Lower Thames Crossing

Pre-Consultation Scheme Assessment Report

Volume 5: Traffic and Economics Appraisal

Section 13: Appendices

Volume 5

Lower Thames Crossing
Route Consultation 2016

Contents

Tables

Figures

Appendix 5.1
Approach to Modelling and Appraisal

A5.1.1 Traffic modelling

A5.1.1.1 The LTC v2 traffic model was used for the appraisal of the short listed options. This is an updated and improved version of the LTC v1 traffic model used to appraise the long list of options, the results of which were reported in the TAR.

A5.1.1.2 LTC v2 (like LTC v1) is based on the same strategic traffic model as that used by AECOM for the 2013 LTC Review as described in the 2013 Review Model Capability Report. The 2013 Review model was itself based on the M25 Traffic Model, but had been enhanced to incorporate network data from local models, most notably Transport for London's (TfL) East London Highways Assignment Model (ELHAM), and more count and journey time data.

A5.1.1.3 The M25 model had a base year of 2004 with demand derived from 2001 London Area Travel Survey (LATS) roadside interview surveys and traffic counts. The 2001 demand matrices had been uplifted to 2004 levels using matrix estimation techniques.

A5.1.1.4 Various data sources were used to enhance the M25 model to produce the 2013 Review model. A short term forecast to 2009 was produced and this served as a 2009 base for the 2013 Review model and LTC v2 model.

A5.1.1.5 LTC v2 has a base year of 2009 and two forecast years – 2025 (opening year) and 2041 (design year). However compared to LTC v1, the LTC v2 model includes a large number of changes and improvements including:

- Revised development planning assumptions.
- TRADS traffic count data from sites along and in the vicinity of the LTC and M25 to north and south. This covered data for the period from October 2013 to November 2014.
- Network coding and traffic data for routes within the M25 from TfL's river crossings' traffic model.
- Updated scheme designs to reflect the current proposals for the LTC.
- A large number of other coding corrections and enhancements.

Traffic Data

<u>Demand Data</u>

A5.1.1.6 The 2009 demand matrices had been enhanced by AECOM to make best use of available local data. The 2009 forecasts from the M25 Model were used as the basis for AECOM's LTC 2009 model demand. The M25 Model 2009 freight matrices were also retained.

<u>Land use and planning assumptions</u>

A5.1.1.7 Revised land use and planning assumptions have been developed following discussions with the local authorities in the areas potentially affected by the project. These have been discussed in detail in "Lower Thames Crossing Options Phase Uncertainty Log" but the major findings of the work are discussed below.

A5.1.1.8 The local authorities consulted with on development plans were:

- Basildon
- Brentwood
- Castle Point
- Dartford
- Gravesham
- LB Barking and Dagenham
- LB Bexley
- LB Bromley
- LB Havering
- Maidstone
- Medway
- Sevenoaks
- Thurrock
- Tonbridge and Malling

A5.1.1.9 These local authorities were selected because DfT's WebTAG guidance Unit M4 requires that uncertainty should be assessed in relation to developments located in 'the vicinity of the scheme being appraised'. This local area should include:

- All district/ unitary council areas though which the scheme passes, either in whole or in part.
- Any adjacent district/ unitary council areas where the results of the appraisal and design are likely to be sensitive to different development scenarios in those areas.

A5.1.1.10 This information has been used to develop the reference case forecast matrices for the LTC v2 traffic model.

A5.1.1.11 The LTC v2 traffic model produced forecasts for the Core Scenario. Forecasts for the Low growth scenario and an Optimistic scenario, reflecting high growth, will be produced and reported on in the Post-consultation version of the SAR.

A5.1.1.12 The uncertainty scenarios will test both national economic uncertainty and development planning uncertainty as shown in **Table A5.1.1**.

A5.1.1.13 In addition, the uncertainty scenarios take into account national economic uncertainties as documented in TAG Unit M4. In terms of national economic uncertainty, traffic growth is driven not only by demographic changes such as an increase in population, but also by GDP growth and fuel prices, both of which can affect car ownership and usage. DfT's National Trip-End Model (NTEM) trip-end growth projections take into account the effect of these factors on car ownership, but future levels of GDP and fuel prices are subject to significant national economic uncertainty. To allow for this uncertainty around the core forecasts for the Optimistic and Low scenarios, forecast ranges of ±2.5% for one year ahead, rising with the square root of the number of years, to ranges of ±15% for forecasts 36 years ahead will be used for LTC, as laid out in TAG Unit M4 (Section 4.2).

A5.1.1.14 Following a comprehensive stakeholder engagement exercise, updated development assumptions have been developed for use for LTC v2. The comparison of the forecasts for households and jobs, excluding London, between LTC v1 and LTC v2 is set out in **Table A5.1.2**.

A5.1.1.15 LTC v1 did not constrain growth to NTEM. In order to follow current guidance, LTC v2 development assumptions have been constrained to NTEM. Because of the substantial development assumptions for Dartford, Thurrock, Gravesham and Medway, this constraint was applied at the county level.

A5.1.1.16 Information from the London Boroughs has not been used directly in the forecasting assumptions. The latest version of LTS growth has been used to determine forecasts in London.

A5.1.1.17 On the basis of the numbers in **Table 2.2**, there is a forecast overall increase in the number of jobs in the local authorities but a decrease in the number of households when compared to LTC v1. The increase in jobs is primarily due to the employment prospects in Dartford, Gravesham and Thurrock. The decrease in household growth, particularly in Thurrock and Maidstone could be due to the slower build out of known development sites than was previously expected up to 2025.

A5.1.1.18 The forecast effects of the proposed London Paramount Entertainment.

A5.1.1.19 Resort and other key assumptions are discussed in **Appendix A5.2**.

TABLE A5.1.1 - FORECASTING UNCERTAINTY

Scenario	National growth	Development planning		
		Probability	Definition	Status
Low	Low	Near Certain	The outcome will happen or there is a high probability that it will happen	Intent announced by proponent to regulatory agencies Approved development proposals Projects under construction
Core	Central	More than Likely	The outcome is likely to happen but there is some uncertainty	Submission of planning or consent application imminent Development application with the consent process
High	High	Reasonably Foreseeable	The outcome may happen, but there is significant uncertainty	Identified within a development plan Not directly associated with the transport strategy/ scheme but may occur if the scheme is implemented Development condition upon the transport/ scheme proceeding A committed policy goal subject to tests whose outcomes are subject to significant uncertainty

TABLE A5.1.2 - LTC V1 LOCAL PLANNING DATA GROWTH FORECAST COMPARED TO DRAFT LTC V2 LOCAL PLANNING DATA GROWTH FORECAST (2009 TO 2025)

Location	LTC v1		LTC v2		Difference (%)	
	Households	Jobs	Households	Jobs	Households	Jobs
Basildon	6,501	8,423	6,800	7,000	**5**	**-17**
Brentwood	2,090	4,000	7,585	1,769	**263**	**-56**
Castle Point	1,865	2,117	4,086	2,110	**119**	**0**
Dartford	14,395	22,610	18,403	43,817	**28**	**94**
Gravesham	3,650	2,491	5,249	5,168	**44**	**107**
Maidstone	10,051	7,666	5,478	1,517	**-45**	**-80**
Medway	15,494	15,634	13,279	13,327	**-14**	**-15**
Sevenoaks	2,718	5,180	1,196	2,146	**-56**	**-59**
Southend-on-Sea	5,079	10,635	-	-	**-**	**-**
Thurrock	18,781	17,344	12,460	27,617	**-34**	**59**
Tonbridge and Malling	7,595	2,983	5,078	67	**-33**	**-98**
Total (Districts)	88,219	99,083	79,614	104,538	**-12**	**5**

*Basildon and Sevenoaks District Councils provided NTEM derived employment forecasts

Network data

A5.1.1.20 The latest version of the TfL LoHAM model provided updated coding for the London area within the M25 London.

Dart Charge

A5.1.1.21 The modelling of the Dart Charge scheme in LTC v2, and its impact on journey times and on the average charge paid, followed the same approach as that used in the LTC v1 model and took account of the revised capacities of the crossing following the introduction of free-flow tolling in 2014. The modelling assumptions are set out below:

- A capacity northbound of 5,612 pcu per hour and southbound of 6,687 pcu per hour.
- Southbound (20mph) the toll booths were removed, increasing capacity to that of the approach road.
- Northbound (20mph) the toll booths were removed but the tunnel standard acts as a constraint and traffic signalisation has been modelled on the approach to represent the operation of the Traffic Management Cell (TMC).
- TMC data on the frequency and duration of interventions to deal with over -height or unregistered dangerous goods has been used to represent signalling in the model to estimate the occurrence and duration of red lights.
- It has been assumed that TMC has a constant operational level with no efficiencies.
- There is an assumed increase in capacity in the southbound direction, but due to the introduction of traffic signals to represent the TMC in the northbound direction the capacity has been reduced in the forecast networks compared to the base year model.

