

Lower Thames Crossing

Post-Consultation Scheme Assessment Report

Volume 6: Environmental Appraisal

Volume 6

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The designs shown and described in this Post-Consultation Scheme Assessment Report have been developed for the detailed appraisal of options as part of the options phase, and may be subject to change in later stages of the scheme development.

1 Introduction

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 – 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 (this volume)** – 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 describes the appraisal approach, Habitats Regulations Assessment (HRA), a summary of stakeholder engagement and outlines the Post-Consultation Appraisal Routes.
- Section 3 provides an environmental appraisal of Location A.
- Section 4 provides an environmental appraisal of Location C north of the River Thames.
- Section 5 summarises the environmental appraisal of Location C crossings and the Part One Appropriate Assessment.¹
- Section 6 provides an environmental appraisal of Location C south of the River Thames.
- Section 7 provides a summary of the results for the environmental appraisal.
- Section 8 lists other documentation referred to in this report.

¹ A Part One Appropriate Assessment was prepared to identify the potential effects on European Sites recognising the stage in the project's development and the fact that there were a number of options under consideration. An Appropriate Assessment in accordance with HD 44/09, the National Policy Statement for National Networks and Planning Inspectorate Advice Note 10 will be undertaken at the next project development stage.

2 Methodology

2.1 Appraisal Approach

2.1.1 An environmental appraisal has been completed for the Post-Consultation Appraisal Routes, as shown in **Figure 2.1**, for the following environmental topics:

- Landscape and townscape
- Historic environment
- Biodiversity
- Water environment
- Air quality
- Noise and vibration
- Greenhouse gases (note that this is reported in **Volume 5**)
- Community facilities



FIGURE 2.1 - POST-CONSULTATION APPRAISAL ROUTES

2.1.2 The method followed for the appraisal of the Post-Consultation Appraisal Routes has comprised a review of baseline conditions which is presented in **Volume 2** of the SAR and then an appraisal using the method outlined in **Table 2.1** below. When undertaking the appraisal, consideration has also been given to the policies outlined in the National Policy Statement for National Networks (NPSNN) largely contained within Section 5.

TABLE 2.1 - METHOD OF APPRAISAL FOR ENVIRONMENTAL TOPICS

Environmental Topic	Method of Appraisal
Landscape and Townscape	WebTAG Unit A3 Environmental Impact Appraisal
Historic Environment	WebTAG Unit A3 Environmental Impact Appraisal
Biodiversity	WebTAG Unit A3 Environmental Impact Appraisal
Water Environment	WebTAG Unit A3 Environmental Impact Appraisal

Environmental Topic	Method of Appraisal
Air Quality	The method of appraisal has been agreed with Highways England drawing upon guidance contained within Volume 11 of the Design Manual for Roads and Bridges (DMRB) and relevant Interim Advice Notes (IANs).
Noise and Vibration	WebTAG Unit A3 Environmental Impact Appraisal A proportionate method to allow comparison of routes has been agreed with Highways England.
Community Facilities	Volume 11 of the DMRB.

- 2.1.3 In undertaking the appraisal, information has been gathered through consultation with key stakeholders including; Statutory Environmental Bodies (SEBs), Port of London Authority, Royal Society for the Protection of Birds (RSPB), DP World and the Kent Downs Area of Outstanding Natural Beauty (AONB). This has also provided valuable details about other projects undertaken in the area, the challenges they have faced and the solutions developed. This consultation will continue in the next development phase.
- 2.1.4 There are a number of interrelationships between the different environmental topics. For example, historic environment and landscape and townscape in relation to the effects on the setting of built heritage assets, biodiversity and water in relation to the effects on freshwater and intertidal habitat. Where there are interrelationships they have been considered and reported in line with the appropriate guidance and to prevent double counting of effects.
- 2.1.5 A Water Framework Directive (WFD) screening assessment has also been completed to inform the water environment appraisal. This informal appraisal would need to be developed and a screening report produced for the Preferred Option in the next development stage of the project. A WFD assessment is required in accordance with NPSNN.
- 2.1.6 A hydrodynamics study comprising 2D flow modelling and sediment modelling has also been completed to inform the design process (refer to Appendix 4.5 in Volume 4 of the Pre-Consultation SAR).
- 2.1.7 The environmental drawings that present the environmental constraints and the routes that have been appraised are included in **Appendix 6.1**. Key locations and features referred to in this volume are shown in **Appendix 2.2** of Volume 2.
- 2.1.8 There are potential waste/ spoil disposal issues associated with all routes. However, this also presents an opportunity to re-use spoil in a beneficial way, for example in a habitat creation scheme, flood defence scheme and noise and landscape bunding. This issue will be considered further in the next stage of scheme development.

2.2 Habitats Regulations Assessment

- 2.2.1 An initial HRA has been undertaken in parallel with the appraisal owing to the presence of a number of European Sites including the Thames Estuary and Marshes Special Protection Area (SPA) and Ramsar site. A Habitats Regulations Assessment (HRA) Screening Matrix was prepared in

accordance with HD44/09 Assessment of Implications (of highways and/or roads projects) on European Sites (including appropriate assessment) for the longlist of options. This was issued to Natural England for comment and it was agreed that a Part One Appropriate Assessment Report should be prepared to inform the shortlist appraisal and the decision-making process. The results of the Part One Appropriate Assessment are summarised in Section 5.

2.3 Stakeholder Engagement

2.3.1 Throughout the appraisal of the longlist and shortlist options there was engagement with the SEBs and other environmental bodies. Workshops or meetings were held on the dates presented in **Appendix 6.2**. The Appendix also contains details of the key findings of the meetings and workshops. The consultations helped guide the appraisal and the development of the options. The SEBs and other environmental bodies engaged to discuss a number of environmental topics are summarised as follows:

- Natural England – ecology and landscape
- Environment Agency – water, flood risk, contaminated land and ecology
- Historic England – cultural heritage, archaeology and historic landscape
- Marine Management Organisation – marine management associated with the River Thames
- Kent Downs AONB – landscape
- RSPB - ecology

2.3.2 **Appendix 6.2** also provides details of meetings that have been held with environmental bodies since the publication of the Pre-Consultation SAR.

2.4 Appraisal of the Post-Consultation Appraisal Routes

2.4.1 This volume provides a summary of the results of the environmental appraisal of the Post-Consultation Appraisal Routes. The results have been described for:

- Location A (Route 1)
- Location C (Routes 3 and 4)
 - North of the River Thames
 - Crossing
 - South of the River Thames. For Location C Routes there are two alternatives - the Western Southern Link (WSL) and the Eastern Southern Link (ESL)

2.4.2 Section 7 provides a summary of the environmental appraisal comparing the routes.

3 Location A

3.1 Overview

- 3.1.1 This section describes the environmental effects of a bridge crossing at Route 1 at Location A north and south of the River Thames and at the crossing with reference to the baseline presented in Volume 2 of the SAR.
- 3.1.2 With regards to Route 1 the key environmental topics where there are potentially significant issues that require detailed consideration are:
- Air quality
 - Noise
 - Biodiversity
- 3.1.3 For air quality there are existing exceedances of European Union air quality standards which have led to the establishment of Air Quality Management Areas (AQMAs). There are a significant number of monitored exceedances of nitrogen dioxide (NO₂) around the Dartford area.
- 3.1.4 For noise, the road network includes several Noise Important Areas and noise mapping has demonstrated that levels of noise exceed 75 decibels for residential properties near to main roads. The effect of increased noise levels as a result of Route 1 on areas which are currently experiencing very high noise levels is a significant consideration.
- 3.1.5 There are several designated biodiversity sites that are a potential constraint to a crossing option. They include the nationally important Sites of Special Scientific Interest (SSSI), the recommended Marine Conservation Zone (rMCZ) as well as the presence further east of International and European Designated Sites and functionally linked land. There could be direct physical effects or indirect effects due to noise, lighting or pollution.
- 3.1.6 The following sections provide a summary of the environmental appraisal carried out for the following environmental topics:
- Landscape and Townscape
 - Historic Environment
 - Biodiversity
 - Water Environment
 - Air Quality
 - Noise
 - Community Facilities
- 3.1.7 The order in which the topics have been presented is consistent throughout this volume irrespective of the importance of the topic for each Post-Consultation Appraisal Route.
- 3.1.8 Key constraints around Route 1 are summarised in **Figure 3.1**. More detailed environmental constraints plans are provided in **Appendix 6.1**.

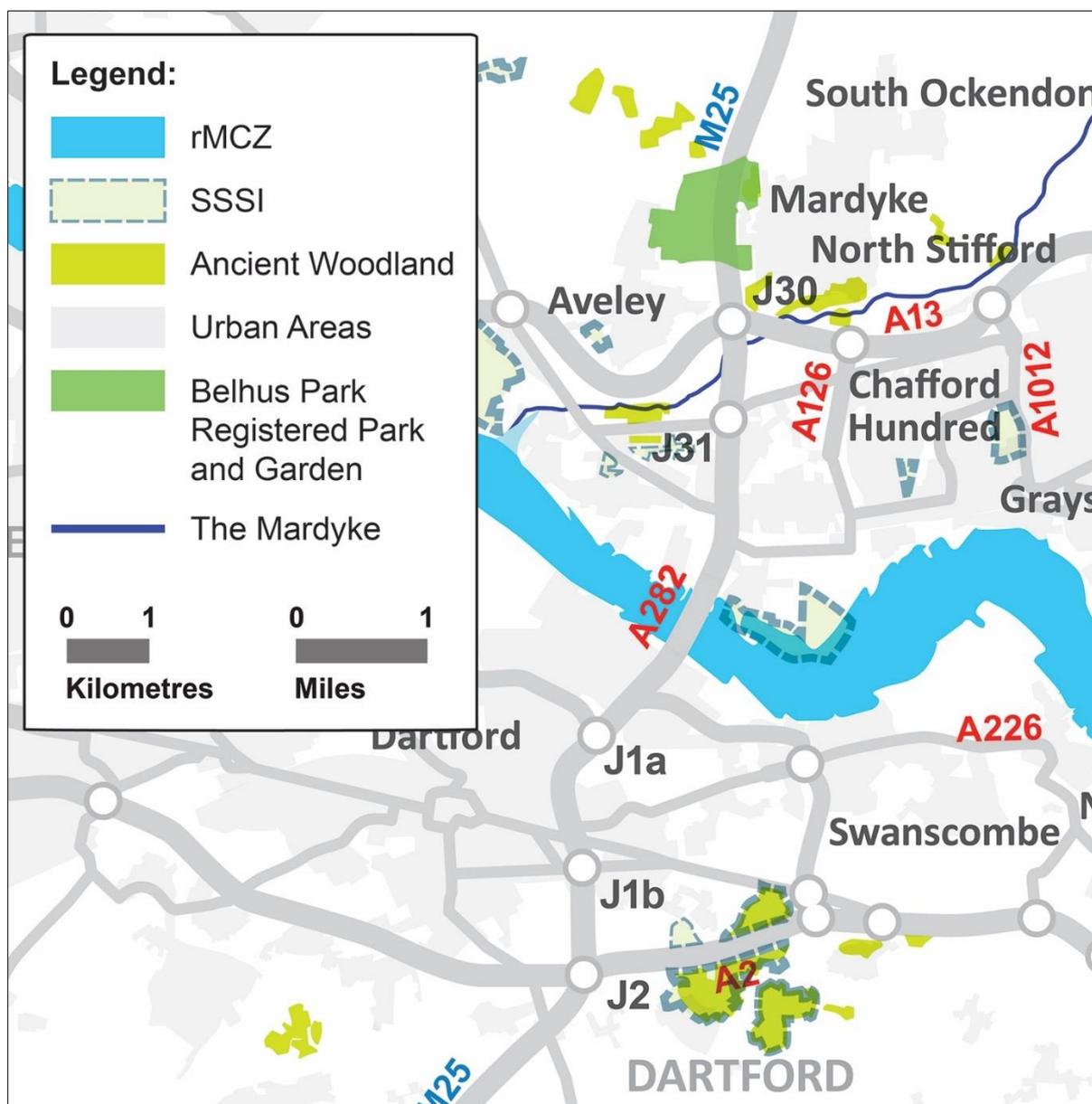


FIGURE 3.1 - KEY LANDSCAPE AND BIODIVERSITY CONSTRAINTS - ROUTE 1

3.2 Landscape and Townscape

3.2.1 Changes to the road infrastructure in the Green Belt designated areas around M25 Junction 30 and M25 Junction 31 including the removal of ancient woodland could have an adverse impact on the more rural setting, particularly on the Mardyke Valley. Whilst ancient woodland is not legally protected, the NPSNN states that:

“The Secretary of State should not grant development consent for any development that would result in the loss or deterioration of irreplaceable habitats including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the national need for and benefits of the development, in that location, clearly outweigh the loss”. (Paragraph 5.32)

- 3.2.2 The effects on ancient woodland, therefore, carry significant weight and the next development phase of the project should aim to avoid or mitigate impacts on such sites.

