



Information Rights
Digital Services
National Highways
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Ref: FOI 3385 / IC-182335-R3F3

26 October 2022

Dear [REDACTED],

RE: Latest Lower Thames Crossing Outline Business Case (OBC)

We are writing in response to your environmental information request under the Environmental Information Regulations 2004 (the EIR) of 11 March 2022 requesting the release of the '*latest Lower Thames Crossing Outline Business Case (OBC)*.' We advised in response to your request that the information was being withheld as it falls under the exception in Regulation 12(4)(d) of the EIR *material in the course of completion, unfinished documents and incomplete data*.

You wrote to us on 13 May 2022 asking us to undertake an internal review, which we completed advising that we were satisfied that the information could be withheld under the exception in Regulation 12(4)(d) and that the exception had been engaged correctly via a public interest test.

You then referred this decision to the Information Commissioner's Office who decided on 14 October 2022 that the information being withheld under regulation 12(4)(d) of the EIR engages that exception but the public interest favours disclosure. The Information Commissioner's Office further stated that National Highways should disclose the withheld information having first redacted from it the information categorised as personal information under regulation 13(1) of the EIR.

Following this decision, National Highways are providing the latest Outline Business Case. This is provided with this letter and will also be published online in due course on the National Highways library of Freedom of Information requests.

The Outline Business Case was prepared in August 2020 and is reflective of the proposals at that time. Subsequent to the preparation of the Outline Business Case a number of changes have occurred:

- National Highways submitted an application for development consent in October 2020, and in November withdrew the application following feedback from the Planning Inspectorate. The revised application is being prepared for resubmission in late 2022. As a result of this, the modelled opening year has changed from 2026 to 2030.

- Revised guidance on future growth has been incorporated into the transport modelling, along with the revised opening year. This has changed the forecast benefits.
- Following public consultation in 2021, a number of changes were made to the proposals. Of particular note are the redesign of the proposals north of the River Thames, to better support the planned Thames Freeport, and modifications have been made to the configuration of the A13 junction, to reduce traffic flow impacts on the local roads in Thurrock.
- The change in opening year, along with the modifications to the proposals, have led to changes in the estimated costs for the project.

The information in the Outline Business Case has therefore been superseded.

The planned application for development consent, being submitted to the Planning Inspectorate in 2022, will contain a revised Economic Appraisal Report. This document will provide an update to the costs and economic benefits of the project. In accordance with the statutory requirements, this document will be provided online by the Planning Inspectorate following receipt of the application from National Highways.

Yours sincerely

Jonathan Drysdale

FOI Manager

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Lower Thames Crossing

Outline Business Case

Executive Summary

Lower Thames Crossing

Outline Business Case – Executive Summary

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1 Executive summary

1.1 Background

- 1.1.1 This document is the Executive Summary of the Outline Business Case (OBC) for the Lower Thames Crossing project (LTC) which is being promoted by Highways England. It sets out the case for investment in LTC, in line with Her Majesty's Treasury (HMT) Green Book and the Department for Transport (DfT) guidance.
- 1.1.2 The business case is being developed in three stages: Strategic, Outline and Full, and sets out five separate but related Cases for LTC:
- a. Strategic Case: shows that there is a robust 'case for change', closely aligned to wider strategic and public policy objectives.
 - b. Economic Case: shows that LTC provides Value for Money (VfM), based on an economic appraisal undertaken in line with DfT guidance.
 - c. Financial Case: explains how much LTC will cost and how it will be paid for, showing that it is affordable.
 - d. Commercial Case: shows that the proposed approach to finance and procurement is robust, showing that LTC is commercially viable.
 - e. Management Case: shows that LTC is achievable in practical terms, explaining how the Project will be managed to ensure it achieves its objectives.
- 1.1.3 In January 2016, a Strategic Outline Business Case (SOBC) was approved by the Department for Transport (DfT) and HM Treasury (HMT) confirming that the proposed crossing would meet the policy and strategic objectives of government and Highways England.
- 1.1.4 In February 2017, a partial OBC presented the case for the Recommended Preferred Route to the DfT. It took account of the work undertaken since the SOBC and the feedback from stakeholders and the public during consultation in early 2016.
- 1.1.5 Following extensive consideration of alternative options, and consultation with local people, stakeholders and the wider public, Route 3 with Western Southern Link was identified as the preferred route for LTC. The Secretary of State for Transport made a Preferred Route Announcement (PRA) in April 2017. In July 2017, a recommendation to increase the capacity of the roads which connect to the tunnel from two to three lanes was approved by government. Since then the design has developed to exclude a junction at Tilbury and to reduce M25 to A13 southbound to 2 lanes.
- 1.1.6 We held a Statutory Consultation, as required by the Planning Act 2008, between 10 October and 20 December 2018. The consultation took place in accordance with the Statement of Community Consultation, which was subject

to a targeted consultation with the eight host local authorities and the 34 additional authorities most likely to have an interest in LTC.

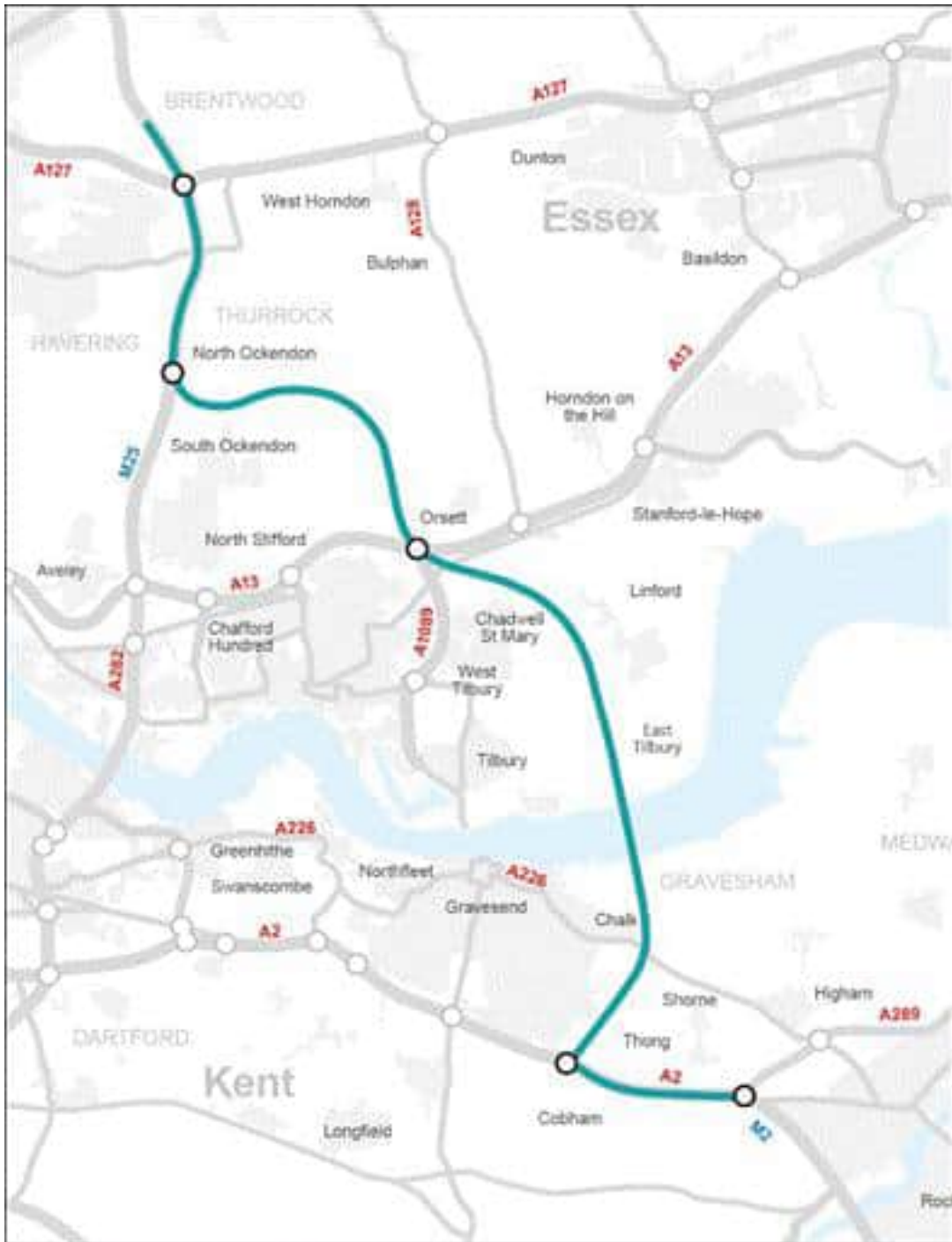
- 1.1.7 We updated the DfT Board Investment and Commercial Committee (BICC) on 16 September 2019 with the results of the recent comprehensive baseline review including the most likely costs of £6,391m (including portfolio risk) and our continued intention to achieve the publicly declared but challenging Open for Traffic date of 2027.
- 1.1.8 Since then we have updated the Commercial and Procurement Strategy, refined the Project schedule, completed the production of a fully assured cost estimate and begun the procurement process for the Delivery Partner. The Economic Case, Commercial Case, Financial Case and Management Case have been amended to reflect these developments. There has been no impact on the Strategic Case.
- a. The Outline Business Case (OBC) was approved in December 2019 and further work commissioned to assure the cost estimate and schedule. The Commercial Strategy for the project has also developed for the two Highways contracts.
 - b. An IPA review of the governance of the project, co-sponsored by DfT and Highways England was completed and feeds into the proposed governance arrangements set out in this paper.
 - c. Since December 2019 there has also been several personnel changes on the project to strengthen the overall capability and capacity of the team.
 - d. The revised most likely costs of £6,752m (including portfolio risk) and the revised Open for Traffic date is October 2028.
- 1.1.9 The next major milestone for the project is for Highways England to publish the OJEU contract notices for the three main works contracts. The OBC will then be updated and developed into the Full Business Case (FBC).
- 1.1.10 Subject to approval of the FBC, government funding will be allocated, and the main works contracts will be awarded to commence the design and build of LTC.

1.2 The Lower Thames Crossing project

- 1.2.1 LTC is a proposed new All-Purpose Trunk Road (APTR) connecting the A2/M2 in Kent, east of Gravesend, crossing under the Thames through a twin-bored tunnel 4.25km in length, before joining the M25 south of Junction 29. The route delivers approximately 23km of new road as well widening and other improvements of the A2/M2 and the M25 where the new road connects to the existing network. The alignment of LTC is presented in Figure 1-1.
- 1.2.2 It will increase road capacity across the Thames east of London by over 90% bringing significant benefits in travel time savings and journey time reliability. It will also bring wider economic benefits, including significant agglomeration benefits.

- 1.2.3 There are environmental challenges along much of its length including an internationally protected wetland. LTC also has a high level of political and stakeholder interest requiring effective management. In addition, and as expected for a size of this scale, there are complex construction and procurement issues and significant technical challenges to overcome to deliver a successful scheme.
- 1.2.4 If approved, construction of the Lower Thames Crossing would start in 2022 and the intention is that it would be Open for Traffic (OfT) by autumn 2028, although this requires an aggressive and challenging schedule.
- 1.2.5 Lower Thames Crossing is the largest road construction project in the United Kingdom since the completion of the M25 over 30 years ago. It is a globally significant tunnelling project with the longest road tunnels in the UK, and with each tunnel at over 16m wide they are more than 2½ times the width and 7 times the area of Crossrail's tunnels.
- 1.2.6 LTC is classified as a Nationally Significant Infrastructure Project (NSIP), as defined by the Planning Act 2008 and was identified by HM Treasury (HMT) as one of the top 40 priority investments in its National Infrastructure Plan. It is part of the Government's Road Investment Strategy period 1 (£15.2bn) and period 2 (£25.3bn) It is classified as a Tier 1 project and is requires DfT and HMT as well as Highways England investment approval.
- 1.2.7 The Lower Thames Crossing has a very good fit with key government and Highways England plans and strategies and contributes towards delivery of Highways England's Key Performance Indicators (KPIs).