Zoning

A5.1.1.22 The LTC v2 model has been modified to provide a greater level of demand zone disaggregation in the key study area and includes additional network information to make best use of the existing model. Currently the LTC v2 model is based on 1,207 zones.

Charging

A5.1.1.23 The assumption for all of the modelled LTC options in Version 2 is that they replicate the charging regime at the existing Dartford Crossing. This takes into account the effects of Dart Charge introduced in 2014. Charges are assumed to remain constant in real terms (i.e. they only rise at the same rate as inflation).

Transaction Data

A5.1.1.24 Transaction data for the Dartford crossing was obtained by AECOM and used to derive counts on the crossing for use in the traffic model. The data was also used to derive average monetary tolls paid in each modelled time period used in both the assignment and demand models and was also used to derive annualisation factors to convert the results for the modelled time periods to annual equivalents

Base Year Model Calibration and Validation

A5.1.1.25 In developing the 2013 Review Model, AECOM obtained observed traffic and journey time data from a number of different models within the region with some strategic road network data having been extracted from Highways England's HATRIS journey time database. The years for these data sources varied and therefore annualisation and seasonality factors were applied. Network calibration was undertaken on a corridor basis and the model coding was deemed satisfactory for the purpose of the study. Assignment of the prior matrices demonstrated that the level of demand within the matrices was broadly consistent with the count data and the performance of the routing in the traffic model against the prior matrix was reasonable.

A5.1.1.26 Validation of the post matrix estimation matrices showed that they broadly represented observed movements within the study area with screenline totals of 96%, 100% and 100% for the AM, inter-peak and PM peak periods respectively. At a strategic route level a good level of calibration was achieved with 81%, 86% and 84% in the AM, inter-peak and PM peak periods respectively. In commencing the LTC Options phase, HHJV accepted that the 2013 Review Model represented a reasonably accurate representation of traffic flows within the study area and was suitable for use in the LTC options phase.

A5.1.1.27 HHJV has not made any changes to the 2013 Review base year model and therefore all documentation regarding that model remains current.

A5.1.1.28 HHJV used the 2013 Review model forecasts as the basis for the long list assessment for the LTC Options Phase. HHJV has undertaken a review of the assumptions used in producing these forecasts. Two model years are assessed, 2025, the opening year and a design year, typically 15 years later, but in the case of LTC, 2041, 16 years later. 2041 was selected as it is the maximum horizon year for current growth assumptions.

Resilience modelling

A5.1.1.29 **Figures A5.1.1 to A5.1.3** show changes in traffic flows in the modelled network as a result of the closure of the western tunnel in the inter-peak hour in 2025. Blue lines show decreases in flow and green show increases in flow. The outcomes are reported below each figure.

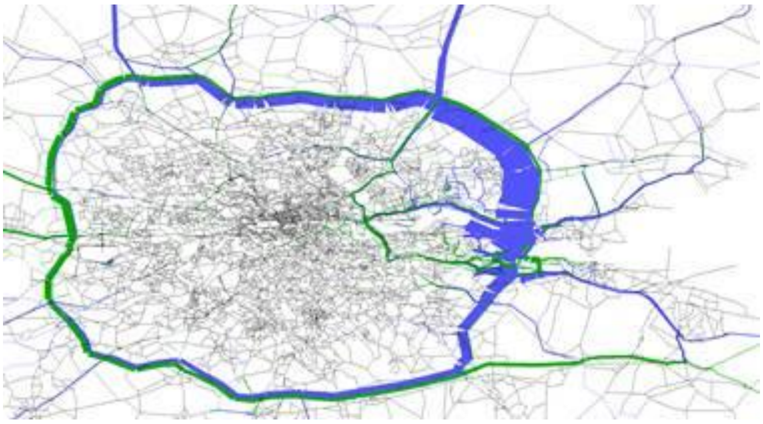

FIGURE A5.1.1 - 2025 INTER-PEAK WITHOUT SCHEME

Outcome: Transfer to western M25 and Blackwall Tunnel or sit in the queue.

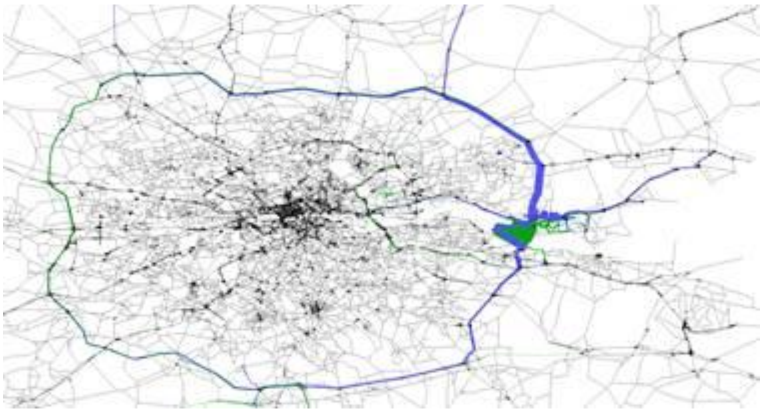

FIGURE A5.1.2 - 2025 INTER-PEAK ROUTE 1

Outcome: Most of the western tunnel flow transfers to new crossing at Dartford, small transfer to western M25 and Blackwall Tunnel.

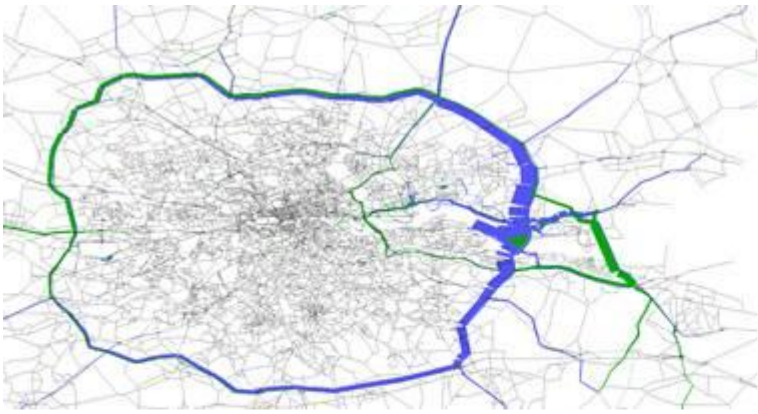

FIGURE A5.1.3 - 2025 INTER-PEAK ROUTE 3 ESL

Outcome: Some transfer to the east tunnel, and approx. 300 vehicles transfer to new Route 3 crossing. Some transfer to western M25 and Blackwall Tunnel.

A5.1.2 Economic appraisal

A5.1.2.1 The purpose of the economic appraisal is to examine the extent to which the investment in the alternative options for the LTC represents good value for money and to identify the options which produce the highest economic returns, a factor which will inform the choice of the proposed solution. This process compares the impacts that would result from the construction of the project which can be measured in monetary terms with the associated costs. The approach to the economic appraisal follows the standard approach set out in DfT's WebTAG guidance.

A5.1.2.2 The main data sources on which the economic assessment has been based include:

- The outputs of the V2 traffic model
- The outputs of the TUBA appraisal tool to determine journey time, vehicle operating cost, user charge and greenhouse gas impacts
- The outputs of the QUADRO modelling to determine impacts during maintenance periods
- Data on economic parameters derived from the WebTAG databook
- Accident rates and costs derived from the COBALT programme
- Noise parameters

A5.1.2.3 For this appraisal the benefits have been assessed over a 60 year period starting with the assumed opening of the scheme in 2025 and continuing until 2084. The costs have been appraised over a longer period to reflect those which would be incurred as the scheme is developed and constructed before it is open to traffic. Both of these have been discounted at a rate of 3.5% per year for the period up to 2044 and 3% subsequently. This is in line with standard Government practice as set out in the Treasury's Green Book. Benefits have been directly calculated for 2025 and 2041 and a linear interpolation has been used to calculate annual benefits between 2025 and 2041. After 2041 the underlying benefits in terms of time and distance related savings have been taken to be constant and have just been increased by the changes in the values of time and vehicle operating cost factors.

A5.1.2.4 The results are based on the outputs of the v2 traffic model for the AM peak, inter-peak and PM peak periods with annualisation factors applied to convert these to annual totals. The annualisation factors also take account of the potential economic impacts for the periods that are not modelled in detail. These periods comprise:

- The evening and night-time period between the PM peak and the AM peak.
- Weekends and bank holidays.

Types of benefits

A5.1.2.5 The scheme benefits comprise a number of economic elements. These include:

- Journey time savings
- Vehicle operating cost (VOC) savings
- Changes in user charges
- Delays to users from construction work
- Monetised environmental effects (in this case comprising the effects of changes in greenhouse gas emissions and noise impacts)
- Changes in general tax revenues

A5.1.2.6 These elements have been assessed using the TUBA program (Version 1.9.5). TUBA also provides splits of journey time savings, VOC savings, user charges and delays to users from construction work between:

- Business users including goods vehicles
- Commuters
- Other car users

A5.1.2.7 In addition TUBA also estimates the change in general tax revenues received by the Government because of the increase in expenditure on transport.

