustrative bridge option proposed at Location A.

FIGURE 7.6 - VISUALISATION OF BRIDGE AT LOCATION A FROM THE WEST

7.3 Route 3

(Refer to **Appendix 3.9** for Plan and Profile drawings and **Appendix 3.10** for Typical Cross Section drawings)

7.3.1 This route would connect the A2 or M2 to the M25 between Junctions 29 and 30, near Ockendon Road. To the south of the River Thames there are two route alignment options. To the west there is the WSL which connects into the A2 to the east of Gravesend and to the east there is the ESL which connects into Junction 1 of the M2. The route is shown in **Figure 7.7**.

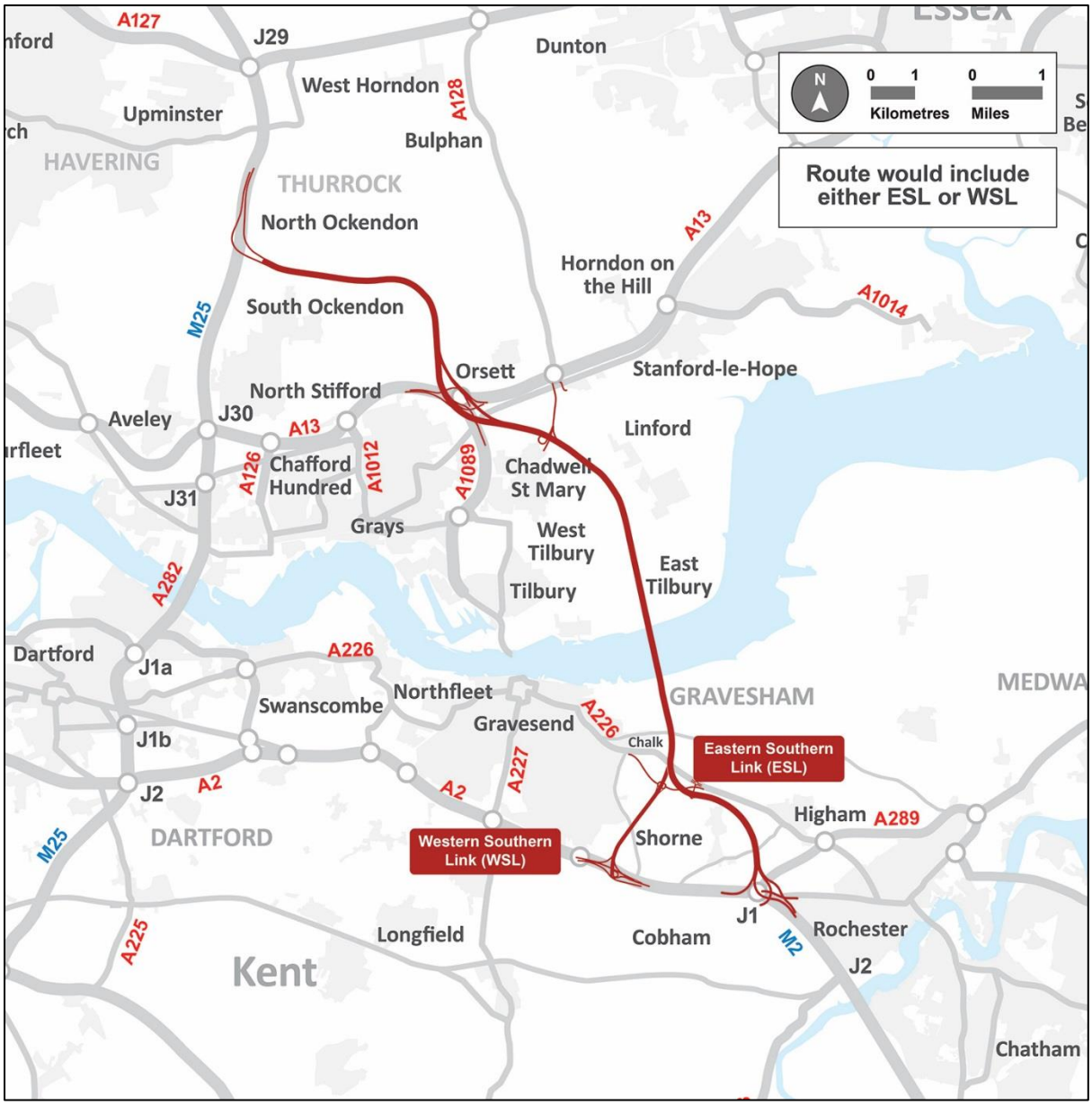

FIGURE 7.7 - ROUTE 3

7.3.2 This route has a bored tunnel for the crossing of the River Thames. The horizontal alignment of the crossing allows either the WSL or the ESL to connect into the crossing.

7.3.3 North of the river the route would go north between West Tilbury and East Tilbury. The route would connect with the A13 at the existing A1089 and A13 junction with a spur to Orsett Cock roundabout and then the M25 near Ockendon Road.

Route 3 South of River Thames - WSL Alignment (horizontal)

(Refer to **Appendix 3.9** for Plan and Profile drawings)

7.3.4 The WSL would connect into the A2 to the east of Gravesend via a free flow junction in the area between Gravesend and Thong.

7.3.5 The main carriageway horizontal and vertical alignments have been designed to the DMRB TD 09/93 Table 3 for highway link design. The design speed has been taken as 120km/h (70mph speed limit) for a dual two-lane all-purpose road.

7.3.6 To the north of the A2 the route would pass across Thong Lane between Gravesend and Thong and would cross a golf course towards the A226. The route would cross the A226, the Thames Medway canal and the adjacent North Kent railway line before crossing the River Thames towards the east of Tilbury power station.

7.3.7 At the A226 to the east of Chalk there would be a proposed grade separated junction. This junction would provide for all movements from LTC and the A226.

WSL Alignment (vertical)

7.3.8 To the north of the proposed A2 junction the route would be on embankment before moving into cutting to the west of Thong, which requires the route to pass beneath Thong Lane. To the north east of Thong Lane the route would enter a long section of deep cutting (up to 26m depth) which would continue down at -4% to the bored tunnel portal which would be located between the A226 and Lower Higham Road.

WSL - A2 Junction

(Refer to **Appendix 3.11** for junction drawing)

7.3.9 At the connection with the A2 an all-movement free-flow compact junction has been developed. To provide a junction in this location with sufficient spacing from the existing junctions to the east and west with the required weaving length it is proposed that the existing A2 would be re-aligned north over an approximate length of 2.5km. The re-alignment would also mitigate the impact of the proposed junction on the existing constraints within the vicinity of this junction, including the adjacent HS1. A new link road would be provided between Henhurst Road roundabout and Brewers Road roundabout on the south side of the A2. This would replace the eastbound merge to the A2 from Hever Court Road roundabout.

7.3.10 Design speeds of the slip roads and link roads are as follows:

- A2 eastbound to LTC northbound slip road - 85kph (50mph)
- A2 westbound to LTC northbound slip road - 50kph (30mph)
- LTC southbound to A2 westbound slip road - 50kph (30mph)
- LTC southbound to A2 eastbound slip road - 100kph (60mph)
- Link road between Henhurst Road roundabout and Brewers Road roundabout - 85kph (50mph)

7.3.11 The re-alignment of the A2 would have a design speed of 120kph (70mph).

7.3.12 The free-flow interchange would impact on the local roads and the connectivity with the A2. The proposal would remove the existing A2 eastbound merge from the roundabout with Hever Court Road and Valley Drive. The link road described above would provide access for vehicles onto

the eastbound A2 from this location. Vehicles would then access the eastbound A2 via the junction near Shorne Woods Country Park off Brewers Road.