Figure 1-1 LTC proposed route



2 The Strategic Case

2.1 Introduction

2.1.1 The Strategic Case details the current problems on the Strategic Road Network (SRN) in the Lower Thames Area to demonstrate the rationale for LTC. It is presented in four further sections: The Case for change; Objectives, Strategic policy context, and Option development and shortlisting.

2.2 The case for change

- 2.2.1 For over 55 years, the Dartford Crossing has provided the only significant road crossing of the River Thames east of London. Designed for 135,000 vehicles per day, it carries over 180,000 vehicles on some days. Traffic flows this far above the design capacity of the road result in frequent congestion and poor journey time reliability, making the Dartford Crossing one of the least reliable sections of the SRN.
- 2.2.2 Congestion is exacerbated when accidents and incidents occur, and these extend the time it takes to restore the SRN to normal operation to as long as five hours. This poor resilience of the Dartford Crossing is further undermined by a lack of alternative routes across the Thames.
- 2.2.3 The crossing is a critical part of the country's Strategic Road Network (SRN). It connects communities and businesses and provides a vital link for the nearby major ports, which play a critically important role in the distribution of goods across the rest of the UK. Reliable river crossings are essential for the provision of services and goods, enabling local businesses to operate effectively and for residents to access housing, jobs, leisure and retail facilities on both sides of the river.
- 2.2.4 The high traffic flows and above average annual increases highlight the significant pressure the Dartford Crossing faces. Despite the lack of capacity, more and more people are trying to cross at this location due to the fact there is no acceptable alternative.
- 2.2.5 On average 26,000 Heavy Goods Vehicles (HGVs) used the Dartford Crossing per day in 2016 accounting for approximately 19% of the total traffic. This is almost double the percentage typically observed on other parts of the SRN, demonstrating the reliance of the crossing for business users.
- 2.2.6 The crossing is of significant regional and national importance including facilitating the movement of goods from Continental Europe.
- 2.2.7 Traffic volumes between peak periods and at the weekend do not drop, as seen elsewhere on the SRN, due to the limited alternative routes across the Thames east of London. Because of these high volumes, speeds are reduced and there is an increased risk of incidents which leads to further congestion and poor reliability.
- 2.2.8 The incremental approach to increasing traffic capacity at the existing crossing has resulted in a sub-optimal configuration with many compromises compared to modern standards. The existing northbound tunnels are of insufficient size and safety standards resulting in numerous operational constraints. When the

forecast crosswind speed exceeds 60mph or the headwind speed exceeds 70mph, the southbound bridge is closed to all traffic for safety reasons. There are junctions less than one mile apart north and south of the crossing. The Traffic Management Cell (TMC) is designed to optimise traffic flow but ultimately the requirement for extractions, escorts and metering of traffic places a lower limit on available capacity northbound through the tunnels compared to the QEII Bridge.

- 2.2.9 The congestion and delay problems arising from high volumes of traffic at the Dartford Crossing are made worse when incidents occur. Due to the crossing frequently operating above capacity, closure in either a northbound or southbound direction, even for a relatively short time, can lead to significant additional congestion. When larger incidents occur, these can take up to five hours for typical operation to resume. Due in part to the high number of incidents at the crossing, the safety record on most of the sections of the M25/A282 in the vicinity of the crossing is worse than the national average.
- 2.2.10 Under free-flow conditions, the journey time on the M25 between junction 2 and junction 30 is approximately six minutes, which equates to an average speed of about 50 mph. However, during peak periods, northbound speeds can drop as low as 10 mph on the crossing approaches which results in journey times more than doubling over the same section.
- 2.2.11 The crossing is a critical part of the country's road network connecting communities and businesses and providing a vital link between the Channel Ports, London and the rest of the UK. It is essential for the provision of services and goods, enabling local businesses to operate effectively and for local residents to access housing, jobs, leisure and retail facilities on both sides of the river.
- 2.2.12 Hundreds of businesses and organisations across dozens of sectors have expressed their frustration at the unreliability of the existing crossing, which is frequently paralysed by accidents, incidents and the impact of inclement weather.
- 2.2.13 The consequences of not proceeding with a new crossing are:
- a. Congestion and delays will continue to worsen both at the crossing and on the local road network, journey times will increase, and journeys will be less reliable.
 - b. National, regional and local productivity and economic growth will be constrained and the cost of moving freight by road will increase.
 - c. There will be further deterioration of safety on the roads close to the existing crossing.
 - d. Increases in road traffic will increase congestion, noise and vehicle emissions in an area which already exceeds acceptable levels.

2.3 Objectives

- 2.3.1 To respond to these challenges, DfT has set the Client Scheme Requirements (CSR) which are issued as a separate document. This sets out the Strategic, Transport, Community and Environmental objectives for the scheme.
- 2.3.2 Highways England's performance is measured against KPIs across the SRN. This Case outlines the contribution of LTC in meeting the performance requirements.
- 2.3.3 LTC will provide a wide range of benefits as a result of improved traffic flows within the Lower Thames Area such as improved journey times, enhanced connectivity and better journey time reliability. The Economic Case describes the full range of benefits that have been valued, as well as other benefits that have been appraised in line with DfT guidance but not expressed in monetary terms.
- 2.3.4 A vision and set of strategic goals have been developed which expand on the Client Scheme Requirements to provide a focus for the long-term legacy of LTC. The key benefits arising from the delivery of LTC described in the Economic Case will be monitored and evaluated after its delivery. The realisation of these benefits will enhance the legacy of LTC in areas not specifically linked to the infrastructure asset itself, such as skills, education or Highways England's continuous capability improvement.

2.4 Strategic policy context

- 2.4.1 European, national, regional and local planning and transport policy context have been examined, relevant to the strategic need for a new river crossing east of Dartford.
- 2.4.2 A new Thames crossing east of Dartford aligns with current government priorities relating to economic, social and environmental objectives, as detailed in the Transport Investment Strategy.
- 2.4.3 Regional and local policies show that local authorities in the area recognise the need to address the congestion-related problems at the existing crossing and the wider impacts on people, the economy and the environment.
- 2.4.4 The need to address the congestion-related problems at the Dartford Crossing as well as the potential benefits for the highway network in the surrounding region is recognised at all levels of policy and planning.

2.5 Option development and shortlisting

- 2.5.1 This section of the Strategic Case provides details of the evolution of LTC from work in 2009 through to the proposed solution as presented at Statutory Consultation. A precis is included in Section 1.1 of this Executive Summary.

3 The Economic Case

3.1 Introduction

3.1.1 The Economic Case assesses the economic, environmental and social impacts of LTC in line with HMT Green Book and DfT guidance, using qualitative, quantitative and monetised information. It calculates the extent to which the benefits outweigh the costs and assigns a Value for Money (VfM) category.

3.2 Project costs and revenues

3.2.1 The estimate of CAPEX cost was prepared by the LTC project team in accordance with Highways England's capital cost estimating process for major projects and assured by Highways England.

3.2.2 LTC's most likely CAPEX outturn cost estimate is £6,752m (£3,167m Present Value Cost). This includes a number of opportunities which are in various stages of valuation and assurance.

3.2.3 The OMR and Road User Charging system costs and revenue were estimated and profiled over the 60-year operational period from scheme opening in 2028. The OMR and Road User Charging System PVC is £-211?m.

3.2.4 The road user charging revenues include user charge receipts collected at LTC, as well as the change in receipts at the Dartford Crossing and within the London Congestion Charge area, and those collected at the Silvertown and Blackwall Tunnels. This is estimated to be a reduction of £670m to the PVC.

3.2.5 The assured Present Value Costs (PVC) used in the BCR calculations is £3,059m (£3,279m+£450m-£670m). The unassured PVC is £3,167m.

3.3 Benefits

3.3.1 Project benefits are placed into three benefits levels to reflect decreasing certainty of the analysis:

- a. Level 1 – established monetised impacts such as journey time savings, vehicle operating costs, accidents, noise, greenhouse gases, air pollution, indirect tax revenues, construction phase dis-benefits.
- b. Level 2 – evolving monetised impacts such as journey time reliability, agglomeration, labour supply, market competition.
- c. Level 3 – indicative monetised and non-monetised impacts, captured in the VfM appraisal but not used to adjust BCR's.

3.3.2 The ratio of the Level 1 and 2 PVB against the PVCs, based on most likely costs, produces adjusted BCR's of 1.46 based on assured CAPEX.

3.3.3 The most significant of these benefits is travel time savings. LTC also has the potential to provide significant journey time reliability benefits. Agglomeration benefits represent the second largest benefit after time savings and are by far the largest type of wider economic impact.

- 3.3.4 The Level 3 appraisal undertaken includes:
- a. non-monetised appraisals of environmental impacts and monetary valuations of landscape impacts based on current and forthcoming guidance.
 - b. non-monetised appraisals of social impacts.
 - c. a distributional appraisal of some impacts on vulnerable social groups.
 - d. evidence about the likely transformative impact of the step change in road capacity on the local, regional, and national economies.
 - e. the impact of LTC on the resilience of the SRN in the area.
 - f. an appraisal of option values reflecting the new choice of routes across the Thames for road users and the opportunity to develop new areas of land.
 - g. a recognition that there is an underestimation of freight benefits via value of time and volume forecasts for the local area.
- 3.3.5 Environmental impacts of LTC are largely adverse, although mitigation measures are yet to be defined in detail. Social impacts are generally slightly positive.
- 3.3.6 LTC is expected to carry a higher percentage of freight users than is typical on the SRN. Highways England is reviewing the potential underestimation of the impact for freight users. Should the study find the values of both freight time and freight reliability are undervalued this would be significant for the LTC Economic Case.
- 3.3.7 LTC is likely to enable wider economic impacts, such as land use change, people moving to more productive jobs and agglomeration based on dynamic clustering, in the Lower Thames local area and wider region. LTC may also encourage the development of new homes and employment spaces. We plan to collect further evidence to be used to inform the value for money assessment. The results of any further Level 3 appraisal will be included in the DCO submission and reported in the FBC.
- 3.3.8 Sensitivity tests have been undertaken using low and high scheme costs combined with low and high traffic growth projections to determine the range of Adjusted BCRs.
- ## 3.4 Value for Money assessment
- 3.4.1 The Value for Money (VfM) assessment takes account of all impacts of LTC, including those expressed in monetary terms, those that are quantified but not monetised, and those that have been qualitatively appraised.
- 3.4.2 LTC was judged on 17 July 2020 to represent Medium Value for Money (VfM) with a significant risk of moving to Low VfM, subject to changes expected in GDP growth and carbon price forecasts in Tripartite Appraisal Guidance in early 2021.