A5.1.2.8 The V2 traffic model is being used to estimate the delay impacts to users during construction.

A5.1.2.9 All of these impacts are presented in Transport Economic Efficiency (TEE) Tables.

A5.1.2.10 Delays to users during programmed maintenance work have not yet been assessed.

<u>Transport Economic Efficiency</u>

A5.1.2.11 HHJV followed a standard process, common across Highways England schemes, for the appraisal of Transport Economic Efficiency (TEE) benefits. TUBA v1.9.4 was used, along with the standard economics file compatible with May 2014 release of the WebTAG databook. The following changes were made in the use of TUBA compared to the previous AECOM work.

A5.1.2.12 User classes include:

- HGV
- LGV
- Car – Business
- Car – Other (No toll)
- Car – Other (Toll 1)

A5.1.2.13 Although the more complex construction solutions would open a little later than the simplest route options, the appraisal period used in all cases was the WebTAG standard sixty years, from an opening year of 2025 through to 2084:

- The matrices used were vehicle matrices from the five user class models (Without Scheme and Location A schemes) and six user class model (Location C schemes).
- The TUBA scheme files were set up to use HHJV calculated annualisation factors for the AM, inter-peak and PM peak periods, and also for the busy charged periods in the off-peak and at weekends.
- The separate non-business car matrices linked to the use of the Dartford Crossing and Location C (Routes 2, 3, 4 and the Alternative Southern Link) crossings were combined so as to provide a direct match to the Without Scheme Dartford Crossing non-business car matrices in the Location C TUBA runs.

A5.1.2.14 These changes permitted a straightforward TUBA run which could be checked using normal HHJV procedures. Following the run, the benefits which would accrue during the quieter, non-charged, off-peak and weekend periods were added by using factors derived from the annualisation factors.

A5.1.2.15 The TUBA results are reported in the TEE tables and feed into the Public Accounts (PA) and Annualised Monetary Costs and Benefits (AMCB) tables, into which values resulting from the safety, greenhouse gas emissions and wider benefit assessments were inserted. To simplify the process, outturn cost estimates were produced for each option and PVCs were calculated within a spreadsheet rather than in TUBA. The WebTAG compliant process involved factoring back the inflation indexed prices provided from Highways England’s commercial services, to 2010 prices using the GDP deflator and discounting the expenditure programmed for each year to 2010 using the standard discount rate of 3.5% for the first 30 years and 3.0% thereafter.

Wider Economic Impacts

A5.1.2.16 Two wider economic impacts have been assessed for each route option and estimates of their benefits have been included in the Adjusted BCRs:

- Wider Impacts
- Journey time reliability

Wider Impacts (WI)

A5.1.2.17 Three types of WI benefits have been appraised in line WebTAG guidance unit A2.1:

- Agglomeration.
- Output change in imperfectly competitive markets.
- Tax revenues arising from labour market impacts (from labour supply impacts and from moves to more or less productive jobs).

A5.1.2.18 The appraisal was carried out using the LTC Version 2 (LTC v2) traffic model and the wider impacts model developed by AECOM for the 2013 LTC Review.

WI Data

A5.1.2.19 The calculation of wider impacts relies on data from three main sources.

<u>1. LTC Traffic model</u>

A5.1.2.20 The LTC traffic model provides highway travel costs and demand data for the following 13 journey purposes:

- Low income commuters
- Middle income commuters
- High income commuters
- Home based business trip makers
- Low income home based trip makers for other journey purposes
- Middle income home based trip makers for other journey purposes
- High income home based trip makers for other journey purposes
- Non-home based business trip makers
- Low income non-home based trip makers for other journey purposes
- Middle income non-home based trip makers for other journey purposes
- High income non-home based trip makers for other journey purposes
- Light goods vehicles
- Heavy goods vehicles

A5.1.2.21 The steps in **Figure A5.1.4** below set out the process undertaken for extracting data. The initial step involves extracting data from various traffic modelling tools and storing it within EMMEBANK which consist of data on production and attraction (PA) metrics. The next step relates processing the PA data to an origin destination format and calculates weighted average cost from the different modelled hours to a 24 hour cost for both home-based and non-home based trips. Finally the processed data is aggregated to cover the geography of the wider impacts model. Journey time data has also been averaged across outbound and reciprocal directions.

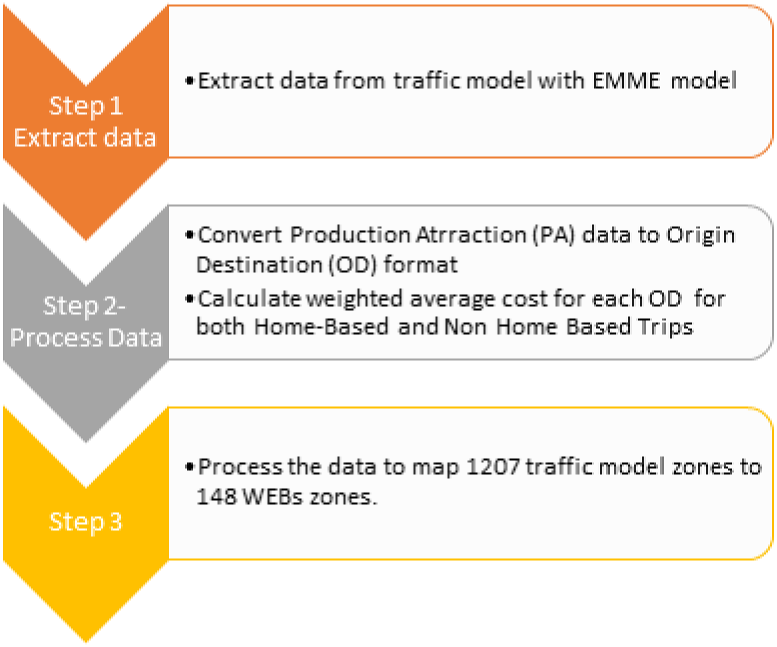

FIGURE A5.1.4 - TRANSPORT MODEL DATA EXTRACTION STEPS

A5.1.2.22 For the purpose of the Wider impacts analysis data has been grouped in to the following categories:

- All segments
- Commuters
- Business trip makers
- Freight

A5.1.2.23 The Traffic model data has been collected for the years 2009, 2025 (Opening year) and 2041 (Design year). Data has been sourced for each of the years for a Without Scheme scenario and for With Scheme scenarios for each LTC option.

2. DfT Wider Impacts dataset

A5.1.2.24 DfT's Wider Impacts dataset contains the following set of relevant economic data and parameters:

- Employment.
- GDP per Worker.
- Elasticities to capture Labour supply impacts and Productivity changes.
- Other economic parameters such as tax rate and productivity index.

A5.1.2.25 This data is provided for four business sectors:

- Construction
- Consumer services

- Manufacturing
- Producer services

A5.1.2.26 Projections for employment until 2041 are based on NTEM version 6.2 and the post-2041 projections are consistent with HM Treasury's long-run assumptions.

A5.1.2.27 NTEM datasets are long-term forecasts - they represent the department's best estimate of the long-term response to demographic and economic trends. The forecasts are run for 2001 and at 5 year intervals to 2041 - for intermediate years, the forecasts are interpolated linearly.[1]

3. National Travel Survey

A5.1.2.28 The calculation of Wider Impacts requires data for journey times averaged across all modes. Data for transport costs and demand for non-highway modes is not present in the LTC Model. A mechanism was required to estimate bus, rail and waking and cycling generalised costs and demand.

A5.1.2.29 The mechanism, which was adopted from the 2013 review, used National Travel Survey (NTS) data to construct the appropriate demand and cost matrices for bus and rail journeys.[2] Individual journey records from the NTS contain information about the time and distance of journeys made by different modes, together with their starting and ending points. At a regional level, using data from the NTS, measures were created of:

- Bus demand as a share of car demand
- Rail demand as a share of car demand
- Bus generalised cost as a share of car generalised cost
- Rail generalised cost as a share of car generalised cost

A5.1.2.30 The generalised cost estimates derived from NTS are based on assumptions about values of time, average vehicle operating costs per kilometre and average vehicle occupancies.

A5.1.2.31 Walking and cycling modes have been treated differently. Walking generalised costs are estimated using a rate of 15 minutes per kilometre and cycling at a rate of 4 minutes per kilometre. Distances have been sourced from the LTC Model. The average value of time for car trips derived from the LTC Model has been used to convert these times into generalised costs.

A5.1.2.32 Demand for walking and cycling modes has been based on national trip data from Transport Statistics Great Britain 2011. This describes how mode shares vary with distance. From this data, a relationship has been developed to estimate walking and cycling demand as a share of car demand at different trip distances.

A5.1.2.33 It is assumed that no walk or cycle trips are made for journeys over 25km.