Bridge Crossing

- 3.2.3 The new road and bridge infrastructure would introduce a new linear element in the townscape, with minor changes to the local character.
- 3.2.4 Although a new bridge crossing would be noticeable over a wider area than the tunnel infrastructure, a bridge would fit well with the existing scale, character and appearance of the QEII Bridge and road infrastructure which are dominant visual features in the area. Therefore, the impact of a bridge structure is not likely to be a significant factor in the decision-making process from a landscape and townscape perspective.

3.3 Historic Environment

- 3.3.1 The historic landscape surrounding Route 1 is characterised by a mixture of industrial and residential development with more open rural areas at the northern and southern ends, including Belhus Park, which is a Grade II registered park and garden and is a designated heritage asset. It is of national value and effects on it would be an important consideration in the decision-making process. The location of the Park is shown in **Appendix 6.1**.

Bridge Crossing

- 3.3.2 There would be no significant impacts to any designated heritage assets which include Listed Buildings north of the A13 (refer to the drawing in **Appendix 6.1**). They would either not have visibility of the scheme, or the road network already forms part of the setting of the asset and so would not be out of character.
- 3.3.3 Construction excavations associated with the proposed bridge may have a physical impact on non-designated and unknown archaeological remains within the scheme footprint. Experience from previous developments within the area suggests that such finds would be a strong possibility. However, it is not likely to be a significant factor in the decision-making process.

3.4 Biodiversity

- 3.4.1 The detailed location of biodiversity features is shown in detail in **Appendix 6.1**. Impacts on Local Wildlife Sites and Biodiversity Action Plan (BAP²) priority habitats (and species these support) are most likely to occur in the vicinity of the Mardyke floodplain. These are most closely associated with the Mardyke floodplain habitat and areas of ancient woodland adjacent to the M25 (Junction 30) and the A13 on the northern side of the crossing.
- 3.4.2 Within the vicinity of the M25 Junction 30, four Local Wildlife Sites would be affected (Mardyke, Low Well Wood, Brickbarn Wood and Arena Essex). Some of these sites also feature ancient woodland and three areas of ancient woodland would be impacted by the route (Hangman's Wood,

² UK Biodiversity Action Plan priority species and habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan (UK BAP).

Brickbarn Wood and Low Well Wood). Embankments/ viaducts to cross the Mardyke Valley may result in the loss of some areas of floodplain habitat and impact on the sites' hydrology. These features are shown in **Figure 3.1** and additional detail is provided in **Appendix 6.1**. The implications of impacts on ancient woodland have been highlighted in section 3.2.

- 3.4.3 There are a small number of areas of deciduous woodland (which is also a BAP habitat) to the south of the crossing (adjacent to the A282) that could also be affected through permanent land take required for the new crossing and road widening. Effects on BAP habitats would need to be clarified through survey for the next development stage of the project and the implementation of appropriate mitigation. From a consenting perspective, effects on these features are unlikely to be significant. However, the effects would require mitigation, such as replacement planting or translocation based on the results of survey and assessment.
- 3.4.4 There is potential to impact on BAP priority habitats due to changes in air quality and/ or pollution such as through the deposition of nitrogen. Work would be undertaken to assess this effect at the next development phase.

Bridge Crossing

- 3.4.5 The bridge would be located in close proximity to the West Thurrock Lagoon and Marshes SSSI and would cross directly over adjacent mudflats. The bridge crossing could impact upon the bird species associated with the SSSI through disturbance/ loss of functionally linked habitat and the potential impact on mudflats from loss of or accumulation of material/ sediment due to hydrodynamic changes.
- 3.4.6 Whilst there would be no direct impacts on the SPA and Ramsar, indirect impacts on its qualifying species could arise from a new bridge crossing. These indirect impacts are the loss of functionally linked land (mudflats) used by SPA and Ramsar qualifying species, due to effects of shading/ sterilisation and disturbance (resulting in avoidance) by birds. There is also a possible collision risk associated with the bridge structure for birds moving between the inner and outer estuary. The magnitude of these indirect impacts depends on the level of use of existing mudflats by SPA qualifying species and numbers of bird movements within the estuary. This would need to be clarified through survey work at the next development stage.
- 3.4.7 Impacts on the Thames Estuary recommended Marine Conservation Zone (rMCZ) would be likely and would be restricted to the construction phase only. The size of the rMCZ is such that it is unlikely that its integrity would be affected by a second bridge crossing, assuming coffer dams are used for pier construction, with limited levels of scour and accretion once the support piers are in place (based on current hydrodynamic modelling). Impacts on this site based on current information are not considered to be significant or a potential showstopper for Route 1.

3.5 Water Environment

- 3.5.1 Impacts on the Mardyke would depend on the nature of the crossings adopted; full viaduct crossings are likely to have only slight impacts. Impacts

on surface water are unlikely to be significant following implementation of mitigation.

- 3.5.2 A Water Framework Directive (WFD) assessment (refer to Section 2.1.5) would be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (River Thames and Mardyke) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the bridge crossing or impacts on the Mardyke or groundwater bodies would lead to a reduction on WFD status³ or would prevent these waterbodies reaching good status or potential in the future. The appraisal has generally assumed that the target 2027 status of good applies, even though the current status of most water bodies is poor.
- 3.5.3 The Thurrock Site Water Management Plan identifies Critical Drainage Areas (CDAs). None of these CDAs are affected by this option.

Bridge Crossing

- 3.5.4 A bridge crossing over the River Thames would need to be developed to minimise impacts on the river channel, although these impacts are expected to be relatively localised with small increases in flow velocity within 1500m upstream and downstream and there would be little impact on high water levels. Navigation could be affected by the position of the piers and bank structures, but the design would ensure main navigable channels remain relatively unaltered.
- 3.5.5 A bridge crossing is unlikely to be impacted by rising groundwater (or impact groundwater), other than dewatering during construction. Larger groundwater resources and public supplies, primarily from the chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial/ agricultural supplies from shallow groundwater in the gravels; these are not thought to be significant.
- 3.5.6 The proposed bridge has potential to increase flood risk in the River Thames channel upstream due to impeding channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span or minimised pier dimensions). This would be assessed at the next development phase of the project.
- 3.5.7 The bridge would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans (including any defences along the Mardyke).

3.6 Air Quality

- 3.6.1 Baseline air quality conditions are described in Volume 2 and represented in **Appendix 6.1**. The DMRB Air Quality Model Version 4.2 (provided by Highways England for use on this assessment) was used to assess the risk that the route would have on air quality and to compare air quality impacts in the Without Scheme and With Scheme scenarios in the year of opening. The

³ The Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy) is a European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies.

modelling work has used the traffic data and forecasts for the different routes.

- 3.6.2 For this stage of the project the study area was limited to an area encompassing the Post-Consultation Appraisal Routes and the surrounding road network. Within that area, representative receptors (residential properties) were selected to assist in understanding the potential impacts of the Scheme on local air quality. A full modelling exercise for the selected route would be undertaken at the next development phase of the project.
- 3.6.3 Annual mean nitrogen dioxide (NO₂) concentrations have been predicted at 102 representative receptors (existing properties) within 200 metres of the Affected Road Network. Receptor locations in the vicinity of the A282 are shown on **Figure 3.2** and all receptors are shown in **Appendix 6.1**.

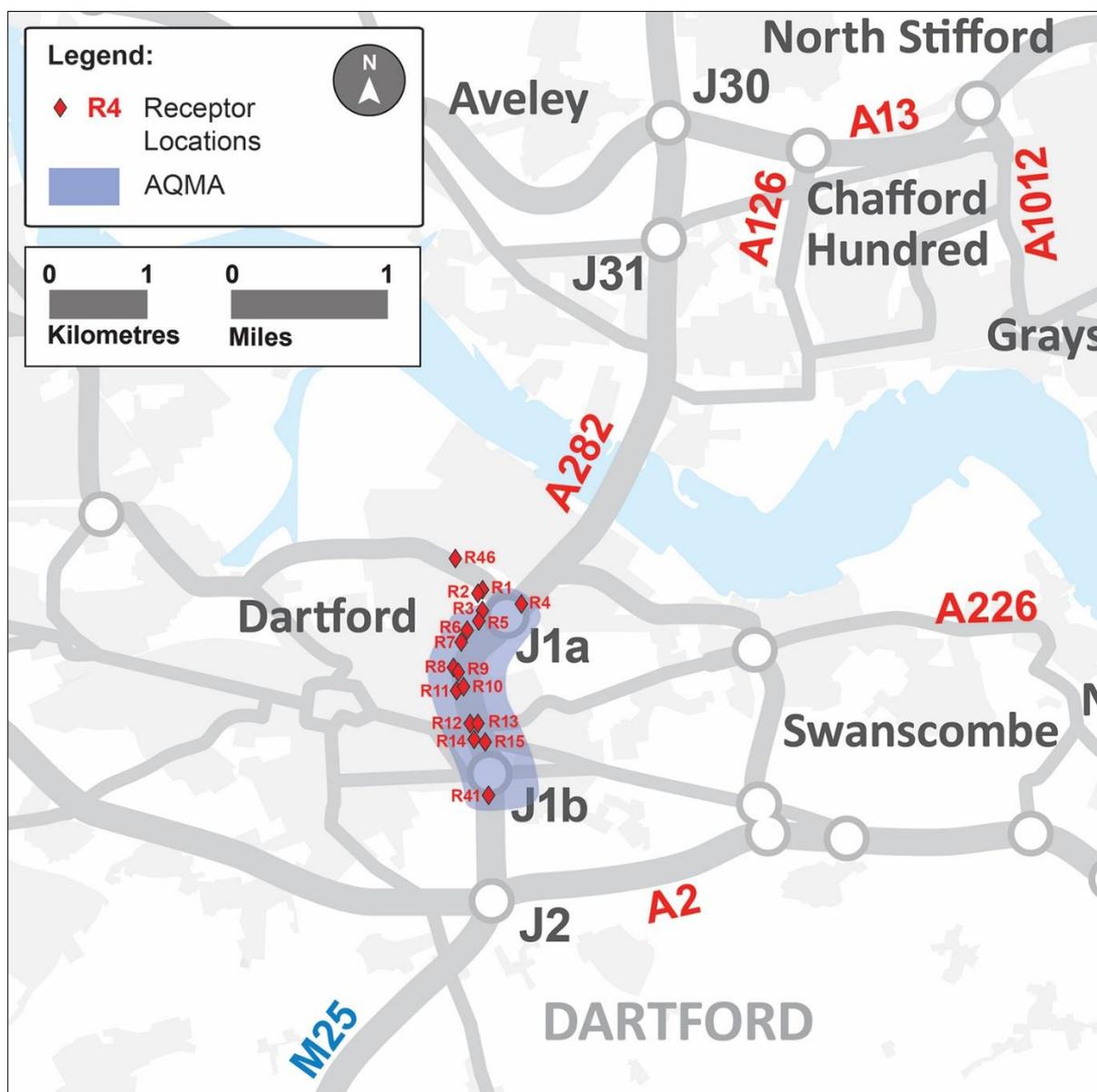


FIGURE 3.2 - LOCATION OF AIR QUALITY RECEPTORS IN THE VICINITY OF THE A282

- 3.6.4 Table 3.1 below presents the results for receptors which are predicted to experience levels which would either exceed the air quality strategy objective

(AQSO) annual mean NO₂ of greater than 40 µg/m³ (shaded red) or are at risk of exceeding it i.e. are predicted to experience levels greater than 36 µg/m³ or less than 40 µg/m³ (shaded amber). The results for all receptors in the Without Scheme scenario and with all routes are presented in **Appendix 6.3**.