- 3.4.3 The main benefits of LTC are travel time savings and wider economic impacts which, under the core traffic growth scenario, account for 96% of total scheme benefits (Level 1 and 2 PVB).
- 3.4.4 While no housing or residential development has been assessed as being dependent on LTC, analysis has identified significant planned developments in the Lower Thames area which are likely to drive additional traffic to the route. Therefore, in assessing the VfM of LTC, additional weight should be given to the appraisal results from the high growth scenario in which the VfM would increase from Low to Medium based on assured costs.
- 3.4.5 There is evidence that further wider economic impacts from dynamic clustering, such as the movement to better jobs, are likely to arise. Additional modelling and appraisal to capture these impacts is planned and the results will be reported in LTC's Full Business Case.
- 3.4.6 In addition, LTC provides valuable options for road users, who will have the choice of a second crossing, and in respect of new areas of development land who could be used for housing and employment.
- 3.4.7 Through ongoing Project development, mitigation measures will be further developed to offset, where possible, the adverse impacts on landscape, biodiversity, townscape, historic environment and water environment and the appraisal will be updated accordingly once mitigation commitments are confirmed.

4 The Financial Case

4.1 Introduction

4.1.1 This case sets out the basis of the capital cost, the funding requirements and the implications for budget and project affordability.

4.2 Capital cost estimate

4.2.1 The estimate has been built bottom-up based on the project scope and design set out in the strategic case and on our knowledge of the land required, topography and ground conditions. The estimation methodology is in accordance with Highways England capital cost estimating process for major projects.

4.2.2 The capital cost estimate follows from a comprehensive re-baseline of cost, schedule and benefits. The re-baseline exercise was supported by peer reviews, independent experts and our own internal assurance process.

4.2.3 Cost estimates have been calculated using a three-point estimating technique. Where practical, a detailed, first principle estimating approach has been adopted to mitigate the substantial levels of uncertainty related to LTC's complex works.

4.2.4 Most of the road construction works have been measured and priced with rates drawn from the Highways England's cost database (containing first principles resource build ups) as well as other detailed estimates derived from external sources and professional experience.

4.2.5 The cost for the civil engineering works for the tunnel approach ramps and portals has been estimated using our standard rates library. There are no comparable tunnelling rates in Highways England's database and there are few precedents worldwide for tunnelling works of this scale, so a parallel estimating approach has been adopted, with separate estimates produced by the project team, our Commercial Services Division and by [REDACTED] and specialises in tunnelling. We have also undertaken extensive benchmarking against other notable tunnelling projects, both at a granular level for the key cost drivers and for the overall cost. The benchmarking shows that LTC estimated rates are close to the average rates/cost across the benchmarked data, thus providing a degree of assurance on the individual cost components.

4.2.6 The estimate includes £302m value of base cost reduction opportunities, with each opportunity individually assessed to arrive at the estimated value. These opportunities have been reviewed and assured by the Commercial Services Division (CSD) within Highways England. The list of opportunities will evolve as the cost and design mature and some of these may drop off and new ones may emerge. On a project of this scale, a 5-7% cost savings target is reasonable.

4.2.7 The risk and uncertainty allowances have been calculated from an assessment of the identified project risks and the financial impact and probability assessment of them occurring in a Quantitative Risk Assessment (QRA).

- 4.2.8 The costs are estimated at Q1 2016 prices and inflation is applied using the Roads Period 2 (RP2) inflation profile; a bespoke index developed by Royal Institution of Chartered Surveyors Building Cost Information Service (BCIS) for Highways England for estimating capital enhancement works. These indices are lower than the inflation indices modelled in the internally assured cost estimate. The decision to formally adopt the use of revised RP2 inflation indices was made after the cost estimate was internally assured. The next iteration of the internally assured cost estimate will incorporate the revised RP2 inflation indices.
- 4.2.9 The estimated capital cost (most likely) for LTC including allowances for risk and uncertainty is £6.75bn (outturn prices) with a P43 cost confidence level. The range is £5.27bn¹ at P10 to £9.02bn at P90.
- 4.2.10 The breakdown of the key components of LTC are shown in Table 4.1 below along with an allowance for risk and uncertainty against each component.

Table 4.1 Project development and construction costs (most likely £m)

Cost categories	Base cost	Opportunities	Net base cost includes opportunities	Risk and uncertainty	NR Vat	Total
Options phase (including pre-options)	28		28			28
Development phase	324		324			324
Lands	235	-32	203	95		298
Pre-enabling works	115		115	31	21	167
Integration Partner	132	-9	123	48	30	202
Enabling works	117	-13	104		19	123
Statutory undertakers	318		318	41	66	425
North Roads	893	-102	791	153	163	1107
A2/M2	356	-43	313	67	62	442
Tunnel	1330	-103	1227	248	285	1760
Technology (HE framework contracts)	24		24	5	4	34
Subtotal: LTC cost excluding inflation	3872	-302	3570	688	651	4910
Inflation	1064		1064	203	186	1446
Subtotal: LTC cost including inflation	4936	-302	4634	891	837	6356
Portfolio risk						396
Total cost Most Likely	4936	-302	4634	891	837	6752

¹ Post-release update - value corrected to align with Table 3.1 of the Financial Case and Table 7.2 of the Economic Case

- 4.2.11 Portfolio risk is included in the cost estimate along with the specific risk allowances. The quantum for this project is £396m. As the project matures and gets closer to delivery, this number will reduce.
- 4.2.12 The risk allowances total £1,077m consisting of Project Risk and Uncertainty at £688m, Portfolio Risk at £389m. This represents a total contingency of 16% of the total cost estimate.
- 4.2.13 Highways England is subject to HMRC's Contracted Out Services regulations. Under these regulations for new road schemes, the amount of VAT that can be recovered is limited to the road works within the existing highway boundary. The Non-recoverable VAT assessment is £651m (excluding inflation).

4.3 Funding

- 4.3.1 The cost and risk profile of LTC is materially different from the wider Highways England's portfolio both in terms of scale, complexity and the level of impact that any potential change in either the cost or the risk provision would make. The scale of LTC is such that if it were funded wholly within the RIS then it has the potential to unbalance the portfolio as any changes to the cost would have a disproportionate effect on the other projects including possible cancellations. In the context of Highways England portfolio, LTC is therefore "non-standard" and in line with Government guidance, a different level of contingency needs to be considered.
- 4.3.2 Highways England has agreed with HMT that P70 is an appropriate level of funding. This funding level provides an appropriate allowance for contingency and changes to costs while also protecting against the potential for wastage if the funding level is set too high, and costs not controlled. In addition, to help avoid against this, it has been agreed that funding up to P70 is held by HMT with Most Likely funding allocated to Highways England. It was also confirmed in the Budget Statement in March 2020 that LTC funding would be ringfenced. The management and reporting of contingency is under discussion with DfT and HMT as is the position with regards to annual flex available for LTC to utilise to maximise efficiency. The position on these points will be of particular relevance during the delivery phase and will therefore be agreed and signed off prior to the Full Business Case submission.
- 4.3.3 Based on the cost estimate in this OBC this would mean overall funding of £7.846bn should be allocated made up of a contingency/Risk Reserve of £1.094bn held by HMT and £6.752bn project funding held by Highways England.
- 4.3.4 **Error! Reference source not found.** below shows the forecast annual funding profile.

Table 4.2 Annual funding requirement (£m) outturn prices

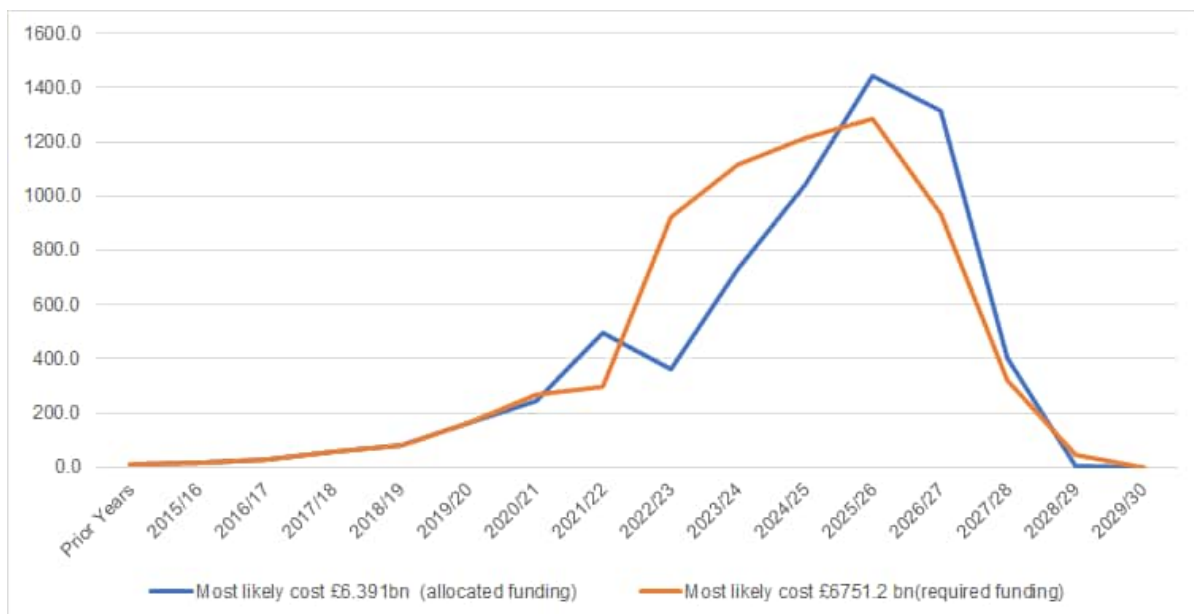
Financial Year	Historic costs	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	Total
Particulars													
Most Likely cost (P43)	188	164	265	295	925	1,115	1,215	1,284	934	318	47	1	6,752
Add: additional contingency	0	0	45	50	158	191	208	220	160	54	8	0	1,094
Total: Funding requirement (P70)	188	164	310	346	1,083	1,306	1,423	1,504	1,094	373	55	1	7,846

4.4 Funding and affordability analysis

4.4.1 In March 2020 of £7.2bn was allocated to the project split between Highways England RIS2 funding, assumed Highways England RIS3 funding and HMT Risk Reserve as shown in Table 4.3. This funding aligned to the 2019 OBC.

4.4.2 The updated cost forecast would suggest that this level of funding will be insufficient and that if funding is allocated on the same basis as that in March 2020 total funding of £7.8bn will be required, as shown in Table 4.3. In addition, the annual profile of the current forecast expenditure profile differs from the March 2020 funding as indicated by Figure 4.1.

Figure 4.1 Allocated funding vs forecasted funding



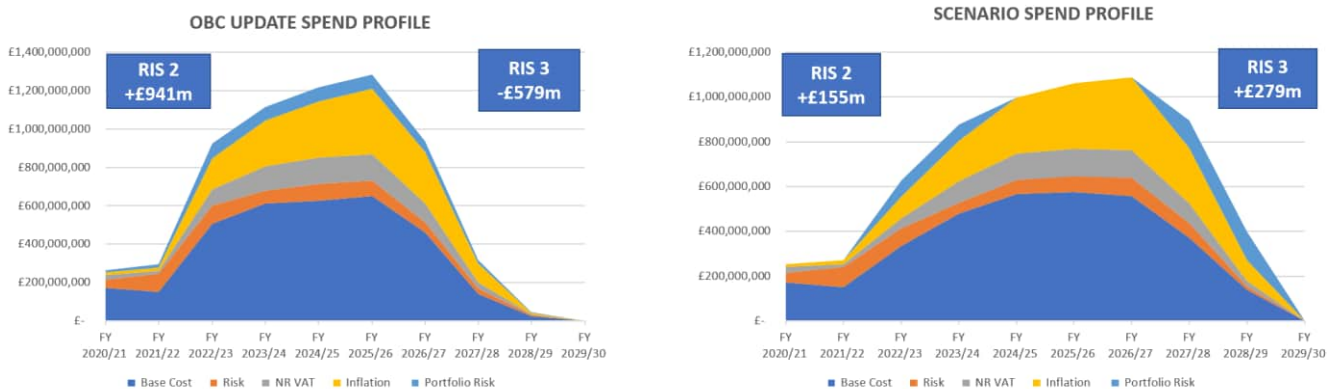
4.4.3 The overall spend profile has shifted to the left, with peak spend now forecasted in the later years of RP2 period as compared to the previous assumption of peak expenditure in early years of RP3 period. There is also a small element of reprofiling in the early years of RP2 and therefore the funding requirement in FY 2021/22 is slightly below the RP2 allocation.

