

Lower Thames Crossing

Pre-Consultation Scheme Assessment Report

Volume 6: Environmental Appraisal

Volume 6

Lower Thames Crossing
Route Consultation 2016

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The designs shown and described in this Pre-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 Pre-Consultation Scheme Assessment Report

- 1.1.1 The Pre-Consultation Scheme Assessment Report (SAR) brings together the engineering, safety, operational, traffic, economic, social and environmental appraisal of the shortlist routes for the Lower Thames Crossing. The appraisal of the longlist options was reported in the *Technical Appraisal Report* (TAR) (refer to sections 2 and 3 of Volume 3 of the SAR).
- 1.1.2 Drawing on the results of the appraisal the SAR recommends which routes should be taken to public consultation. It also sets out Highways England's proposed scheme.
- 1.1.3 The SAR is set out in a number of Volumes, as follows:
- Volume 1 – Executive Summary
 - Volume 2 – Introduction and Existing Conditions
 - Volume 3 – Identification and Description of Shortlist Routes
 - Volume 4 – Engineering, Safety and Cost Appraisal
 - Volume 5 – Traffic and Economics Appraisal
 - **Volume 6 – Environmental Appraisal**
 - Volume 7 – Appraisal Conclusions and Recommendations
- 1.1.4 Following public consultation, this document will be reviewed and updated to produce a final Post-Consultation Scheme Assessment Report that takes account of the comments received. It will also include the report on public consultation, and the recommendation for the Preferred Option. The Preferred Option will be the scheme that Highways England recommends should be taken forward into an application for development consent.

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 shortlist routes.
- Section 3 provides an appraisal of Location A.
- Section 4 provides an appraisal of Location C north of the River Thames.
- Section 5 provides an appraisal of Location C crossings.
- Section 6 provides an appraisal of Location C south of the River Thames.
- Section 7 provides a summary of the results for the environmental appraisal and the Part One Appropriate Assessment¹.

¹ A Part One Appropriate Assessment is being prepared to identify the potential effects on European Sites recognising the stage in the project's development and the fact that there are 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 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

2.1.2 The method followed for the appraisal of the shortlist of routes is outlined in the *Appraisal Specification Report*. In summary, this 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
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 4.4 in Volume 4).
- 2.1.7 This environmental appraisal should be read in conjunction with the following:
- The environmental WebTAG worksheets presented in Volume 7 Appendices.
 - The Appraisal Summary Tables for each shortlist route presented in Volume 7.
- 2.1.8 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.
- 2.1.9 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 would be considered further in the next development stage.

2.2 Habitats Regulations Assessment

- 2.2.1 An initial HRA has been undertaken in parallel with the appraisal of both the long and shortlist of options owing to the presence of a number of European Sites including the Thames Estuary and Marshes Special Protection Area (SPA) and Ramsar site. A 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 7.

2.3 Stakeholder Engagement

2.3.1 Throughout the appraisal of the longlist and shortlist options there has been engagement with the SEBs and other environmental bodies. Workshops or meetings have been 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 have helped guide the appraisal and the development of the options. The SEBs and other environmental bodies have been engaged to discuss a number of environmental topics which can be broadly summarised as follows:

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

2.4 Appraisal of the Shortlist Routes

2.4.1 This volume provides a summary of the results of the environmental appraisal of the shortlist Routes. The results have been described for:

- Location A
- Location C
 - North of the River Thames
 - Crossing Type
 - South of the River Thames. For Location C Routes (Route 2, 3 and 4), 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 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 and this is demonstrated by the presence of Air Quality Management Areas (AQMAs). There are a significant number of monitored exceedances of nitrogen dioxide (NO₂) around the Dartford area. Therefore, the effects of a route at this location on AQMAs and exceedances would be a significant issue in the decision-making process.
- 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 key decision-making factor.
- 3.1.5 For biodiversity the presence of the nationally important Sites of Special Scientific Interest (SSSI) and the recommended Marine Conservation Zone (rMCZ) as well as the presence further east of International and European Designated Sites and functionally linked land associated with them are potential constraints to a crossing option. 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 shortlist route.

3.1.8 Key landscape and biodiversity constraints are summarised on **Figure 3.1**.

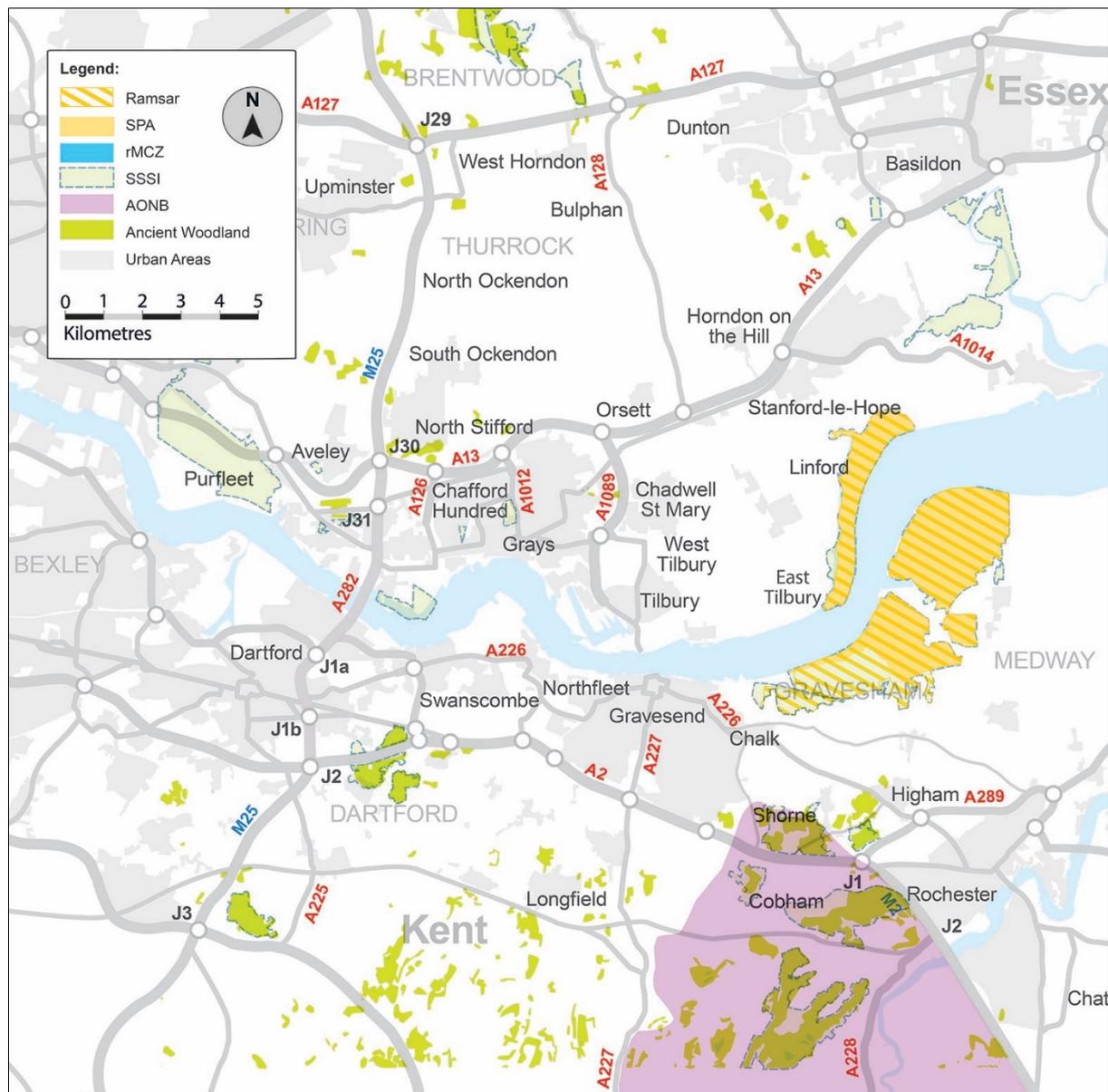


FIGURE 3.1 - KEY LANDSCAPE AND BIODIVERSITY CONSTRAINTS

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 existing 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.

Bored Tunnel Crossing

- 3.2.5 The new road infrastructure would introduce a new linear element in the townscape, with minor changes to the local character associated with the tunnel portals. A new tunnel crossing would have limited impact on the River Thames corridor i.e. the environment in proximity to the river. To the north and south of the River Thames new road infrastructure would have a limited impact on the surrounding townscape.
- 3.2.6 Therefore, a bored tunnel 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, a Grade II registered park and garden (a designated heritage asset). The location of the Park is shown in **Appendix 6.1**.

Bridge Crossing

- 3.3.2 Designated heritage assets 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. Therefore, there would be no significant impacts.
- 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.