7.3.13 Vehicles on the westbound A2 who currently access the junction at Henhurst Road would not be able to do this as the proposed junction arrangement would remove the exit slip road. Vehicles would have to exit the A2 at the off-slip onto the roundabout with Brewers Road before using the proposed link road between Henhurst Road roundabout and Brewers Road roundabout.

WSL Route - A226 Junction

(Refer to **Appendix 3.11** for junction drawings)

7.3.14 It is proposed that a connection would be provided between this route option and the A226. The proposal is for a grade-separated junction on the alignment of the A226 and LTC. The tunnel option would require the junction to be located south from the A226, which would result in the existing A226 needing to be re-aligned to tie into the new junction. The location of the junction for the tunnel option is determined by the requirement to fit the slip roads in before the tunnel portals, in order to comply with the relevant design standards. As a consequence of the requirements the junction would be located approximately 1km from the proposed tunnel portal to the south of Lower Higham Road.

WSL - Highway Structures

7.3.15 The WSL route would require the construction of a number of highway structures crossing the A226 and minor roads and public rights of way. A single underbridge would also be required at the junction with the A2. The range of structures required is summarised in **Table 7.5**.

7.3.16 All the structure details given in this section are indicative of potential solutions and are subject to change as the routes are developed and appraised further.

TABLE 7.5 - SUMMARY OF THE STRUCTURE TYPES AND LOCATIONS FOR ROUTE 3 WITH WESTERN SOUTHERN LINK

Structure Type	Mainline Structures Bored Tunnel Crossing	Junction Structures A2
New rail bridges	0	0
New road overbridges	3	0
New road underbridges (up to 4 spans)	1	1
New road viaducts (5 spans or more)	0	0
New footbridges	3	0
New underpasses	0	0
New main river bridges	0	0

Structure Type	Mainline Structures	Junction Structures
	Bored Tunnel Crossing	A2
Existing structures to be modified	0	0
Existing structures to be demolished	0	0
Total	**7**	**1**

Route 3 South of River Thames - ESL Alignment (horizontal)

(Refer to **Appendix 3.9** for Plan and Profile drawings)

7.3.17 This route would connect into Junction 1 of the M2 and would go to the west of Great Crabbles Wood and east of Shorne and then northwest towards Church Lane, Lower Higham Road and Chalk.

7.3.18 Horizontal and vertical alignments have been designed to the DMRB TD 9/93 Table 3 for highway link design. The design speed has been taken as 120km/h (70mph speed limit) for a dual two-lane all-purpose road.

ESL Alignment (vertical)

7.3.19 To the north of the junction with the M2, the alignment would be elevated on a viaduct. It would then go into deep cutting beneath Peartree Lane and then embankment for approximately 800m. At Crown Lane the route would go into cutting for approximately 500m before a short length of embankment at the proposed A226 junction. After the A226 junction the route would go into a cutting up to 16m deep (-4% gradient) which would continue to the tunnel portal to the south of Lower Higham Road.

ESL - M2 Junction 1

(Refer to **Appendix 3.11** for junction drawing)

7.3.20 This is a complex junction that would provide links to the M2 and A2 via a series of slip/ link roads at different levels on new structures. The proposed layout would require four levels with the lowest being the existing A289 connection to the A2/ M2 and the highest being the proposed LTC link roads.

7.3.21 Design speeds of the slip roads and link roads are as follows:

- A2 eastbound to LTC northbound slip road has a design speed of 120kph (70mph)
- M2 westbound to LTC northbound has a design speed of 100kph (60mph)
- LTC southbound to A2 westbound has a design speed of 85kph (50mph)
- LTC southbound to M2 eastbound has a design speed of 100kph (60mph)

7.3.22 This junction would require a number of major structures as it is located at the existing junction between the A2, M2 and A289. The complexity of the

junction requires four levels of slip roads and the heights of the slip roads are further increased by the topographical dip located between the existing junction and the LTC mainline located on the Shorne to Higham ridge.

7.3.23 A series of five viaducts would therefore be required with lengths varying from 300m to 1000m with pier heights up to 23m.

7.3.24 No connection would be provided with the A289 as the proposed junction with the A226 would provide this movement.

ESL - A226 Junction

(Refer to **Appendix 3.11** for junction drawings)

7.3.25 The proposed junction would have a new roundabout on the existing A226 and would have a bridge under the new route, which would connect into another roundabout, forming an elongated dumbbell arrangement.

ESL - Highway Structures

7.3.26 The route would require the construction of a number of highway structures including crossings of A226 and a number of unclassified roads and public rights of way. There would also be a number of significant structures required at the junction with the A2/ M2. The structures required are summarised in **Table 7.6** below.

7.3.27 All the structure details given in this section are indicative of potential solutions and are subject to change as the routes are developed and appraised further.

TABLE 7.6 - SUMMARY OF THE STRUCTURE TYPES AND LOCATIONS FOR ROUTE 3 WITH EASTERN SOUTHERN LINK

Structure Type	Mainline Structures	Junction Structures
		A2 / M2/ A289
New rail bridges	0	0
New road overbridges	3	3
New road underbridges (up to 4 spans)	2	0
New road viaducts (5 spans or more)	0	4
Jacked box highway underbridges	0	0
Cut and cover tunnel	0	0
New footbridges	2	0
New underpasses	1	1
New main river bridges	0	0
Existing structures to be modified	0	0

Structure Type	Mainline Structures	Junction Structures
		A2 / M2/ A289
Existing structures to be demolished	0	0
Total	**8**	**8**

Route 3 River Crossing

River Crossings - Location

7.3.28 Three crossing options were considered at Location C for the shortlist routes, a bridge, bored tunnel and immersed tunnel.

7.3.29 The key constraints taken into account in determining the location of a crossing at Location C were:

- The Ramsar site, the SPA, functionally linked land and a SSSI.
- Proximity to the village of Chalk.
- Listed buildings including the Grade II* listed Church of St Mary.
- Impact on the river hydrodynamics (current, water level and sediment dispersion).
- Impacts on river navigation and PLA considerations.
- The Metropolitan Police facilities.
- Physical constraints including existing major services beneath river (HV cable tunnel, gas main), overhead power cables, clearances under/ over the North Kent Railway and Thames and Medway Canal.

7.3.30 **Figure 7.8** below demonstrates the effect of moving the crossing location east or west from the selected alignment. Moving further west, in the case of a bridge or an immersed tunnel, would increase impact on the village of Chalk, potentially requiring substantial demolition with increasing noise impacts, air quality effects and visual intrusion on properties and people. Depending on the alignment, it could also require demolition of the Metropolitan Police training centre.