Table 4.3 Revised forecast and allocated funding by year (£m)

	Pre RIS	RIS	RIS2					RIS 2 Total	RIS	Total
			2020/21	2021/22	2022/23	2023/24	2024/25			
Most likely cost (ML)	10	342	265	295	925	1115	1215	3815	2585	6751
Additional contingency with Treasury (P70 less ML)	0	0	45	50	158	191	208	652	442	1094
Total: Required funding	10	342	310	346	1083	1306	1423	4467	3026	7845
Allocated funding/ (commitment for RP2)										
Highways England RIS (ML)	10	344	245	495	359	728	1,047	2,874	3,164	6,391
Treasury risk reserve (P70 less ML)			41	41	17	17	17	131	690	822
Total: Allocated funding / (commitment for RP3)	10	344	286	536	376	745	1,063	3,006	3,854	7,213
Gap between current forecast and allocated funding										
Highways England RIS (ML)		2	-20	200	-566	-387	-168	-941	579	-360
Treasury risk reserve (P70 less ML)		0	-5	-10	-141	-174	-191	-521	249	-272
Total: Gap in allocated funding / (commitment for RP3)	0	2	-25	190	-707	-561	-359	-1462	827	-633

- 4.4.4 The RIS2/RIS3 boundary falls close to start on site (SoS) making it a particularly volatile time for the project cashflow, as the speed of ramp up/mobilisation has disproportionate impact on the final two years of RIS2. The cash flow presented in Table 7 reflects the earliest mobilisation and a high level of risk expenditure within the RIS2 period.
- 4.4.5 The project team have therefore specifically considered whether further funding is required within RIS2. The team have run several scenarios, testing the cashflow in RIS2 whilst maintaining the DCO grant and opening dates, and have reached the conclusion that the project can keep within the current Budget allocation.
- 4.4.6 As with any major project of this scale, focusing on segments of the cashflow is problematic, and the project team will continue working this issue up to FBC, but the basis of our conclusion and management levers to do so are as set out below:
- 4.4.7 The profile of risk (both cost and schedule) has a major impact on the overall cost profile during construction. We have therefore considered when & where risks are likely to materialise and have modelled this in the scenario shown in Figure 3.2 below and compared it to the profile included in the updated OBC.

Figure 4.2 Comparison of spend profile between the OBC update and scenario



4.4.8 The two profiles differ in 4 ways as shown in Table 4.4 below:

Table 4.4 Differences between profile and scenario

	OBC Update [Earliest possible mobilisation with high-level of early risk expenditure]	Scenario [Most likely mobilisation and benchmarkable approach to risk]	RIS2 Impact
Schedule Activities	Activity period = Base + Duration Uncertainty	Activity period = Base + Duration Uncertainty + Risk	£-550m
Project Risk	Risk linked to associated activity	Risk lagging on “bow wave” profile	£-79m
Ringfenced LTC contingency	Flat annual %	Back-end loaded	£-97m
Inflation	HE approved profile	2019/20 inflation changed to “actual”	£-91m
Remaining RIS2 overspend			£+155m +5%

Schedule Activities

4.4.9 In the updated OBC baseline we have aligned the base costs to associated activities in accordance with the planned schedule and then allowed for duration uncertainty.

4.4.10 In the scenario we have included duration risk (at most likely) to each of the activities which extends the period over which the costs are profiled. This gives a more aligned representation as it accounts for both the risk costs and the risk of delay on the same basis.

Risk Profile

4.4.11 Risks are linked to associated activities but an observed feature on all major projects is that there is a time lag between the activity and materialisation of costs associated with risk events. This has therefore been adjusted for in the modelling for the scenario shown. This has therefore been adjusted for in the modelling for the scenario shown

Ringfenced LTC contingency

4.4.12 In the OBC estimate this has been profiled as a flat percentage of project spend in each year. The scenario modelling takes account of the fact this risk will always be back end loaded as we would not seek to request permission to use this until project risk has been used up

Inflation

4.4.13 An adjustment has been made to account for the “actual” inflation rate for 2019/20

Overall

4.4.14 The net impact of the adjustments described is that the projected project overspend in RIS2 has reduced to c £155m against a total RIS2 approved budget of £2.8BN is +5%.

4.4.15 The associated cash flow is shown in Table 4.5

Table 4.5 Cashflow updated for revised cash flow scenario

Project profiles (£m):	Prior Years	Roads Period 2					RP2	RP3	Total Project
		20/21	21/22	22/23	23/24	24/25			
Most Likely (including HE Risk Reserve)									
Agreed Funding	353.2	245.0	495.4	359.1	728.1	1046.6	2874.2	3163.5	6390.9
Latest Forecast	352.0	254.1	282.3	616.5	877.3	998.9	3029.1	3442.9	6824.0
Surplus / (Shortfall)	1.2	(9.1)	213.1	(257.4)	(149.2)	47.7	(154.9)	(279.4)	(433.1)

4.4.16 Although the total project cost in this scenario is more than the £6,752m due to a slight inflationary increase – it is not suggested the cost estimate be changed at this time and the difference of £72m will be treated as a cost pressure.

4.4.17 At this stage of the project with high levels of fixity on scope and design, ahead of engaging with an increasingly competitive market it is felt that this is within acceptable margins of error.

4.4.18 However, should an overspend manifest there are several key levers that the project can use to manage an overspend of this nature which include:

- Adjusting delivery timeframes not on the critical path:

For example: The construction of Roads North is not on the critical path and it has been estimated that this could be delayed by up to one year without an impact on the project cost or schedule. There is therefore an option to delay this work, if required, to enable the project to manage within its budget. Reduced impact on RIS2 cashflow would be c £300m.

- Adjusting start or peak expenditure:

At its peak the monthly project spend will be c £100m. A slight delay in activities could therefore be used to manage an overspend of this order of magnitude, with limited impact on the opening date.

4.4.19 Following the FBC, all the main works contracts will be awarded, and we will have expenditure plans based on the contractor's construction programmes. In addition, any conditions stemming from the DCO will also be included. At this time, we will have a much more accurate view of the annualised funding needs of the project.

4.4.20 The modelling has given us confidence that we have sufficient opportunities to manage spend in the latter part of RIS2 to enable us to ensure that this profile does not exceed the Budget allocation in this period. But it does highlight the need for continued focus on affordability overtime as well as on total cost and time.

4.5 Operations, Maintenance and Renewal (OMR) costs

4.5.1 Highways England will need to provision an average of £20m per annum plus inflation for operations, maintenance and renewal (OMR) from the OFT date in 2028.

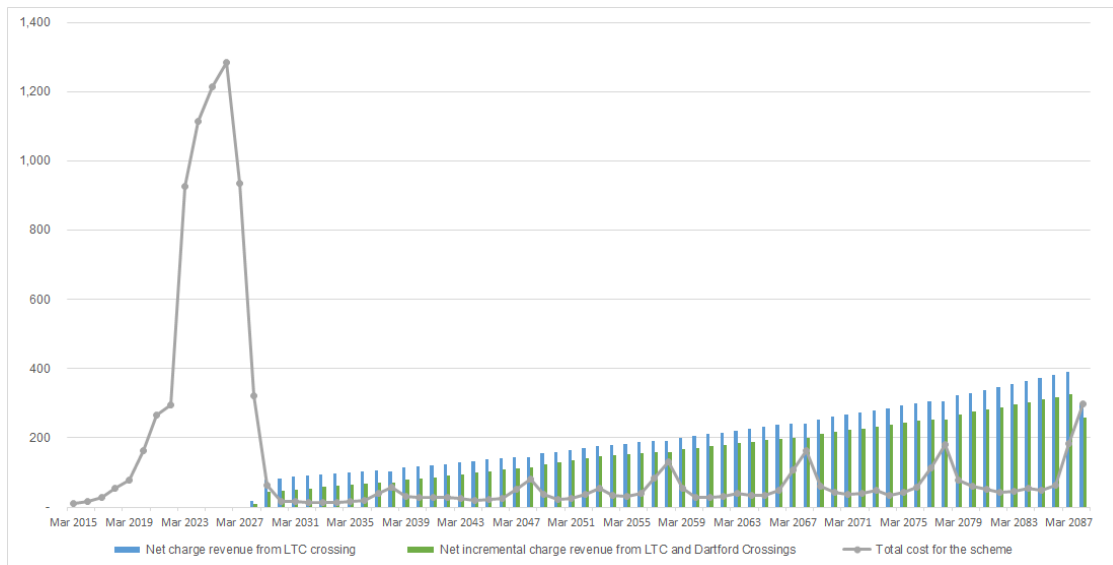
4.5.2 The total cost likely to be incurred over the 60-year assessment period (outturn prices) is £3.415bn.

4.6 Road user charge

4.6.1 Highways England is proposing to charge for the use of Lower Thames Crossing for long term network performance management and as such, the charge is expected to continue for a foreseeable future. The assumption is that the current charges at Dartford Crossing will apply and that the Dartford charge will remain unchanged from today's prices except for an annual RPI inflation increase.

4.6.2 Highways England currently manages the revenue from Dartford on a protocol basis with the revenue it collects being returned to the DfT. A similar arrangement is being assumed for LTC which means that user charge revenue and the related charge collection cost would accrue to the government and not Highways England. Figure 4-2 indicates the incremental revenue from the Dartford Crossing and LTC accruing to government as a result of building LTC.

Figure 4-2 Net cost and revenue to the government



5 The Commercial Case

5.1 Introduction

- 5.1.1 This case demonstrates how we will deliver the project outputs that support the benefits identified in the Economic Case, within the financial constraints identified in the Financial Case and to the programme set out in the Management Case.
- 5.1.2 The case also confirms we will procure in accordance with the Public Contract Regulations 2015 (PCR 2015) to minimise the risk of any legal challenge to the procurement process succeeding.

5.2 Packaging strategy

- 5.2.1 The works required to deliver the Lower Thames Crossing have been split into Early works - surveys to provide improved site and geotechnical data;
- 5.2.2 and Main works -The Main Works are split as follows:
- a. Roads North (circa £1,107m)
 - b. Tunnels and Approaches (circa £1,760m)
 - c. the A2/M2 Connections (circa £442m)
- 5.2.3 The approach to packaging was partially reappraised following the decision not to utilise the PF2 financing model. Splitting the main works into three separate contracts reduces our reliance once a single entity while maintaining sufficient package size to attract interest from the biggest contractors. It also allowed the tunnel package to be expanded to incorporate the immediate approach roads, simplifying the logistics and physical interfaces.
- 5.2.4 One of the three main works contracts will be procured using the Competitive Dialogue (CD) procedure. Dialogue will focus on the areas of most significant method related risk and opportunity. Bidders will be required to submit their tenders, including their design, cost estimate, schedule, evidencing any betterment against our benchmark.
- 5.2.5 We have selected CD for the Tunnels main works procurements because it allows us to gain confidence that participants' developing proposals will meet our requirements; address areas of significant method related risk or uncertainty prior to tender; seek proposals in targeted areas that offer greater value against our critical success factors; and mitigate risk associated with the consenting process.
- 5.2.6 The A2/M2 Connections package will be procured as a two-stage contract, using the Competitive Procedure with Negotiation (CPN). The package is dominated by its complex junction with a busy part of the network which will be constructed in a major utilities corridor with significant environmental constraints from the Kent Downs Area of Outstanding Natural Beauty (AONB) and areas of natural woodland.
- 5.2.7 The key to successful delivery of the A2/M2 package lies in traffic management and utility diversion work. This means it is preferable to get the construction partner on board at an earlier stage in the process (than is possible under CD)

to reduce risk by undertaking critical planning, design, and utilities consenting. The approach delivers value by maturing the methodology, phasing and design in order to reduce risk, before reaching a final agreement on the cost of delivering the package. The extent of the third party interfaces on this package mean that this is not possible during a procurement process and must be carried out in Stage 1 of the contract.