Bored Tunnel Crossing

- 3.3.4 The effects of the bored tunnel option would be similar to those of the bridge at tunnel portals and tunnel approaches and may impact upon non-designated and/ or unknown archaeological remains.

3.4 Biodiversity

- 3.4.1 Impacts on Local Wildlife Sites and Biodiversity Action Plan (BAP) 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, Brickbarn Wood and Low Well Wood) and 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 (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 qualifying 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.
- 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.

Bored Tunnel Crossing

- 3.4.8 This option would run in close proximity to the West Thurrock Lagoon and Marshes SSSI but a bored tunnel crossing would be unlikely to have a significant effect on the habitats and species associated with the SSSI.
- 3.4.9 Whilst there would be no direct impacts to the Thames Estuary and Marshes SPA; indirect impacts on its qualifying species could arise from the construction of a bored tunnel crossing. These indirect impacts could arise from the disturbance (resulting in avoidance) of birds using the West Thurrock Lagoon and Marshes SSSI and/ or areas of mudflat adjacent to the above ground elements of the route. The magnitude of this indirect impact would depend on the level of use of existing mudflats by SPA qualifying species which would need to be determined by survey work if this option is selected.
- 3.4.10 The location of the tunnel entrance points and associated road widening to tie into the A282 to the north of the crossing may result in the loss of some areas of functionally linked land (historic grazing marsh) associated with the Thames Estuary and Marshes SPA to the north of the crossing between Junction 31 and Junction 30 of the M25. However, the suitability of the habitat for use by SPA qualifying species would need to be determined by surveys in the next development stage of the project.
- 3.4.11 The bored tunnel itself would have no physical impact on the Thames Estuary or the rMCZ. Best practice construction techniques and environmental management would be required to mitigate any effects on this site such as control of runoff and transport of materials to site.
- 3.4.12 Impacts on local wildlife sites and BAP priority habitats would be the same as for the bridge option (refer to section 3.4.1).

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 WFD assessment (refer to section 2.1) 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 status² or

² 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.

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 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).

Bored Tunnel Crossing

- 3.5.8 A bored tunnel would have little impact on the River Thames.
- 3.5.9 Issues with rising groundwater levels have been identified in the vicinity of the crossing. 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 licensed commercial/ industrial/ agricultural supplies from shallow groundwater in the gravels; these are not thought to be significant.
- 3.5.10 The bored tunnel would have no impact on channel conveyance. The bored tunnel would be at a higher risk of route closure due to high flood levels than a bridge option as the consequence of inundation of the tunnel portals (which are located in the defended floodplain). These impacts would need to be addressed in the design of the crossing.
- 3.5.11 The tunnel would require a design that does not compromise TE2100 River Thames flood defence plans. During detailed design there would need to be consideration of piling on the flood defences.

3.6 Air Quality

- 3.6.1 Baseline air quality conditions are described in Volume 2 and represented in **Appendix 6.1**. The DMRB Volume 11 version 4.2 draft screening model 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 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 shortlist routes and the surrounding road network. Within that area representative receptors (residential properties) were selected to assist in understanding the likely implications of the With and Without Scheme scenarios. 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 a representative 89 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**.

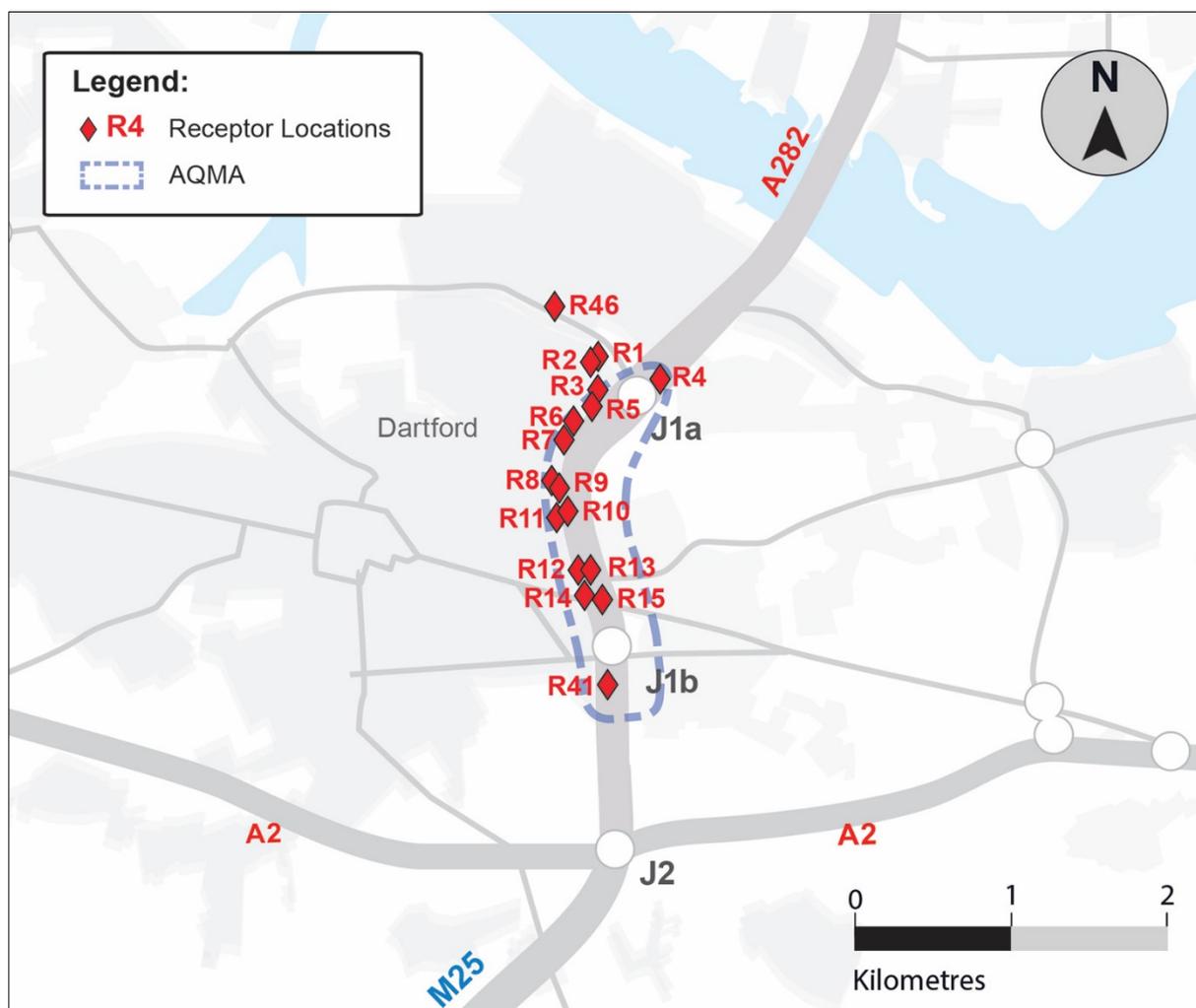


FIGURE 3.2 - LOCATION OF AIR QUALITY RECEPTORS IN THE VICINITY OF THE A282

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). Those affected receptors which may experience a decrease are shaded green. This is generally as a result of the reduced effects of congestion outweighing the increase in traffic at these receptors. This is represented by property ID R4 and R12.

TABLE 3.1 - PREDICTED ANNUAL MEAN NO₂ CONCENTRATIONS AT SELECTED RECEPTORS WITHIN 200 METRES OF AFFECTED ROAD NETWORK AT SHORTLIST 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]
R4	43.0	42.0	-1.0	<10
R5	35.3	36.3	1.0	<50
R8	39.0	41.4	2.4	<50
R9	37.2	39.6	2.4	<50
R10	35.8	36.6	0.8	<50
R12	43.7	42.5	-1.2	<50
R13	35.8	36.2	0.4	<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.

3.6.5 If Route 1 is built 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 property ID R5, R10 and R13. The modelling also predicts that properties that are at risk of exceeding the AQSO would exceed the AQSO at Route 1 as shown by property ID R8.

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 throughout the study area in this location there would be a worsening in air quality with Route 1 due to increases in traffic flow and congestion. This appraisal at this stage 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 a worsening and breaching of EU limits.