TABLE 3.1 - PREDICTED ANNUAL MEAN NO₂ CONCENTRATIONS AT SELECTED RECEPTORS WITHIN 200 METRES OF AFFECTED ROAD NETWORK AT ROUTE 1

Property ID	Without Scheme (µg/m ³) ^[1]	Route 1 (µg/m ³) ^[1]	Difference between Route 1 and Without Scheme (µg/m ³)	Approximate Number of Potentially Influenced Receptors ^[2]
R1	34.3	39.5	5.2	<10
R3	40.0	39.5	-0.5	<50
R4	50.5	47.7	-2.8	<10
R5	41.4	42.6	1.2	<50
R6	34.8	36.8	2.0	<50
R8	47.7	51.2	3.5	<50
R9	47.9	51.9	4.0	<50
R10	42.1	45.1	3.0	<50
R11	41.7	44.4	2.7	<100
R12	52.0	55.6	3.6	<50
R13	41.9	44.0	2.1	<50
R14	34.7	36.6	1.9	<50
R15	35.2	37.3	2.1	<50
R27	37.3	37.0	-0.3	<100
R28	38.1	37.5	-0.6	<100
R41	36.9	40.3	3.4	<50
R53	35.4	38.9	3.5	<10

[1] LTT=Long Term Trend. Predicted NO₂ concentrations were adjusted using a Gap Factor based on the long term adjustment factor calculated by the Highways Agency's "Interim Highways Agency Alternative Long Term Gap Analysis Calculator v1.1". All values reflect predicted concentrations for the future year 2025.

[2] Value reflects an approximated number of receptors which occur in the vicinity (and thereby may experience a similar effect of the scheme) as the modelled receptor.

3.6.5 With Route 1 in operation the modelling predicts that some properties which are not currently at risk of exceeding the AQSO, would be at risk of exceeding the AQSO. This is represented by receptors R1, R6, R14, R15 and R53. The modelling also predicts additional properties could exceed the AQSO as a result of the impact on air quality of the option in the opening year as shown by receptor R41.

3.6.6 As previously described the modelling has taken place for selected receptors to identify the potential for exceedances. The results at these receptors indicate that in this location there would be a worsening of air quality with Route 1 due to increases in traffic flows. The appraisal at this stage only considers selected receptors. There is the potential for a larger number of properties that may experience a worsening in air quality and exceedances of the AQSO.

- 3.6.7 As there are receptors which are predicted to exceed the AQSO for annual mean NO₂ with the scheme, there is a risk in accordance with Interim Advice Note 174/13 that Route 1 could lead to a significant impact on air quality without mitigation. Essentially, air quality is poor already at the Dartford Crossing and would worsen with Route 1.
- 3.6.8 A high level appraisal has been undertaken to consider whether there is a risk that the route will impact on the UK's ability to comply with the EU Directive on ambient air quality. The NPSNN requires consideration of this, as well as effects on residential properties and their air quality (refer to paragraphs 5.6 to 5.9 of the NPSNN). This appraisal considers effects on zones identified by Defra and their compliance with EU requirements.
- 3.6.9 The appraisal completed indicates that the scheme overall will not result in either a delay to compliance or cause the zones which the scheme impacts on to become non-compliant.
- 3.6.10 This conclusion is based on the latest information reported by Defra to the European Commission. 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. Defra reports the year that the zone will become compliant with the EU Directive to the European Commission. Defra determines this date by undertaking modelling to predict when the zone will be compliant with the EU Limit Value, for annual mean NO₂ i.e. no exceedances of the 40µg/m³ Limit Value. The scheme is located in the South East and Eastern zones which Defra has reported will be compliant with the Directive in 2020 (for NO₂, for all other pollutants the zones are reported as being compliant).
- 3.6.11 The Pollution Climate Mapping modelling that Defra undertakes for the purpose of reporting against compliance with the Directive and the modelling undertaken as part of this appraisal are not comparable. Defra uses a combination of modelling and monitoring to report against compliance with the EU Directive on air quality. The modelling for compliance only includes representative roads in each zone/ agglomeration to determine the year in which the zone/ agglomeration will become compliant with the Directive. Therefore, not all roads within the zone are modelled by Defra. As the Defra compliance modelling is undertaken on a national scale it is also very high level and is not comparable with the detailed modelling undertaken at a local scheme level. For the purposes of scheme assessments, the advice in DMRB and associated Interim Advice Notes (IAN) would be followed. The advice in IAN 170/12v3 adds more precaution in the projections on future concentrations (when compared to Defra compliance modelled projections) for the purposes of determining significance in relation to Environmental Impact Assessment.

Construction

3.6.12 Given that air quality modelling undertaken as part of the appraisal process for operational conditions in 2025 predicts exceedances of AQS Objectives for NO₂ in the Dartford area, there is the potential for construction activities to cause a deterioration in air quality at receptors exceeding the AQS Objective. This would be as a result of traffic management and additional construction vehicles required during this phase which would last approximately 6.5 years.

3.7 Noise

3.7.1 As described in Volume 2, the A282 is a Noise Important Area, with properties immediately adjacent to the A282 at Dartford experiencing very high noise levels. This Noise Important Area is illustrated on **Figure 3.3**.

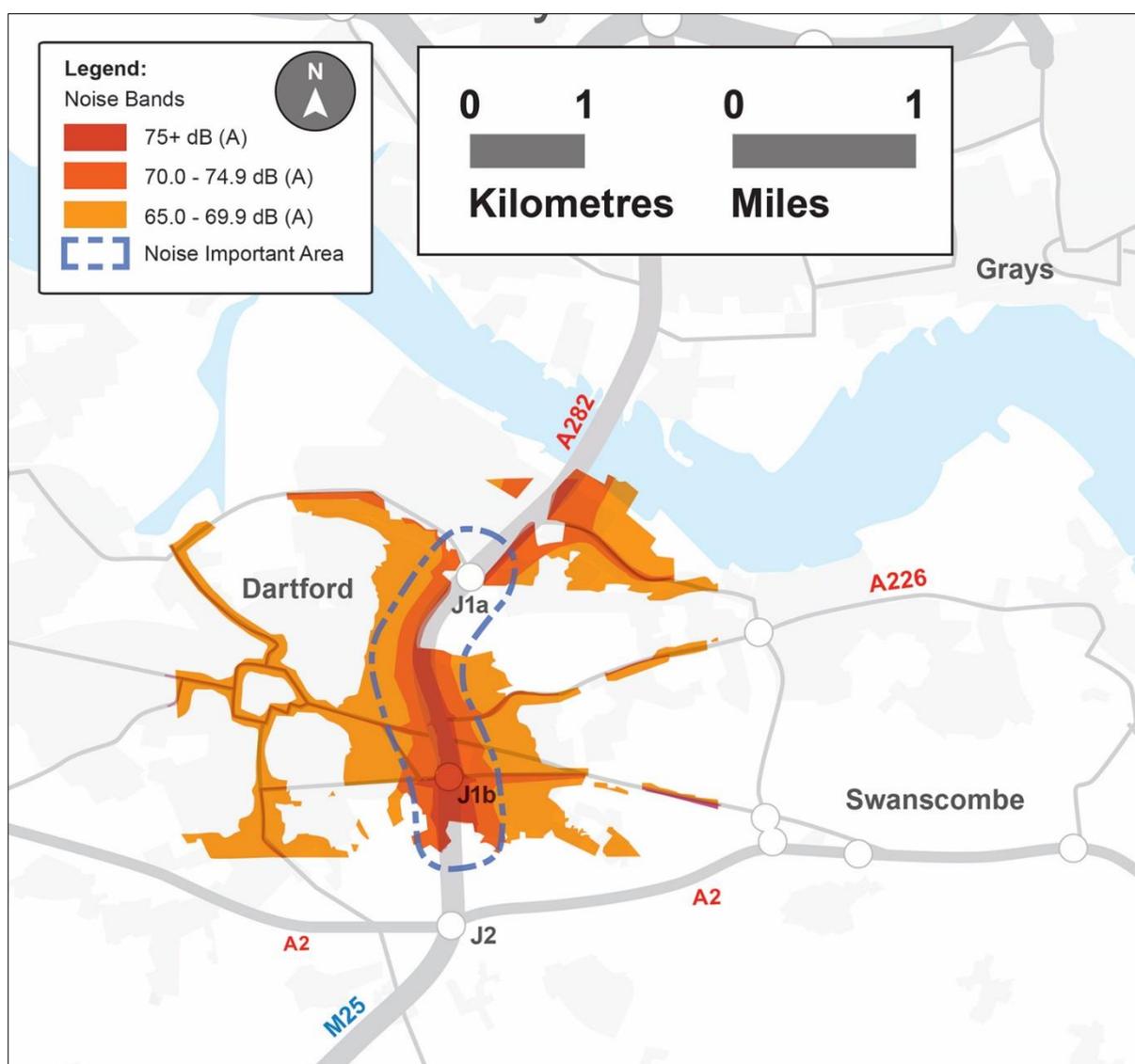


FIGURE 3.3 - EXISTING NOISE LEVELS ALONG THE A282 CORRIDOR AT DARTFORD

3.7.2 The noise appraisal used a study area that was confined to main roads within the vicinity of all options. Therefore, the study area used was the same irrespective of the routes. From all of the roads considered, properties

within 600m were modelled to determine whether there would be an improvement or a deterioration in noise level. These roads included the A127, M25, A282, A13, A2 and M2.

- 3.7.3 The appraisal considered whether there would be a net noise benefit or disbenefit for each option. The total number of properties within 600m of the roads in the study area was considered and the level of noise increase or decrease they experience calculated. The changes in noise levels from the appraisal are allocated a monetary value, which is included in the economic appraisal reported in Volume 5 of the Post-Consultation SAR.
- 3.7.4 With Route 1 there would be a worsening of noise compared to the Without Scheme scenario. There would be a worsening of noise with Route 1 in a Noise Important Area, along the A282 south of the existing Dartford Crossing.

3.8 Community Facilities

- 3.8.1 A community facilities appraisal has been undertaken considering potential effects on local facilities, pedestrian, equestrian and cycle routes and planning applications for any community facilities. The location of the community facilities is shown in **Appendix 6.1**.
- 3.8.2 Route 1 would directly affect small areas of Mardyke Woods and Davy Down Riverside Park. Footpaths, local cycle routes and Sustrans National Cycle Route Networks are all potentially affected by the route.
- 3.8.3 Effects may include severance and therefore at the next development stage of the project, the nature, status and use level of the routes would need to be confirmed and mitigation implemented, such as overbridges and diversions. There may also be a loss of amenity for users of these facilities and this would also need to be assessed in further detail. The existing Queen Elizabeth II cycle pick up point would need to be relocated further north.
- 3.8.4 Other community facilities could be indirectly affected e.g. due to loss of amenity and there is potential for direct effects on a small area of Open Access land that lies to the north of the A13, near junction 30 of the M25. These impacts are not considered material to a decision on route selection.