[1] DfT (2014): TEMPro Important information https://www.gov.uk/government/publications/tempro-important-information

[2] AECOM (2013): Lower Thames Crossing Review Report

WEBs Impacts

A5.1.2.34 An assessment of Wider Impacts (WIs) for each of the long listed route options has been carried out using the LTC Wider Impacts (WI) model.[3] This model is based on the Wider Impacts model used in the 2013 Review. However HHJV has updated the model with minor structural amendments; with changes to the calculation methodology for effective density and discounting, to be consistent with the Wider Impacts methodology in DfT's WebTAG guidance[4]; and in significantly reducing the model's running time.

Type of impacts

A5.1.2.35 The following wider impacts have been estimated for each of the LTC route options in line with WebTAG

- WI1 - Agglomeration resulting from moves to more or less productive jobs
- WI2 - Output change in imperfectly competitive markets
- WI3 - Tax revenues arising from labour market impacts

A5.1.2.36 In line with other components of the economic benefits, all WEBs have been *assessed* over a 60 year appraisal period from 2025 to 2084.

Geography

A5.1.2.37 The Wider Impacts model consists of 148 zones (129 in London, south east and east of England, 19 zones elsewhere). The generalised cost and demand data from the traffic model has been aggregated to these zones using demand weightings. Journey time changes have been masked to exclude those which do not have an origin or destination within Kent, Essex or certain London boroughs.

A5.1.2.38 The masking has been implemented to enable the net national Wider Impacts to be captured while avoiding spurious results from small changes in journey times in remote locations.

Agglomeration

A5.1.2.39 Agglomeration refers to the concentration of economic activity in an area and is measured using effective density. Where a transport scheme facilitates a reduction in journey times and therefore generalised cost[5], this alters the accessibility of firms in an area to other firms and workers to deliver improvement in relative agglomeration. The benefits arise as businesses and its labour are better connected, yielding additional productivity through spill-over benefits such as improved labour market matching and the sharing of ideas, technology and best practice.

[3] The terms Wider Economic Benefits (WEBs) and Wider Impacts (WI) are used interchangeably.

[4] DfT WebTAG guidance, Unit A2.1, Wider Impacts

[5] The base demand was used to avoid counter-intuitive changes in generalised costs, by keeping the demand matrix fixed. This is consistent with DfT guidance.

A5.1.2.40 Changes in effective economic density from the transport investment are translated into changes in productivity using an econometric relationship.[6] Each area's change in productivity is then multiplied by its existing level of output, whereby the largest agglomeration impacts will likely occur in areas with significant decreases in generalised cost and a significant existing business base.

Change in Output in Imperfectly Competitive Markets

A5.1.2.41 A reduction in the costs of transport allows businesses to operate more efficiently - it allows them to raise their output due to a reduction in their business costs. This forms as an additional welfare impact, where in imperfectly competitive markets firms set prices above the marginal cost of production, resulting in the increased (or decreased) output being valued more highly by consumers than the cost of producing this output

A5.1.2.42 The change in output in imperfectly competitive markets has been calculated based on the modelled value of business travel time savings. The calculations of these WI2 benefits assume that 10% of the change in business costs is passed onto consumers as an additional welfare benefit. This Wider Impact is in addition to the business user benefits which are captured in the TUBA user benefits.

Tax Wedge on Labour Market Impacts

A5.1.2.43 Decisions about whether to take a job are based on the combination of wages and commuting costs. As the costs of commuting change, these decision can result in a potential increase or decrease in the supply of labour. Reductions in journey time or cost will increase the returns from the combination of working and commuting and are likely to result in greater labour supply. The benefits to the individual are assumed to be captured in user benefits. However the change in tax revenues that results from the labour market impacts is what is being captured as part of WI3 calculations.

Journey Time Reliability

A5.1.2.44 Estimates have been calculated of the impacts of the options on Journey Time Reliability. This was done using the urban equation for journey time reliability provided in the WebTAG guidance. These benefits are included in the Adjusted BCRs.

A5.1.3 Social impact appraisal

A5.1.3.1 A social impact appraisal was carried out for the short listed options (core scenarios) in line with WebTAG Unit A4.1.

A5.1.3.2 The impacts of accidents have been quantified and monetised. Qualitative assessments of the impacts of the route options on journey quality, severance and security were carried out and are summarised in Chapter 6.

A5.1.3.3 The methods used to appraise each impact are summarised below.

[6] The effective density depends on the destination's employment level and generalised costs decayed by the distance parameter.

Accidents

A5.1.3.4 The number and value of additional accidents and fatalities were calculated using DfT's COBALT tool. This forecasts the economic costs and benefits associated with changing accident and casualty patterns following the provision of new or improved roads. HHJV used COBALT to refresh the safety assessment of the LTC route options. The calculations were performed over a more restricted area due to the lack of link attributes included the traffic model. There are two other differences compared to the previous AECOM modelling:

- Buffer links were excluded, as these are not modelled fully by SATURN.
- Spigot links were excluded, as these are added to the model solely as a means of introducing traffic to the simulation area and are not 'real' links.
- Some minor changes to the Without and With Scheme networks were necessary to reflect changes made to the traffic models particularly in the vicinity of M25 Junction 30 and M2 Junction 3.

A5.1.3.5 Otherwise the COBALT input files were prepared directly using Access and Excel from the original AECOM spreadsheets. The accident rates for each link used by AECOM were retained. In view of the extent of the network, the appraisal was for the most part undertaken using default accident rates for links and junctions combined. These rates were established in COBALT's predecessor program, COBA. This is a standard approach but does not take account of local conditions. The data collection and processing which would be required to use observed accident rates on a network of this size would be unrealistic at this stage in the development of the project.

A5.1.3.6 However, COBA accident rates for some road types had been replaced by AECOM with rates they had derived in the free-flow charging study. This data was based on observed accident data collected in and around the Dartford - Thurrock area. These modified rates were retained in the COBALT runs and were applied to all links in the particular road categories.

A5.1.3.7 Accidents costs have been appraised using COBALT Version 2013.2. The model estimates the number of accidents by summing the product of accident rates and forecast annual flows for each link using the relationships built into the software. Accident rates in terms of personal injury accidents per million vehicle kilometres are defined for different link types. COBA accident rates for some road types were replaced by AECOM with those derived in the free-flow charging study. The traffic flows are derived from the LTC model. The costs of accidents are calculated by multiplying the numbers of accidents by type by the unit costs set out in the WebTAG data book.

A5.1.3.8 Changes in the number of accidents are primarily driven by changes in traffic flows, although they are also affected by the switching of traffic between roads with accident characteristics. As in the case of the greenhouse gas emissions compared to the without scheme case the increases in traffic taking advantage of the expanded opportunities for travel result in increased accident costs.

A5.1.3.9 The appraisal has taken account of traffic flows over a fairly wide area of southeast and eastern England. While the use of a large network for appraisal does provide a potentially comprehensive assessment of the possible impacts, there is some risk that modelling noise away from the main study area, shifting traffic between links with different accident characteristics may impact unduly on the estimated results and these findings therefore need to be treated with caution. The changes in accident costs between the Without Scheme and Do Something scenarios only represent about 0.3 per cent of the total accidents estimated for each scenario.

Physical Activity

A5.1.3.10 To achieve the scheme objectives for LTC one of the project requirements is to include provision for non-motorised users (cyclists and pedestrians). In the appraisal of the route options, impacts on physical activity refers to the physical activity of these road users. During the options phase provision for non-motorised users has been considered but has not yet been incorporated into the designs for the route options.

Journey Quality

A5.1.3.11 A qualitative approach to assessing journey quality has been taken. Each option has been assessed using three key areas capturing the impacts on the user journey that are not covered in the traffic modelling: traveller care; travellers' views; and traveller stress.

- Traveller care covers aspects such as level of facilities and cleanliness. In a highways project this could relate to road side stations and roads free of debris.
- Traveller views from a highways perspective covers the view and pleasantness of external surroundings and includes visibility linked to safety.
- Traveller stress covers frustration, fear of accidents and route uncertainty.

A5.1.3.12 The rankings for journey quality are based on a scale of beneficial, neutral and adverse. Where beneficial and adverse impacts affects 10,000+ users, the effect is "high beneficial" or "high adverse", smaller impacts are categorized as moderate or low. The assessment has been based on the assumption that no new provision would be made for pedestrians and cyclists.

Severance

A5.1.3.13 An assessment of the community facilities is included in Volume 6.

A5.1.3.14 An assessment of public rights of way (footpaths, bridle paths and cycle routes) has been prepared for Volume 5, the results of which have been used to help complete the Appraisal Summary Tables (AST) using a qualitative scoring. Each route has been given a score based on the level of severity of the severance and the number of people affected. The number of people that are likely to be affected has also been presented. These figures have been based on ONS 2011 Census travel to work data at Middle Super Output Area level and have been forecast to 2025 based on NTEM growth factors.

Property Acquisition

The assessment of property acquisition is described in Volume 4.