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. 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 dates reported by Defra to the European Commission. However, Defra has recently updated the modelling and air quality action plans which were submitted to the European Commission (as part of the Supreme Court ruling) in December 2015. This information, if accepted by the European Commission, would need to be used to determine whether there is any impact on compliance in subsequent assessments undertaken at the next development stage of the project.
- 3.6.11 Caution should be used when undertaking comparisons of the Defra compliance modelling and the modelling undertaken as part of this appraisal. Defra uses a combination of modelling and monitoring to report against compliance with the EU Directive on air quality. The modelling includes representative roads in each zone/ agglomeration to determine the year in which the zone/ agglomeration will become compliant with the Directive. As the Defra compliance modelling is undertaken on a national scale it is very high level and the results from the compliance modelling are not comparable with the detailed modelling undertaken at a local scheme level. The compliance reporting for the purpose of the Directive for example excludes areas 25m from major junctions that in all likelihood would be included in the scheme modelling as sensitive receptors.
- 3.6.12 The Defra compliance modelling also predicts concentrations from individual roads whereas the scheme modelling predicts the cumulative impacts from roads. The scheme modelling is also verified at a local level using a combination of local monitoring data from diffusion tubes and automatic stations whereas the Defra compliance modelling is verified at a much higher level. In addition the air quality modelling for the scheme appraisal in accordance with DMRB incorporates the advice in IAN 170/12v3 which adds a greater degree of precaution in the projections on future concentrations (when compared to Defra compliance projections) for the purposes of determining significance in relation to EIA.

Construction

- 3.6.13 Given that air quality modelling undertaken as part of the appraisal process for operational conditions in 2025 predicts exceedances of EU limits for NO₂ in the Dartford area, it is considered likely that during the construction phase, with additional congestion, that air quality may further deteriorate. The construction phase would increase congestion for approximately six years in advance of the year of opening. In addition background levels are likely to be higher during these earlier years. This together with increased construction phase congestion could lead to additional exceedances of EU limits. People that live close to the Dartford Crossing would therefore be subjected to prolonged air quality impacts.

Next Steps

3.6.14 Air quality effects at this stage do not differentiate between a bridge and tunnel solution as this would require detailed information about the design, for example the precise location of vents and the method of venting for a tunnel. In the next development phase of the project detailed modelling would take place and would include consideration of the location of tunnel portals and vents. Pollution concentrations diminish rapidly with distance from source, for example traffic pollutants decrease to background levels within 200m of the road centre. There are few properties in the likely locations of tunnel vents and those that are present would be taken into account in the assessment and design. The design and assessment process would be iterative to reduce as far as possible the air quality impacts on residential properties.

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, in excess of 75dB(A). This is illustrated on **Figure 3.3**.

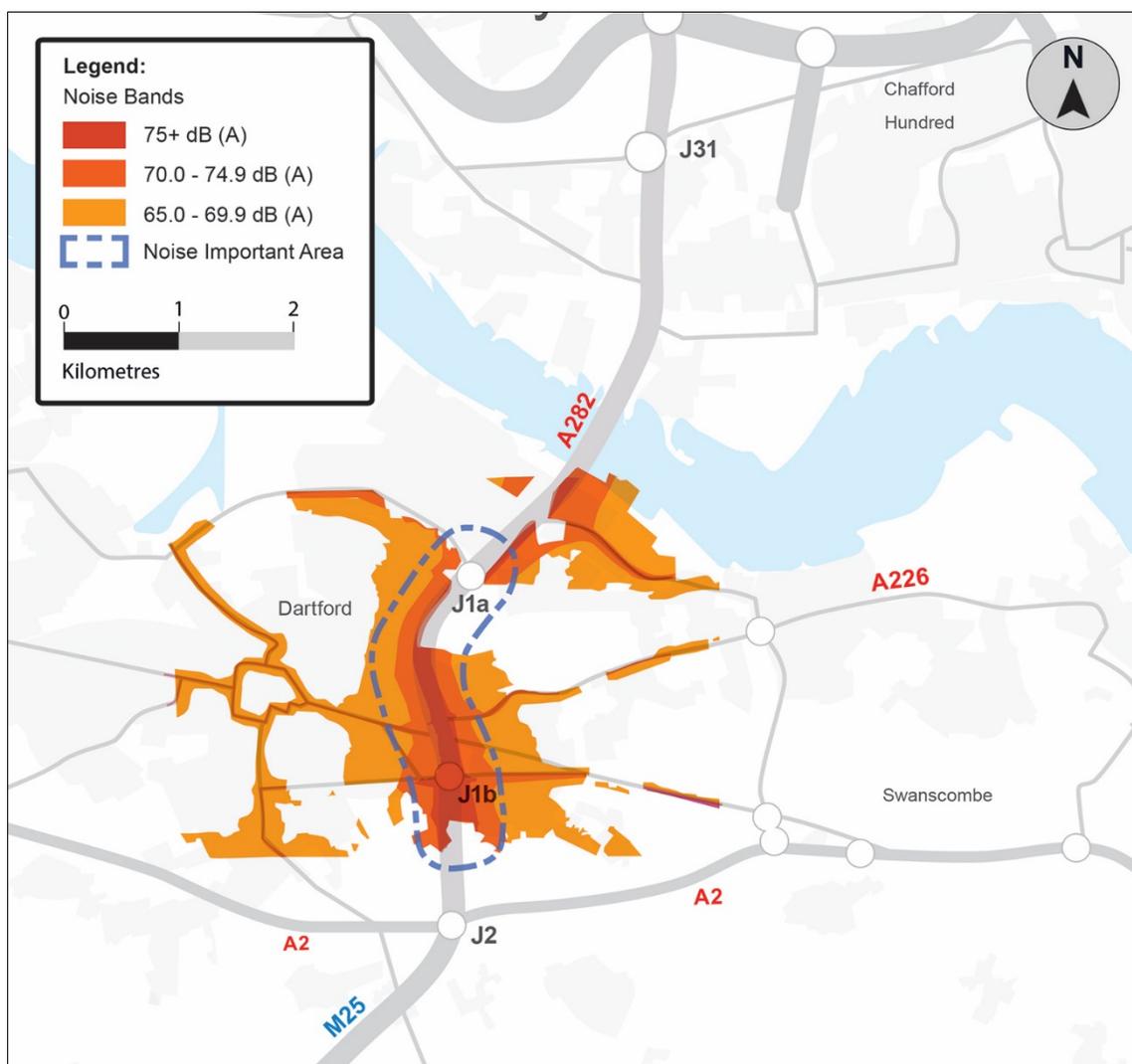


FIGURE 3.3 - EXISTING NOISE LEVELS ALONG THE A282 CORRIDOR AT DARTFORD

- 3.7.2 The noise appraisal used a study area that was confined to main roads within the vicinity of Routes 1, 2, 3 and 4 to enable comparison of the effects 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. The noise appraisal method used considered whether there would be a net benefit or disbenefit by taking the total number of properties within 600m of those roads and determining the level of noise increase or decrease they experience.
- 3.7.3 Based on this appraisal method, when comparing Route 1 with the Without Scheme scenario, there would be a worsening of noise. With Route 1 additional properties are predicted to exceed 70dB.
- 3.7.4 At the next development stage of the project modelling would be undertaken over a wider extent to reflect changes in traffic across the road network. This would enable prediction of noise levels at individual receptors and development of appropriate mitigation measures. Notwithstanding, the work completed to date has demonstrated that there would be worsening of noise with Route 1 in a Noise Important Area where noise exceeds 75dB (A).

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.
- 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.
- 3.8.5 The nature of these impacts would be quantified at the next development phase of the project but they 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 air quality EU limit values. Therefore, Route 1 would be very difficult for Highways England to promote

as there would likely 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 and a bridge option would have greater 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). Therefore, for Route 1, a bored tunnel would be the most appropriate crossing type with least consenting risk.

4 Location C north of the River Thames

4.1 Overview

- 4.1.1 This section describes the effects of Location C Routes 2, 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 2, 3 and 4 the key environmental topics where there are potentially significant issues that require consideration are:
- Biodiversity
 - Historic environment
 - Landscape and townscape
- 4.1.3 For biodiversity there are a number of areas of nationally important ancient woodland and local wildlife sites.
- 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 shortlist route.

4.2 Landscape and Townscape

Route 2

- 4.2.1 Route 2 would partially create a new road corridor (this route partially uses the A1089) and introduce a significant change to the existing landscape character which is designated as Green Belt. 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. A number of features near West Tilbury would be affected. The location of features is shown in **Appendix 6.1**.

Route 3

- 4.2.2 Whilst Route 3 would be an entirely offline solution the effects assessed are similar to those for Route 2 owing to the sensitivity of the features that would be affected. 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.