3.9 Conclusion

- 3.9.1 Our modelling for air quality and noise has demonstrated that existing problems would be exacerbated with Route 1. Despite the limited study area used for comparative purposes, it is likely that these effects would be experienced over a wider area and could be a factor in the decision-making process, for example additional exceedances of the AQSO. Therefore, Route 1 would be very difficult for Highways England to promote as it is likely that there would be a significant air quality impact and the Secretary of State is required to give this issue significant weight in the decision-making process.
- 3.9.2 The other key issue at this location is biodiversity. The bridge option would have risks from a consenting perspective in view of the potential for effects on species associated with the International and European sites located to the east (Thames Estuary and Marshes Ramsar and SPA). These risks

would have to be quantified through survey work but are an important material consideration to the decision-making process affecting the likelihood of the option to be successfully delivered. There is likely to be a requirement for extensive mitigation to reduce these risks and to ensure no adverse effects on the European sites.

4 Location C north of the River Thames

4.1 Overview

4.1.1 This section describes the effects of Location C Routes 3 and 4 north of the River Thames with reference to the baseline presented in Volume 2 of the SAR.

4.1.2 With regards to Routes 3 and 4 the key environmental topics where there are potentially significant issues that require consideration are:

- Biodiversity
- Historic environment
- Landscape and townscape

Key landscape and biodiversity constraints are summarised in **Figure 4.1** with more detailed plans provided in **Appendix 6.1**.

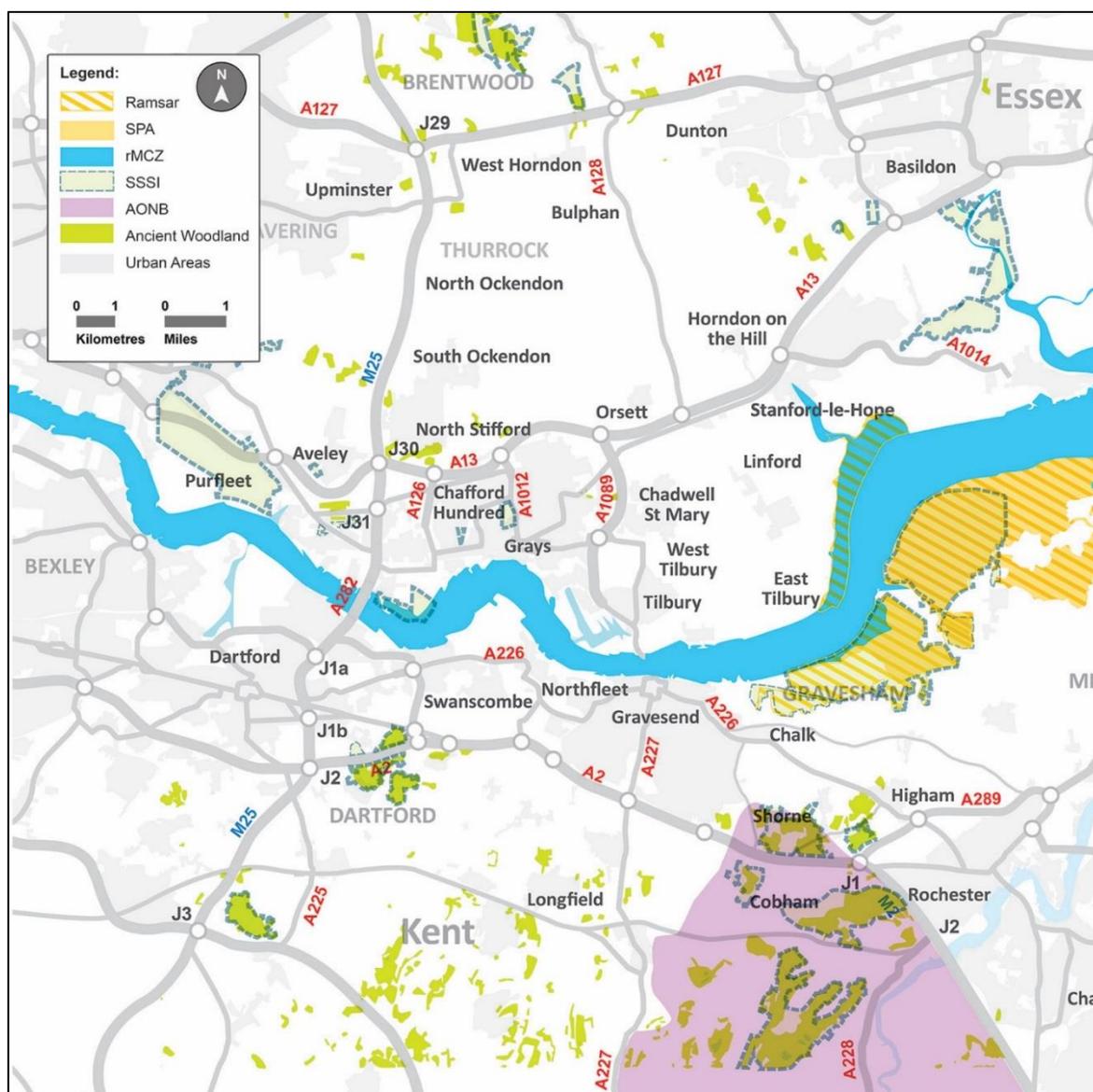


FIGURE 4.1 - KEY LANDSCAPE AND BIODIVERSITY CONSTRAINTS, LOCATION C

- 4.1.3 For biodiversity there are a number of areas of nationally important ancient woodland and Local Wildlife Sites (LWS).
- 4.1.4 For the historic environment the key issues are the presence of Scheduled Monuments, Listed Buildings and a Grade II* Registered Park and Garden.
- 4.1.5 For landscape and townscape the routes pass through Green Belt and would introduce new road infrastructure into the undeveloped landscape.
- 4.1.6 The following sections provide a summary of the environmental appraisal carried out for the following environmental topics:
- Landscape and Townscape
 - Historic Environment
 - Biodiversity
 - Water Environment
 - Air Quality
 - Noise
 - Community Facilities
- 4.1.7 The order in which the topics have been presented is consistent throughout this volume irrespective of the importance of the topic for each Post-Consultation Appraisal Route.

4.2 Landscape and Townscape

Route 3

- 4.2.1 Whilst Route 3 would be entirely offline it would introduce a significant change to the existing, open landscape character which is also designated as Green Belt (refer to plans in **Appendix 6.1**). The significant change would occur as a result of the construction and operation of a major new transport corridor with its associated infrastructure including signage, lighting, bridges and embankments in a largely rural area. This would impact on locally, regionally and nationally valued features including Scheduled Monuments and Listed Buildings (refer to section 4.3, Historic Environment, for further details) as well as the existing pattern and landform of the landscape. This route would pass through gently undulating countryside north of the River Thames towards the A13 becoming flatter north of the A13 towards the A127. The landscape is characterised by medium and large fields, occasional farm buildings and small settlements. Route 3 would affect this character and would run between the two settlements of East and West Tilbury and affect Green Belt.
- 4.2.2 Route 3 is entirely offline in a new road corridor through the Green Belt. It runs northwards from the crossing into the green gap between West Tilbury and Chadwell St Mary and East Tilbury/ Linford. It then wraps around the northern side of Chadwell St Mary, between the town and the golf course. North of the A103 Route 3 would introduce a significant change to the openness of the Green Belt to the east and north of South Ockendon.

Route 4

- 4.2.3 As for Route 3, Route 4 would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt.
- 4.2.4 Route 4 is the longest route within the Green Belt and is entirely offline in a new road corridor for much of its length. Similar to Route 3 it runs northwards from the Crossing into the green gap between West Tilbury and Chadwell St Mary and East Tilbury/ Linford, before heading north eastwards between Southfields and Linford. It then crosses the A13 west of Stanford-le-Hope and heads northwards again, parallel to the A128. This section would introduce a significant change to the openness of the Green Belt north of the A13. The route then follows the alignment of the A127 westwards towards the M25.
- 4.2.5 Thorndon Park Grade II* Registered Park and Garden could be affected by the route. Only a small section of the Registered Park would be affected by the main route which runs along the line of the A127. A distributor road to the north would cut through part of the park, isolating a small area from the main body of the park.

4.3 Historic Environment

Route 3

- 4.3.1 The scheme could directly affect two Grade II listed buildings (Thatched Cottage and 1 & 2 Grays Corner Cottages). It could also potentially affect the setting of a Grade I listed building near to the M25 during the construction works. There could potentially be setting effects to several Grade II listed buildings and four scheduled monuments at South Ockendon Old Hall, South Ockendon Hall West Tilbury and Bowaters Farm. Also indirect impacts on two Conservation Areas at North Ockendon and Cranham.
- 4.3.2 Road construction within the scheduled monument (the Orsett cropmark complex) could cause a direct physical impact to this nationally designated asset.
- 4.3.3 There could also be adverse effects on any non-designated archaeological remains within the Scheme footprint. Engagement with Essex County Council has indicated that this is a possibility in view of current knowledge of the area.

Route 4

- 4.3.4 The scheme could directly affect one Grade II listed building (Dunton Hills Farm), it may also affect the setting of one Grade I Listed Building adjacent to the A127 and several other Grade II and Grade II* listed buildings throughout the scheme corridor.
- 4.3.5 The scheme could have a direct impact upon the Thorndon Park Registered Park and Garden (Grade II*) and the Thorndon Park Conservation Area. The scheme may also impact on the settings of the West Tilbury and East Tilbury Conservation Areas. The scheme may also impact on the settings of the scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm.

- 4.3.6 There could also be adverse effects on any non-designated archaeological remains within the Scheme footprint. Engagement with Essex County Council has indicated that this is a possibility in view of current knowledge of the area.

4.4 Biodiversity

Route 3

- 4.4.1 The northern section of this route does not affect any designated sites or any areas of ancient woodland. However it does result in the loss of habitat from three Local Wildlife Sites (LWSs) (Low Street Pit, Mucking Heath and Blackshots Nature Area) and four areas that support UK BAP priority habitats. Low Street Pit LWS is an important site for rare Thames Terrace invertebrates. This site may provide important high tide roosting habitat for SPA interests. At a future development stage it will be necessary to undertake surveys to better understand the level of risk associated with the wildlife site and its role as functional habitat to the European Sites. Goshem's Farm LWS is included in Section 5.2.

Route 4

- 4.4.2 The northern section of this route does not affect any designated sites, but does result in the loss of habitat from six areas of ancient woodland (Codham Hall Woods, an area north west of Junction 29 of the M25, Hobbs Hole, Warley Hall Wood, Straight Path Shaw and Thick Hollow Bottom Shaws), some of which occur within LWSs that are adjacent to the A127 and Junction 29 of the M25. LWS containing ancient woodland may also be affected by changes in air quality (increase in nitrogen) from increased traffic flows. In addition, four LWS and 23 areas that support UK BAP priority habitats are impacted by the route, either directly - through habitat loss, or indirectly – through changes in air quality. As discussed above, this includes Low Street Pit LWS which is an important site for rare Thames Terrace invertebrates. This site may provide important high tide roosting habitat for SPA interest features. At a future development stage it will be necessary to undertake surveys to better understand the level of risk associated with the LWS and its role as functional habitat to the European Sites. In addition to Low Street Pit LWS, the other LWSs which could be directly affected are Linford Pit, Straight Path Shaw, Thick Hollow Bottom Shaws, Barrett's Shaw, Hobbs Hole, Warley Hall Wood and Codham Hall Woods. Therefore in total the northern section of Route 4 affects six areas of ancient woodland and eight LWSs representing a significantly greater effect than the other routes. Goshem's Farm LWS is included in Section 5.2.