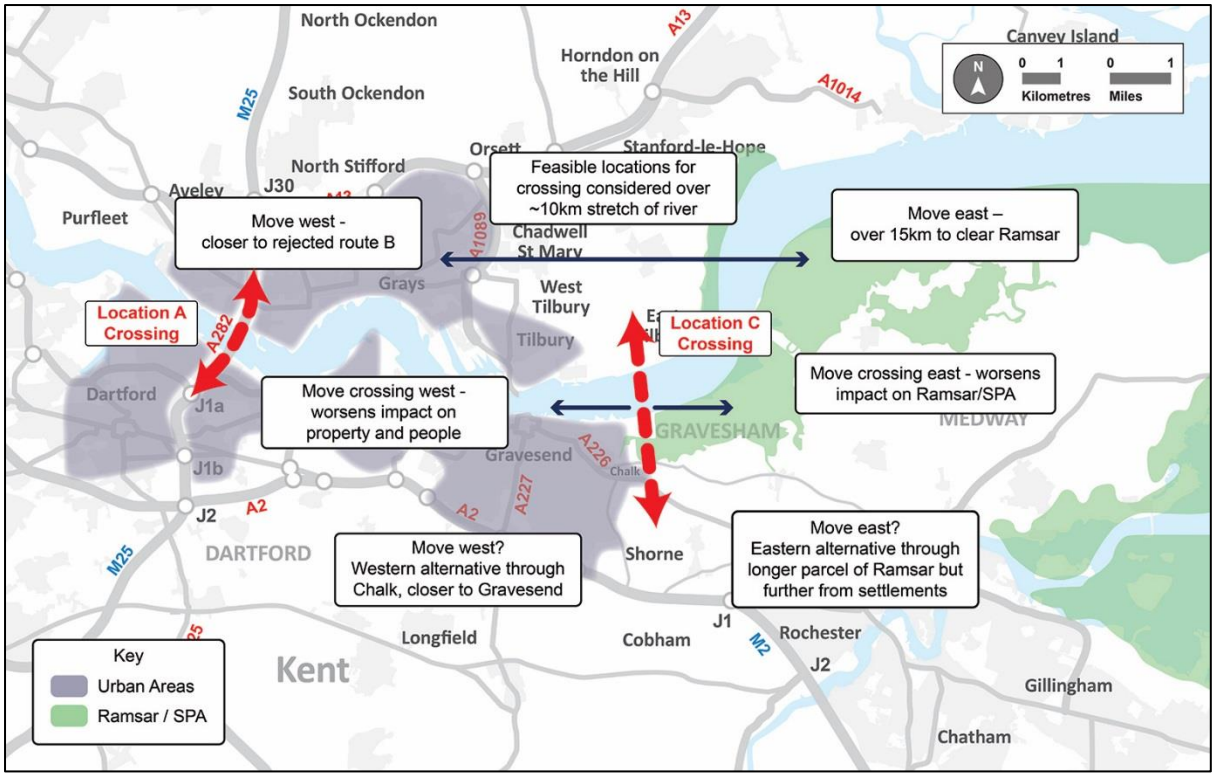

FIGURE 7.8 - DETERMINATION OF CROSSING POSITION AT LOCATION C

7.3.31 A bridge located further to the west that just avoided physical construction within the Ramsar site was judged to require demolition of a significant number of additional properties. There would also be significant worsening of noise and air quality impacts on many more properties, including a school. An immersed tube tunnel concept at this location was judged to be no better than a bridge and was not examined further.

7.3.32 Moving further east would intrude further into the Ramsar site and SSSI and physically affect the SPA. It may also directly affect listed buildings and would be less favoured by the PLA as it would be closer to the bend in the river potentially increasing impacts on marine traffic and river navigation.

7.3.33 The selected alignment, approximately 200m east from the village of Chalk, balances air quality, noise and visual effects, avoiding listed buildings, reducing intrusion into the Ramsar, avoiding the SPA and limiting impact on the Metropolitan Police training facilities to the area of land used as a firing range. This crossing location is at the western extent of the Ramsar site and just west of the western extent of the SPA. The same location was adopted for the three crossing types of bridge, immersed tunnel and bored tunnel appraised with the shortlist routes. This is the same location adopted for the bored tunnel crossing option now appraised as part of the Post-Consultation Appraisal Routes.

7.3.34 The Post-Consultation Appraisal Route bored tunnel concept would avoid physical construction within the Ramsar site. Assumptions on length and depth of bore and location of the tunnel portals have been made in order to achieve this.

7.3.35 To the north of the river, in order to limit the structure length, and thereby costs, the tunnel concept assumes construction and siting of permanent structure within the functionally linked land (refer to Section 4.6 in Volume 2).

River Crossing - Bored Tunnel

(Refer to **Appendix 3.12** for Bored Tunnel General Arrangement Drawing)

7.3.36 For the Post-Consultation Appraisal Routes the river crossing would comprise a twin-bored tunnel and sections of cut and cover tunnel at the north and south approaches with one bore carrying northbound traffic and the other southbound traffic. Each bore of the tunnel would contain an all-purpose road designed in accordance with TD 27/05. The design speed of the crossing is 120kph. The twin bored tunnels would each be large enough to contain an 11m wide three lane carriageway but would be arranged initially with a 7.3m wide two lane carriageway. Emergency walkways would be provided each side of the carriageway. The assumed bored tunnel section at the cross passage location (refer to paragraph 7.3.37) is shown in **Figure 7.9**:

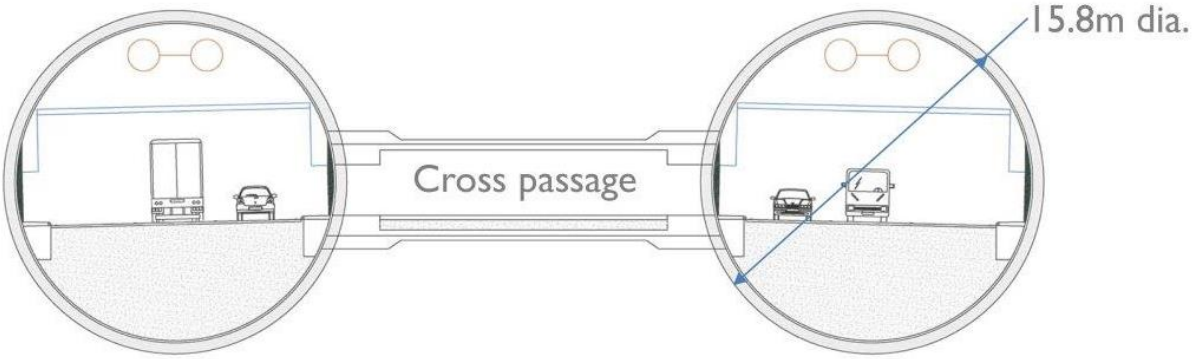

FIGURE 7.9 - BORED TUNNEL CROSS SECTION AT LOCATION C

7.3.37 The total length of the tunnel between portals would be about 3330m. The bored part of the tunnels are designed to provide clear internal space of 14.8m diameter in each bore, which for the assumed construction and tunnel lining design results in an external diameter for construction of 15.8m diameter. Sections of cut and cover structure and retained ramp structure are assumed at the tunnel portals. Total lengths of these structures in the option design is 320m at the north portal and 100m at the south portal. Cross passages would connect both bored tunnels and cut and cover tunnels typically at 100m intervals for use in the event of an incident in the tunnel to provide an access route for emergency services interception and an escape route for tunnel users to leave the incident.

7.3.38 On the south bank of the river, the approach to the tunnel would be in deep chalk cutting. The high groundwater and permeability of the ground would likely require extensive dewatering and treatment to construct the portal and approach structures. From the portal, heading northwards, the tunnels would pass under Lower Higham Road before passing under the Ramsar site, under the North Kent railway line, under the disused canal (which is proposed to be brought back into recreational use) and under the Metropolitan Police Firing Range. The tunnels would then pass under the river bed with sufficient cover above the tunnel to counter the potential for

flotation and provide structural stability. For the purposes of the appraisal the assumed cover to the top of the tunnel under the river was assumed to be one and a half tunnel diameters.

7.3.39 On the north bank of the river, the route would pass under and through an area of current and historic landfill before emerging at the north portal. Based on the limited information currently available about the site some of the landfill is assumed to be contaminated.