Route 4

- 4.2.3 As for Routes 2 and 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 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 2

- 4.3.1 The historic landscape within the study area is characterised by a mixture of residential and open countryside, with several historic features throughout.
- 4.3.2 The scheme could directly affect two Grade II listed buildings, it could also affect the setting of a Grade I listed building near to the M25 during the construction works. Several other Grade II listed buildings throughout the scheme corridor may potentially experience setting effects.
- 4.3.3 The scheme directly affects scheduled monuments; earthworks near church, West Tilbury and cropmark complex, near Orsett. The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, Ockendon Hall, Orsett, West Tilbury and Bowaters Farm. Road construction within the scheduled area of the Orsett cropmark complex could cause a direct physical impact to this designated asset.
- 4.3.4 There would be a direct permanent effect on two conservation areas at West Tilbury and indirect impacts on two Conservation Areas at North Ockendon and Cranham. Direct effects on earthworks near church, West Tilbury scheduled monument and on two Grade II listed buildings (Thatched Cottage and 1 & 2 Grays Corner Cottages) would occur. In addition the graveyard associated with the Church of St James (the Church being a Grade II listed building) would be affected. This means that there are significant effects on nationally important assets whereby they are lost or their integrity is severely damaged. This would require mitigation and engagement with Historic England and County Archaeologists to agree the mitigation required.

- 4.3.5 Construction excavations associated with road 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 could occur. Engagement with Essex County Council has indicated that this is a possibility in view of current desk based knowledge of the area.

Route 3

- 4.3.6 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 potential construction works. There could potentially be setting effects to several Grade II listed buildings and four scheduled monuments at South Ockenden Old Hall, South Ockendon Hall West Tilbury and Bowaters Farm and indirect impacts on two Conservation Areas at North Ockendon and Cranham.
- 4.3.7 Road construction within the scheduled area of the Orsett cropmark complex could cause a direct physical impact to this designated asset.
- 4.3.8 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 desk based knowledge of the area.

Route 4

- 4.3.9 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.
- 4.3.10 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.
- 4.3.11 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 desk based knowledge of the area.

4.4 Biodiversity

Route 2

- 4.4.1 The northern section of this route does not directly affect any designated sites and changes in air quality are considered unlikely to affect Hangman's Wood and Deneholes SSSI. However it does result in the loss of habitat from five Local Wildlife Sites (West Tilbury Church, Broom Hill, Little Thurrock Reedbeds, Terrels Heath and Blackshots Nature Area), one of which contains ancient woodland, and five areas that support UK BAP priority habitats. Goshems Farm Local Wildlife Site (LWS) is included in section 5.4. Chadwell Wood ancient woodland may also be affected.

Route 3

- 4.4.2 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 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. Goshems Farm LWS is included in section 5.4.

Route 4

- 4.4.3 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 wildlife site 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. Goshems Farm LWS is included in section 5.4.

4.5 Water Environment

Route 2

- 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. 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 Thurrock Surface Water Management Plan (SWMP) (URS 2013) identifies CDAs³. The route crosses the identified CDA 008, which includes Tilbury Flood Storage Area (FSA), designed to store surface water and so protect Tilbury from flooding. The EA has stated that no net reduction in available storage within the scheme would be considered acceptable. For this route to be considered further, principles for mitigating any displaced storage within Tilbury FSA would need to be agreed with the EA and/ or Thurrock Council. Based on discussions held to date it is understood that it would be difficult to find this alternative 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 3

- 4.5.5 Route 3 would pass through CDA 012 as defined in the Thurrock 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, unlike Route 2.

Route 4

- 4.5.6 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 2, 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 version 4.2 draft screening model 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 likely implications of the With and Without Scheme scenarios. The modelling takes 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

³ Critical Drainage Areas comprise areas at risk of flooding as well as the contributing catchment that influences the predicted flood extent.

used to understand what would happen to receptors which are currently exceeding EU limits in the Without Scheme scenario and also to understand if there would be new exceedances if any of the Location C Routes were built.

- 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. EU limits are exceeded or are at risk of being exceeded). All receptors are shown in **Appendix 6.1**.
- 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 2, 3 and 4, properties that currently experience an exceedance or are at risk of exceeding i.e. close to Dartford Crossing would benefit.

TABLE 4.1 - PREDICTED ANNUAL MEAN NO₂ CONCENTRATIONS AT SELECTED RECEPTORS WITHIN 200 METRES OF AFFECTED ROAD NETWORK AT SHORTLIST ROUTES 2 - 4

Property ID	Without Scheme (µg/m ³) ^[1]	Routes 2, 3 and 4 WSL and ESL (µg/m ³) ^[1]	Difference between Routes 2, 3 and 4 WSL and ESL and Without Scheme (µg/m ³)	Approximate Number of Potentially Influenced Receptors ^[2]
R4	43.0	40.4	-2.6	<10
R8	39.0	37.2	-1.8	<50
R9	37.2	35.8 or 35.9	-1.3 or -1.4	<50
R12	43.7	38.1 or 38.2	-5.5 or -5.6	<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 2, 3 or 4 would exceed or be at risk of exceeding the EU limit value. Generally levels at the properties that are closest to Routes 2, 3 and 4 are in the order of 20 µg/m³ in the Without Scheme scenario and in the With Scheme scenario levels decrease or increase by only 1 µg/m³ (recognising that the EU limit value is 40 µg/m³).
- 4.6.8 Tin 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, the benefits identified at Property ID 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 2, 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 2, 3 or 4 impact on to become non-compliant.
- 4.6.12 This conclusion is based on the latest dates reported by Defra to the European Commission. However, Defra has recently updated the modelling and air quality action plans which were submitted to the European Commission (as part of the Supreme Court ruling) in December 2015. This information, if accepted by the European Commission, would need to be used to determine whether there is any impact on compliance in subsequent assessments undertaken at the next development stage of the project.
- 4.6.13 Air quality effects at this stage do not differentiate between a bridge and tunnel solution as this would require detailed information about the design, for example the precise location of vents and the method of venting for a tunnel. Pollution concentrations diminish rapidly with distance from source, for example traffic pollutants decrease to background levels within 200m of the road centre. In the next development phase of the project detailed modelling will take place and will include consideration of 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.
- 4.6.14 In summary Routes 2, 3 and 4 would lead to improvements in air quality at the A282 where exceedances of EU limits currently occur. Properties within the vicinity of Routes 2, 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within EU limits in the With Scheme scenario.

4.7 Noise

- 4.7.1 This section reports noise appraisal results for the entire route (2, 3 and 4) comprising south and north of the River Thames and the crossing.

Route 2

- 4.7.2 The noise appraisal used a study area that was confined to main roads within the vicinity of Routes 1, 2, 3 and 4. 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. The noise appraisal method used considered whether there would be a net benefit or disbenefit by taking the total number of properties within 600m of those roads and determining the level of noise increase or decrease they experience.

- 4.7.3 Based on this appraisal method, when comparing Route 2 with the Without Scheme scenario, there would be an overall improvement in noise (a greater number of properties would benefit than disbenefit). Whilst there would be properties experiencing an increase in noise as a result of new traffic on the route or increases in traffic on other existing routes, this would be offset by reductions in traffic on other routes for example the A282 and the A2. One of the major components of traffic noise levels is the amount of traffic on a road and in the vicinity of the Dartford Crossing, where levels exceed 75dB (refer to **Figure 3.3**) traffic flows are more than double those predicted on the new routes.
- 4.7.4 At the next development stage of the project modelling will be undertaken over a wider extent to reflect changes in traffic across the road network. This would enable prediction of noise levels at individual receptors and development of appropriate mitigation measures. Based on the flows predicted at this stage, levels at properties are likely to be within appropriate standards or be able to be mitigated to remain within appropriate standards.

Route 3

- 4.7.5 Based on this appraisal method, when comparing Route 3 with the Without Scheme scenario, there would be an overall improvement in noise (a greater number of properties would benefit than disbenefit). Whilst there would be properties experiencing an increase in noise as a result of new traffic on the route or increases in traffic on the existing route, this would be offset by reductions in traffic on other routes for example the A282 and the A2.
- 4.7.6 At the next development stage of the project modelling will be undertaken over a wider extent to reflect changes in traffic across the road network. This would enable prediction of noise levels at individual receptors and development of appropriate mitigation measures. Based on the flows predicted at this stage, levels at properties are likely to be within appropriate standards or be able to be mitigated to remain within appropriate standards.

Route 4

- 4.7.7 Based on this appraisal method, when comparing Route 4 with the Without Scheme scenario, there would be an overall improvement in noise (a greater number of properties would benefit than disbenefit). Whilst there would be properties experiencing an increase in noise as a result of new traffic on the route or increases in traffic on the existing route, this would be offset by reductions in traffic on other routes for example the A282 and the A2.
- 4.7.8 At the next development stage of the project modelling will be undertaken over a wider extent to reflect changes in traffic across the road network. This would enable prediction of noise levels at individual receptors and development of appropriate mitigation measures. Based on the flows predicted at this stage, levels at properties are likely to be within appropriate standards or be able to be mitigated to remain within appropriate standards.

Conclusion

- 4.7.9 Overall Route 2 provides the least noise benefit compared to Routes 3 and 4 with Route 4 providing the greatest benefit. This is based on an overall (net) number of properties within the study area comprising main roads around the properties routes and those near the existing Dartford Crossing.