5.2.8

5.2.9 Recent market feedback suggests that interest in A2/M2 has grown since the adoption of a two-stage contract and that appetite for Roads North as a single stage contract procured through CD has declined to the point where we cannot be confident in securing three bidders. We are therefore moving to a two-stage contract for Roads North using a Competitive Procedure with Negotiation. The key to successful delivery of Roads North is planning around the delivery of the complex box under tunnel at the M25, the design of the Mardyke aqueduct for productivity and the overall earthworks balancing strategy. The approach for the two-stage contract will be finally tested with the market on August

5.2.10 The Main Works contracts will be based on the NEC4 ECC form of contract. The terms will encourage delivery within the Target Budget and before the handover date. Compensation events will be restricted to a limited number of defined risks and the fee will be fixed at contract award. To secure profit greater than that included in the fee, contractors will have to mitigate risk and secure opportunities to avoid spending the risk quota and complete the contract within the Target Budget. Should costs exceed the Target Budget, contractors will be liable for a share of the cost overrun, up to a proportion of the fee. The incentive model for the A2/M2 connections and Roads North packages will be developed to align as closely as practicable with the other main works packages.

5.2.11 Early completion would reduce contractors time related costs, contributing to savings against the Target Budget. A further incentive payment will be available if all contracts complete ahead of LTC's committed road opening date.

5.2.12 In addition to the main works contracts there are three key services packages:

- a. Technical Partner
- b. Integration Partner
- c. Road User Charging

5.2.13 The Technical Partner contract was awarded in 2016 to a joint venture (JV) of Arcadis, CH2M (now Jacobs) and Cowi. The Technical Partner has supported us in developing LTC and preparing for delivery.

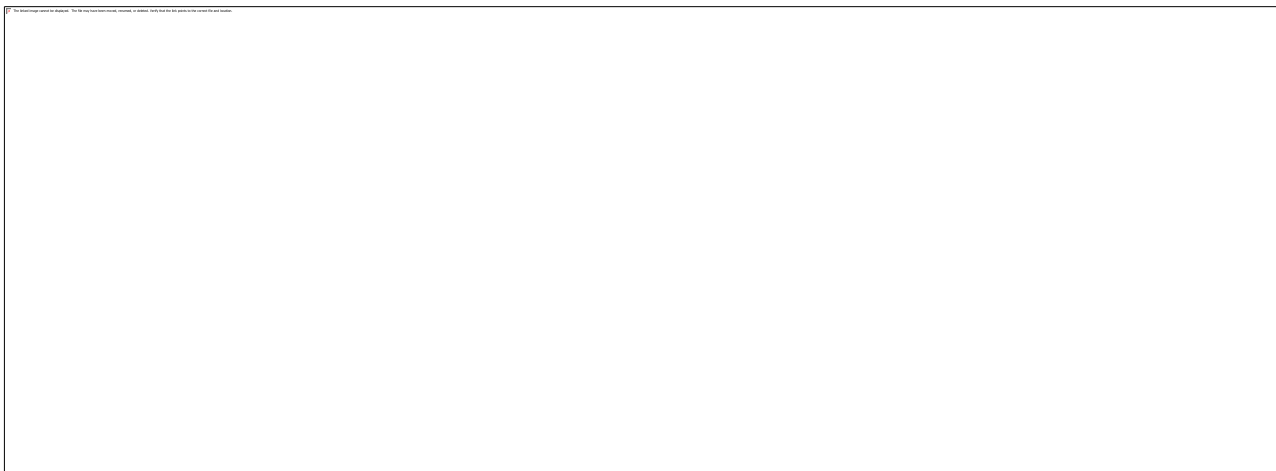
5.2.14 The Integration Partner is a client-side role and this organisation will support us throughout the Delivery Phase of LTC. Their scope will include:

- provision of management capability and capacity to ensure that we deliver on our obligations in contract and under our consents
- supporting us in our role as the integrator, managing cross package interfaces, identifying risk and opportunity at the interfaces, and resolving issues to maintain progress

- supporting our focus on a high availability asset via quality management, assurance, system integration and testing and commissioning and the handover to the Operations Directorate at the end of the project.

- 5.2.15 The Road User Charging systems will be procured through the road user charging service provider. This aligns with the Dartford Charge which is currently being reviewed. The same provider for the road user charging system will be used on LTC as used on the Dartford Charge.
- 5.2.16 The packages and the high-level chronological relationship between the delivery of the packages, Development Consent Order (DCO) grant and the Open for Traffic (OfT) are illustrated in Figure 5-1.

Figure 5-1 Scheduled durations of Main Works procurement processes

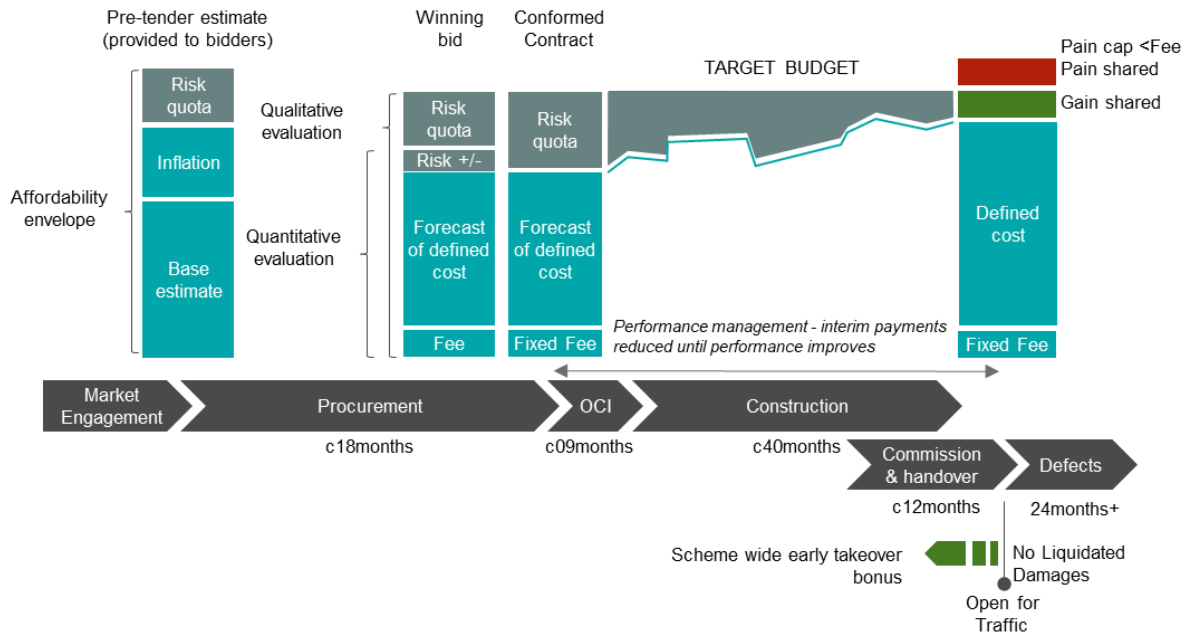


- 5.2.17 The key drivers of the proposed packaging approach are market appeal, scale and concentration risk, construction logistics and interface risks, customer focus, and programme.

5.3 Procurement

- 5.3.1 We commenced procurement of the Integration Partner in July 2020 and plan to award the contract by December 2020. Once mobilised, the Integration Partner will primarily be focussed on preparing for delivery. The current Technical Partner will continue to support us with responding to the DCO Examination and with the technical aspects of main works procurement.
- 5.3.2 We have allowed circa 18 months for procurement of the Tunnel and Approaches package being procured under Competitive Dialogue, i.e., from contract notice to contract award. This is consistent with other significant public procurements that have used or are using the same procedure, including A303 Amesbury to Berwick Down (Stonehenge).

Figure 5-2 Scheduled durations of key procurement processes



- 5.3.3 Where a two-stage design and build contract, strategy is adopted (A2/M2 Connections and Roads North), the procurement process will take circa 12 months depending on the extent of any negotiation. Stage 1 of the contract will then be between 6 and 12 months. The principal aim of Stage 1 is to mature the delivery plan and reduce risk so that the cost incentivisation target for the contract can be confidently finalised at an ambitious level. The contractor will work on the detailed design, securing consent, mobilisation, design and planning for utilities diversions and the construction phasing during Stage 1.
- 5.3.4 Commencement of procurement is also closely linked to the DCO consenting process. The DCO submission provides sufficient scope certainty on which to start procurement and we plan to place our contract notices as soon as possible after the DCO submission. It is common in infrastructure mega-projects for procurement to overlap the consenting process.
- 5.3.5 Running our procurements in parallel to the DCO creates three risks: resource intensity required to simultaneously support three major procurements and the consenting process is significant; commercial risk in leaving any changes to the DCO to be addressed post contract award; some potential procurement risk associated with changes introduced by the DCO process. We believe that these risks can be managed, and we are developing our plans accordingly.
- 5.3.6 Running three complex procurement processes in parallel is resource intensive and carries a risk of an administrative or procedural failure. Accordingly, we have progressed detailed planning of each procurement, including our governance and assurance approach, conflict of interest processes, resourcing, training, processes and systems. We plan to use dedicated technical teams for each process and have introduced a small stagger to the evaluations to reduce the burden on key decision makers. Most of our procurement team is now in place and we are developing our management procedures and governance arrangements, building on the approaches adopted on the A303 Amesbury to Berwick Down (Stonehenge) project.