7.3.40 The bored tunnels would be constructed using a continual process by first excavating with a tunnel boring machine (TBM) and lined with reinforced concrete segmental linings fitted with gaskets to ensure water tightness.

7.3.41 The approaches to the tunnels on the north bank of the river would be formed from reinforced concrete structures comprising retained ramps and cut and cover tunnels. In view of the high groundwater and permeability of the ground, extensive dewatering or treatment is expected to be required in order to facilitate construction of these and other underground structures.

7.3.42 On completion of the heavy civil engineering works associated with tunnel and approach works construction, the tunnel would be fitted out with civil works such as road construction and mechanical and electrical installations, including ventilation systems, lighting, signing, signalling and monitoring.

7.3.43 The new tunnel for Routes 3 or 4 could be operated from either a local control room or a remote location which could include sharing the existing Dartford Crossing control centre.

Route 3 North of River Thames – horizontal alignment

7.3.44 On the north side of the river the route would go to the west of East Tilbury and then between Chadwell St Mary and Linford. The route would cross the A13 to the west of Orsett at the location of the existing A13/ A1089 junction.

7.3.45 To the north of the A13 the route would pass to the west of Orsett and then turn to the west and would be north of South Ockendon before connecting with the M25 between Junctions 29 and 30 via a one-way free-flow junction with north facing slip roads.

Route 3 North of River Thames – vertical alignment

7.3.46 To the north of the river the route would remain in cutting before rising to embankment. In the area of Bowaters Farm the route would be on a small embankment or at existing ground level before rising up over Station Road and the railway line to the west of East Tilbury.

7.3.47 North of the railway, the route would alternate between short sections of cutting and embankment. Approaching the A13, the route would go below ground level in order to go beneath the A13, with the northbound and southbound carriageways splitting in order to accommodate the new slip roads.

7.3.48 North of the A13, the route would be on embankment through to the M25, with the embankment height typically around 4.5m.

Route 3 North of River Thames - Brentwood Road Junction

(Refer to **Appendix 3.11** for junction drawing)

7.3.49 The proposal at Brentwood Road would be to provide a northbound off-slip, which would allow the north to east movement along the A13. In addition there would be an on-slip which would provide the A13 westbound to LTC southbound movement. This would also allow traffic from A1089 northbound to access LTC southbound and LTC northbound to access A1089 southbound via the A13. These movements are not catered for at the A13 junction.

7.3.50 This option would require widening the Brentwood Road between the proposed junction and the Orsett Cock Interchange, and improvements at Orsett Cock Interchange in order to accommodate the wider Brentwood Road.

7.3.51 This junction proposal removes the need to provide these movements at the proposed A13 interchange and provides a shorter route for traffic to and from the A13 east. Providing this junction would reduce the complexity of the proposed junction at the A13 and reduce the amount of land required at that junction.

Route 3 North of the River Thames - A13 Junction

(Refer to **Appendix 3.11** for junction drawing)

7.3.52 The route would connect with the A13 at the existing junction between the A1089 and the A13.

7.3.53 In order to accommodate all of the movements the main carriageways would be split and they would go beneath the existing A13. A series of link and slip-roads would be necessary in order to provide all the movements required.

7.3.54 The following movements would be provided at this junction:

- A13 westbound to LTC northbound
- LTC southbound to A13 eastbound
- LTC southbound to A1089 southbound
- LTC northbound to A13 westbound
- A1089 northbound to LTC northbound
- A13 eastbound to LTC southbound

Route 3 North of the River Thames - M25 Junction

(Refer **Appendix 3.11** for junction drawing)

7.3.55 At the M25 a free-flow junction is proposed (as it is not considered that a grade separated junction is practicable and would not meet the scheme objectives). It is proposed that only north facing slip roads would be provided giving access for northbound LTC vehicles onto the northbound M25 and M25 southbound vehicles onto LTC southbound. This is because the traffic modelling indicated that there would be very little demand for the other two movements.

Route 3 North of the River Thames - Highway Structures

7.3.56 The route would require the construction of a range of highway structures including crossings of the Tilbury Loop rail line, the Upminster and Grays Branch rail line, A1013, A13, B186, B188 and B1421. Several structures would also be required at the A13 and M25 Junctions. The structures are summarised in **Table 7.7** below.

7.3.57 All the structure details given in this section are indicative of potential solutions and would be subject to change as the routes are developed and appraised further.

TABLE 7.7 - SUMMARY OF THE STRUCTURE TYPES AND LOCATIONS FOR ROUTE 3 NORTH OF RIVER THAMES

Structure Type	Mainline Structures	Junction Structures	
		A13	M25
New rail bridges	1	0	1
New road overbridges	7	7	0
New road underbridges (up to 4 spans)	8	1	2
New road viaducts (5 spans or more)	0	2	1
Jacked box tunnels	3	0	0
New footbridges	0	0	0
New underpasses	4	0	1
New main river bridges	3	0	0
Existing structures to be modified	0	1	0
Existing structures to be demolished	0	0	0
Total	**26**	**11**	**5**

7.3.58 One existing structure would be affected by the route, the A13 overbridge. This is a four-span reinforced concrete bridge carrying the A13 over the A1089. The A1089 currently passes below the two central spans of this bridge and it is anticipated that ground retaining or stabilisation works would be required either behind or in front of the east abutment to allow an LTC slip road to pass through the eastern end span.

7.3.59 The most significant single structure associated with this route would be the viaduct carrying the LTC westbound to M25 northbound slip road over the M25 and the Upminster and Grays Branch rail line. The length of the viaduct structure would be determined by the extent of slip road located above the height at which embankment construction is deemed economic. At this location the M25 is located on an 8m high embankment and thus the

proposed slip road would be up to 17m above existing ground level, which leads to an assumed viaduct length of 810m.

7.4 Route 4

(Refer to **Appendix 3.9** for Plan and Profile drawings and **Appendix 3.10** for Typical Cross Section drawings)

7.4.1 This route would connect the A2 or M2 to the M25 at Junction 29. To the south of the River Thames the route has the same two options as Route 3, WSL and ESL. The proposed junctions at the A2, M2 and A226 would be the same as those described for Route 3 in Section 5.3. The route is shown in **Figure 7.10**.