4.8 Community Facilities

Route 2

- 4.8.1 The route would directly affect two areas of Open Access Land (at West Tilbury and Orsett Fen) and the Condoverters Scout Activity Centre. 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 as a result of noise, air and visual intrusion. Other community facilities could be indirectly affected e.g. due to loss of amenity. The nature of these impacts would be quantified at the next development phase of the project.

Route 3

- 4.8.2 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. The extent of these impacts would be quantified at the next development phase of the project.

Route 4

- 4.8.3 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 extent of these impacts would be quantified at the next development phase of the project but they are not considered material to a decision on route selection.

5 Location C Crossings

5.1 Overview

- 5.1.1 This section describes the effects of Location C Routes 2, 3 and 4 at the crossing of the River Thames with reference to the baseline presented in Volume 2 of the SAR.
- 5.1.2 With regards to the crossing types at Location C the key environmental topic where there are potentially significant issues that require consideration is:
- Biodiversity
- 5.1.3 For biodiversity there is the potential to impact on internationally and nationally designated sites. These features are identified on the drawings presented in **Appendix 6.1**.
- 5.1.4 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 sensitive and 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.
- 5.1.5 Works within, adjacent to or affecting European Sites need to consider the requirements of the *Habitats Directive* (implemented through the *Habitats Regulations*), which describes the procedure for assessment and subsequent decisions relating to development proposals that are likely to have an impact on such sites. Under the *Habitats Regulations*, where there is likely to be a significant effect on a European Site derogation tests exist which allow projects to proceed under the following specific circumstances:
- That no feasible, less-damaging alternative solutions exist.
 - That there are Imperative Reasons of Overriding Public Interest (IROPI) for the proposal to go ahead.
 - That adequate and timely compensatory measures will be put in place to ensure the overall coherence of the network of protected sites is maintained.
- 5.1.6 An initial Habitats Regulations Assessment (HRA) has been undertaken in parallel with the appraisal of routes. 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 European Sites. 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 which are summarised in section 7.

5.1.7 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

5.1.8 The order in which the topics have been presented is consistent throughout this volume irrespective of the importance of the topic for each shortlist route.

5.2 Landscape and Townscape

Bridge

5.2.1 A bridge crossing could have a considerably greater adverse impact on the River Thames corridor than either type of tunnel as it would change its existing expansive, open character. A bridge, approach viaducts and associated infrastructure would also change the level of tranquillity, the existing townscape/landscape and views. However, a new bridge also presents the opportunity to create a new iconic structure.

Bored Tunnel

5.2.2 A bored tunnel would have a lesser impact on the River Thames corridor than a bridge as, with the exception of the portals and the immediate approach roads, it would be underground.

Immersed Tunnel

5.2.3 An immersed tunnel would have a lesser impact on the River Thames corridor than a bridge as it would be underground.

5.3 Historic Environment

Bridge

5.3.1 The presence of the new bridge may also have an impact on the settings of high value designated and non-designated assets such as Tilbury, Coalhouse, Cliffe and Shornemead forts (the first three of which are scheduled monuments) as their settings extend for some distance.

5.3.2 Excavations associated with the bridge 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.

Bored Tunnel

- 5.3.3 Excavation effects of a bored tunnel would be similar to a bridge although the effects on the setting of assets particularly near to the River Thames would be avoided as the tunnel would be underground.

Immersed Tunnel

- 5.3.4 Excavation effects of an immersed tunnel would be similar to a bridge although the effects on the setting of assets near to the River Thames would be avoided as the immersed tunnel would be covered.
- 5.3.5 There is the potential for disturbance of currently unknown marine archaeology assets as advised during consultation with Historic England and County Archaeologists. The nature of these assets is unknown at this stage but would be determined through desk study and potentially other surveys at the next development stage of the project.

5.4 Biodiversity

- 5.4.1 The different crossing types would result in differing degrees of habitat loss and fragmentation and would result in different degrees of disturbance.
- 5.4.2 Under the Habitats Directive, the consideration of alternatives is a prerequisite in the event of significant adverse effects on a European Site being likely. A scheme can only be granted consent in the absence of alternative solutions that would achieve the scheme objectives.
- 5.4.3 Counsel advice has been sought and their advice included within the appraisal. Their advice on each of the crossing options is reported below.

Bridge

- 5.4.4 The construction of a bridge at the western extents of the Ramsar/ South Thames Estuary and Marshes SSSI could cause a number of negative impacts which may not be easily mitigated. These include habitat loss/deterioration of coastal grazing marsh and intertidal mudflats, shading and disturbance / mortality of SPA qualifying species (e.g. through collision with a new bridge structure and moving vehicles).
- 5.4.5 It should also be noted that both freshwater habitats and intertidal mudflat habitat are difficult to replace and compensate for and may take a long time to become effective.
- 5.4.6 The new bridge crossing would pass through the western extent of the site, which is currently agricultural land (although habitat improvement is currently taking place through a grazing regime at Higham Marsh, which is being managed as an RSPB reserve and is therefore likely to improve in quality).
- 5.4.7 There would be a direct impact on the Canal and Grazing Marsh Higham LWS and on the rMCZ and its associated habitats and species due to habitat loss/deterioration and disturbance.
- 5.4.8 There would be a direct effect on Goshems Farm Local Wildlife Site which is an important site for rare Thames Terrace invertebrates and 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 wildlife site and its role as functional habitat to the European Sites.

- 5.4.9 The provision of a new bridge crossing could potentially have consenting risks from a Habitat Regulations Assessment perspective as a less damaging alternative exists (refer to bored tunnel below). Counsel has confirmed that a bridge option would be very unlikely to be deliverable in this location.

Bored tunnel

- 5.4.10 The main impacts would be during the construction phase. A completed tunnel would not impact the marine environment and the coastal/ terrestrial impacts would be greatly reduced in comparison to the construction of a bridge (where permanent effects for example from loss of habitat and shading effects could occur) or immersed tunnel (with very large impacts on habitats and species during construction).
- 5.4.11 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 LWS (Goshems Farm), 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).
- 5.4.12 There would be no direct impact on the Ramsar site and the tunnel portal has been optimised to reduce biodiversity effects.
- 5.4.13 The provision of a new bored tunnel crossing is unlikely to have consenting risks from a *Habitats Regulations* perspective as it offers a less damaging alternative to either a bridge or immersed tunnel crossing. Counsel has confirmed this position.

Immersed tunnel

- 5.4.14 The construction of an immersed tunnel has the potential for a large adverse impacts on the Thames Estuary rMCZ and its associated species and habitats due to habitat loss/ deterioration and disturbance. Whilst the significance of the potential hydrodynamic effects is still uncertain the effects are believed unlikely to extend beyond 6km upstream or downstream of the crossing. However, the size of the rMCZ is such that it is unlikely that the integrity of the site would be affected by an immersed tunnel, assuming appropriate levels of avoidance, mitigation and compensation were put in place.
- 5.4.15 Significant impacts on the Thames Estuary and Marshes Ramsar and South Thames Estuary and Marshes SSSI may occur due to the cut and cover for the southern section of the tunnel. This is due to potential changes in hydrology, which could have significant impacts on this area of wetland habitat and species that it supports (including SPA qualifying species). Impacts on freshwater and intertidal habitats would be difficult to mitigate for. Disturbance to SPA qualifying species during construction is also likely to be significant (given the proximity of the crossing to the SPA boundary). 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 Goshems Farm Local Wildlife Site, 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). However, the casting basin could be moved to a different location and, therefore, the impacts could be reduced.

- 5.4.16 The provision of a new immersed tunnel crossing could potentially have consenting risks from a Habitat Regulations Assessment perspective as a less damaging alternative exists (refer to bored tunnel). Counsel has confirmed that an immersed tunnel option would be very unlikely to be deliverable in this location.

Conclusion

- 5.4.17 The appraisal has demonstrated the risk of significant effects to European Sites with both the bridge and the immersed tunnel options. In this case a bored tunnel is the only viable alternative as it meets the scheme objectives and is the least damaging alternative. This conclusion has been supported by advice provided by Counsel.

5.5 Water Environment

Bridge

- 5.5.1 The bridge crossing of the River Thames would need to be developed to minimise impacts on river morphology, although these are expected to be relatively localised with small increases in flow velocity up and downstream to a distance of 2000m. There would be little impact on high water levels based upon 2D flow modelling that has been completed (refer to Appendix 4.4 in Volume 4).
- 5.5.2 Impacts on the Thames and Medway canal (WFD water body) could be avoided as the River Thames crossing approach viaduct would span this watercourse.
- 5.5.3 A WFD assessment would be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface and WFD groundwater bodies. With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the groundwater 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.
- 5.5.4 A bridge crossing would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans.