Security

A5.1.3.15 WebTAG Unit A4.1 requires an assessment of the changes in security and the likely numbers of users affected. It does not however, provide formal guidance for highways schemes. In order to assess the impacts, a qualitative review of the security considerations and impacts has been carried out drawing on the Table of security indicators in WebTAG Unit A4.1. The WebTAG security worksheet has been completed and included in the report providing a ranking for each route based on the qualitative review. The impacts for each route have been compared to the without scheme scenario to identify the potential level of change that will occur.

A5.1.3.16 At this stage a very high level assessment has been carried out. Security will be explored in more depth at the development stage of the project.

Accessibility

A5.1.3.17 WebTAG guidance on accessibility is for appraising public transport schemes. LTC is a road scheme and consequently the guidance is not appropriate for this appraisal. Accessibility has instead been assessed through severance, NMU impacts (measured in physical activity) and time savings.

Personal Affordability

A5.1.3.18 Assessing changes to personal affordability is part of the WebTAG Unit A4.1. This is carried out when changes are made to user costs. No changes in real terms have been made to the user costs in the core scenarios in respect of the charges to cross the river crossing. Consequently an assessment of personal affordability has not been carried out.

A5.1.4 Benefit cost ratios

A5.1.4.1 The economic and social returns from the options can be measured in several different ways. These include:

- The total discounted benefits of the option referred to as the Present Value of Benefits (PVB).
- The extent to which the discounted benefits exceed the discounted costs of construction and operation, referred to as the Present Value of Costs (PVC). This difference is known as the Net Present Value (NPV).
- The ratio of the PVB and PVC is known as the benefit-cost ratio or BCR.

A5.1.4.2 In a scenario where there are ample funds for investment the NPV is a useful measure. However where funds are constrained the BCR is the more useful indicator of value for money and is the one which is recommended for use in WebTAG.

A5.1.4.3 In line with WebTAG guidance, two BCRs were calculated for each of the options:

1. An Initial BCR which includes all benefits and costs except WEBs and Journey Time Reliability benefits.
2. An Adjusted BCR which also incorporates WEBs and Journey Time Reliability benefits.

A5.1.4.4 **Tables A5.1.3** and **A5.1.4** present the appraisal results for Routes 1 to 4 for each crossing type (bridge, bored tunnel and immersed tube tunnel) with the Western Southern Link and the Eastern Southern Link.

A5.1.5 Distributional Impact Appraisal

A5.1.5.1 The purpose of the distributional impact (DI) analysis is to identify where there are particularly high concentrations of specific demographic groups in the impact areas of the short listed options. It is also to identify which groups in society will be most affected by the project in either a positive or negative way. DI analysis will be carried out for the Post-consultation version of the SAR.

TABLE A5.1.3 - APPRAISAL RESULTS ROUTES 1 AND 2

	R1		R2/WSL			R2/ESL		
PVB (£bn)	BR	BT	BR	BT	ITT	BR	BT	ITT
Greenhouse Gases	-0.144	-0.144	-0.260	-0.260	-0.260	-0.284	-0.284	-0.284
Accidents	-0.074	-0.074	-0.126	-0.126	-0.126	-0.118	-0.118	-0.118
Travel time	2.310	2.310	3.393	3.393	3.393	3.468	3.468	3.468
VOC	0.049	0.049	0.031	0.031	0.031	0.212	0.212	0.212
User charges	-0.124	-0.124	-0.107	-0.107	-0.107	-0.123	-0.123	-0.123
Indirect Taxation	0.269	0.269	0.550	0.550	0.550	0.585	0.585	0.585
Noise	-0.001	-0.001	0.003	0.003	0.003	0.004	0.004	0.004
Construction delays	-0.291	-0.291	n/a	n/a	n./a	n/a	n/a	n/a
Total (excl WEBs & Reliab)	1.995	1.995	3.483	3.483	3.483	3.744	3.745	3.745
PVC (£bn)	1.222	1.372	1.285	1.370	1.515	1.380	1.464	1.610
NPV (£bn)	0.773	0.623	2.198	2.114	1.968	2.365	2.280	2.135
Initial BCRs	1.6	1.5	2.7	2.5	2.3	2.7	2.6	2.3
WEBs (£bn)	0.737	0.737	1.264	1.264	1.264	1.626	1.626	1.626
Reliability	0.135	0.135	0.142	0.142	0.142	0.146	0.146	0.146
Adjusted BCRs	2.3	2.1	3.8	3.6	3.2	4.0	3.8	3.4

BR = bridge   BT = bored tunnel   ITT = immersed tube tunnel   n/a = not appraised

TABLE A5.1.4 - APPRAISAL RESULTS FOR ROUTES 3 AND 4

	R3/WSL			R3/ESL			R4/WSL			R4/ESL		
PVB (£bn)	BR	BT	ITT	BR	BT	ITT	BR	BT	ITT	BR	BT	ITT
Greenhouse Gases	-0.273	-0.273	-0.273	-0.288	-0.288	-0.288	-0.289	-0.289	-0.289	-0.304	-0.304	-0.304
Accidents	-0.128	-0.128	-0.128	-0.120	-0.120	-0.120	-0.121	-0.121	-0.121	-0.113	-0.113	-0.113
Travel time	3.119	3.119	3.119	3.489	3.489	3.489	3.235	3.235	3.235	3.514	3.514	3.514
VOC	0.124	0.124	0.124	0.333	0.333	0.333	0.009	0.009	0.009	0.210	0.210	0.210
User charges	-0.117	-0.117	-0.117	-0.131	-0.131	-0.131	-0.100	-0.100	-0.100	-0.112	-0.112	-0.112
Indirect Taxation	0.565	0.565	0.565	0.589	0.589	0.589	0.603	0.603	0.603	0.629	0.629	0.629
Noise	0.011	0.012	0.012	0.009	0.010	0.010	0.014	0.015	0.015	0.012	0.012	0.012
C&M delays	n/a	n/a	n/a	-0.026	-0.026	-0.026	n/a	n/a	n/a	n/a	n/a	n/a
Total (excl WEBs & Reliab)	3.300	3.300	3.300	3.856	3.856	3.856	3.353	3.353	3.353	3.836	3.837	3.837
PVC (£bn)	1.264	1.354	1.498	1.358	1.447	1.592	1.454	1.548	1.688	1.555	1.649	1.781
NPV (£bn)	2.036	1.947	1.802	2.498	2.409	2.264	1.898	1.805	1.665	2.281	2.188	2.056
Initial BCRs	2.6	2.4	2.2	2.8	2.7	2.4	2.3	2.2	2.0	2.5	2.3	2.2
WEBs (£bn)	1.353	1.353	1.353	1.677	1.677	1.677	1.678	1.678	1.678	1.735	1.735	1.735
Reliability	0.143	0.143	0.143	0.147	0.147	0.147	0.146	0.146	0.146	0.150	0.150	0.150
Adjusted BCRs	3.8	3.5	3.2	4.2	3.9	3.6	3.6	3.3	3.1	3.7	3.5	3.2

BR = bridge BT = bored tunnel ITT = immersed tube tunnel n/a = not appraised

Appendix 5.2
Paramount London

A5.2.1 Introduction

A5.2.1.1 London Paramount Entertainment Resort (LPER) would be a major development that would generate a large amount of leisure and employment traffic on the road network around the existing Dartford Crossing and LTC crossing locations. However the information that is currently available to HHJV is insufficient to enable LPER to be incorporated into the V2 traffic model.

A5.2.1.2 To model the impacts of LPER, HHJV will need much more detailed technical information. Despite requests this information has not yet been provided to HHJV. Given the scale and importance of LPER on the choice LTC corridor and number of traffic lanes, it is not possible or appropriate to simply make assumptions.

A5.2.1.3 The technical information that is needed would be included within the Transport Assessment that LPER needs to produce to support its DCO application which HHJV understands is unlikely to be submitted until 2016.[7] Therefore the LTC short list appraisal results within the Business Case and included in the Public Consultation do not take account of LPER. Specifically the technical information needed to model LPER would cover:

- The spatial distribution of visitor and employee trips to and from the Resort i.e. what geographical areas are people coming from to get to the Park and what routes are they likely to take.
- How traffic flows to and from LPER vary by time of day i.e. what will be the peak periods for visitor and employee trips.
- What will be the highway modal shares for people getting to and from the LPER.

Likely impacts of LPER

A5.2.1.4 It is possible to make a qualitative assessment about the likely impacts. These are:

- LPER will be much larger than other leisure parks in the UK and the may be inappropriate to simply scale up the pattern of trips from other parks.
- Given the Resort’s proximity to London, a large share of its visitors are likely to come from the capital. However it is unclear what proportion of visitors that will be and what the overall spatial distribution of trips to and from the Resort.
- The opening and closing times for LPER are unknown, but are likely to be similar to those for other UK leisure parks (typically 10am to 5pm). Therefore the peak periods for visitor traffic to and from the Resort will be slightly different to the peak periods (7am to 9am and

[7] Even with the technical information about LPER, it will still be a major task to incorporate LPER into the LTC v2 model and test its impact on the road network.