4.5 Water Environment

Route 3

- 4.5.1 Impacts on the Mardyke (WFD water body) would depend on the nature of the structure adopted to cross that watercourse. Fully spanning and viaduct structures are likely to have the least impacts. Where the route crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstream. The route crosses Mardyke floodplain and an assessment of the effect on flood risk would be

required to mitigate potential adverse effects at the next development stage. However, there is also potential for the road embankment to be designed to hold back flood water. This would alleviate flood risk downstream (consistent with South Essex Catchment Flood Management Plan (CFMP) policy).

- 4.5.2 A WFD assessment would be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters and WFD groundwater bodies. With appropriate mitigation, it is not anticipated that the impacts on the Mardyke or groundwater bodies would lead to a reduction in WFD status or would prevent these water bodies reaching good status or potential in the future. The appraisal has generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.
- 4.5.3 Route 3 would pass through Critical Drainage Area (CDA) 012 as defined in the Thurrock Site Water Management Plan (SWMP). Therefore, the road should be designed so that any drainage problems in the area are not exacerbated (with improvements provided where feasible). Route 3 would not affect the Tilbury Flood Storage Area.
- 4.5.4 The surface water drainage strategy/ design (in accordance with Highways England guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities.

Route 4

- 4.5.5 Route 4 would pass through CDA 010a and CDA 010b (located west of Stanford-le-Hope) and CDA 011 (located in the upper Mardyke catchment in and around Bulphan as identified in the Thurrock SWMP). For these areas there is potential for the road design to act to reduce local flood risk, for example, by providing attenuation of road drainage, providing flood storage directly upstream of the road.

4.6 Air Quality

- 4.6.1 This section reports air quality modelling results for Routes 3 and 4 in their entirety i.e. comprising south and north of the River Thames and the crossing; not just effects north of the River Thames.
- 4.6.2 The DMRB Air Quality Model Version 4.2 (provided by Highways England for use in this assessment) was used to predict concentrations of NO₂ at selected receptors (properties) within a limited study area that included the routes and other main roads within the Affected Road Network such as the A282, A13, A2, M2 and the A127. Within that area representative receptors (residential properties) were selected to assist in understanding the potential impacts of the Schemes on local air quality. The modelling took into account Annual Average Daily Traffic (AADT) flows, average speeds including the level of congestion and the percentage of Heavy Goods Vehicles in the traffic flows. The results were used to understand whether there is a risk that the Location C Routes may lead to a significant impact on air quality if they were progressed.
- 4.6.3 A full modelling exercise for the selected route will be undertaken at the next development phase of the project and would cover a larger number of receptors.

- 4.6.4 The receptor locations are shown on **Figure 3.2** for those in the vicinity of the A282 where there is an existing air quality problem (i.e. AQSOs are exceeded or are at risk of being exceeded). All receptors are shown in **Appendix 6.1** and all results for all receptors are presented in the Volume 6 appendices.
- 4.6.5 **Table 4.1** below presents the results for receptors which are predicted to experience levels which would either exceed the AQSO annual mean NO₂ of greater than 40 µg/m³ (shaded red) or are at risk of exceeding i.e. are predicted to experience levels greater than 36 µg/m³ or less than 40 µg/m³ (shaded amber) in the Without Scheme scenario. These are receptors that are close to the existing Dartford crossing.
- 4.6.6 **Table 4.1** demonstrates that with Routes 3 and 4, properties that currently experience an exceedance or are at risk of exceeding i.e. close to Dartford Crossing would benefit with the exception of a minor increase at R3.

TABLE 4.1 - PREDICTED ANNUAL MEAN NO₂ CONCENTRATIONS AT SELECTED RECEPTORS WITHIN 200 METRES OF AFFECTED ROAD NETWORK AT ROUTES 3 AND 4

Property ID	Without Scheme (µg/m ³) ^[1]	Routes 3 WSL and ESL (µg/m ³) ^[1]	Routes 4 WSL and ESL (µg/m ³) ^[1]	Difference between Routes 3 WSL and ESL and Without Scheme (µg/m ³)	Difference between Routes 4 WSL and ESL and Without Scheme (µg/m ³)	Approximate Number of Potentially Influenced Receptors ^[2]
R3	40.0	40.0 or 40.1	40.1	0.0 or 0.1	0.1	<50
R4	50.5	46.6 or 46.7	46.7 or 46.8	-3.9 or -3.8	-3.8 or -3.7	<10
R5	41.4	40.7	40.8	-0.7	-0.6	<50
R8	47.7	47.4 or 47.5	47.6	-0.3 or -0.2	-0.1	<50
R9	47.9	44.1	44.2	-3.8	-3.7	<50
R10	42.1	39.1 or 39.2	39.2 or 39.3	-3.0 or -2.9	-2.9 or -2.8	<50
R11	41.7	37.2	37.3	-4.5	-4.4	<100
R12	52.0	45.0	45.2	-7.0	-6.8	<50
R13	41.9	39.4	39.5	-2.5	-2.4	<50
R27	37.3	37.2	37.1	-0.1	-0.2	<100
R28	38.1	37.6 or 37.7	37.5 or 37.6	-0.5 or -0.4	-0.6 or -0.5	<100
R41	36.9	36.0	36.1	-0.9	-0.8	<50

[1] LTT=Long Term Trend. Predicted NO₂ concentrations were adjusted using a gap factor based on the long term adjustment factor calculated by the Highways Agency's "Interim Highways Agency Alternative Long Term Gap Analysis Calculator v1.1". All values reflect predicted concentrations for the future year 2025.

[2] Value reflects an approximated number of receptors which occur in the vicinity (and thereby may experience a similar effect of the scheme) as the modelled receptor.

- 4.6.7 The modelling has shown that no properties within the vicinity of Routes 3 or 4 would exceed or be at risk of exceeding the AQSO for annual mean NO₂. Generally concentrations predicted at properties that are closest to Routes 3 and 4 range between 11.9 to 26.8 µg/m³. For Route 3 the predicted maximum increase in total annual mean NO₂ concentration for receptors located near the road (within 7.5 metres) is 10.1 µg/m³. For Route 4 the

maximum predicted increase in total annual mean NO₂ concentration for receptors located near the road (within 7.5 metres) is 9.9 µg/m³. The largest concentration increase predicted for both Routes 3 and 4 occurs at R68, which is located at Junction 1 of the M2.

- 4.6.8 In attracting traffic away from the existing crossing all of the routes at Location C would improve air quality close to the existing Dartford Crossing. For example, there would be a reduction in annual mean NO₂ of approximately 7 µg/m³ at receptor R12 in **Table 4.1**.
- 4.6.9 This appraisal is conservative as in all likelihood with a larger number of receptors considered there would be a larger number of properties affected that may experience an improvement in air quality.
- 4.6.10 A high level appraisal has been undertaken to consider whether there is a risk that the Routes 3 or 4 will impact on the UK's ability to comply with the EU Directive on ambient air quality. The NPSNN requires consideration of this as well as effects on residential properties and their air quality. This appraisal considers effects on zones identified by Defra and their compliance with EU requirements.
- 4.6.11 The appraisal completed indicates that the scheme overall would not result in either a delay to compliance or cause the zones which Routes 3 or 4 impact on to become non-compliant.
- 4.6.12 This conclusion is based on the latest information reported by Defra to the European Commission. 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 reports 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, NO₂ and PM₁₀ being the pollutants which are the most difficult to achieve compliance). The scheme is located in the South East and Eastern zones which Defra has reported will be compliant with the Directive in 2020 (for NO₂, for all other pollutants the zones are reported as being compliant).
- 4.6.13 In summary Routes 3 and 4 would lead to improvements in air quality at the A282 where exceedances of the AQSO currently occur. Properties within the vicinity of Routes 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within the AQSO in the With Scheme scenario.

Next Steps

- 4.6.14 As part of the Environmental Impact Assessment (EIA) for the preferred route, a detailed air quality assessment will be undertaken in accordance with DMRB Volume 11 Section 3 Part 1 HA 207/07 and associated interim advice notes. This assessment will consider both local and regional air quality impacts of the scheme, and the methodology for the assessment will be developed and agreed with relevant Local Authorities and Statutory Environmental Bodies (SEBs). Consideration will also be given to the location of tunnel portals and vents. The design and assessment process will

be iterative to reduce as far as possible the air quality impacts on residential properties.

4.6.15 The air quality assessment will be undertaken in accordance with the requirements of the NPSNN which states:

“Where the impacts of the project (both on and off-scheme) are likely to have significant air quality effects in relation to meeting EIA requirements and / or affect the UKs ability to comply with the Air Quality Directive, the applicant should undertake an assessment of the impacts of the proposed project as part of the environmental statement.

The environmental statement should describe:

- *existing air quality levels;*
- *forecasts of air quality at the time of opening, assuming that the scheme is not built (the future baseline) and taking account of the impact of the scheme; and*
- *any significant air quality effects, their mitigation and any residual effects, distinguishing between the construction and operation stages and taking account of the impact of road traffic generated by the project.*

Defra publishes future national projections of air quality based on evidence of future emissions, traffic and vehicle fleet. Projections are updated as the evidence base changes. Applicant’s assessment should be consistent with this but may include more detailed modelling to demonstrate local impacts.

In addition to information on the likely significant effects of a project in relation to EIA, the Secretary of State must be provided with a judgement on the risk as to whether the project would affect the UK’s ability to comply with the Air Quality Directive”.

4.7 Noise

4.7.1 This section reports noise appraisal results for the entire route (3 and 4) comprising south and north of the River Thames and the crossing with either the WSL or the ESL and not just the effects north of the River Thames.

4.7.2 The noise appraisal used a study area that was confined to main roads within the vicinity of all options. Therefore, the study area used was the same irrespective of the routes. From all of the roads considered, properties within 600m were modelled to determine whether there would be an improvement or a deterioration in noise level. These roads included the A127, M25, A282, A13, A2 and M2.

4.7.3 The appraisal considered whether there would be a net noise benefit or disbenefit for each option. The total number of properties within 600m of the roads in the study area was considered and the level of noise increase or decrease they experience calculated. The changes in noise levels from the

appraisal are allocated a monetary value, which is included in the economic appraisal reported in Volume 5 of the Post-Consultation SAR.

- 4.7.4 When comparing Route 3 and Route 4 with the Without Scheme scenario, there would be a disbenefit. Whilst there would be properties experiencing an increase in noise as a result of traffic on the new route, there would also be reductions in traffic on other routes, such as the A282 and the A2, which would result in noise reductions.
- 4.7.5 Overall the noise appraisal of the Location C routes shows that Route 4 with the ESL performs better than the other routes, as there are fewer properties affected.
- 4.7.6 As part of the EIA for the preferred route, a detailed noise and vibration assessment in accordance with the 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 the NPSNN and the National Planning Policy Framework.
- 4.7.7 The noise and vibration assessment will predict both construction and operational effects at individual receptors. It will include consideration of appropriate mitigation measures such as low-noise surfacing, bunds or acoustic barriers to reduce noise levels at sensitive receptors.

4.8 Community Facilities

Route 3

- 4.8.1 The route would directly affect an area of Open Access Land (at Orsett Fen) and the westernmost edge of Orsett Golf Course south of the A13. Footpaths, bridleways and local cycle routes are all potentially affected by the route. Effects may include severance, temporary or permanent diversions and loss of amenity. Other community facilities could be indirectly affected e.g. due to loss of amenity as a result of noise, air and visual intrusion. Paragraph 5.184 of the NPSNN states:

“Public rights of way, National Trails, and other rights of access to land (e.g. open access land) are important recreational facilities for walkers, cyclists and equestrians. Applicants are expected to take appropriate mitigation measures to address adverse effects on coastal access, National Trails, other public rights of way and open access land and, where appropriate, to consider what opportunities there may be to improve access. In considering revisions to an existing right of way consideration needs to be given to the use, character, attractiveness and convenience of the right of way. The Secretary of State should consider whether the mitigation measures put forward by an applicant are acceptable and whether requirements in respect of these measures might be attached to any grant of development consent”.