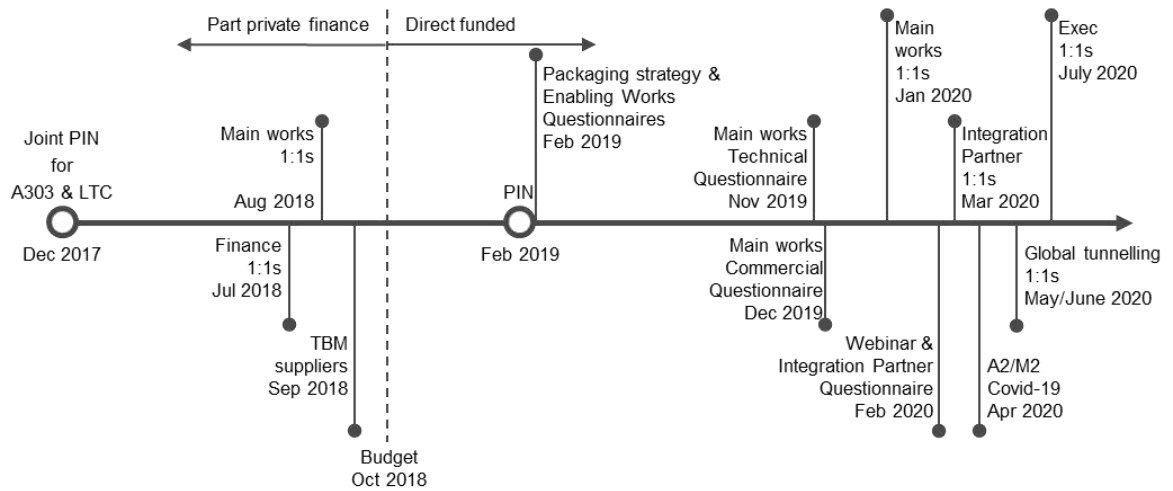
- 5.3.7 If the early part of the DCO examination reveals areas of unexpected challenge, requiring significant concessions, we could choose to extend the dialogue phase for the Roads North and/or Tunnels and Approaches packages to address this prior to tender. There is also potential to provide clarification of consenting constraints, even after tenders have been submitted, if this clarification is not material to the evaluation.
- 5.3.8 Where we adopt a two-stage contract for A2/M2 and Roads North), contract award is planned towards the end of DCO Examination. If the DCO Examination has resulted in substantive changes, we could extend the procurement with a negotiation stage, prior to final tender and a contract award 8-12 weeks later.
- 5.3.9 In line with lessons learnt from other projects and from market engagement feedback, the procurements conducted under the CD procedure will be c12 months from the start of Selection Questionnaire (SQ) to tender submission, with 5 months allowed for tender evaluation. This duration offers a balance between effectiveness of the dialogue and the cost to bidders in terms of time and resource. We will test the approach during market engagement and carry out more detailed analysis of the timing of the CDs.
- 5.3.10 We are currently undertaking a review of the procurement timeline following the update to the commercial approach on Roads North.
- 5.3.11 Our current proposal for the start of the process is Feb-2021 which allows us to maintain the current programme without impacting critical path.
- 5.3.12 Tender submissions will be received for the Roads North and/or Tunnels and Approaches packages in spring 2022 and, after initial analysis to confirm compliance and to establish the competitive range on pricing the defined scope, the financial information will be validated. The Final Business Case (FBC) will then be put forward for governance approval between spring 2022 in parallel to the full evaluation of tenders. A period of 2 months has been allowed for governance between the end of tender evaluation and prior to contract award. The main works packages will not be awarded until DfT and HMT and Ministers have approved the FBC.

5.4 Market engagement

- 5.4.1 Our market engagement strategy is designed to:
- stimulate interest in the market for our contracts
 - test our commercial and procurement approach
 - mobilise and prepare participants ahead of Contract Notices being raised.
- 5.4.2 We first issued a combined Prior Information Notice (PIN) for both the A303 Amesbury to Berwick Down (Stonehenge) project and the Lower Thames Crossing project in December 2017¹. Engagement was paused, as the strategy was revised, following the decision not to pursue PF2 in October 2018. It was reinvigorated with a new programme of engagement, starting in the autumn of 2019.

¹ A new PIN was issued in February 2019 following the decision not to utilise private financing for the project.

5.4.3 We use a range of media to engage, including supplier engagement events; information packs with written questionnaires; 1:1 meetings; webinars; pre-tender launch events; and LTC website. The significant events to date are illustrated in the figure below:



5.4.4 We have a final round of main works market engagement planned for August and September 2020. This is intended to:

- d. Update the market on the changes we have made in response to what we have heard from them.
- e. Provide more detail on the proposed financial tests, commercial arrangements and our view of the cost and schedule to deliver the scheme

5.5 Commercial risks

5.5.1 In line with the commercial model proposed for the main works contracts, risks arising under the main works contracts will comprise three distinct categories:

- a. risks that sit solely with Highways England (e.g. a change in Project Requirements, and any other “Fundamental Change”)
- b. risks that sit solely with the contractor (e.g. components that are deemed to be included in the Fee, Disallowed Costs, Damages and Losses)
- c. other risks that are jointly owned and managed within the envelope of the risk quota

5.5.2 Further work is ongoing to confirm which risks sit:

- a. solely with the contractor and as such are to be included within the Contractors’ pricing to be submitted with the tender
- b. those which are to be accommodated within the risk quota (and therefore Target Budget)
- c. those which sit solely with the Highways England
- d. those that are to be insured

6 The Management Case

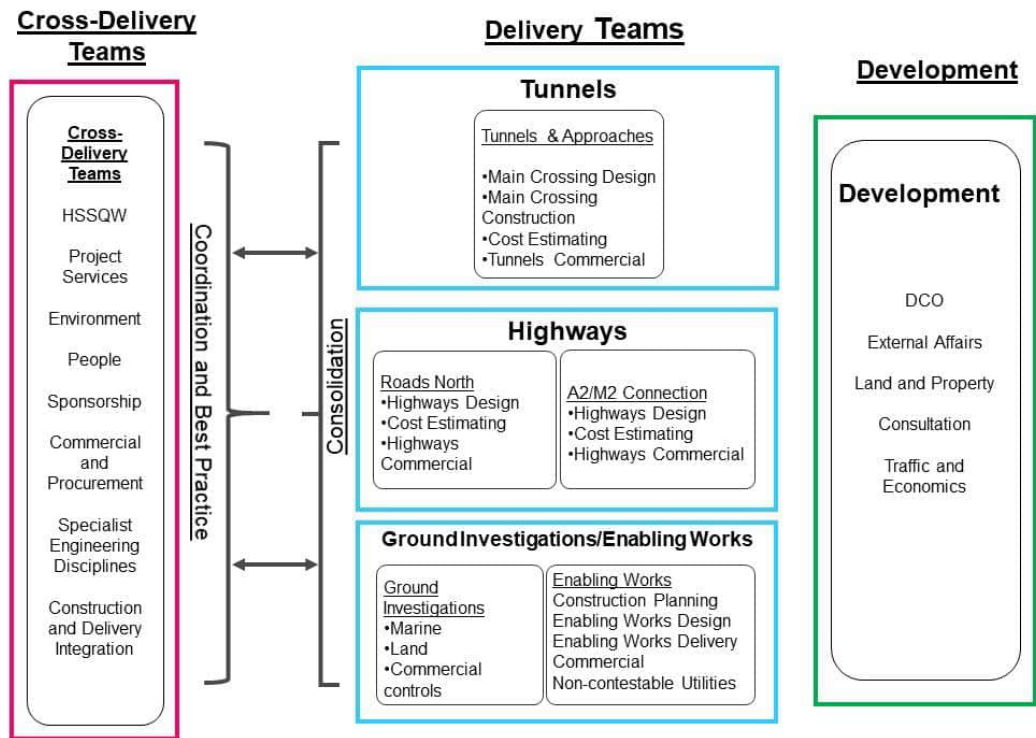
6.1 Introduction

- 6.1.1 The Management Case sets out how LTC will be controlled and governed through the development phase. The proposed approach to the construction phase (construction, commissioning, handover and closeout) is also set out at a high level.
- 6.1.2 Throughout the life of LTC lessons learned are identified, reviewed, and appropriately recorded. The Governance and Assurance project manager maintains a lessons learned log for the project and ensures that key lessons are captured at the end of each stage.
- 6.1.3 LTC, A303, A14 and A428 projects are managed within the Complex Infrastructure Programme (CIP) and overseen by the same Senior Responsible Owner (SRO) and Programme Sponsor ensuring the sharing of good practice and experience as a regular and ongoing activity. Lessons learned from our previous projects (such as A3 Hindhead Tunnel, the M25 DBFO and the ongoing delivery of the A14 Huntingdon to Cambridge project) are regularly assessed to ensure knowledge and experience is successfully transferred.
- 6.1.4 projects such as London 2012, Crossrail, the Thames Tideway Tunnel and HS2. This experience is informing the way the team works and supports robust management of LTC. It has also been applied directly to:
- the development of the Commercial and Procurement Strategy
 - the Design Management Strategy
 - the approach to the DCO
- 6.1.5 The project team has also looked beyond Highways England to gain knowledge and learn lessons from other projects. In addition, LTC has a dedicated Lean, Value Management and Innovation (LVMI) team which focuses on knowledge management and learning lessons.

6.2 Organisational structure and operational model

- 6.2.1 All CIP projects are delivered in accordance with the Project Control Framework (PCF); a structured approach to project delivery which places focus on the approval of key deliverables at staged gateways. CIP brings our most complex projects under a single leadership team which facilitates the sharing of lessons learned and resources between the projects.
- 6.2.2 To manage LTC effectively, we have put in place an operating model (see Figure 6-1) consisting of a dedicated project team which is based in its own project office, plus satellite offices, to promote a strong focus on delivery. This is designed to be in place throughout the development stage when we will be running the procurement of the main works and the DCO process in parallel. The model will then evolve and develop as the project matures and moves through its phases.

Figure 6-1 Lower Thames Crossing operating model



- 6.2.3 In 2016 we engaged a Technical Partner (Cascade) to develop the design, obtain approval, procure suitable contractors to construct LTC and monitor work through to OfT.
- 6.2.4 Given the size, the complexity and the engineering challenges, the operating model is based on a programmatic approach. Hence each of the main works contracts plus the pre-enabling works are treated as pseudo separate projects with dedicated delivery teams. Whilst each delivery area has its own support structure, designers, cost estimators, risk managers, schedulers, etc; functional leads will ensure consistency and the use of best practice across the project.
- 6.2.5 Governance, the Programme Management Office (PMO), assurance, and commercial and procurement teams continue to be led by key Highways England personnel under the operating model. The project team also benefits from support from the CIP Sponsor team.
- 6.2.6 The key roles and responsibilities for overseeing LTC are DfT Client Sponsor, Senior Responsible Owner (SRO), Programme Sponsorship Director (PSD), Project Director and Senior User. The project team is led by the Project Director and managed using a 'One Team' approach, involving our staff working in a collaborative integrated team environment with staff from the Technical Partner.
- 6.2.7 Specialist CIP business partners together with business partners supporting Highways England as a whole, provide challenge to the project. We also employ specialist advisers to provide legal services.
- 6.2.8 To meet the challenge of moving to a delivery organisation, if the DCO is awarded LTC will move to the Designed to Deliver model which will retain and build on the product-focused teams. The model will be designed to ensure the