4pm to 7pm) on the strategic road network (SRN). The peak periods for employee traffic might be more similar to the peak periods on the SRN.

- Many of the Resort's employees are likely to come from the local area, although London could provide a significant share of employees.
- The Resort is close to Ebbsfleet International railway station and some form of shuttle bus service is expected to be provided between Ebbsfleet and the Resort. However, in view of the nature of the Resort and the number of planned car parking spaces, the expected public transport usage for visitors is likely to be relatively low, but the precise share is unknown. Similarly the employee share of public transport is unknown.

A5.2.1.5 Based on the above qualitative assessment, the inclusion of Paramount within V2 might indicate that a dual-3 lane crossing is needed at Option A or Option C. It would also make Highways England's current work on A2 Bean to Ebbsfleet redundant and require a more detailed network-wide assessment of what supporting schemes are required to maintain network performance and the extent to which LPER should provide developer contributions.

Approach to LPER

A5.2.1.6 Given the lack of information about LPER and the uncertainties inherent in the qualitative assessment set out above, the Highways England's LTC Appraisal Certifying Officer has advised that HHJV should not seek to model LPER based on assumptions, but should wait for the production of the Transport Assessment report to inform how we should incorporate LPER into the V2 model.

Appendix 5.3
Journey Quality Assessment Tables

TABLE A5.3.1 - JOURNEY QUALITY ASSESSMENT TABLES

		Without Scheme Scenario	
Factor	Sub Factor	Construction Stage	Operational Stage
Traveller Care	Cleanliness	na	Neutral.
	Facilities	na	Existing facilities are available for motorists on the A2828 and M25 including service stations. However there are limited facilities along existing narrow roads at the sites of the route options.
	Information	na	Congestion updates on A282 and M25. Limited information available for narrower rural roads.
	Environment	na	Current roads at the site of Routes 2, 3 and 4 are not adequate for the HGV traffic that use them. The A126, Muckingford Road and nearby narrow country roads are often used as a rat run by HGVs to escape congestion on the A13 and M25. 
Travellers' Views		na	Traveller's views across the site area vary. There is generally good visibility along the A282 / M25. The roads around the site of Route 2,3 and 4, however, are much smaller, and views are limited. This possess a hazard when HGVs are traveling along narrow roads.
	Fear of potential accidents	na	Travelling through the tunnel at Dartford Crossing itself leads to some road users fearing accidents, the small enclosed nature of the tunnel can exacerbate this fear. The bridge requires fewer closures but some users of the bridge also fear going over it. At least once a week the bridge is closed to help a concerned road user get off the bridge.
Traveller Stress	Frustration	na	Congestion along the A282 / M25 at the crossing and along the A13 is a frequent occurrence. This leads to traveller frustration and problems of rat running where road users seek out alternative routes locally. The tunnel at Dartford Crossing is closed several times a day. This causes significant delays for northbound users. Reasons include the need to escort convoys of HGVs carrying oil

		Without Scheme Scenario	
Factor	Sub Factor	Construction Stage	Operational Stage
			products. Each time the convoys go through the crossing is temporarily closed for safety reasons. The bridge requires fewer closures and consequently the southbound delays are less extreme than the northbound route. 
	Fear of potential accidents	na	Travelling through the tunnel at Dartford Crossing itself leads to some road users fearing accidents, the small enclosed nature of the tunnel can exacerbate this fear. The bridge requires fewer closures but some users of the bridge also fear going over it. At least once a week the bridge is closed to help a concerned road user get off the bridge.
	Route Uncertainty	na	The frequent delays caused by the closure of the tunnel and congestion leads to significant route uncertainty.

ROUTE 1		ROUTE 1 BRIDGE		ROUTE 1 – TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
Traveller Care	Cleanliness	Increased risk of debris on road due to construction.	Neutral.	Increased risk of debris on road due to construction.	Neutral.
	Facilities	Possible limited access to existing facilities during construction such as access to the existing crossing.	Improved access to and capacity at Dartford Crossing enabling access to facilities north and south of the river.	Possible limited access to existing facilities during construction such as access to the existing crossing.	Improved access to and capacity at Dartford Crossing enabling access to facilities north and south of the river.
	Information	Travel information updates and road signage may be affected during construction.	Neutral.	Travel information updates and road signage may be affected during construction.	Neutral.
	Environment	Increased overcrowding/congestion on roads, increase in noise and dust from construction, tense environment created as a result of increased frustration.	Reduced overcrowding/congestion at the crossing.	Increased overcrowding/congestion on roads, increase in noise and dust from construction, tense environment created as a result of increased frustration.	Reduced overcrowding/congestion at the crossing.
Travellers' Views		Traveller views may be restricted due to increase in equipment and the construction activities.	Traveller views improved at Crossing with bridge option providing wide vistas. However, the issue of limited traveller views along the narrow routes near site of routes 2-4 will not be resolved. Reduction in rat running expected but not likely to be fully resolved by route 1 options. Therefor concerns HGV	Traveller views may be restricted due to increase in equipment and the construction activities.	Slightly negative impact on traveller views. Views at Crossing with tunnel option will be limited. The issue of limited traveller views along the narrow routes near the site of routes 2-4 will not be resolved. Reduction in rat running expected but not likely to be fully resolved by route 1 options. Therefor

ROUTE 1		ROUTE 1 BRIDGE		ROUTE 1 – TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
			traffic along narrow roads will continue.		concerns HGV traffic along narrow roads will continue.
Traveller Stress	Frustration	Increase in frustration due to delays in journey time caused by construction.	Frustration likely to reduce as the time spent in congested traffic reduces. Bridge option less likely to require closures of the crossing as there are fewer security restrictions required for a bridge than a tunnel.	Increase in frustration due to delays in journey time caused by construction.	Frustration likely to reduce as the time spent in congested traffic reduces. However there is likely to still be build-up of congestion when the tunnel closes. Tunnel option likely to require more closures of the crossing as there are more security restrictions required for a tunnel than a bridge.
	Fear of potential accidents	Fear of potential accidents likely to increase during construction phase. Increase in large vehicles and equipment creating hazards.	Potential reduction in fear of accidents. Reduced congestion and less dependency on the tunnel likely to reduce users concerns. Though some users feel intimidated using a bridge option.	Fear of potential accidents likely to increase during construction phase. Increase in large vehicles and equipment creating hazards.	Potential reduction in fear of accidents. Reduced congestion and less dependency on the tunnel likely to reduce users concerns. Though some users feel intimidated using a bridge option.

ROUTE 1		ROUTE 1 BRIDGE		ROUTE 1 – TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
	Route Uncertainty	Travel disruption caused by construction works. Increase in congestion, particularly at the crossing, and at Junction 30 through to Junction 2 on the M25. Likely to have a knock on impact on the network. Smaller amount of equipment required compared to tunnel options.	Route uncertainty likely to reduce as congestion reduces and access between north and south of the river improves. However HGV rat running through narrow roads still a possibility.	Travel disruption caused by construction works. Increase in congestion, particularly at the crossing, and at Junction 30 through to Junction 2 on the M25. Likely to have a knock on impact on the network. Larger amount of equipment required compared to bridge options. The material from under the river will require transportation out of the area. If this is done by road it will cause severe disruption. Other options include transportation by boat. This will impact on river traffic.	Route uncertainty likely to reduce as congestion reduces and access between north and south of the river improves. However HGV rat running through narrow roads still a possibility.

ROUTE 2		ROUTE 2 BRIDGE OPTION		ROUTE 2 TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
Traveller Care	Cleanliness	Increased risk of debris on road due to construction.	Neutral.	Same as bridge option	Same as bridge option
	Facilities	Possible temporary reduction in access to road user facilities. However this is likely to be less so than for route 1 options.	Improved access to facilities north and south of the river in Thurrock and Gravesend created by the new river crossing on Route 2.	“	“
	Information		Improved information along Route 2	“	“
	Environment		Improved environment for users due to new wider roads with two lanes each way compared to existing small rural roads. Relieves future congestion around the route 2 area near London Gateway Port. However congestion issue at Dartford Crossing may not be fully resolved, will still have to regularly close the tunnel the original crossing.	“	“
Travellers' Views			Travellers views likely to improve as larger open roads provide a clear route for HGVs that currently rat run through the area.	“	Travellers views reduced through a tunnel option.

ROUTE 2		ROUTE 2 BRIDGE OPTION		ROUTE 2 TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
Traveller Stress	Frustration		Frustration likely to be reduced as the congestion reduces at the existing Dartford Crossing, and the Route 2 provides larger, clearer roads to travel on. There will be an increase in HGVs driving along them which could affect existing traffic, particularly along A1089	Increased disruption caused constructing a tunnel due to transporting material from river.	Frustration may be generated at the crossing if tunnel closes. The roads along the route will be highway rather than motorway. There will be an increase in HGVs driving along them which could affect existing traffic, particularly along A1089.
	Fear of potential accidents		Vehicle drivers fear of accidents likely to reduce given the reduced congestion and new roads. However there may be an increase in fear of accidents for pedestrians and cyclists depending upon what provision is made for them. An increase in severance of rural paths could lead to an increase in fear of accidents.		Fear of accidents potentially greater for a tunnel option.
	Route Uncertainty		Route uncertainty likely to reduce as Route 2 opens up the route for HGVs that currently rat run through the area.	Possible increase in route uncertainty for road users.	Route uncertainty generated by possible tunnel closures. There would be less closures at the new tunnel because it would be built to modern standards unlike the existing Dartford Crossing.