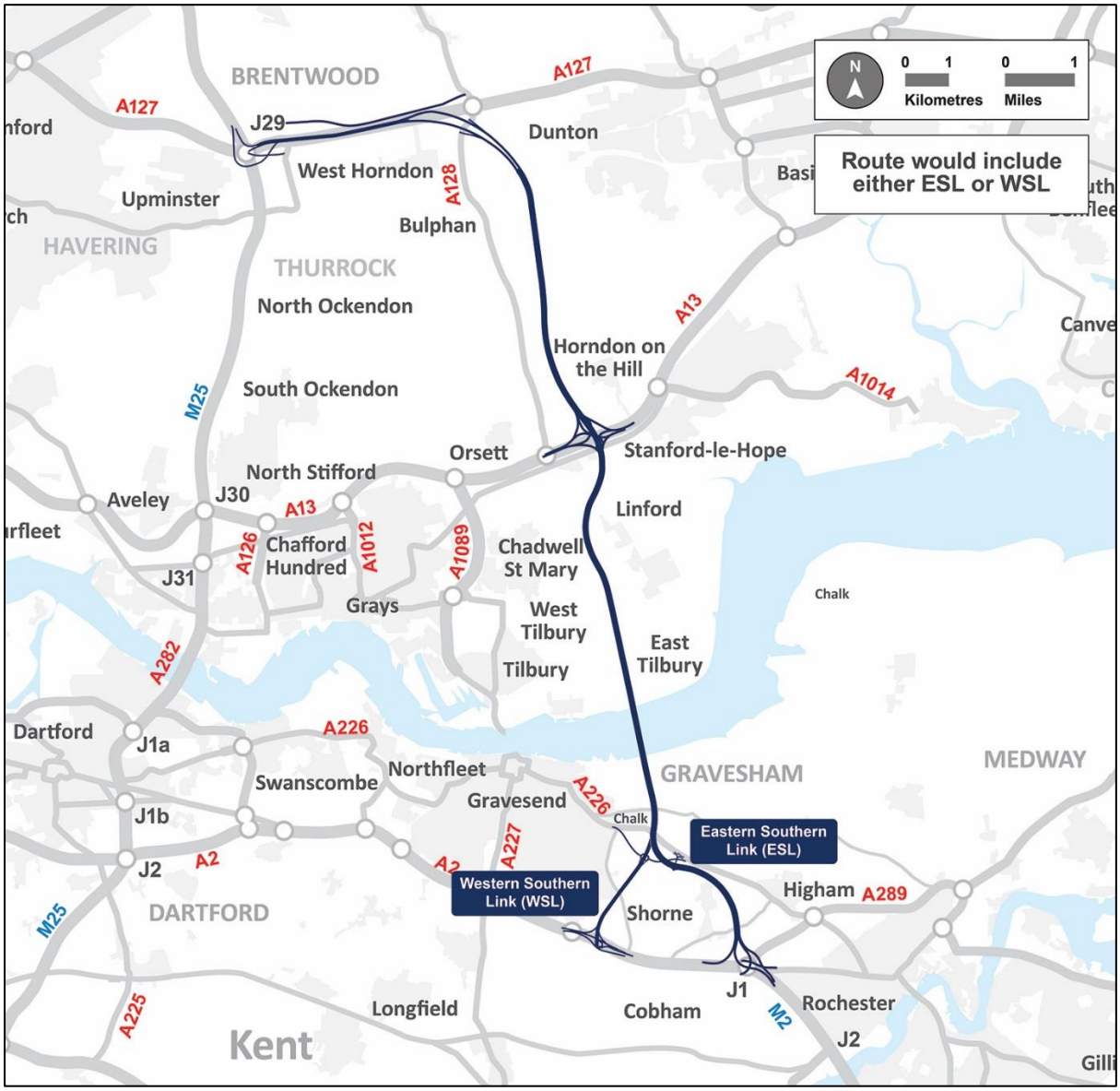

FIGURE 7.10 - ROUTE 4

7.4.2 This route also has a bored tunnel crossing of the River Thames. The horizontal alignment of the crossing is the same as for Route 3 allowing

either the WSL or the ESL to connect into the crossing. The alignments south of the river would all be as described in Section 7.3 for Route 3.

7.4.3 North of the river the route would go north between West Tilbury and East Tilbury. The route would connect with the A13 to the east of the Orsett Cock Interchange and then connect with the A127 in the vicinity of the existing A127/ A128 junction. From this point it would use the A127, upgraded to dual four-lanes, to M25 Junction 29.

Route 4 River Crossing

7.4.4 The crossing location and conceptual design would all be as described in paragraphs 7.3.28 to 7.3.43 for Route 3.

Route 4 North of River Thames - Alignment (horizontal)

7.4.5 Horizontal and vertical alignments have been designed to the DMRB TD 9/93 Table 3 for highway link design. The design speed has been taken as 120km/h (70mph speed limit) for a dual two-lane all-purpose road.

7.4.6 North of the river the route would go to the west of East Tilbury and then turn east to go north of East Tilbury and through the south east edge of a golf course. At the A13 there would be an all movement free-flow junction which would be located between Orsett Cock Interchange and the grade separated junction with the A13 and B1007/ A1014 (The Manorway).

7.4.7 To the north of the A13 the route would head north towards the A127 following an alignment parallel to and east of the A128. The LTC carriageways would connect into the A127 to the west of the A127/ A128 junction. The A127 would be widened to four lanes in each direction between the LTC/ A127 merge and M25 Junction 29.

Route 4 North of River Thames - Alignment (vertical)

7.4.8 North of the river towards the A13, the alignment would typically be on short sections of embankment and would pass over the Tilbury Loop railway line as well as Station Road and Muckingford Road. At the A13 the route would pass over the A13 on viaduct and then north of the A13 the alignment would generally be on short sections of embankment.

7.4.9 At the A127 the route would connect into the existing dual carriageway and would utilise the existing road corridor through to M25 Junction 29.

Route 4 North of River Thames - A13 Junction

(Refer to **Appendix 3.11** for junction drawing)

7.4.10 The proposed junction at the A13 would be an all movement free-flow junction located between the existing Orsett Cock Interchange and the existing grade separated junction with the A13 and B1007/ A1014 (The Manorway). The junction would have a four-level layout with a complex series of slip roads, loops and interchange links to the adjacent road network.

7.4.11 The junction layout has been developed to take account of the changes proposed as part of the Thurrock widening of this section of the A13 from dual two to dual three lanes (refer Volume 2 Section 3.10).

7.4.12 In order to locate the junction at the proposed location it would be necessary to remove the existing east facing slip roads on the Orsett Cock Interchange. This would remove the issue of weaving lengths from the existing east-facing slip roads at Orsett Cock to the LTC west-facing slip roads associated with this junction.

7.4.13 In order to compensate for the removal of the slip roads it would be necessary to utilise the existing road (A1013/ Stanford Road) which runs parallel with the A13 between Orsett Cock Interchange and the junction with the B1007/ A1014. Improvements on this road would be required to accommodate the additional traffic.

Route 4 North of River Thames - A127 Junction

(Refer to **Appendix 3.11** for junction drawing)

7.4.14 As described in paragraph 7.4.7, LTC would join the existing A127 west of the existing A127/ A128 junction.

7.4.15 On the westbound A127 carriageway the A127 would be maintained as lanes three and four with the LTC northbound carriageway connecting as a two lane gain, as lanes one and two. These four lanes would continue to Junction 29 where lanes one and two would diverge as a two lane drop via a viaduct to the south of Junction 29, providing a free flow connection to the northbound M25. This proposed layout would minimise the weaving between A127 and LTC traffic.

7.4.16 On the eastbound A127 carriageway, the A127 would be maintained as lanes three and four with the LTC southbound carriageway connecting as a two lane gain as lanes one and two from the southbound M25. These four lanes would continue towards the A127/ A128 junction, where lanes one and two would diverge as a two lane drop via a viaduct over the A127 as the southbound LTC carriageway. This proposed layout would again minimise the weaving between A127 and LTC traffic.

Route 4 North of River Thames - M25 Junction 29

(Refer to **Appendix 3.11** for junction drawing)

7.4.17 At this junction, the existing grade-separated junction would be maintained and two new link roads would be constructed directly linking the new route with the M25. There would be a link road on a viaduct southwest of the existing junction over the existing road network that would take traffic onto the northbound M25. A dedicated link road from the M25 southbound would take traffic onto the A127/ LTC eastbound. This arrangement would mean that LTC traffic would be segregated from the existing roundabout and slip roads.

7.4.18 To the east of Junction 29 on the M25 there is an existing junction between the A127 and the B186. In order to provide the merge and diverges to the proposed slip roads from and to the M25 it would be necessary to close this junction. To mitigate against this closure two new link roads are proposed that would provide the lost movements at the existing junction and retain access for properties.

7.4.19 A link road is proposed to connect from the B186 into the existing roundabout at Junction 29. This would provide access to and from the A127 onto the B186.