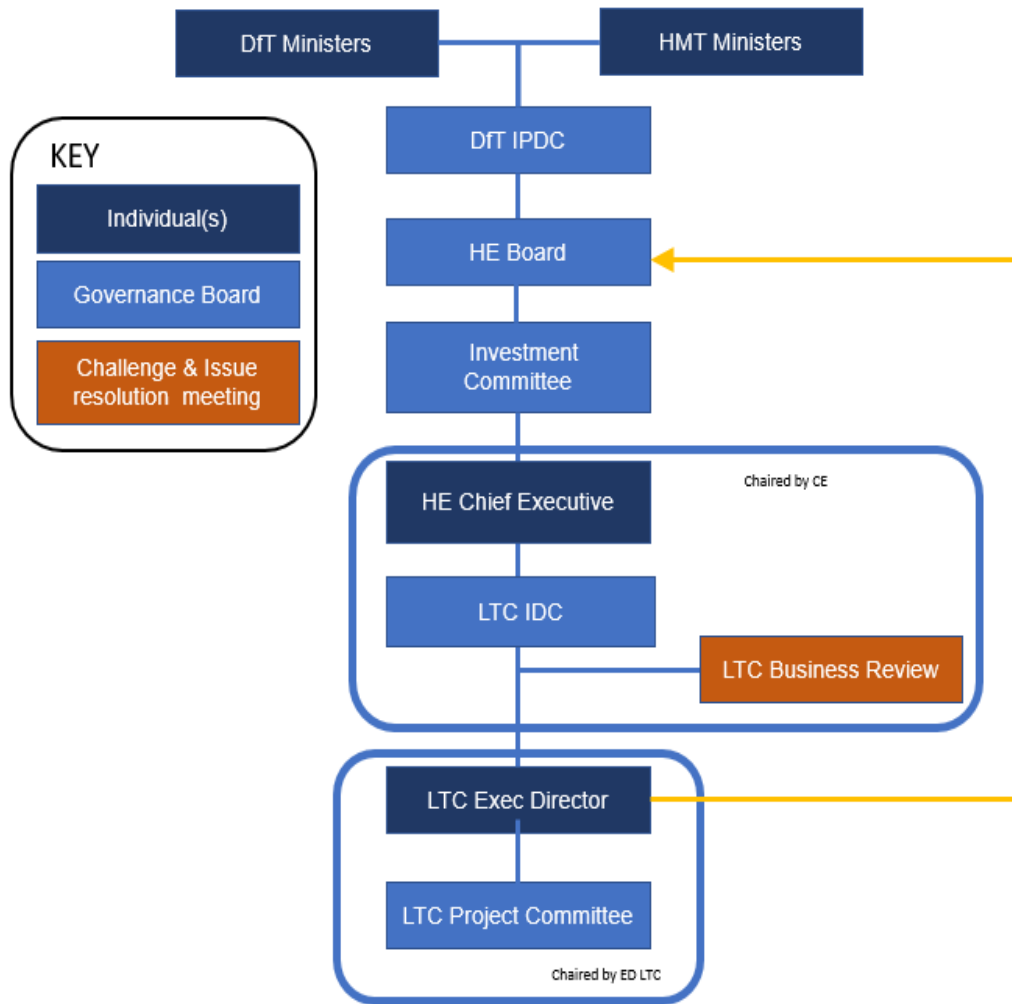
team is focused on managing the interfaces between the enabling works, the main works contracts, the road user charge contract and the existing SRN.

- 6.2.9 The leadership and management functions that the Technical Partner has supported us with during the development phase will transition to the Integration Partner for the delivery phase. The Technical Partner will be retained to focus on its role in the Design Authority, supporting us with technical expertise in tunnelling in particular. The Integration Partner is scheduled to be appointed by late 2020 to allow sufficient time for the transition of responsibility from Technical Partner to Integration Partner before the delivery phase starts following the DCO award. The Integration Partner will work alongside Highways England staff in an Integrated Client team responsible for integrating the various components of this project during delivery. The Technical Partner will be retained to focus on its role in the Design Authority, supporting us with technical expertise.

6.3 Governance and assurance

- 6.3.1 As a Tier 1 Project the ultimate authority to invest is granted by the DfT's Secretary of State and the Chief Secretary to the Treasury. Before submission to these Ministers a well-established process of approvals must be followed.
- 6.3.2 The proposed updated governance arrangements for the delivery of LTC are set out in Figure 6-2 Revised LTC governance and assurance model. These will be presented for approval alongside this updated OBC. The DfT and the Infrastructure and Projects Authority (IPA) are represented in several governance meetings, including the Project Committee and the Procurement Steering Group (PSG). Responsibility for routine management, issue resolution and coordination of day to day activities on LTC is delegated to the Project Executive Group (PEG) which meets at least monthly.

Figure 6-2 Revised LTC governance and assurance model



- 6.3.3 A clear governance and assurance pathway provides the required distinction between co-ordination/issue resolution, decision making and assurance. This is structured to include project, Highways England, DfT and broader government processes.
- 6.3.4 The Executive Director LTC, who has clear delegated authority, is the ultimate decision maker but is supported in the decision-making by the other Project Committee members and, where appropriate, technical experts and independent project advisors.
- 6.3.5 Any decisions that go beyond these boundaries are escalated upwards to the relevant Highways England Committee (e.g. IDC, IC).
- 6.3.6 The sponsorship team regularly meet with DfT, as well as HMT and the IPA, to update them on Project progress and provide detail as needed. This provides transparency and shared understanding on an ongoing basis and supports progressive assurance across the four levels of defence which, in turn, benefits the programme. IPA provides an additional level of assurance and critique.
- 6.3.7 LTC follows the Major Projects PCF process which sets out how we manage and deliver projects over £10m. The PCF is designed to ensure that we deliver

road schemes which meet customers' aspirations in a consistent, cost efficient and timely manner.

6.3.8 LTC undergoes both internal and independent assurance and commercial reviews, run by specialist external reviewers (including the IPA) at key points in the delivery lifecycle. These reviews are generally timed to support requests for funding and business case approval.

6.3.9 In line with the Tier 1 governance process, DfT and HMT Ministers will approve the updated OBC and FBC and provide investment approval to support the issue of the OJEU and contract award. Under our procurement delegations, Highways England would approve all other steps in the process.

6.4 Benefits realisation management

6.4.1 Highways England is committed to ensuring LTC delivers the outcomes required to promote the scheme objectives, as defined in the CSR, as well as additional, sustainable outcomes which will benefit the environment, local economy and communities. LTC's Legacy and Benefits Strategy (LBS) is aligned with the IPA 'Guide to Effective Benefits Management in Major Projects.

6.4.2 As set out in the Economics Case LTC will directly deliver, or indirectly promote, a range of economic benefits to customers, local communities and to Highways England. Whilst some of these benefits are realised during the lifetime of LTC many will only be realised when Highways England operates the crossing after the LTC project has been completed.

6.5 Communications and stakeholder management

6.5.1 Support from key stakeholders is critical to LTC's timely and successful passage through the design, DCO and procurement processes.

6.5.2 We have produced a Stakeholder Engagement and Communications Strategy for LTC, which provides direction and an overarching framework for all engagement and communication with stakeholders and customers. It is updated at regular milestones to ensure a balance between long and shorter-term delivery objectives. We are delivering the strategy via a series of specific stakeholder engagement and campaign plans to take LTC through its defined stages.

6.5.3 Whilst there are relatively high levels of support in principle for LTC, there are also challenges, particularly in areas close to the proposed route. The strategy and delivery plans reflect this by ensuring an appropriate balance between engaging meaningfully with those who oppose LTC and enabling them to influence LTC and maximising and building a good understanding of the need for LTC with the (often silent) wider audience.

6.5.4 We held a Statutory Consultation, as required by the Planning Act 2008, during late 2018. The details of the issues raised will be set out within the Consultation Report which forms part of the DCO application.

6.5.5 Building on the 10-week statutory consultation held in October 2018, we held an eight-week non-statutory supplementary consultation in January 2020 with the updated design that had evolved from the engineering reviews and feedback from the Statutory Consultation.

- 6.5.6 We have further refined the design proposed as a result of ongoing feedback received and ongoing stakeholder engagement, as well as final design development. As a result, we commenced a final 30 day design refinement consultation commencing 14 July 2020 to give the project sufficient time to receive, review and respond to feedback ahead of the submission of the application for a DCO at the end of October 2020.
- 6.5.7 We are not consulting on any changes to the core scheme which have not already been discussed in the previous supplementary consultation. There are no changes to the road layout itself.

6.6 Project management

- 6.6.1 The LTC Project Management Plan (PMP) sets out the approach to managing LTC as part of a suite of documents that together define LTC and its delivery.
- 6.6.2 As LTC moves through each phase, the PMP will be updated and processes will be developed and implemented to deliver each phase. It will be substantially revised before the Construction phases.
- 6.6.3 Key systems and controls include integrated management system, project baseline, schedule management, change control, cost management, risk and opportunity management, issue management, project monitoring and reporting.
- 6.6.4 Changes to the baseline (cost, schedule, scope and quality or benefits) are controlled by the Change Process. Any member of the project team can identify a change and submit a change form after ratification by the relevant Steering Group. This form allows the Project Controls team to assess the impact on cost, schedule and risk, in addition to reviews of the quality and HSW impacts. Changes are then reviewed and approved by the Change Board. Changes are escalated to Project Committee and further where required by governance.
- 6.6.5 We have a Risk and Opportunity Management Plan (RMP) which sets out our approach to the management of risks and opportunities at the strategic, delivery and delivery levels. The RMP addresses our approach to identifying/registering risks and opportunities, quantification, developing mitigation plans, reviewing the status or risks and opportunities, and assurance. Regular risk management reviews take place to ensure risks are being managed in line with the RMP.

6.7 Project close out

- 6.7.1 Like the Dartford Crossing, the LTC will have a free flow road charging system, where drivers pay remotely and therefore do not stop to pay on the crossing. We will seek powers under the DCO for Highways England to administer LTC on behalf of the Secretary of State, who as the Charging Authority sets the level. The project team has been working with the current HE Dart Charge team so that this contract can be expanded to include LTC.

Lower Thames Crossing

Outline Business Case

Strategic Case

Lower Thames Crossing Outline Business Case

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1 Introduction

1.1 Background

- 1.1.1 The Lower Thames Crossing project (LTC) is a proposed All Purpose Trunk Road (APTR) connecting Kent, Thurrock and Essex by a tunnel underneath the River Thames. It will increase road capacity across the Thames east of London by nearly 90%.
- 1.1.2 LTC is:
- classified as a Nationally Significant Infrastructure Project (NSIP), as defined by the Planning Act 2008
 - included in HM Treasury's top 40 priority investments identified in its National Infrastructure Plan 2013¹
 - part of the Government's £15.2 billion Road Investment Strategy² over the period 2015-2020, and part of the £27.4 billion Road Investment Strategy 2³ over the period 2020-2025.

1.2 Development of the Business Case

- 1.2.1 In January 2016, a Strategic Outline Business Case (SOBC) was approved by the Department for Transport (DfT) and HM Treasury confirming that the proposed crossing at Location C (see Figure 5.1) would meet the policy and strategic objectives of government and Highways England.
- 1.2.2 In February 2017, a partial Outline Business Case (OBC) presented the case for the Recommended Preferred Route to DfT. It took account of the work undertaken since the SOBC and the feedback from stakeholders and the public during consultation in early 2016.
- 1.2.3 Government made a Preferred Route Announcement (Route 3 with Western Southern Link – see Figure 5.3) in April 2017. In July 2017, a recommendation to increase the capacity of the roads which connect to the tunnel from two to three lanes was approved by government.
- 1.2.4 This document is the Strategic Case for the updated OBC; updated in April 2020 to reference updated data sources where appropriate.