ROUTE 3		ROUTE 3 - BRIDGE OPTION		ROUTE 3 - TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
Traveller Care	Cleanliness	Increased risk of debris on road due to construction.	Neutral.	Same as bridge option	Same as bridge option
	Facilities	Possible temporary reduction in access to road user facilities. However this is likely to be less so than for route 1 options.	Improved access to facilities north and south of the river in Thurrock and Gravesend created by the new river crossing on Route 3.	"	"
	Information		Improved information along Route 3	"	"
	Environment		Improved environment for users due to new wider roads with two lanes each way compared to existing small rural roads. Relieves future congestion around the area near London Gateway Port. However congestion issue at Dartford Crossing may not be fully resolved, will still have to regularly close the tunnel the original crossing.	"	"
Travellers' Views			Travellers views likely to improve as larger open roads provide a clear route for HGVs that currently rat run through the area.		Travellers views reduced through a tunnel option.

ROUTE 3		ROUTE 3 - BRIDGE OPTION		ROUTE 3 - TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
Traveller Stress	Frustration		Frustration likely to be reduced as the congestion reduces at the existing Dartford Crossing, and the Route 3 provides larger, clearer roads to travel on. However the roads along the route will be highway rather than motorway. There will be an increase in HGVs driving along them which could affect existing traffic.	Increased disruption caused constructing a tunnel due to transporting material from the river. Impacts on river traffic during construction.	Frustration may be generated at the crossing if tunnel closes. Frustration likely to be reduced as the congestion reduces at the existing Dartford Crossing, and the Route 3 provides larger, clearer roads to travel on. However the roads along the route will be highway rather than motorway. There will be an increase in HGVs driving along them which could affect existing traffic.
	Fear of potential accidents		Vehicle drivers fear of accidents likely to reduce given the reduced congestion and new roads. However there may be an increase in fear of accidents for pedestrians and cyclists depending upon what provision is made for them. An increase in severance of rural paths could lead to an increase in fear of accidents.		Fear of accidents potentially greater for a tunnel option.
	Route Uncertainty		Route uncertainty likely to reduce as Route 3 opens up the route for HGVs that currently rat run through the area.	Possible increase in route uncertainty for road and river users.	Route uncertainty likely to reduce as Route 3 opens up a route for HGVs that currently rat run through the area. There would be fewer closures at the new tunnel because it would be built to modern standards unlike the existing Dartford Crossing.

ROUTE 4		ROUTE 4 - BRIDGE OPTION		ROUTE 4 - TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
Traveller Care	Cleanliness	Increased risk of debris on road due to construction.	Neutral.		
	Facilities	Possible temporary reduction in access to road user facilities. However this is likely to be less so than for route 1 options.	Improved access to facilities north and south of the river in Thurrock and Gravesend created by the new river crossing on Route 4.	Same as bridge option	“
	Information		Improved information along Route 4	“	“
	Environment		Improved environment for users due to new wider roads with two lanes each way compared to existing small rural roads. Relieves future congestion around the area near London Gateway Port. However congestion issue at Dartford Crossing may not be fully resolved, will still have to regularly close the tunnel the original crossing.	“	“
Travellers' Views			Travellers’ views likely to improve as larger open roads provide a clear route for HGVs that currently rat run through the area.	“	Travellers’ views reduced through a tunnel option.

ROUTE 4		ROUTE 4 - BRIDGE OPTION		ROUTE 4 - TUNNEL OPTIONS	
Factor	Sub Factor	Construction Stage	Operational Stage	Construction Stage	Operational Stage
Traveller Stress	Frustration		Frustration likely to be reduced as the congestion reduces at the existing Dartford Crossing, and the Route 4 provides larger, clearer roads to travel on. There will be an increase in HGVs driving along them which could affect existing traffic.	Increased disruption caused constructing a tunnel due to transporting river material. Impacts on river traffic during construction.	Frustration likely to be reduced as the congestion reduces at the existing Dartford Crossing, and the Route 4 provides larger, clearer roads to travel on. However the roads along the route will be highway rather than motorway. There will be an increase in HGVs driving along them which could affect existing traffic.
	Fear of potential accidents		Vehicle drivers fear of accidents likely to reduce given the reduced congestion and new roads. However there may be an increase in fear of accidents for pedestrians and cyclists depending upon what provision is made for them. An increase in severance of rural paths could lead to an increase in fear of accidents.		Vehicle drivers fear of accidents likely to reduce given the reduced congestion and new roads. However there may be an increase in fear of accidents for pedestrians and cyclists depending upon what provision is made for them. An increase in severance of rural paths could lead to an increase in fear of accidents.
	Route Uncertainty		Route uncertainty likely to reduce as Route 4 creates a route for HGVs that currently rat run through the area.	Possible increase in route uncertainty for road and river users.	Route uncertainty likely to reduce as Route 4 opens up a route for HGVs that currently rat run through the area. There would be fewer closures at the new tunnel because it would be built to modern standards unlike the existing Dartford Crossing.

Appendix 5.4
Severance Table

TABLE A5.4.1 - CONSTRUCTION STAGE AND OPERATIONAL STAGE SEVERANCE IMPACTS

							Pedestrians		Cyclists		
Route Options		Pedestrians		Cyclists		Total population	Travel to work (walking main mode)	Non work[8]	Travel to work (cycling main mode)	Non work[9]	Total walkers & cyclists
Without scheme			Moderate/large		Moderate /large						
Route 1	Bridge	Large	Slight adverse	Large	Slight adverse	1,039,100	3,800	10,100	26,900	243,400	284,200
Route 1	Tunnel	Large	Slight adverse	Large	Slight adverse	1,039,100	3,800	10,100	26,900	243,400	284,200
Route 2 with western southern link	Bored tunnel	Large	Slight adverse	Large	Slight adverse	1,437,100	4,400	11,500	33,500	302,900	352,200
	Immersed tunnel	Large	Slight adverse	Large	Slight adverse	1,437,100	4,400	11,500	33,500	302,900	352,200
	Bridge	Large	Slight adverse	Large	Slight adverse	1,437,100	4,400	11,500	33,500	302,900	352,200
Route 3 with western southern link	Bored tunnel	Large	Slight adverse	Large	Slight adverse	1,135,400	4,900	12,900	37,000	334,600	389,400

[8] This is based on the assumption that non work pedestrian trips are 92% of all pedestrian trips.

[9] This is based on the assumption that non work cycle trips are 69% of all cycle trips.

							Pedestrians		Cyclists		
Route Options		Pedestrians		Cyclists		Total population	Travel to work (walking main mode)	Non work[8]	Travel to work (cycling main mode)	Non work[9]	Total walkers & cyclists
	Immersed tunnel	Large	Slight adverse	Large	Slight adverse	1,135,400	4,900	12,900	37,000	334,600	389,400
	Bridge	Large	Slight adverse	Large	Slight adverse	1,135,400	4,900	12,900	37,000	334,600	389,400
Route 4 with western southern link	Bored tunnel	Large	Slight adverse	Large	Slight adverse	1,236,800	4,900	12,900	35,300	319,000	372,000
	Immersed tunnel	Large	Slight adverse	Large	Slight adverse	1,236,800	4,900	12,900	35,300	319,000	372,000
	Bridge	Large	Slight adverse	Large	Slight adverse	1,236,800	4,900	12,900	35,300	319,000	372,000
Route 2 with eastern southern link	Bored tunnel	Large	Slight adverse	Large	Slight adverse	1,437,100	4,400	11,500	33,500	302,900	352,200
	Immersed tunnel	Large	Slight adverse	Large	Slight adverse	1,437,100	4,400	11,500	33,500	302,900	352,200
	Bridge	Large	Slight adverse	Large	Slight adverse	1,437,100	4,400	11,500	33,500	302,900	352,200
Route 3 with eastern southern link	Bored tunnel	Large	Slight adverse	Large	Slight adverse	1,135,400	4,900	12,900	37,000	334,600	389,400
	Immersed tunnel	Large	Slight adverse	Large	Slight adverse	1,135,400	4,900	12,900	37,000	334,600	389,400
	Bridge	Large	Slight adverse	Large	Slight adverse	1,135,400	4,900	12,900	37,000	334,600	389,400