Bored Tunnel

- 5.5.5 There would be no direct impact on the surface water environment of the River Thames.
- 5.5.6 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.

- 5.5.7 As for the bridge option, a WFD assessment would be required to ensure assessment of any effects of changes in groundwater on WFD compliance.
- 5.5.8 The bored tunnel option would have no impact on channel conveyance. A tunnel option could be at a higher risk of inundation due to high flood levels (i.e. through breach or overtopping of existing defences).
- 5.5.9 A tunnel crossing would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. The bored tunnel option has 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) and the impacts on the CDA remain the same as for the bridge option.

Immersed Tunnel

- 5.5.10 Assuming the current bed profile of the River Thames is restored post construction, impacts from the immersed tunnel crossing type depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). These may have a local impact within the context of the Thames Middle water body. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats and are assessed under biodiversity.
- 5.5.11 Impacts on the Thames and Medway canal (WFD water body) depend on the construction methods adopted; a cut and cover tunnel through this area associated with this option could lead to a loss of part of the water body and could impact its WFD status. Appropriate mitigation could reduce effects on this water body.
- 5.5.12 Groundwater may be adversely affected by dewatering at the tunnel portals. This would require appropriate mitigation.
- 5.5.13 As for the bridge option, a WFD assessment would be required to ensure assessment of any effects of changes in groundwater on WFD compliance.
- 5.5.14 The immersed tunnel once constructed, would have no impact on channel conveyance. A tunnel option could be at a higher risk of inundation due to high flood levels (i.e. through breach or overtopping of existing defences).
- 5.5.15 An immersed tunnel crossing would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. The immersed tunnel option has 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.

- 5.5.16 The opportunities associated with the TE2100 Plan (Policy P3 for Policy Unit North Kent Marshes, south of the River Thames) and the impacts on the CDA remain the same as for the bridge option.

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 2, 3 and 4.

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 2, 3 and 4.

5.8 Community Facilities

Bridge

- 5.8.1 The bridge crossing would directly affect Shorne Marshes RSPB Nature Reserve which is located immediately south of the River Thames. Footpaths, Sustrans National Cycle Network routes and a local trail are all potentially affected by the bridge. Effects may include severance, temporary or permanent diversions and loss of amenity.
- 5.8.2 As described in section 5.2 a new bridge could present the opportunity to create a new iconic structure that becomes a tourist attraction.

Bored Tunnel

- 5.8.3 There are unlikely to be any direct effects on community facilities although there may be temporary, indirect effects on amenity at the RSPB Nature Reserve during construction.

Immersed Tunnel

- 5.8.4 The immersed tunnel would directly affect Shorne Marshes RSPB Nature Reserve during the construction phase and would require reinstatement. Footpaths, Sustrans National Cycle Network routes and a local trail are all potentially affected by the immersed tunnel although impacts are likely to be less significant and potentially reversible when compared with the bridge.

6 Location C south of the River Thames

6.1 Overview

6.1.1 This section describes the effects of Location C Routes 2, 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 2, 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 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 shortlist 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.

Eastern Southern Link

- 6.2.2 The ESL junction with the A2/ M2 would have a greater physical impact on the Kent Downs AONB as there would be a greater transport infrastructure footprint within it. There would also be a greater loss of ancient woodland that forms an important part of the landscape fabric.

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. There are also potential setting effects on the Shorne Conservation Area.
- 6.3.5 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 Mitigation measures for impacts on ancient woodland would comprise avoidance or minimising the area affected as other measures, such as translocation, are very difficult to achieve successfully.
- 6.4.3 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.

Eastern Southern Link

- 6.4.4 The ESL would result in the direct loss of habitat from and fragmentation of the woodland within the Great Crabbles Wood SSSI at the connection with the A2/ M2. There would also be a loss of ancient woodland at Great Crabbles Wood and Court Wood which is also a Local Wildlife Site.

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 is an opportunity for any new road embankment to provide this structural defence.
- 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 2, 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 2, 3 and 4.
- 6.7.2 Route 2 has less of a noise benefit with the WSL compared to the ESL. Routes 3 and 4 have more of a benefit with the WSL to the ESL.

6.8 Community Facilities

Western Southern Link

- 6.8.1 The WSL would directly affect the Southern Valley Golf Club due to loss of land and Claylane Wood. 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

- 6.8.2 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 in order for a comparison to be made. The comparisons are for:

- Location A, Route 1 (**Table 7.1**)
- Location C, Routes 2, 3 and 4 north of the River Thames (**Table 7.2**)
- Location C River crossings (**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 EU standards 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 EU standards for NO ₂ .
Noise	There would be a small overall noise disbenefit with Route 1, compared with the Without Scheme scenario. There would be greater effects for a bridge than a tunnel once operational.
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 2	Route 3	Route 4
Landscape / Townscape	Affects Greenbelt land. Significant changes to landscape character.	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	Affects 2 parts of a conservation area, direct effects on 2 scheduled monuments and 2 Grade II Listed Buildings.	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, an area of ancient woodland and 5 local wildlife sites.	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 Tilbury flood storage area and Mardyke floodplain.	Affects Mardyke floodplain.	Avoids effects on Mardyke floodplain.
Air Quality (whole route)	All 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 2, 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within EU limits in the With Scheme scenario.		
Noise (whole route based on ESL)	There would be an overall noise benefit with routes 2, 3 and 4, compared with the Without Scheme scenario. Overall Route 4 provides the largest benefit, followed by Route 3, and Route 2. 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, this would be offset by reductions in traffic on other roads; for example the A282 and the A2.		
Community Facilities	Direct effect on 2 areas of Open Access Land, the Condovers Scout Activity Centre, footpaths, bridleways and local cycle routes.	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 2 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 the crossing options for Routes 2, 3 and 4.

TABLE 7.3 - LOCATION C, SUMMARY TABLE – CROSSING OPTIONS

Topic	Bridge Routes 2, 3 and 4	Bored Tunnel Routes 2, 3 and 4	Immersed Tunnel Routes 2, 3 and 4
Landscape / Townscape	Adverse impact on the River Thames corridor and visual intrusion.	Minor effect	Minor effect
Historic Environment	Setting effects including on listed buildings and scheduled monuments. Potential for disturbance of currently unknown marine archaeology assets.	No significant effects.	No significant effects although potential for disturbance of currently unknown marine archaeology assets.
Biodiversity	Direct effect on SSSI, Ramsar, 2 local wildlife sites and rMCZ. Possible impact on qualifying species associated with Ramsar/ SPA e.g. through loss of functionally linked land and collision risk.	Direct effect on a local wildlife site. Possible impact on qualifying species associated with Ramsar/ SPA e.g. through loss of functionally linked land.	Direct effect on SSSI, Ramsar, 2 local wildlife sites and rMCZ some of which may be temporary. Possible impact on qualifying species associated with Ramsar/ SPA e.g. through loss of functionally linked land.
Water Environment	Direct effect on Thames rMCZ and complex hydrology.	No significant effect	Direct effect on Thames rMCZ and complex hydrology.
Air Quality (whole route with ESL)	All 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 2, 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within EU limits in the With Scheme scenario.		
Noise	Greater effects for a bridge than a tunnel once operational.	Reduced effects for a tunnel than a bridge once operational.	Reduced effects for a tunnel than a bridge once operational.
Community Facilities	Direct effect on Shorne Marshes RSPB Nature Reserve, footpaths, Sustrans National Cycle Network routes and a local trail.	Unlikely to be any direct effects.	Direct effect on Shorne Marshes RSPB Nature Reserve, footpaths, Sustrans National Cycle Network routes and a local trail.

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.	Greater intrusion into the Kent Downs AONB 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 (whole route with ESL)	All 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 2, 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within EU limits in the With Scheme scenario.	
Noise	There would be an overall noise benefit with routes 2, 3 and 4, compared with the Without Scheme scenario. 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, this would be offset by reductions in traffic on other roads; for example the A282 and the A2. Route 2 has less of a benefit with the WSL compared with the ESL. Routes 3 and 4 have more of a benefit with the WSL compared with 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.

7.2 Part One Appropriate Assessment Results

7.2.1 A Part One Appropriate Assessment is undertaken to identify the potential effects of a project on European Sites. It is more commonly known as an Appropriate Assessment but as there are currently a number of options under consideration at this early development stage of the project this is termed 'Part One' as further work will need to be undertaken. Further work will be undertaken in accordance with HD 44/09, the National Policy Statement for National Networks and Planning Inspectorate Advice Note 10.

7.2.2 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.

7.2.3 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.

7.2.4 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).

7.2.5 Given the presence of the Thames Estuary and Marshes Ramsar and 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.