- 4.8.2 The extent of these impacts would be quantified at the next development phase of the project and appropriate mitigation measures identified.

Route 4

The route would directly affect two areas of Open Access Land (south of East Tilbury and at Junction 29 of the M25), woodland which could be used for recreational purposes (for example south of Thorndon Country Park) and Dunton Hills Family Golf Centre. Footpaths, bridleways, a Byway Open to All Traffic and local cycle routes are all potentially affected by the route. Effects may include severance, temporary or permanent diversions and loss of amenity. Other community facilities could be indirectly affected e.g. due to loss of amenity as a result of noise, air and visual intrusion. The requirements of the NPSNN would also need to be followed at the next development phase of the project and appropriate mitigation measures identified.

5 Location C Crossing

5.1 Overview

- 5.1.1 This section describes the effects of Location C Routes 3 and 4 at the crossing of the River Thames with reference to the baseline presented in Volume 2 of the SAR. With regard to the crossing at Location C, biodiversity is the key environmental topic where there are potentially significant issues requiring consideration.
- 5.1.2 The following sections provide a summary of the environmental appraisal carried out for the following environmental topics:
- Biodiversity (including the Part One Appropriate Assessment)
 - Landscape and Townscape
 - Historic Environment
 - Water Environment
 - Air Quality
 - Noise
 - Community Facilities

5.2 Biodiversity and Part One Appropriate Assessment

- 5.2.1 Possible locations for a crossing of the River Thames at Location C are limited to a narrow corridor approximately 800m wide bounded by the conurbation of Gravesend on the south-western side and the European Sites to the east. The sites include the Thames Estuary and Marshes Ramsar site and Thames Estuary and Marshes SPA. These are sites of European and international value and are given the highest level of protection in UK law under the Habitats Regulations. The protection of these sites is due to a number of sensitive habitats and species, including a complex of brackish floodplain grazing marsh ditches, saline lagoons and intertidal saltmarsh and mudflats. These habitats together support internationally important numbers of wintering waterfowl, diverse wetland plants and invertebrates. The Location C routes have the potential to affect both the Ramsar and the SPA. These features are identified on the drawings presented in **Appendix 6.1** and are shown in **Figure 4.1**.
- 5.2.2 The UK is required to comply with the terms of the EU *Habitats Directive*⁴ and the *Wild Birds Directive*⁵. The UK also has to meet its obligations under the Ramsar Convention⁶. The protection given by the *Habitats Directive* and the *Wild Birds Directive* is transposed into UK legislation through the Habitats Regulations.

⁴ The aim of the Habitats Directive is to conserve particular natural habitats and wild species across the Europe Union by, amongst other measures, establishing a network of sites known as Natura 2000 sites

⁵ The Wild Birds Directive seeks to protect all wild birds and also sites important for the protection of wild birds

⁶ The Ramsar convention focuses on wetlands of international importance.

5.2.3 Regulation 61 of the *Habitats Regulations* requires the competent authority, before deciding to give consent for a plan or project which:

- Is likely to have a significant effect on a European site (either alone or in combination with other plans or projects)
- Is not directly connected with or necessary to the management of that site

to make an 'Appropriate Assessment' of the implications for that site in view of its conservation objectives.

5.2.4 In the light of the conclusions of the assessment, the competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site. In the case of LTC, the competent authority will be the Secretary of State for Transport as the application for consent will be made through the *Planning Act 2008* as LTC will be a Nationally Significant Infrastructure Project (NSIP).

5.2.5 Given the presence of the Thames Estuary, the Marshes Ramsar, the SPA and the proposed proximity of a crossing at Location C, this was a fundamental consideration to the development of the project and the selection of the crossing type.

5.2.6 An HRA Screening Matrix was prepared in accordance with HD44/09 Assessment of Implications (of highways and/or roads projects) on European Sites (including appropriate assessment) for the longlist of options which identified the potential for options to have a likely significant effect on the following European Sites:

- Thames Estuary and Marshes SPA
- Thames Estuary and Marshes Ramsar
- Holehaven Creek pSPA
- South Downs Woodland SAC (note this site would not be affected by the Crossing at Location C but other elements of the LTC scheme)

5.2.7 This was issued to Natural England for comment and it was agreed that a Part One Appropriate Assessment Report should be prepared to inform the shortlist appraisal and the decision-making process. It is more commonly known as an Appropriate Assessment but as there were a number of options under consideration at this early development stage of the project it was termed 'Part One' as further work would need to be undertaken at future development stages. Further work will be undertaken in accordance with HD 44/09, the NPSNN and Planning Inspectorate Advice Note 10.

5.2.8 **Table 5.1** presents a summary of the key effects at Location C of the different crossing types on European Sites.

TABLE 5.1 - SUMMARY OF EFFECTS ON EUROPEAN SITES FOR LOCATION C, ROUTES 3 AND 4

Bridge	Bored Tunnel	Immersed Tunnel
<p>Disturbance impacts during construction on SPA/ Ramsar species.</p> <p>Loss of habitat within the designated site (Ramsar) associated with bridge piers (direct impact).</p> <p>Loss of functional habitat both north and south of the river associated with bridge piers and approach roads.</p> <p>Potential collision risk issues for species associated with the SPA also potential barrier/avoidance issues.</p> <p>Some permanent loss of intertidal mudflat due to bridge piers and impact from shading on bird behaviour when using mudflat beneath/adjacent to bridge.</p> <p>Long term operational shading effects in Ramsar.</p> <p>May be a requirement to create freshwater habitat – significant lead in time – could be up to 20 years.</p> <p>Potential effects of lighting on SPA species if lighting is required.</p> <p>There would be a direct effect on Goshem’s Farm LWS which is an important site for rare Thames Terrace invertebrates and may provide important high tide roosting habitat for SPA interest features.</p>	<p>Least damaging of three – avoids direct loss of habitat from European Sites</p> <p>Disturbance impacts during construction, disturbance impacts during operation likely to be minimal.</p> <p>The location of the tunnel portal to the north of the crossing (and, in particular, the potential works area associated with the tunnel portal) would potentially impact on an area of historic coastal grazing marsh and Goshem’s Farm LWS which supports a diverse range of Red Data Book invertebrates and may also provide important functionally linked land for the SPA designated species (e.g. high tide roost).</p> <p>Potential for hydrogeological changes to affect ecology</p>	<p>Disturbance impacts during construction on SPA/ Ramsar species.</p> <p>Direct loss of habitat associated with trench construction – intertidal mudflat and freshwater habitat – potential requirement for compensatory land – could be long lead in times to deliver.</p> <p>The location of the tunnel entrance (and, in particular, the potential works area associated with the casting basin and tunnel portal) to the north of the crossing currently has a significant impact on an area of historic coastal grazing marsh and Goshem’s Farm LWS, which supports a diverse range of Red Data Book invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Note the area lost could be reduced if the casting basin was off site)</p> <p>Potential land take within Ramsar during construction (cut and cover). Habitat restoration after construction may take a long time to achieve (impact may be considered permanent).</p> <p>May be a requirement to create freshwater habitat – significant lead in time – could be up to 20 years</p> <p>Key issue associated with the option is timeline for habitat restoration following construction that may push potential construction impact into long-term (permanent) impact.</p>

5.2.9 The above table demonstrates that there are risks of significant adverse effects on the sites as a result of all options, although they are greater with the bridge and immersed tunnel and more likely to be mitigated with the bored tunnel. For Location C Routes 3 and 4, a bored tunnel crossing is the only option that does not directly affect the Thames Estuary and Marshes Ramsar site. Both a bridge and immersed tunnel would result in direct loss of habitat in relation to the southern end of, and approaches to the crossing.

5.2.10 Article 6 (4) of the *Habitats Directive* states that where an Appropriate Assessment has been carried out and results in a negative assessment (where adverse effects on a European site (s) cannot be ruled out, despite mitigation measures), consent can only be granted if: there are no alternative solutions, there are Imperative Reasons of Overriding Public Interest (IROPI) and compensatory measures have been secured. With regard to the consideration of alternatives the following should be noted:

- The onus is on the applicant to identify an absence of alternatives.
- An alternative that does not achieve the scheme objectives is not an alternative and can be rejected.
- An alternative need not achieve the objective to exactly the same extent as the scheme under consideration – if it largely achieves the objectives (a judgement of degree) it should not be rejected for reasons relating to objectives. Objectives should be considered broadly and objectively.
- Given an objective to do something reasonable, a “do nothing” option is not an alternative.
- Alternatives must be legally and technically feasible, including consideration of physical planning and timing considerations.
- Greater cost or inconvenience are not necessarily reasons to rule an alternative out, although there will come a point where an alternative would be so much more expensive or inconvenient that it would be unreasonable to pursue it. At this point it could be rejected. There is no definitive guidance on what would constitute unreasonable additional cost or inconvenience.
- An alternative with the same or very similar negative effect on the integrity of the site is not really a less damaging alternative and could be rejected.

5.2.11 In view of the above, it was necessary to consider which would be the least damaging alternative to determine the proposed crossing type.

5.2.12 On the basis of the appraisal results it was concluded that of the three crossing types under consideration, a bored tunnel, both at Location A and Location C, would be the least damaging options in terms of impacts on European Sites. However, a crossing at Location A would largely not achieve the scheme’s objectives and could therefore not be taken forward and be considered a viable alternative.

5.2.13 Therefore, of the crossing types at Location C, it was determined that the bored tunnel would be the least damaging alternative based upon the assessment work completed to date and the avoidance of a direct impact in the Ramsar site. For this reason, it was determined that the crossing option at least risk of being refused consent in the context of the *Habitats Directive* was the bored tunnel.

5.2.14 In summary, a bored tunnel at Location C represents the only viable alternative that meets the scheme objectives and for which there are a wider and more practical array of mitigation measures that would increase likelihood of compliance with the *Habitats Directive*.

5.3 Landscape and Townscape

5.3.1 A bored tunnel would have little impact on the River Thames corridor as, with the exception of the portals and the immediate approach roads, it would be underground.

5.4 Historic Environment

- 5.4.1 Excavations associated with the bored tunnel construction may have a physical impact on any non-designated archaeological remains within the scheme footprint. As such, adverse effects to any non-designated archaeological remains within the scheme footprint are predicted but would be limited to the portals and any potential cut and cover sections.
- 5.4.2 Effects on the setting of assets particularly near to the River Thames would be avoided as the tunnel would be underground.

5.5 Water Environment

- 5.5.1 There would be no direct impact on the surface water environment of the River Thames from the bored tunnel.
- 5.5.2 A tunnel crossing could require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the chalk aquifer at depth are unlikely to be impacted, although there may be some impact on local licenced commercial/ industrial/ agricultural supplies from shallow groundwater in the gravels. These are not thought to be significant. Impact at Source Protection Zones may be mitigated by adopting appropriate construction and drainage practices. There is potential for residual effects on groundwater following construction.
- 5.5.3 A WFD assessment would be required to ensure assessment of any effects of changes in groundwater on WFD compliance.
- 5.5.4 A bored tunnel would have no impact on channel conveyance. There are potential risks associated with inundation of a tunnel due to high flood levels (i.e. through breach or overtopping of defences) and this would need to be assessed in a Flood Risk Assessment.
- 5.5.5 A tunnel crossing would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. The bored tunnel option would have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences. The opportunities associated with the TE2100 Plan (Policy P3 for Policy Unit North Kent Marshes, south of the River Thames) should also be considered at the next development phase.