							Pedestrians		Cyclists		
Route Options		Pedestrians		Cyclists		Total population	Travel to work (walking main mode)	Non work[8]	Travel to work (cycling main mode)	Non work[9]	Total walkers & cyclists
Route 4 with eastern southern link	Bored tunnel	Large	Slight adverse	Large	Slight adverse	1,236,800	4,900	12,900	35,300	319,000	372,000
	Immersed tunnel	Large	Slight adverse	Large	Slight adverse	1,236,800	4,900	12,900	35,300	319,000	372,000
	Bridge	Large	Slight adverse	Large	Slight adverse	1,236,800	4,900	12,900	35,300	319,000	372,000

Appendix 5.5
Security Impacts

TABLE A5.5.1 - SUMMARY TABLE SHOWING RELATIVE SCALE OF IMPACTS FOR EACH OPTION (OPERATIONAL STAGE)

	Crossing point	Highway
Existing situation	There is currently formal surveillance and lighting at the crossing (bridge and tunnel). Site parameters clearly marked.	Street lighting exists along the motorways and A roads. Standard highway boundary fence along M25.There is provision for emergency calls along the M25. Limited street lighting along narrow routes and across land that is currently green space.
Route 1 Bridge	Formal surveillance at the crossing similar to existing surveillance, street lighting will be provided at the crossing. Site parameters will be clearly marked. Gantries containing ADS and traffic cameras and CCTV. Automatic fire detection and alarm systems on the bridge, in the event of a vehicle fire.	The route will run along the M25 which already has lighting, surveillance, standard highway boundary fence and provision for emergency calls.
Route 1 Tunnel	Formal surveillance at the crossing similar to existing surveillance. Site parameters will be clearly marked. Legal requirement for lighting in road tunnels.	see above
Route 2 (with WSL or ESL)		
Tunnel Option (Bored or Immersed)	Formal surveillance at the crossing similar to surveillance at existing Dartford Crossing. CCTV. Site parameters will be clearly marked. Legal requirement for lighting in road tunnels. Intruder detection.	The route would cut through land that is currently greenspace and peri urban. There are currently no plans for lighting new roads except at junctions due to results of cost benefit analysis on lighting and legal standards. CCTV surveillance along the full route.
Bridge Option	Formal surveillance at the crossing similar to existing surveillance. Site parameters will be clearly marked. Gantries containing ADS and traffic cameras and CCTV. Intruder detection.	see above
Route 3 (with WSL or ESL)		
Tunnel Option (Bored or Immersed)	Formal surveillance at the crossing similar to existing surveillance. CCTV. Site parameters will be clearly marked. Legal requirement for	see above

	Crossing point	Highway
	lighting in road tunnels. Intruder detection.	
Bridge Option	Formal surveillance at the crossing similar to existing surveillance. Site parameters will be clearly marked. Gantries containing ADS and traffic cameras and CCTV. Intruder detection.	see above
Route 4 (with WSL or ESL)		see above
Tunnel Option (Bored or Immersed)	Formal surveillance at the crossing similar to existing surveillance. CCTV. Site parameters will be clearly marked. Legal requirement for lighting in road tunnels. Intruder detection.	see above
Bridge Option	Formal surveillance at the crossing similar to existing surveillance. Site parameters will be clearly marked. Gantries containing ADS and traffic cameras and CCTV. Intruder detection.	see above

Appendix 5.6
Charging Model

A5.6.1 Background

A5.6.1.1 The purpose of the Lower Thames Crossing Charging Model is to provide a robust basis for testing alternative road user charging options for the LTC. This is required as part of the evidence for the scheme Business Case, since two of the key criteria for the provision of the new crossing relate to the tolls levied for the crossing and the revenue generated:

- Be affordable to government and users
- Achieve value for money

A5.6.1.2 This section summarises the development and application of the LTC Charging Model. Fuller details are set out in the report *Highways England Project Support Framework, Charging Model Results, Lower Thames Crossing*.

A5.6.2 Base Model Overview

A5.6.2.1 The LTC Charging Model has been developed from, and is consistent with, the LTC v1 traffic model used for the appraisal of the long list LTC Options. For the charging model, the LTC models have been extended to incorporate 18 User Classes, disaggregated to reflect a range of trip purposes and income bands. In addition, the SATURN simulation model was converted into buffer format to allow multiple charging tests to be undertaken in a time efficient manner.

A5.6.2.2 Despite the disaggregation of the user classes and conversion to buffer format, the traffic forecasts from the charging model based on the continuation of the existing tolling policy at the Dartford Crossing and the assumption of similar toll levels for the new crossings compare satisfactorily against the results from the main model.

A5.6.3 Charges

A5.6.3.1 The modelled crossing charges match those currently levied in 2015 levels and are shown in **Table A5.6.1**:

TABLE A5.6.1 - TOLL CHARGES AT DARTFORD CROSSING

Year	Vehicle Type	TAG	Local Residents	Licence Plate Number
2015	Car	£1.67	£0.20	£2.50
	LGV	£2.63	N/A	£3.00
	HGV	£5.19	N/A	£6.00

A5.6.3.2 The introduction of Dart-Charge has changed the proportion of users paying by each method as demonstrated in **Table A5.6.2**. A high proportion of drivers are now paying using the TAG system as this represents a cheaper and more straightforward way to pay than using the post-pay Licence Plate Number system.

TABLE A5.6.2 - PAYMENT TYPE PROPORTIONS

Year	Vehicle Type	TAG	Local Residents	Licence Plate Number	No Pay
2015	Car	57.3%	6.2%	34.9%	1.7%
	LGV	70.1%	0.0%	29.9%	0.0%
	HGV	86.0%	0.0%	14.0%	0.0%

A5.6.3.3 The estimated annual toll revenue for 2015 based on transaction data by payment type is £110m (at 2015 prices, not factored to market prices) or £95m (at 2010 prices, not factored to market prices).

A5.6.4 Charging Tests

A5.6.4.1 The alternative charging tests and predicted revenues are shown in **Table A5.6.3**, in which the existing 2015 Dart-Charge is denoted as '100%' charge and other percentages are relative to the 100%.

TABLE A5.6.3 - TOTAL ANNUAL REVENUES WITH ALTERNATIVE CHARGING POLICIES (2010 PRICES £M)

Route	Charging Policy		Revenue in 2025	Revenue in 2041	Total Discounted Revenues
	Existing Crossing	New Crossing			
Route 1	100% (as now)		122.5	150.1	2,268
	50%		66.3	78.8	1,199
	150%		170.5	213.3	3,206
	200%		211.5	271.1	4,051
	250%		245.3	323.6	4,802
Routes 2/3/4	100% (as now)	100%	132.5	158.8	2,412
	100% (as now)	50%	110.9	133.1	2,021
	100% (as now)	0%	78.1	98.4	1,476
	150%	100%	166.7	205.9	3,104
	150%	50%	138.0	174.3	2,614
	150%	0%	97.9	133.1	1,961
	200%	50%	153.1	204.7	3,028
	200%	100%	188.6	242.7	3,623

A5.6.5 Summary of key findings

A5.6.5.1 The results of the charging tests for Route 1 indicate that there is a relatively captive market using the existing crossing for which the charges at the crossing do not represent a significant factor in choice of route. The results suggest that increasing charges for Route 1 will generate significantly more revenue than the current situation. However, the scope to increase charges will be more constrained by political and public acceptability rather than the impact such increases will have on traffic levels.

A5.6.5.2 The results indicate that most of the route choice interaction for Route 1 takes place with the Blackwall Tunnel and the western side of the M25. In percentage terms the flows that switch to and from these alternative routes as a result of changes to charges and the construction of LTC are relatively low compared with the overall crossing flows. There is very little interaction between Route 1 and the other central London crossings with very few trips reassigning to these routes even with the 250% charge increase at Dartford.

A5.6.5.3 A wide range of revenues could be generated from Routes 2, 3 or 4 depending on the level of charges at the existing Dartford Crossing and LTC. The highest revenues are predicted if LTC is charged at the existing 2015 tariffs and higher tariffs are charged at the Dartford Crossing.

A5.6.5.4 Increasing the differential charge between the Dartford Crossing and Routes 2, 3 or 4 results in higher levels of traffic relocating from Dartford onto LTC. In particular trips to and from the M20 are predicted to divert onto the M2 and across the Thames using LTC rather than continuing along the M20 and joining the M25. Even if the charges at Dartford are doubled and the LTC charge is only half of the existing Dart-Charge, no M25 traffic is predicted to divert via LTC as the LTC route is 40% longer than the route via Dartford (26.6km via LTC, 18.5km via Dartford).

A5.6.5.5 For the test assuming 150% charge at Dartford and 100% charge at LTC, the generated revenues generated could be 30% higher than if the Dartford and LTC charges were the same as the Dart-Charge in 2015. This suggests that there may be an opportunity to raise charges at the Dartford Crossing before 2025 and apply differential charging in order to maximise the benefits of LTC in terms of traffic relief for the Dartford Crossing and to maximise the toll revenues collected from the combined crossings of Dartford and LTC. This would however affect the economic benefits and the two elements would need to be considered together.

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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.