7.4.20 A two-way link road is proposed from the B186 to the A128 to provide traffic access from and to the B186 from the A127, via the A128 junction.

Route 4 North of River Thames - Highway Structures

7.4.21 The route would require the construction of a range of highway structures including crossings of the Tilbury Loop rail line, the Fenchurch Street and Shoeburyness rail line, the A1013, A13, A128 and B186. Structures would also be required at each of the A13, A127 and M25 junctions. Finally the route would require the widening of the existing A127 along a length of approximately 3.5km to accommodate the proposed dual four-lane carriageway. This would require the replacement of two existing highway structures. The structures required are summarised in **Table 7.8** below.

7.4.22 All the structure details given in this section are indicative of potential solutions and would be subject to change as the options are developed and appraised further.

TABLE 7.8 - SUMMARY OF THE STRUCTURE TYPES AND ROUTES FOR ROUTE 4 NORTH OF RIVER THAMES

Structure Type	Mainline Structures	Junction Structures		
		A13	A127	M25
New rail bridges	2	0	0	0
New road overbridges	5	4	0	0
New road underbridges (up to 4 spans)	9	1	0	1
New road viaducts (5 spans or more)	0	2	0	2
Jacked box highway underbridges	0	2	0	0
Cut and cover tunnel	0	3	0	0
New footbridges	4	1	0	0
New underpasses	3	0	0	0
New main river bridges	4	0	0	0
Existing structures to be modified	0	0	0	0
Existing structures to be demolished	2	1	0	0
Total	**29**	**14**	**0**	**3**

7.4.23 The following existing structures would be affected by the route:

- Saffron Garden overbridge - a four-span concrete slab bridge carrying a minor road over the A13. It is assumed that this bridge would be demolished and the bridge reconstructed in order to span over the diversion of the A1013 associated with the proposed A13 junction.
- Warley Street overbridge - a four-span prestressed beam bridge carrying the B186 over the A127, assumed to be replaced as part of the A127 widening works.
- Codham Hall access road - a three-span steel composite bridge spanning the A127 assumed to be replaced as part of the A127 widening works.

8 References

Title	Document number or date
DMRB - Road Geometry	TD 9/93
DMRB - Layout of Grade Separated Junctions	TD 22/06
DMRB - Cross-sections and Headroom	TD 27/05
Lower Thames Crossing Consultation: Analysis of findings report (Final version)	Ipsos MORI - February 2017

9 Abbreviations and Glossary

Abbreviation	Description
2025 Opening year	A modelled year in the LTC traffic model in which flows are estimated for each option
2041 Design year	A modelled year in the LTC traffic model. The design year is typically 15 years after opening, but for LTC 2041, 16 years after opening, was assessed as it is the maximum horizon year for current growth assumptions. Traffic flows are estimated for each option.
AADT	Average Annual Daily Traffic
ADMS-Roads	Comprehensive software for modelling road traffic pollution.
AECOM	AECOM Technology Corporation
Affected Road Network	This comprises the area within which roads could be considered within the air quality model (selection of the roads within the model depends upon a number of criteria such as changes in Heavy Duty Vehicle flows).
Alignment	The alignment is the horizontal and vertical route of a road, defined as a series of horizontal tangents and curves or vertical crest and sag curves, and the gradients connecting them.
AM	07:00 to 10:00
AMCB	Analysis of monetary costs and benefits
ANPR	Automated Number Plate Recognition
AOD	Above ordnance datum, vertical datum used by an ordnance survey as the basis for delivering altitudes on maps.
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.
APS	Annual Population Survey
APTR	All-purpose trunk road
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.
AST	Appraisal Summary Table; a summary of impacts of introducing new infrastructure, setting out impacts using a structured set or economic, social and environmental measures.
AURN	Defra's Automatic Urban and Rural Network: the UK's largest automatic monitoring network and the main network used for compliance reporting against the Ambient Air Quality Directives.
BAP	Biodiversity Action Plan: National, local and sector-specific plans established under the UK Biodiversity Action Plan, with the intention of securing the conservation and sustainable use of biodiversity.
Batter slope	In construction is a receding slope of a wall, structure, or earthwork. The term is used with buildings and non-building structures to identify when a wall is intentionally built with an inward slope.
BenefitCost 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.
BGS	British Geological Survey: a partly publicly funded body which aims to advance geoscientific knowledge of the United Kingdom landmass and its continental shelf by means of systematic surveying, monitoring and research.
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).
Bluewater	Bluewater Shopping Centre, an out of town shopping centre in Stone, Kent, outside the M25 Orbital motorway, 17.8 miles (28.6 km) east south east of London's centre.
BR	Bridge (when used as part of a LTC shortlist route reference) Bridleway
Bridge Management System (BMS)	A means for managing bridges throughout design, construction, operation and maintenance of the bridges.
BSL	British Sign Language

Abbreviation	Description
BT	Bored tunnel
BTEC	Business and Technology Education Council
BTO	British Trust for Ornithology: an organisation founded in 1932 for the study of birds in the British Isles.
C2 enquiry	An initial enquiry made to a utility company under the New Roads and Street Works Act (NRWSA) about the locations of their plant and equipment.
Capex	Capital expenditure, the cost of developing or providing non-consumable parts of the product or system.
Catchpit chamber	Catchpits are a precast concrete drainage product that are recommended for use as a filter and collector in land drainage systems that do not make use of any sort of geo-membrane. A catchpit is essentially an empty chamber with an inlet pipe and an outlet pipe set at a level above the floor of the pit. Any sediment carried by the system settles out whilst in the catchpit, from where it can be periodically pumped out or removed
CCC	Highways England Customer Contact Centre
CCTV	Closed-circuit television. Highways England CCTV cameras are used to monitor traffic flows on the English motorway and trunk road network primarily for the purposes of traffic management.
CDA	Critical Drainage Area, an area which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency.
CEMP	Construction Environmental Management Plan
CESS	Highways England Commercial Services Division Cost Estimation Summary Spreadsheet
CFMP	Catchment Flood Management Plan: A strategic planning tool through which the Environment Agency works with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.
CO2e	Carbon dioxide equivalent; a standard unit for measuring carbon footprints. The idea is to express the impact of each different greenhouse gas in terms of the amount of CO2 that would create the same amount of warming.
COBALT	New 'light touch' version of COBA, COst Benefit Analysis computer program, DfT's tool for estimating accident benefits. The COBA program compares the costs of providing road schemes with the benefits derived by road users
CoCP	Code of Construction Practice
Connect Plus	Connect Plus (M25) Ltd, management company for the Dartford-Thurrock Crossing.
C.RO Ports	C.RO is the brand name for the subsidiaries of C.RO Ports SA that operate ro-ro terminals in the UK, the Netherlands and Belgium.
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.
D2AP	Dual two-lane all-purpose road
Dart Charge	The Dartford Crossing free-flow electronic number plate recognition charging system (operates between 0600 and 2200).
Dartford Cable Tunnel	An £11m tunnel upstream of the Dartford Crossing, built in 2003-4, whose diameter is ~3m and designed to carry - and allow for - maintenance of 380kV National Grid electrical cable beneath the River Thames.
DBFO	Design, build, finance, operate: a way of creating "public–private partnerships" (PPPs) by funding public infrastructure projects with private capital.
DC	Dartford Crossing
DCC	Dartford Crossing Control Centre
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs: the government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the United Kingdom of Great Britain and Northern Ireland.
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