5.6 Air Quality

- 5.6.1 Refer to Section 4.6 which presents the results of the air quality appraisal for the entire route (north and south of the River Thames and the crossing) for Routes 3 and 4. The emissions from the tunnel portal would be assessed at the next stage of the project to determine the impact on sensitive receptors. Whilst there would be elevated pollutant concentrations around the portals it is unlikely that the impacts would be significant. Mitigation can also be included in the design as part of the tunnel ventilation, such as stacks to reduce the concentrations of pollutants around the portals where necessary.

5.7 Noise

- 5.7.1 Refer to Section 4.7 which presents the results of the noise appraisal for the entire route (north and south of the River Thames and the crossing) for Routes 3 and 4.

5.8 Community Facilities

- 5.8.1 There are unlikely to be any direct effects on community facilities from a bored tunnel crossing although there may be temporary, indirect effects on amenity at the RSPB Nature Reserve during construction.

6 Location C south of the River Thames

6.1 Overview

6.1.1 This section describes the effects of Location C Routes 3 and 4 south of the River Thames with reference to the baseline presented in Volume 2 of the SAR.

6.1.2 With regards to Routes 3 and 4 south of the River Thames the key environmental topics where there are potentially significant issues that require consideration are:

- Biodiversity
- Historic environment
- Landscape and townscape

6.1.3 For biodiversity there are a number of areas of nationally important ancient woodland, SSSIs and local wildlife sites.

6.1.4 For the historic environment the key issues are the presence of Scheduled Monuments, Listed Buildings and a Grade II* Registered Park and Garden.

6.1.5 For landscape and townscape, the routes lie within and adjacent to the nationally important Kent Downs AONB.

6.1.6 The effects of the routes on many of these features would be key factors in the decision-making process.

6.1.7 The following sections provide a summary of the environmental appraisal carried out for the following environmental topics:

- Landscape and Townscape
- Historic Environment
- Biodiversity
- Water Environment
- Air Quality
- Noise
- Community Facilities

6.1.8 The order in which the topics have been presented is consistent throughout this volume irrespective of the importance of the topic for each Post-Consultation Appraisal Route.

6.2 Landscape and Townscape

Western Southern Link

6.2.1 The WSL junction with the A2 would mostly be located outside of the Kent Downs AONB with only a slip road located within it. The new road infrastructure to the north and west would be visible from parts of the AONB at Shorne and Ashenbank Woods, the Timeball and Telegraph Trail and National Cycle Route 177. There would potentially be significant effects on

the setting of the AONB as a result of the construction of major new road infrastructure, loss of open farmland and vegetation around the Gravesend urban edge and the rural settlement of Thong that is also a designated Conservation Area resulting in the potential coalescence of settlements.

- 6.2.2 There would be a requirement for extensive mitigation including new woodland planting, use of false cuttings, modifications to the vertical alignment of the road and the types of associated infrastructure such as gantries. As noted in the NPSNN considerable weight should be given to effects on AONBs:

“Great weight should be given to conserving landscape and scenic beauty in nationally designated areas. National Parks, the Boards and Areas of Outstanding Natural Beauty have the highest status of protection in relation to landscape and scenic beauty. Each of these designated areas has specific statutory purposes which help ensure their continued protection and which the Secretary of State has a statutory duty to have regard to in decisions.” (Paragraph 5.150)

- 6.2.3 The WSL runs northwards through the Green Belt from a new junction on the A2 roughly parallel to the edge of the urban area and in the green gap between Thong and Gravesend and across the Southern Valley Golf Course. North of the A226 both the ESL and WSL run through the green gap between the small settlement of Chalk and the Church of St Mary and Memorial Park. The route is offline in a new road corridor and would introduce a significant change to the openness of this part of the Green Belt.

Eastern Southern Link

- 6.2.4 The ESL junction with the A2/ M2 would have a greater physical impact on the Kent Downs AONB than the WSL as there would be a greater transport infrastructure footprint within it. There would be major new junctions, embankments and structures directly affecting vegetation and open pasture farmland and indirectly affecting features within its setting. The Timeball and Telegraph Trail and the National Cycle Route 177 all traverse the area and the ESL would be visible in views from it. The sensitivity of users of the Timeball and Telegraph Trail was identified in the consultation response from Natural England and the Kent Downs AONB.
- 6.2.5 There would potentially be significant effects on the setting of the AONB as a result of the construction of major new road infrastructure, loss of open farmland, ancient woodland/SSSI (Great Crabbles Wood) and effects on the quality and tranquillity of the rural landscape. There would also be effects on the setting of Shorne Conservation Area and the coalescence of settlements. The major earthworks and the loss of trees at the Warren (a local landmark) which forms part of the setting of the adjacent Conservation Area and the wider setting of the AONB would also result in adverse effects. There would also be loss of a mature wooded ridgeline in the vicinity of Shorne Ridgeway affecting the landscape character and quality.
- 6.2.6 The ESL runs northwards through the Green Belt through the green gap between Shorne and Higham, before turning northwest and running parallel to the A226 until it rejoins the alignment of the WSL. North of the A226 both the ESL and WSL run through the green gap between the small settlement

of Chalk and the Church of St Mary and Memorial Park. The route is offline in a new road corridor and would introduce a significant change to the openness of this part of the Green Belt.

- 6.2.7 The Natural England consultation identified that the ESL would have a greater direct adverse impact on the Kent Downs AONB and that there would be adverse effects on setting as a result of loss of ancient woodland in and around Great Crabbles Wood, which is a key component of the AONB's setting.
- 6.2.8 Significant mitigation would be required for the ESL to reduce the environmental effects of the ESL on landscape and visual amenity. There would remain a likelihood of a significant effect on the Kent Downs AONB and its setting with mitigation.
- 6.2.9 At the next development stage of the project, a Landscape and Visual Impact Assessment will be undertaken in accordance with the requirements of the NPSNN which states:

“Where the development is subject to EIA the applicant should undertake an assessment of any likely significant landscape and visual impacts in the environmental impact assessment and describe these in the environmental assessment. A number of guides have been produced to assist in addressing landscape issues. The landscape and visual assessment should include reference to any landscape character assessment and associated studies, as a means of assessing landscape impacts relevant to the proposed project. The applicant's assessment should also take account of any relevant policies based on these assessments in local development documents in England.

The applicant's assessment should include any significant effects during construction of the project and/or the significant effects of the completed development and its operation on landscape components and landscape character (including historic landscape characterisation).

The assessment should include the visibility and conspicuousness of the project during construction and of the presence and operation of the project and potential impacts on views and visual amenity. This should include any noise and light pollution effects, including on local amenity, tranquillity and nature conservation.

Any statutory undertaker commissioning or undertaking works in relation to, or so as to affect land in a National Park or Areas of Outstanding Natural Beauty, would need to comply with the respective duties in section 11A of the National Parks and Access to Countryside Act 1949 and section 85 of the Countryside and Rights of Way Act 2000.” (Paragraphs 5.144 to 5.147)

6.3 Historic Environment

Western Southern Link

- 6.3.1 The WSL could affect the setting of listed buildings including the Grade II* listed building, Chalk Church.

- 6.3.2 The scheme could have a direct effect on Cobham Hall Registered Park and Garden and a temporary effect on the Thong Conservation Area. There are also potential long term setting effects on Thong Conservation Area.
- 6.3.3 Construction excavations may have a physical impact on any non-designated archaeological remains within the scheme footprint. Experience from previous developments within the area suggests that such finds would be a strong possibility.

Eastern Southern Link

- 6.3.4 The ESL could also affect the setting of Grade II* and Grade II listed buildings including the Grade II* listed building, Chalk Church.
- 6.3.5 There are also potential setting effects on the Shorne Conservation Area with the route lying in close proximity to its northern boundary. Within the Conservation Area at this location are several listed buildings including the Grade II* Little St Katherine's. The scheme would affect the setting of the Conservation Area and listed buildings and views out of it.
- 6.3.6 As for WSL, construction excavations may have a physical impact on any non-designated archaeological remains within the scheme footprint. Experience from previous developments within the area suggests that such finds would be a strong possibility.

6.4 Biodiversity

Western Southern Link

- 6.4.1 Where the WSL connects with the A2 there would be habitat loss from Claylane Wood ancient woodland. Whilst not legally protected, the NPSNN states that:
- “The Secretary of State should not grant development consent for any development that would result in the loss or deterioration of irreplaceable habitats including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the national need for and benefits of the development, in that location, clearly outweigh the loss”. (Paragraph 5.32)*
- 6.4.2 Direct loss of ancient woodland cannot be mitigated. Therefore, the permanent loss arising from the construction activities would need to be minimised. Fragmentation effects on the ancient woodland could be reduced through the incorporation of underpasses and green bridging structures.
- 6.4.3 Compensation for loss of ancient woodland would be necessary and is likely to involve translocation of soils, litter material and where practical, trees and shrubs to an alternative site.
- 6.4.4 In addition, a small area of deciduous woodland would be lost from the Shorne and Ashenbank Woods SSSI from widening of the A2 at this location. The part of the SSSI affected by the route lies within Natural England's Management Unit 4 of the SSSI. This is presently considered to be in an unfavourable recovering condition. Loss of land within the SSSI would need to be minimised.

Eastern Southern Link

- 6.4.5 The ESL would result in the direct loss of habitat from and fragmentation of the woodland within the Great Crabbles Wood SSSI and ancient woodland at the connection with the A2/ M2.
- 6.4.6 There would also be a loss of ancient woodland at Court Wood which is also a LWS (note this site also includes Court Wood, Cole Wood and Starmore Wood) and loss of an area of woodland planted as compensatory habitat for losses arising from the A2/ M2 scheme. There would be a greater loss of ancient woodland with the ESL option.
- 6.4.7 Mitigation as outlined above for the WSL would be required for the impacts on the SSSI and the ancient woodland.
- 6.4.8 Consultation feedback from Natural England highlighted that the ESL would be the most environmentally damaging option owing to the loss of SSSI and extensive areas of ancient woodland. Ancient or veteran trees are irreplaceable habitats and they cannot be replicated elsewhere. Ancient woodland also provides other additional benefits including soils, recreation, and cultural value, and contributes to the landscape fabric and character.

6.5 Water Environment

Western Southern Link

- 6.5.1 Policy P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk) of TE2100 includes an action to provide a secondary defence to Gravesend to protect the settlement from flooding from the tidal River Thames from the east. There may be potential for materials from construction of this option to be used in new flood defences although this opportunity would need to be considered in more detail at the next stage of the project.
- 6.5.2 The surface water drainage strategy/ design (in accordance with Highways England guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities.

Eastern Southern Link

- 6.5.3 A WFD assessment would be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters and WFD groundwater bodies.
- 6.5.4 The ESL would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans.
- 6.5.5 The surface water drainage strategy/ design (in accordance with Highways England guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities.

6.6 Air Quality

- 6.6.1 Refer to Section 4.6 which presents the results of the air quality appraisal for the entire route (north and south of the River Thames and the crossing) for Routes 3 and 4.

6.7 Noise

- 6.7.1 Refer to Section 4.7 which presents the results of the noise appraisal for the entire route (north and south of the River Thames and the crossing) for Routes 3 and 4.
- 6.7.2 There would be a lower noise impact with the ESL compared to the WSL.

6.8 Community Facilities

Western Southern Link

- 6.8.1 The WSL would directly affect the Southern Valley Golf Club. It would run through the central part of the golf course causing severance and resulting in the loss of land. There would also be effects on its amenity value owing to the presence of a new road and construction of it. The NPSNN states the following in relation to recreational land:

“Existing open space, sports and recreational buildings and land should not be developed unless the land is surplus to requirements or the loss would be replaced by equivalent or better provision in terms of quantity and quality in a suitable location. Applicants considering proposals which would involve developing such land should have regard to any local authority’s assessment of need for such types of land and buildings.