7.2.6 An HRA Screening Report which comprised an assessment of whether the longlist of options would be likely to have significant effects on European Sites was prepared and engagement undertaken with Natural England. Based upon the HRA Screening Report and engagement, the following sites were identified as having the potential to be affected by the options:

- Thames Estuary and Marshes SPA
- Thames Estuary and Marshes Ramsar
- Holehaven Creek pSPA
- South Downs Woodland SAC

7.2.7 Therefore, the next stage of the HRA process was initiated and applied to the shortlist routes in the form of an initial Part One Appropriate Assessment. The initial Part One Appropriate Assessment examined in more detail the potential effects upon the above sites and the likelihood of them being significant.

7.2.8 **Tables 7.5 and 7.6** present a summary of the key effects at Locations A and C and the different crossing types.

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.

TABLE 7.5 - SUMMARY OF EFFECTS ON EUROPEAN SITES FOR LOCATION A, ROUTE 1

Route 1 – Bridge	Route 1 – Bored Tunnel
<p>Potential collision risk issues for species associated with the SPA also potential barrier/avoidance issues – if birds moving from outer estuary towards Rainham Marshes</p> <p>Potential effects of lighting on SPA species if lighting is required</p> <p>Loss of functionally linked land (mudflats) from footprint of bridge piers in and from scour/accretion around bridge piers.</p>	<p>Loss of functionally linked land (coastal floodplain/ grazing marsh at Mardyke).</p> <p>Potential for hydrogeological changes to affect ecology</p>

TABLE 7.6 - SUMMARY OF EFFECTS ON EUROPEAN SITES FOR LOCATION C, ROUTES 2, 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>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>Loss of functional habitat on north side of river</p> <p>Potential for hydrogeological changes to affect ecology</p>	<p>Disturbance during construction</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.</p> <p>Loss of functional habitat on north side of river (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>

7.2.9 The above tables demonstrate 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. In particular, for Location C Routes 2, 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.

7.2.10 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.
- But 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 which 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.

7.2.11 In view of the above the LTC team had to consider which would be the least damaging alternative and as part of this process sought Counsel advice on the application of the *Habitats Directive* to the scheme and the selection of the proposed crossing type.

7.2.12 On the basis of the appraisal results and the subsequent advice from Counsel 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 perform poorly against a number of the scheme objectives and could therefore not be taken forward and be considered a viable alternative.

7.2.13 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 and this was supported by Counsel.

- 7.2.14 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*.

8 References

Title	Document number
Appraisal Specification Report	HA540039-HHJ-ZZZ-REP-TRA-012
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. NOx and NO2 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
HRA Screening Matrix for the Long List of Options	HA540039-HHJ-ZZZ-REP-ENV-001
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
Technical Appraisal Report - Executive Summary	HA540039-HHJ-ZZZ-REP-ZZZ-009
Technical Appraisal Report - Main Report	
Technical Appraisal Report - Appendices	
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
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
AMI	Advanced Motorway Indicator, with optical feedback for enforcement.
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.
AQSO	Air Quality Strategy Objective: 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.
Armour	Riprap - also known as rip rap, rip-rap, shot rock, rock armour or rubble - is rock or other material used to armour shorelines, streambeds, bridge abutments, pilings and other shoreline structures against scour, water or ice erosion.
ASC	Asset Support Contract(or)
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 Rural and Urban 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.
BCR	Benefit-Cost Ratio, 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.
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.
BMS	Bridge Management System
BR	Bridge (when used as part of a LTC shortlist Route reference) Bridleway
BT	Bored tunnel
BTO	British Trust for Ornithology: an organisation founded in 1932 for the study of birds in the British Isles.
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
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(s): As defined in the Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 a Critical Drainage Area is "an area within Flood Zone 1 which has critical drainage problems and which has been notified... [to]...the local planning authority by the Environment Agency".
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.
Chart Datum	The level of water from which charted depths displayed on a nautical chart are measured.
CKD	Combined kerb drain(s): a combined kerb and drainage system.
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
Connect Plus	Connect Plus (M25) Ltd, management company for the Dartford-Thurrock Crossing.
CRM	Customer relationship management
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
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. It is 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.
DCC	Dartford Crossing Control Centre
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.
Deneholes	An underground structure consisting of a number of small chalk caves entered by a vertical shaft.
DFFC	Dartford Free Flow Crossing (tollbooths removed)
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
DI	Distributional Impact
Disbenefit	A disadvantage or loss resulting from something.
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
DRCC	Dartford River Crossing Control Centre
DVS	DVS Property Specialists, the specialist property arm of the Valuation Office Agency (VOA).
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.
EB	eastbound
ELHAM	TfL's East London Highway Assignment Model
EMME	Equilibre Multimodal, Multimodal Equilibrium, a complete travel demand modelling system for urban, regional and national transportation forecasting.
EMMEBANK	Neue Emme Bank Vorm.Amtersparniskasse Burgdorf
ERA	Emergency Refuge Area: on roads for use in emergency or breakdown only, located approximately every 800 metres and separated from the main carriageway.
ERT	Emergency roadside telephone(s)
ESL - Eastern Southern Link	The Eastern Southern Link (ESL) is an alternative for shortlist Routes 2, 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 any of the Routes 2, 3 and 4 north of the river utilising all of the crossing options for these route options.
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.
FP	Footpath
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
HADECS	Highways England Digital Enforcement Camera System
HAGDMS	Highways England Geotechnical Data Management System
HAM	TfL's Highway Assignment Model
Hanson	Hanson UK, part of the HeidelbergCement Group.
HATO	Highways Agency Traffic Officer
HATRIS	Highways England journey time database
HGV	Heavy Goods Vehicle
HHJV	Halcrow Hyder Joint Venture: a joint venture between Halcrow Group Limited and Hyder Consulting Limited.
HRA	Habitats Regulations Assessment: A tool developed by the European Commission to help competent authorities (as defined in the Habitats Regulations) to carry out assessment to ensure that a project, plan or policy will not have an adverse effect on the integrity of any Natura 2000 or European sites (Special Areas of Conservation, Special Protection Areas and Ramsar sites), (either in isolation or in combination with other plans and projects), and to begin to identify appropriate mitigation strategies where such effects were identified.
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
IT	Immersed tunnel
ITS	Intelligent Transportation System
Jacked box tunnelling	Jacked box tunnelling is a method of construction that enables engineers to create underground space at shallow depth in a manner that avoids disruption of valuable infrastructure and reduces impact on the human environment.
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.
LATS	London Area Transport Surveys
LCS	Lane Control Signs
LDP	London Distribution Park: offers 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 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 Option C with additional widening of the A229 between the M2 and the M20.
London Gateway	A new deep-water port, able to handle the biggest container ships in the world, and part the London Gateway development on the north bank of the River Thames in Thurrock, Essex, 20 miles (32 km) east of central London.
LPER	see Paramount London
LTC	Lower Thames Crossing: a proposed new crossing of the Thames estuary linking the county of Kent with the county of Essex, at or east of the existing Dartford Crossing.
LTS railway	London Tilbury Southend railway
LWS	Local wildlife site
Mainline	The through carriageway of a road as opposed to a slip road or a link road at a junction
Mardyke	A small river, mainly in Thurrock, that flows into the River Thames at Purfleet, close to the QEII Bridge.
MIDAS	Motorway Incident Detection and Automatic Signalling
MMO	Marine Management Organisation: 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.
MS4	The latest generation of Variable Message Signs designed to display both pictograms and text; uses internationally recognised warning symbols and provides a dual colour display matrix for amber and red coloured characters or symbols.
MTM	Medway Traffic Model
NB	northbound
NCR	National Cycle Route: a cycle route part of the National Cycle Network created by Sustrans to encourage cycling throughout Britain.
NDD	Highways England Network Development Directorate
NIA	Noise-important area(s): 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.
NMU	Non-motorised user, e.g. pedestrians, cyclists, equestrians.
NO ₂ / NO ₂	Nitrogen dioxide
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 Networks National: 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.
NRTS	National Roads Telecommunications Services