Abbreviation	Description
	exceptions for vehicle Tunnel Restriction Code C). Vehicles with Tunnel Restriction Codes D and E are subject to convoying or 'check and allow' using the procedures describe in the Dartford Dangerous Goods Listing.
Disbenefit	A disadvantage or loss resulting from something.
Distributional Impact	Distributional impacts (DIs) consider the variance of transport intervention impacts across different social groups. The analysis of DIs is mandatory in the appraisal process and is a constituent of the Appraisal Summary Table (AST).
DMRB	Design Manual for Roads and Bridges: A comprehensive manual (comprising 15 volumes) which contains requirements, advice and other published documents relating to works on motorway and all-purpose trunk roads for which one of the Overseeing Organisations (Highways England, Transport Scotland, The Welsh Government or the Department for Regional Development (Northern Ireland)) is highway authority. The DMRB has been developed as a series of documents published by the Overseeing Organisations of England, Scotland, Wales and Northern Ireland. For the Lower Thames Crossing the Overseeing Organisation is Highways England.
DP World	Dubai Ports World, London Gateway Port
DV	District Valuer
DWT	Deadweight tonnage, a measure of how much weight a ship is carrying or can safely carry.
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.
EB	eastbound
Environment Impact Assessment (EIA)	The purpose of Environmental Impact Assessment is to protect the environment by ensuring that a consenting authority, when deciding whether to grant consent for a project which is likely to have significant effects on the environment, does so in the full knowledge of the likely significant effects, and takes this into account in the decision making process.
ERA	Emergency Refuge Area: on roads for use in emergency or breakdown only and separated from the main carriageway.
EU	European Union: A politico-economic union of 28 member states that are located primarily in Europe.
Fastrack	A bus rapid transit scheme operating in the Thames Gateway area of Kent, operated by Arriva Southern Counties.
FRA	Flood Risk Assessment.
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'.
GDP	Gross Domestic Product
GIS	Geographic information system: an integrated collection of computer software and data used to view and manage information about geographic places, analyse spatial relationships, and model spatial processes.
GVA	Gross Value Added
Ha	Hectares
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.
Habitats Regulations	This is a multi-stage process undertaken to determine whether a project, plan or policy will have an adverse effect on the integrity of any Natura 2000 or European sites (Special Areas of Conservation, Special Protection Areas and Ramsar sites), (either in isolation or in combination with other plans and

Abbreviation	Description
Assessment (HRA)	projects). The outcomes of this process should inform decision-making and whether consent should be granted for a project.
HAGDMS	Highways England Geotechnical Data Management System
Hanson	Hanson UK, part of the HeidelbergCement Group.
HGV	Heavy Goods Vehicle
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.
HMRC	HM Revenue & Customs
HRA	Habitats Regulations Assessment
HS1	High Speed 1 rail line (formerly Channel Tunnel Rail Link (CTRL))
IAN	Interim Advice Notice: Issued by Highways England from time to time. They contain specific guidance, which should only be used in connection with works on motorways and trunk roads in England.
Inter-peak	10:00 to 16:00
IP	Internet Protocol
IPA	Infrastructure and Projects Authority
Ipsos MORI	A UK market research organisation appointed by Highways England to analyse and report on the responses to the LTC public consultation.
IROPI	Imperative Reasons of Overriding Public Interest
IT	Immersed tunnel
ITS	Intelligent Transportation System
KMEP	Kent and Medway Economic Partnership
Lafarge Tarmac	Lafarge Tarmac Limited is a British building materials company headquartered in Solihull, Birmingham.
Lakeside	Lakeside Shopping Centre, branded as Intu Lakeside, is a large out-of-town shopping centre located in West Thurrock, in the borough of Thurrock, Essex just beyond the eastern boundary of Greater London.
London Distribution Park (LDP)	An area, 70 acres (28Ha), of land for industrial and logistics development 6.5 miles from the M25, adjacent to Port of Tilbury, London.
LGV	Light Goods Vehicle
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.
LoHAM	Transport for London's Highway Assignment Model
London Gateway	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.
LRCH	London Resort Company Holdings, developer for the proposed entertainment resort on the Swanscombe peninsula, Kent.
LSOA	Lower Super Output Area; LSOAs typically contain 4 to 6 OAs (census output areas, the smallest unit for which census data is published) with a population of around 1500.
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.
LTS railway	London, Tilbury and Southend railway
LVIA	Landscape and Visual Impact Assessment
LWS	Local wildlife site
Mainline	The through carriageway of a road as opposed to a slip road or a link road at a junction
Mardyke	A small river, mainly in Thurrock, that flows into the River Thames at Purfleet, close to the QEII Bridge.

Abbreviation	Description
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.
Marine Management Organisation (MMO)	An executive non-departmental public body in the UK established under the Marine and Coastal Access Act 2009. The MMO exists to make a significant contribution to sustainable development in the marine area, and to promote the UK government's vision for clean, healthy, safe, productive and biologically diverse oceans and seas.
National Cycle Route (NCR)	A cycle route part of the National Cycle Network created by Sustrans to encourage cycling throughout Britain.
National Vegetation Classification (NVC)	A system of classifying natural habitat types in Great Britain according to the vegetation they contain.
Natura 2000	A network of nature protection areas in the territory of the EU. It is made up of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) designated respectively under the Habitats Directive and Birds Directive. The network includes both terrestrial and marine sites (Marine Protected Areas (MPAs)).
NB	northbound
NIDP	National Infrastructure Delivery Plan
NMU	Non-motorised user, e.g. pedestrians, cyclists, equestrians.
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.
NPPF	National Planning Policy Framework: published in March 2012 by the UK's Department of Communities and Local Government, consolidating over two dozen previously issued documents called Planning Policy Statements (PPS) and Planning Policy Guidance Notes (PPG) for use in England.
NPS	National Policy Statement (see NPSNN)
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.
NPV	Net present value, a measure of the total impact of a scheme upon society, in monetary terms, expressed in 2010 prices.
NTCC	National Technology Control Centre: based in the West Midlands, the NTCC is an ambitious telematics project aimed at providing free, real-time information on England's network of motorways and trunk roads to road users, allowing them to plan routes and avoid congested areas.
NTEM	DfT's National Trip End Model
NTIS	Highways England National Traffic Information Service
NUTS	Nomenclature of Territorial Units for Statistics
NVQ	National Vocational Qualification
O&M	Operations and Maintenance
ONS	Office for National Statistics: the executive office of the UK Statistics Authority, a non-ministerial department which reports directly to the UK Parliament.
Opex	An operating expense or operating expenditure or operational expense or operational expenditure: an ongoing cost for running a product, business or system.
PA	Public accounts Public address
PACTS	Parliamentary Advisory Council for Transport Safety: a registered charity and an All-party parliamentary group of the UK parliament. Its charitable objective is to protect human life through the promotion of transport safety for the public benefit.