During any pre-application discussions with the applicant, the local planning authority should identify any concerns it has about the impacts of the application on land-use, having regard to the development plan and relevant applications, and including, where relevant, whether it agrees with any independent assessment that the land is surplus to requirements. These are also matters that local authorities may wish to include in their Local Impact Report which can be submitted after an application for development consent has been accepted.” (Paragraphs 5.166 and 5.167)

- 6.8.2 Footpaths, a bridleway, a Sustrans National Cycle Network route and a local cycle route are all potentially affected. Effects may include severance, temporary or permanent diversions and loss of amenity. Other community facilities could be indirectly affected e.g. due to loss of amenity. The extent of these impacts would be quantified at the next development phase of the project.

Eastern Southern Link

- 6.8.3 The ESL would directly affect Great Crabbles Wood, The Warren Wood and Cole Wood (the latter two forming parts of Court Wood LWS). Footpaths, a Sustrans National Cycle Network route, a local cycle route and a local trail are all potentially affected. Effects may include severance, temporary or permanent diversions and loss of amenity. Other community facilities could be indirectly affected e.g. due to loss of amenity. The extent of these impacts would be quantified at the next development phase of the project.

7 Summary of Results

7.1 Environmental Appraisal Results

7.1.1 This section provides a high level summary of the key differences between options where relevant in order for a comparison to be made. The summaries are for:

- Location A, Route 1 (**Table 7.1**)
- Location C, Routes 3 and 4 north of the River Thames (**Table 7.2**)
- Location C Bored Tunnel Crossing (**Table 7.3**)
- Location C, Western and Eastern Southern Links (**Table 7.4**)

7.1.2 **Table 7.1** presents a summary of the effects of Location A, Route 1.

TABLE 7.1 - LOCATION A, ROUTE 1 SUMMARY TABLE

Topic	Route 1
Landscape / Townscape	Potential effect on Mardyke Valley setting.
Historic Environment	No significant effects.
Biodiversity	Possible indirect impacts on qualifying species associated with Ramsar/ SPA e.g. through loss of functionally linked land and collision risk with a bridge. Directly affects functionally linked land, 4 local wildlife sites and 3 areas of ancient woodland.
Water Environment	Affects Mardyke as a result of multiple crossings. Direct effect on Thames rMCZ with a bridge.
Air Quality	There would be a worsening of air quality at some properties compared with the Without Scheme situation, including new exceedances of the AQSO for NO ₂ . During the 80 month construction period, there would be additional congestion resulting from traffic management requiring temporary speed limits and contraflow working. It is likely that air quality would worsen during the construction period, and that there would be additional exceedances of the AQSO for NO ₂ .
Noise	There would be an overall noise disbenefit with Route 1, compared with the Without Scheme scenario.
Community Facilities	There could be direct effects on small areas of Mardyke Woods and Davy Down Riverside Park, footpaths, local cycle routes and Sustrans National Cycle Route Networks and a small area of Open Access land. The existing Queen Elizabeth II cycle pick up point would need to be relocated further north.

7.1.3 **Table 7.2** presents a summary of the effects of the Location C Routes north of the River Thames.

TABLE 7.2 - LOCATION C, SUMMARY TABLE – NORTH OF RIVER THAMES

Topic	Route 3	Route 4
Landscape / Townscape	Affects greenbelt land. Significant changes to landscape character.	Affects greenbelt land. There would also be loss of landscape features such as woodland including from Thorndon Park Grade II* Registered Park and Garden.
Historic Environment	Directly affects a scheduled monument and 2 Grade II Listed Buildings.	Directly affects a Grade II listed building. Direct impact upon Thorndon Park Registered Park and Garden (Grade II*) and the Thorndon Park Conservation Area.
Biodiversity	Directly affects functionally linked land and 3 local wildlife sites.	Directly affects functionally linked land, 6 areas of ancient woodland and 8 local wildlife sites.
Water Environment	Affects Mardyke floodplain.	Avoids effects on Mardyke floodplain.
Air Quality	The majority of properties which are predicted to exceed or are at risk of exceeding the AQSO adjacent to the A282 would experience an improvement in air quality compared with the Without Scheme situation. Properties within the vicinity of Routes 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within the AQSO in the With Scheme scenario.	
Noise	Overall Route 4 ESL has the lowest noise impact followed by Route 4 WSL, Route 3 ESL and then Route 3 WSL. Within the vicinity of each of the routes there would be properties experiencing an increase in noise as a result of new traffic or increases in traffic on some existing roads. There would be reductions in traffic on other roads; for example the A282 and the A2.	
Community Facilities	Direct effect on an area of Open Access Land and the westernmost edge of Orsett Golf Course, footpaths, bridleways and local cycle routes.	Direct effect on two areas of Open Access Land, woodland which could be used for recreational purposes, Dunton Hills Family Golf Centre, footpaths, bridleways, a Byway Open to All Traffic and local cycle routes.

7.1.4 **Table 7.3** provides a summary of the main environmental effects associated with the bored tunnel crossing for Routes 3 and 4.

TABLE 7.3 - LOCATION C, SUMMARY TABLE – BORED TUNNEL CROSSING

Topic	Bored Tunnel Routes 3 and 4
Landscape / Townscape	Minor effect associated with the presence of the tunnel portals north and south of the river.
Historic Environment	No significant effects.
Biodiversity	Direct effect on a local wildlife site. Possible impact on qualifying species associated with Ramsar/ SPA e.g. through loss of functionally linked land.
Water Environment	No significant effect.
Air Quality	Refer to Table 7.2 for the air quality effects.
Noise	Refer to Table 7.2 for the noise effects.
Community Facilities	Unlikely to be any direct effects.

7.1.5 **Table 7.4** provides a summary of the main environmental effects associated with the Western and Eastern Southern Links from where the two schemes diverge south of the River Thames crossing southwards.

TABLE 7.4 - LOCATION C, SUMMARY TABLE – WESTERN AND EASTERN SOUTHERN LINKS

Topic	Western Southern Link	Eastern Southern Link
Landscape / Townscape	Minor intrusion into Kent Downs AONB at the junction with the A2. Impacts on the setting of the AONB.	Greater intrusion into the Kent Downs AONB and its setting than Western Southern Link at the A2/M2 junction.
Historic Environment	Direct effect on Registered Park and Garden. Potential setting effects on listed buildings and Thong Conservation Area.	Potential setting effects on listed buildings and Shorne Conservation Area.
Biodiversity	Direct habitat loss from Claylane Wood ancient woodland and Shorne and Ashenbank Woods SSSI.	Direct loss of habitat from and fragmentation of the woodland within the Great Crabbles Wood SSSI. Direct loss of 2 areas of ancient woodland and Court Wood LWS.
Water Environment	No significant effect	No significant effect
Air Quality	The majority of properties which are predicted to exceed or are at risk of exceeding the AQSO adjacent to the A282 would experience an improvement in air quality compared with the Without Scheme situation. Properties within the vicinity of Routes 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within the AQSO in the With Scheme scenario. The largest impact on annual mean NO ₂ concentration in comparing the ESL versus the WSL occurs at M2 Junction1, where there is a predicted increase up to 10.1 µg/m ³ with the ESL in comparison to the Without Scheme Scenario.	
Noise	Within the vicinity of each of the routes there would be properties experiencing an increase in noise as a result of new traffic or increases in traffic on some existing roads. However, there would be reductions in traffic on other roads; for example the A282 and the A2. Overall, Routes 3 and 4 would have a lower noise impact with the ESL compared to the WSL, as there are fewer properties in the vicinity of the ESL.	
Community Facilities	Direct effect on Southern Valley Golf Club, Claylane Wood, footpaths, a bridleway, a Sustrans National Cycle Network route and a local cycle route.	Direct effect on Great Crabbles Wood, The Warren Wood and Cole Wood (the latter two forming part of Court Wood LWS), footpaths, a Sustrans National Cycle Network route, a local cycle route and a local trail are all potentially affected.

8 References

Title	Document number
Design Manual for Roads and Bridges (DMRB) – Environmental Assessment	DMRB Volume 11
DMRB Assessment of Implications (of highways and/ or roads projects) on European Sites (including appropriate assessment)	DMRB HD 44/09
DfT National Policy Statement for National Networks (NPSNN)	2015
EA Thames Estuary 2100 (TE2100) Plan	November 2012
Habitat Regulations	2010 No. 490
Habitats Directive	92/43/EEC
Highways England Interim Advice Notice (IAN) Updated air quality advice on the assessment of future. NO _x and NO ₂ projections for users of DMRB Volume 11	IAN 170/12v3
Highways England Interim Advice Notice (IAN) Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality (HA207/07)	IAN 174/13
Planning Act 2008	2008 c. 29
Red Data Book of British Invertebrates (Bratton, 1991) (Updated 31/19/2007)	NBNSYS0000000021
TAG Unit A3 Environmental Impact Appraisal	DfT
Thurrock Surface Water Management Plan (SWMP)	URS 2013
Wild Birds Directive	2009/147/EC

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 of 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.
Benefit Cost Ratio (BCR)	The net benefit of a scheme divided by the net cost to Government. The ratio of present value of benefits (PVB) to present value of costs (PVC), an indication of value for money.
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 Post-Consultation Appraisal 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,

Abbreviation	Description
Assessment (HRA)	Special Protection Areas and Ramsar sites), (either in isolation or in combination with other plans and 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

Abbreviation	Description
Mardyke	A small river, mainly in Thurrock, that flows into the River Thames at Purfleet, close to the QEII Bridge.
Marine Conservation Zones (MCZs)	A Marine Conservation Zone (MCZ) is a type of marine nature reserve in UK waters. They were established under the Marine and Coastal Access Act (2009) and are areas designated with the aim to protect nationally important, rare or threatened habitats and species.
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

Abbreviation	Description
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.
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 or 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-	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

Abbreviation	Description
Consultation Appraisal Route)	carriageway road provided from B186 to A128 parallel with the A127. See also Eastern Southern Link and Western Southern Link.
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

Abbreviation	Description
TBM	Tunnel boring machine, machine used to excavate tunnels with a circular cross section.
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

Appendix 6.1 - Environmental drawings

Drawing reference		Description
1	HA540039-HHJ-EGN-ZZZZZZZZEG-MP-EN-0001	Landscape / Townscape Constraints
2	HA540039-HHJ-EGN-ZZZZZZZZEG-MP-EN-0002	Biodiversity, Historic Environment and Planning Constraints
3	HA540039-HHJ-EGN-ZZZZZZZZEG-MP-EN-0003	Internationally Designated Sites
4	HA540039-HHJ-EGN-ZZZZZZZZEG-MP-EN-0004	Air and Noise Constraints and Air Quality Modelling Receptor Locations
5	HA540039-HHJ-EGN-ZZZZZZZZEG-MP-EN-0005	Community Land Use Constraints
6	HA540039-HHJ-EGN-ZZZZZZZZEG-MP-EN-0006	Public Rights of Way and Cycle Routes
7	HA540039-HHJ-EGN-AD0ZZZZZEG-MP-EN-0003	Route 1 Bridge Land Take High Level Constraints
8	HA540039-HHJ-EGN-AD0ZZZZZEG-MP-EN-0004	Route 1 Bridge Land Take Water Constraints
9	HA540039-HHJ-EGN-CD3ZZZZZEG-MP-EN-0001	Route 3 Bored Tunnel Land Take High Level Constraints
10	HA540039-HHJ-EGN-CD3ZZZZZEG-MP-EN-0002	Route 3 Bored Tunnel Land Take Water Constraints
11	HA540039-HHJ-EGN-CD4ZZZZZEG-MP-EN-0001	Route 4 Bored Tunnel Land Take High Level Constraints
12	HA540039-HHJ-EGN-CD4ZZZZZEG-MP-EN-0002	Route 4 Bored Tunnel Land Take Water Constraints

Appendix 6.2 - Engagement with Environmental bodies

Appendix 6.3 - Air Quality results

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