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
NTS	National Transport Survey
O&M	Operations and Maintenance
OD	Origin-destination: origin-destination data (also known as flow data) includes the travel-to-work and migration patterns of individuals, cross-tabulated by variables of interest (for example occupation).
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.
Orifice plate	A device used for measuring flow rate, for reducing pressure or for restricting flow (in the latter two cases it is often called a restriction plate). Either a volumetric or mass flow rate may be determined, depending on the calculation associated with the orifice plate.
Orthotropic steel deck plate	An orthotropic bridge or orthotropic deck is one whose deck typically comprises a structural steel deck plate stiffened either longitudinally or transversely, or in both directions. This allows the deck both to directly bear vehicular loads and to contribute to the bridge structure's overall load-bearing behaviour. The orthotropic deck may be integral with or supported on a grid of deck framing members such as floor beams and girders.
PA	Public accounts Public address
PACTS	Parliamentary Advisory Council for Transport Safety: a registered charity and an All-party parliamentary group of the UK parliament. Its charitable objective is to protect human life through the promotion of transport safety for the public benefit.
PA metrics	Production and attraction metrics
Paramount Park, London	London Paramount Entertainment Resort (LPER). A proposed theme park and entertainment precinct on the Swanscombe peninsula, Kent. Construction could begin in autumn 2016 with the opening estimated for Easter 2021.
PCF	Highways England Project Control Framework process.
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.
Penstock	A sluice or gate or intake structure that controls water flow, or an enclosed pipe that delivers water to hydro turbines and sewerage systems. It is a term that has been inherited from the earlier technology of mill ponds and watermills.
PIA	Personal Injury(ies) Accident(s)
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).
PRoW	Public Right of Way: A right possessed by the public, to pass along routes over land at all times. Although the land may be owned by a private individual, the public may still gain access across that land along a specific route. The mode of transport allowed differs

according to the type of public right of way which consist of footpaths, bridleways and open and restricted byways.

pSPA	Potential Special Protection Area: Sites which are approved by Government that are in the process of being classified as Special Protection Areas.
PSSR	Preliminary Sources Study Report
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	QURues 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.
RADAR	Radar is an object-detection system that uses radio waves to determine the range, angle, or velocity of objects, including motor vehicles.
Ramsar site	A wetland of international importance, designated under the Ramsar convention.
RCC	Regional Control Centre
RET	Range Estimation Tool
RFID	Radio-frequency identification, the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information.
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.
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.
RTMC	Regional Technology Maintenance Contract(or)
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 <i>Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora</i> . 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 project; bi-lateral meetings with SAP members have also been held.
SAR	HHJV's Pre-Consultation Scheme Assessment Report of the Lower Thames Crossing.
SATURN	Simulation and Assignment of Traffic to Urban Road Networks, Transport Model
SCADA	Supervisory Control and Data Acquisition
S-CGE	Spatial Compatible General Equilibrium
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 project.

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.’
SGAR	Stage Gateway Assessment Review: part of Highways England Project Control Framework (PCF) process.
Shortlist Route 1	A new trunk road connecting M25 Junction 2 to M25 Junction 30, with a new 4 lane bridge crossing or a 4 lane twin-bored tunnel 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).
Shortlist Route 2	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.
Shortlist Route 3	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 option of a bridge / twin-bored tunnel / immersed tunnel. 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.
Shortlist Route 4	A new trunk road connecting A2 (2 km east of Gravesend) to M25 at Junction 29, using A127 (upgrading), with dual 2 lane crossing option of a bridge / twin-bored tunnel / immersed tunnel. Single carriageway road provided from B186 to A128 parallel with the A127. See also Eastern Southern Link and Western Southern Link.
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.
SPA	Special Protection Area: A designation under the European Union Directive on the Conservation of Wild Birds.
SPECS	Average Speed Enforcement Camera System
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.
SuDS	A sustainable drainage system designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges.
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.
TAG	Transport Analysis Guidance: national guidance document produced by the Department for Transport.
TAR	HHJV’s Technical Appraisal Report of the Lower Thames Crossing.
TBM	Tunnel boring machine, machine used to excavate tunnels with a circular cross section.

TDSCG	Tunnel Design and Safety Consultation Group: formed to ensure effective design, construction and operation within the context of safety.
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)
TfL	Transport for London: created in 2000, the integrated body responsible for London's transport system.
TM	Highways England's Traffic Management (directorate)
TMC	Traffic Management Cell
TRADS	Traffic Flow Data System (holds information on traffic flows at sites on the network)
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.
TTMS	Temporary Traffic Management Signs
TUBA	Transport Users Benefit Appraisal (DfT economic appraisal software tool)
UPS	Uninterruptible power supply
Urban All Purpose	A road in an urban area designed for all types of traffic in accordance to the relevant DMRB Standards.
V/C	Volume over Capacity (volume/capacity)
VMS	Variable Message Sign, typically mounted on a portal gantry.
VMSL	Variable Mandatory Speed Limits
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.
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.
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.
WI	Wider Impacts, 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.
WSL - Western Southern Link	The Western Southern Link (WSL) is an alternative for shortlist Routes 2, 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 any of the Routes 2, 3 and 4 north of the river utilising all of the crossing options for these route options.

10 Appendices

APPENDIX 6.1 - ENVIRONMENTAL DRAWINGS

Drawing reference		Description
1	HA540039-HHJ-EGN-ZZZZZZZEG-MP-EN-0001	Landscape / Townscape Constraints
2	HA540039-HHJ-EGN-ZZZZZZZEG-MP-EN-0002	Biodiversity, Historic Environment and Planning Constraints
3	HA540039-HHJ-EGN-ZZZZZZZEG-MP-EN-0003	Internationally Designated Sites
4	HA540039-HHJ-EGN-ZZZZZZZEG-MP-EN-0004	Air and Noise Constraints and Air Quality Modelling Receptor Locations
5	HA540039-HHJ-EGN-ZZZZZZZEG-MP-EN-0005	Community Land Use Constraints
6	HA540039-HHJ-EGN-ZZZZZZZEG-MP-EN-0006	Public Rights of Way and Cycle Routes
7	HA540039-HHJ-EGN-AD0ZZZZEG-MP-EN-0003	Route 1 Bridge Land Take High Level Constraints
8	HA540039-HHJ-EGN-AD0ZZZZEG-MP-EN-0004	Route 1 Bridge Land Take Water Constraints
9	HA540039-HHJ-EGN-AA0ZZZZEG-MP-EN-0001	Route 1 Bored Tunnel Land Take High Level Constraints
10	HA540039-HHJ-EGN-AA0ZZZZEG-MP-EN-0002	Route 1 Bored Tunnel Land Take Water Constraints
11	HA540039-HHJ-EGN-CD2ZZZZEG-MP-EN-0005	Route 2 Bridge Land Take High Level Constraints
12	HA540039-HHJ-EGN-CD2ZZZZEG-MP-EN-0006	Route 2 Bridge Land Take Water Constraints
13	HA540039-HHJ-EGN-CD2ZZZZEG-MP-EN-0001	Route 2 Bored Tunnel Land Take High Level Constraints
14	HA540039-HHJ-EGN-CD2ZZZZEG-MP-EN-0002	Route 2 Bored Tunnel Land Take Water Constraints
15	HA540039-HHJ-EGN-CD2ZZZZEG-MP-EN-0003	Route 2 Immersed Tunnel Land Take High Level Constraints
16	HA540039-HHJ-EGN-CD2ZZZZEG-MP-EN-0004	Route 2 Immersed Tunnel Land Take Water Constraints
17	HA540039-HHJ-EGN-CD3ZZZZEG-MP-EN-0005	Route 3 Bridge Land Take High Level Constraints
18	HA540039-HHJ-EGN-CD3ZZZZEG-MP-EN-0006	Route 3 Bridge Land Take Water Constraints
19	HA540039-HHJ-EGN-CD3ZZZZEG-MP-EN-0001	Route 3 Bored Tunnel Land Take High Level Constraints
20	HA540039-HHJ-EGN-CD3ZZZZEG-MP-EN-0002	Route 3 Bored Tunnel Land Take Water Constraints
21	HA540039-HHJ-EGN-CD3ZZZZEG-MP-EN-0003	Route 3 Immersed Tunnel Land Take High Level Constraints
22	HA540039-HHJ-EGN-CD3ZZZZEG-MP-EN-0004	Route 3 Immersed Tunnel Land Take Water Constraints
23	HA540039-HHJ-EGN-CD4ZZZZEG-MP-EN-0005	Route 4 Bridge Land Take High Level Constraints
24	HA540039-HHJ-EGN-CD4ZZZZEG-MP-EN-0006	Route 4 Bridge Land Take Water Constraints
25	HA540039-HHJ-EGN-CD4ZZZZEG-MP-EN-0001	Route 4 Bored Tunnel Land Take High Level Constraints
26	HA540039-HHJ-EGN-CD4ZZZZEG-MP-EN-0002	Route 4 Bored Tunnel Land Take Water Constraints
27	HA540039-HHJ-EGN-CD4ZZZZEG-MP-EN-0003	Route 4 Immersed Tunnel Land Take High Level Constraints
28	HA540039-HHJ-EGN-CD4ZZZZEG-MP-EN-0004	Route 4 Immersed Tunnel Land Take Water Constraints

APPENDIX 6.2 - ENGAGEMENT WITH ENVIRONMENTAL BODIES

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The Pre-Consultation Scheme Assessment Report details the assessment of options leading up to consultation. A final Scheme Assessment Report will be published post consultation.