Abbreviation	Description
PCM	Pollution Climate Model
pcu	passenger car units. This is a metric to allow different vehicle types within traffic flows in a traffic model to be assessed in a consistent manner. Typical pcu factors are: 1 for a car or light goods vehicle; 2 for a bus of heavy goods vehicle; 0.4 for a motorcycle; and 0.2 for a pedal cycle.
Peel Ports	Britain's second largest group of ports, part of the Peel Group.
PIA	Personal Injury(ies) Accident(s)
PIE	Public Information Event. Highways England held a total of 24 PIEs in 20 locations during the six-week public consultation period between January and March 2016; almost 13,000 people attended.
PLA	Port of London Authority: a self-funding public trust established by The Port of London Act 1908 to govern the Port of London. Its responsibility extends over the Tideway of the River Thames and its continuation (the Kent/ Essex strait). It maintains and supervises navigation, and protects the river's environment.
PM	16:00 to 19:00
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
pSPA	Potential Special Protection Area: Sites which are approved by Government that are in the process of being classified as Special Protection Areas.
PTSD	Highways England Professional and Technical Services Division
PV	Present Values
PVB	Present value of benefits: PVBs less PVCs provide estimates of Net Present Values (NPVs) and the ratio of the PVB to the PVC constitutes the BCR.
PVC	Present value of costs: a measure of the monetary cost of a scheme, less revenues, discounted to and expressed in 2010 prices.
QEII Bridge	Queen Elizabeth II Bridge, part of the Dartford-Thurrock crossing.
QUADRO	QUeues And Delays at ROadworks computer program: a Highways England sponsored computer program maintained and distributed by TRL Software; its primary use is in rural areas. It estimates the effects of roadworks in terms of time, vehicle operating and accident costs on the users of the road. Individual roadworks jobs can be combined to produce the total cost of maintaining the road over time.
R&D	Research and development.
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.
RIS	DfT's Road Investment Strategy
rMCZ	Recommended Marine Conservation Zone: A site put forward for designation under the Marine and Coastal Access Act 2009 to conserve the diversity of nationally rare, threatened and representative habitats and species.
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-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 crossing of a twin-bored tunnel river crossing large enough to accommodate a 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.

Abbreviation	Description
RSPB	Royal Society for the Protection of Birds: A charitable organisation that works to promote conservation and protection of birds and the wider environment through public awareness campaigns, petitions and through the operation of nature reserves throughout the United Kingdom.
RTC	Road traffic collision
RWE npower	A leading integrated UK energy company.
SAC	Special Area of Conservation: defined in the European Union's Habitats Directive (92/43/EEC), also known as the Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora. SACs are to protect the 220 habitats and approximately 1000 species listed in annex I and II of the directive which are considered to be of European interest following criteria given in the directive.
Sanef	Société des Autoroutes du Nord et de l'Est de la France, a motorway operator company.
SAP	LTC Stakeholder Advisory Panel: comprises key local authority stakeholders to share local knowledge, their needs, priorities and opinions with respect to LTC. SAP meetings have been held at key stages of the LTC scheme; bi-lateral meetings with SAP members have also been held.
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 revised report that reports on the consultation, response to consultation findings and presents Highways England's Recommended Preferred Route.
SATURN	Simulation and Assignment of Traffic to Urban Road Networks, Transport Model
SCADA	Supervisory Control and Data Acquisition
S-CGE	Spatial Compatible General Equilibrium economic model
SEB(s)	Statutory Environmental Body(ies): Any principal council as defined in subsection (1) of section 270 of the Local Government Act 1982 for the area where the land is situated. Where the land is situated in England; Natural England, Historic England, the Environment Agency, Natural Resources Wales and the National Assembly for Wales where, in the opinion of the Secretary of State, the land is sufficiently near to Wales to be of interest to them and any other public authority which has environmental responsibilities and which the Secretary of State considers likely to have an interest in the scheme.
SELEP	South East Local Enterprise Partnership: the business-led, public/ private body established to drive economic growth across East Sussex, Essex, Kent, Medway, Southend and Thurrock.
Setting	This is defined in the National Planning Policy Framework as 'The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of the asset, may affect the ability to appreciate that significance or may be neutral.'
SIA	Social Impact Appraisal
Smart motorway	Term for a range of types of actively controlled motorway, using technology to optimise use of the carriageway including the hard shoulder.
SOCC	Statement of Community Consultation, sets out how local communities in the vicinity of the scheme will be consulted. Directly affected and neighbouring local authorities will be consulted on the content of the SOCC before it is finalised.
SoS	Secretary of State (for Transport)
SPA	Special Protection Area: A designation under the European Union Directive on the Conservation of Wild Birds.
SPZ	Source protection zone: EA-defined groundwater sources (2000) such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area.
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.
STEM subjects	Science, Technology, Engineering and Mathematics
SuDS	A sustainable drainage system designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges.
Sustrans	A UK charity enabling people to travel by foot, bike or public transport for more of the journeys they make every day; their flagship project is the National Cycle Network.
SWMP	Surface Water Management Plan: Plan to provide sufficient information to support the development of an agreed strategic approach to the management of surface water flood risk within a given geographical area by ensuring the most sustainable measures are identified.
TAME	Highways England's Traffic Appraisal Modelling and Economics division
TBM	Tunnel boring machine, machine used to excavate tunnels with a circular cross section.

Abbreviation	Description
TE2100	EA's Thames Estuary 2100 project (formed November 2012) to develop a comprehensive action plan to manage flood risk for the Tidal Thames from Teddington in West London, through to Sheerness and Shoeburyness in Kent and Essex.
TEE	Transport Economic Efficiency (economic efficiency of the transport system)
TEN-T	Trans-European transport network
TfL	Transport for London: created in 2000, the integrated body responsible for London's transport system.
TGSEP	Thames Gateway South Essex Partnership
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.
TM	Highways England's Traffic Management (directorate)
TMC	Traffic Management Cell
TRRL	Transport and Road Research Laboratory (now TRL Ltd): a fully independent private company offering a transport consultancy and research service to the public and private sector. Originally established in 1933 by the UK Government as the Road Research Laboratory (RRL), it was privatised in 1996.
TUBA	Transport Users Benefit Appraisal (DfT economic appraisal software tool)
ULEV	Ultra Low Emission Vehicle
Urban All Purpose	A road in an urban area designed for all types of traffic in accordance to the relevant DMRB Standards.
VAT	Value Added Tax
VfM	Value for Money
VMSL	Variable Mandatory Speed Limit(s)
VOC	Vehicle operating cost(s)
Vopak	Royal Vopak N.V. is a Dutch company that stores and handles various oil and natural gas-related products.
Vortex separator/ device	A vortex separator is a device for effective removal of sediment, litter and oil from surface water runoff.
VOSA	Vehicle and Operator Services Agency, now merged with the Driving Standards Agency into a single agency, the Driver and Vehicle Standards Agency (DVSA).
vpd	Vehicles per day
WASHMS	Wind and Structural Health Monitoring System: the process of implementing a damage detection and characterisation strategy for engineering structures.
WB	westbound
WEBs	Wider economic benefits
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.
WFD	Water Framework Directive: A European Community Directive (2000/60/EC) of the European Parliament and council designed to integrate the way water bodies are managed across Europe.
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.
Without Scheme/ With Scheme	Without Scheme: The scenario where government takes the minimum amount of action necessary and is used as a benchmark in the appraisal of options. With Scheme: An option that provides enhanced services by comparison to the benchmark Without Scheme scenario.

10 Appendices

	Title
Appendix 3.1	Options not selected from previous DfT studies
Appendix 3.2	Options not selected for shortlist
Appendix 3.3	Approach to consultation and feedback
Appendix 3.4	Further appraisal of Location A options undertaken post-consultation
Appendix 3.5	Congestion reference flow analysis
Appendix 3.6	Route 1 Plan and Profile Drawings
Appendix 3.7	Route 1 Typical Cross Section Drawings
Appendix 3.8	Route 1 Bridge General Arrangement Drawing
Appendix 3.9	Routes 3 and 4 Plan and Profile Drawings
Appendix 3.10	Routes 3 and 4 Typical Cross Sections
Appendix 3.11	Routes 3 and 4 Junction Drawings
Appendix 3.12	Routes 3 and 4 Bored Tunnel General Arrangement Drawings

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