¹ Section 3.19, Page 36-37: Priority investments and key projects

² <https://www.gov.uk/government/collections/road-investment-strategy>

³ <https://www.gov.uk/government/publications/road-investment-strategy-2-ris2-2020-to-2025>

1.3 Structure of the Strategic Case

1.3.1 The Strategic Case details the current problems on the Strategic Road Network (SRN) in the Lower Thames Area to demonstrate the rationale for LTC. It is presented in four further sections:

- Section 2 – The case for change
- Section 3 – Objectives
- Section 4 – Strategic policy context
- Section 5 – Option development and shortlisting

2 The case for change

2.1 Introduction

- 2.1.1 For over 56 years, the Dartford Crossing has provided the only significant road crossing of the River Thames east of London. Designed for 135,000 vehicles per day, since 2016, average daily flows have exceeded 150,000 and it consistently carries over 180,000 vehicles on the busiest days of the year. Traffic flows this far above the design capacity of the road result in frequent congestion and poor journey time reliability⁴, making the Dartford Crossing one of the least reliable sections of the SRN.
- 2.1.2 Congestion is exacerbated when accidents and incidents occur and extends the time it takes to restore normal operation to as long as five hours. This poor resilience⁵ of the Dartford Crossing is further undermined by a lack of alternative routes across the Thames.
- 2.1.3 The crossing is a critical part of the country's road network. It connects communities and businesses and provides a vital link for the nearby major ports, which play a critically important role in the distribution of goods across the UK, including the Midlands and North of England. Reliable river crossings are essential for the provision of services and goods, enabling local businesses to operate effectively and for residents to access housing, jobs, leisure and retail facilities on both sides of the river.
- 2.1.4 This section sets out the need for a new crossing and the rationale for intervention by providing:
- a. an overview of the incremental development of the Dartford Crossing which has resulted in a sub-optimal configuration with many compromises in relation to modern standards
 - b. an analysis of the traffic using the crossing showing it is capacity constrained
 - c. a summary of the current operational issues at the crossing highlighting the impact on users and non-users in terms of economic productivity and trade, social and user experience and environmental impacts
 - d. an assessment on how these negative impacts will increase in the future without new additional capacity to improve the reliability and strengthen the resilience of the existing crossings
 - e. a summary of stakeholder views

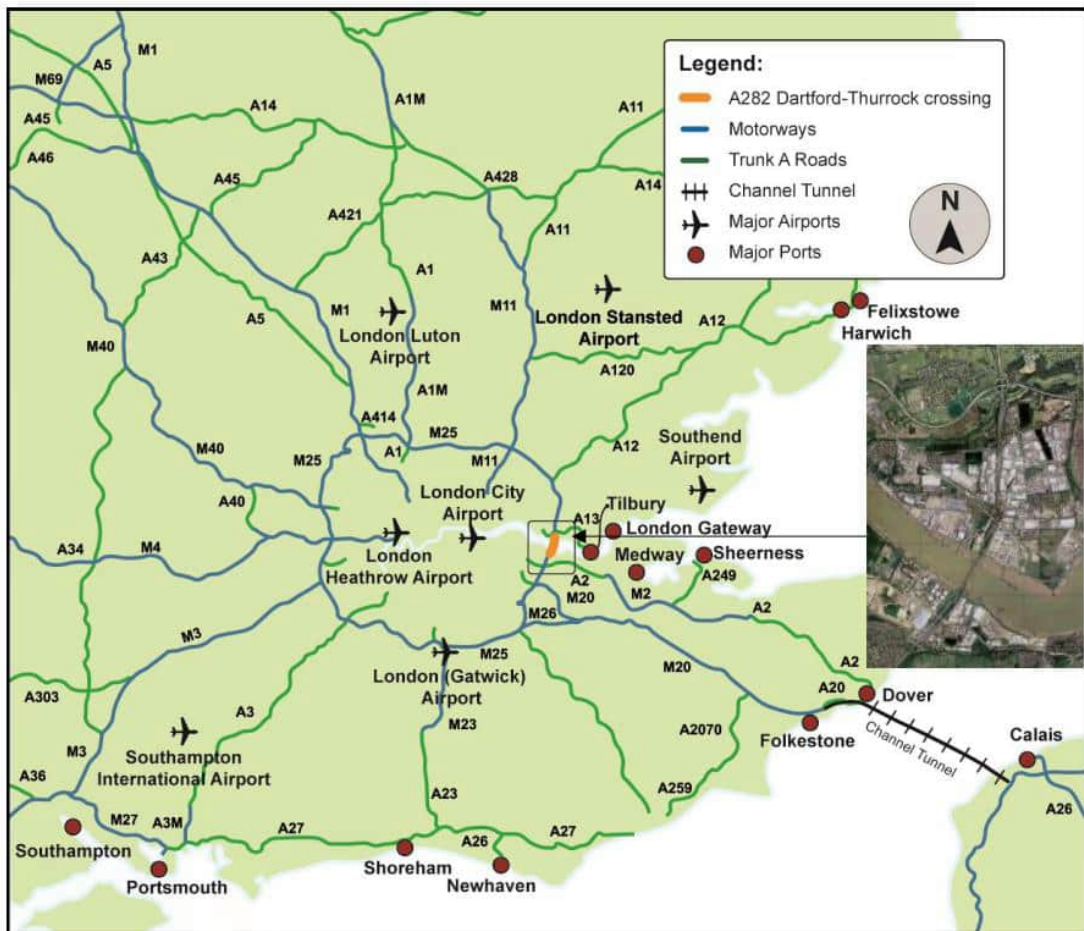
⁴ Reliability: the variability of journey times, in terms of sensitivity to planned/unplanned incidents and variations in day-to-day volumes.

⁵ Resilience: how well the network can cope with full or partial closure of key links, for example, part of the existing Dartford Crossing, for either a short or long period of time

2.2 The Dartford Crossing

- 2.2.1 The first crossing in this location was provided by a single, two-lane tunnel opened in 1963. A second tunnel was completed in 1980, offering two additional lanes. The Queen Elizabeth II (QE11) Bridge opened in 1991 dedicated to southbound traffic and the tunnels were then dedicated to northbound traffic. There are now four traffic lanes crossing the Thames, in each direction. The Dart Charge scheme was introduced in June 2015, providing a free flow charging scheme at the crossing.
- 2.2.2 Figure 2.1 shows the SRN in the south east of England. This highlights the importance of the Dartford Crossing (the A282) in allowing orbital movements around London on the M25 and north-south movements on the SRN, including to the Midlands and the North.
- 2.2.3 It also highlights the strategic role of the crossing due to the role of the M25, which provides a key link between locations in the Midlands, M62 corridor, the North East and Scotland and the ports of Dover and the Channel Tunnel.

Figure 2.1 Location of the Dartford Crossing on the SRN



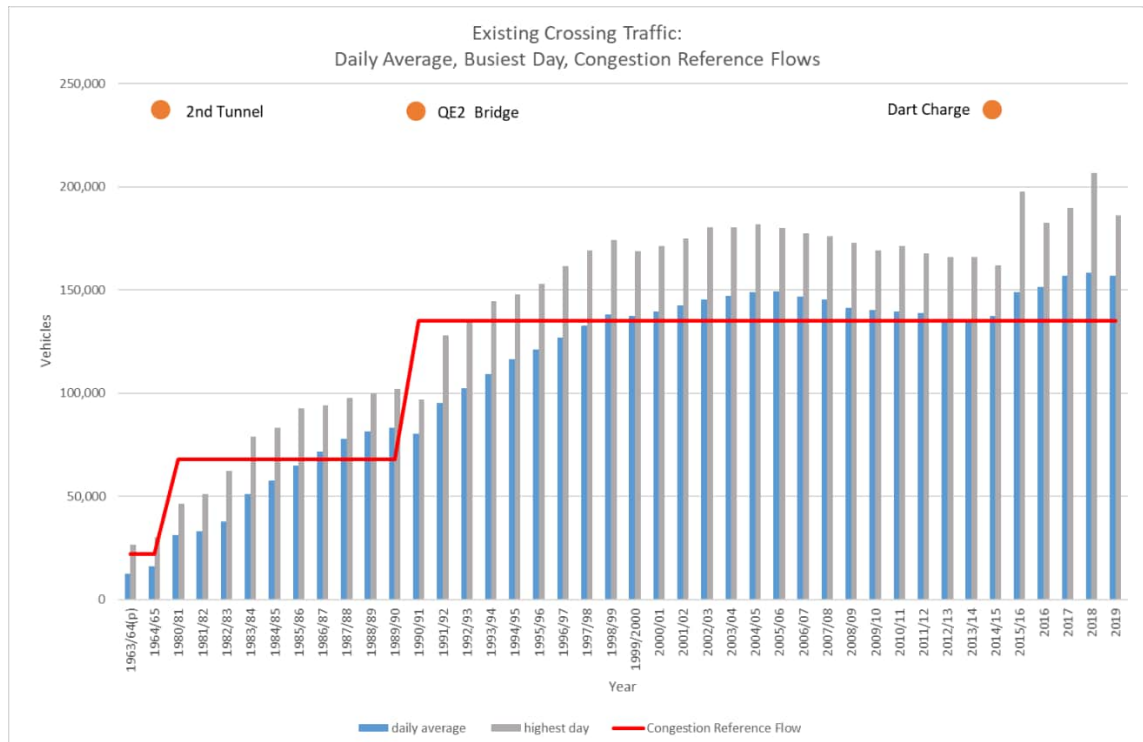
Source: *Post-Consultation Scheme Assessment Report (Volume 2), Highways England, March 2017*

2.3 Traffic using the Dartford Crossing

Traffic growth and crossing capacity

- 2.3.1 Figure 2.2 shows how traffic has grown over time, when additional physical lane capacity has been introduced at the crossing and with the implementation of Dart Charge. There was a steady increase in traffic until 1999 when traffic began to be capacity constrained. Following the opening of the QE11 Bridge, which effectively doubled capacity, it only took seven years until traffic was again capacity constrained.
- 2.3.2 Removal of the toll booths in June 2015 following implementation of Dart Charge provided some relief on the capacity constrained approaches; however, suppressed demand saw traffic volumes increase in the first year by four times more than the average increase on the SRN⁶. In the following year to April 2017, traffic increased at the crossing at double the national average⁷. From 2017 until 2028 national traffic is forecast to increase by nearly 10.5% and by up to 17% on motorways within the local area⁸.
- 2.3.3 The high traffic flows and above average annual increases highlight the significant pressure the Dartford Crossing faces. Despite the lack of capacity, more and more people are trying to cross at this location due to the fact there is not an acceptable alternative.

Figure 2.2 Timeline of average daily flows compared to capacity increases⁹



Source: *Dart Charge and Design Manual for Roads and Bridges vol 5 section 1*

⁶ Road Traffic Estimates: Great Britain, DfT, April 2016

⁷ Road Traffic Estimates: Great Britain, DfT, April 2017 (Provisional)

⁸ Data taken from TEMPRO 7.2, 2017- 2028. Local area defined as counties of Kent and Essex, Thurrock, Medway and LB Havering

⁹ Congestion reference flow - the flow at above which congestion would be expected in peak periods

Traffic composition

- 2.3.4 On average 26,000 Heavy Goods Vehicles (HGVs) used the Dartford Crossing per day in 2016 accounting for approximately 19% of the total traffic¹⁰. This is almost double the percentage typically observed on other parts of the SRN, demonstrating the reliance of the crossing for business users.
- 2.3.5 In the AM peak period around 9% of the HGVs using the Dartford Crossing have an origin/destination of the Port of Dover or the Channel Tunnel Freight Terminal. In the PM peak, this figure is around 15%. This also demonstrates the importance of the crossing for facilitating the movement of goods from Continental Europe¹¹.

Traffic distribution

- 2.3.6 Table 2.1 provides details of the distribution of two-way trips at Dartford Crossing during peak periods from the Lower Thames Area Model (LTAM)¹² in the 2016 base year. This shows that while 18% of trips start or finish in the local area, only 4% are local to local trips and almost 50% of trips have an origin or destination in the wider Kent or Essex regional area. This demonstrates the crossing is of significant regional and national importance.

Table 2.1 Traffic distribution by region (2016 Base Model)

	Local northside (J31)	Essex regional (A13/J30)	The North; M25 beyond J29	Total
Local southside (J1A/J1B)	4%	8%	5%	18%
Kent regional (M2/A2 and M20)	8%	19%	22%	49%
The South, M25 beyond J3	6%	18%	9%	33%
Total	18%	45%	37%	100%

Source: Lower Thames Area Model (Base100)

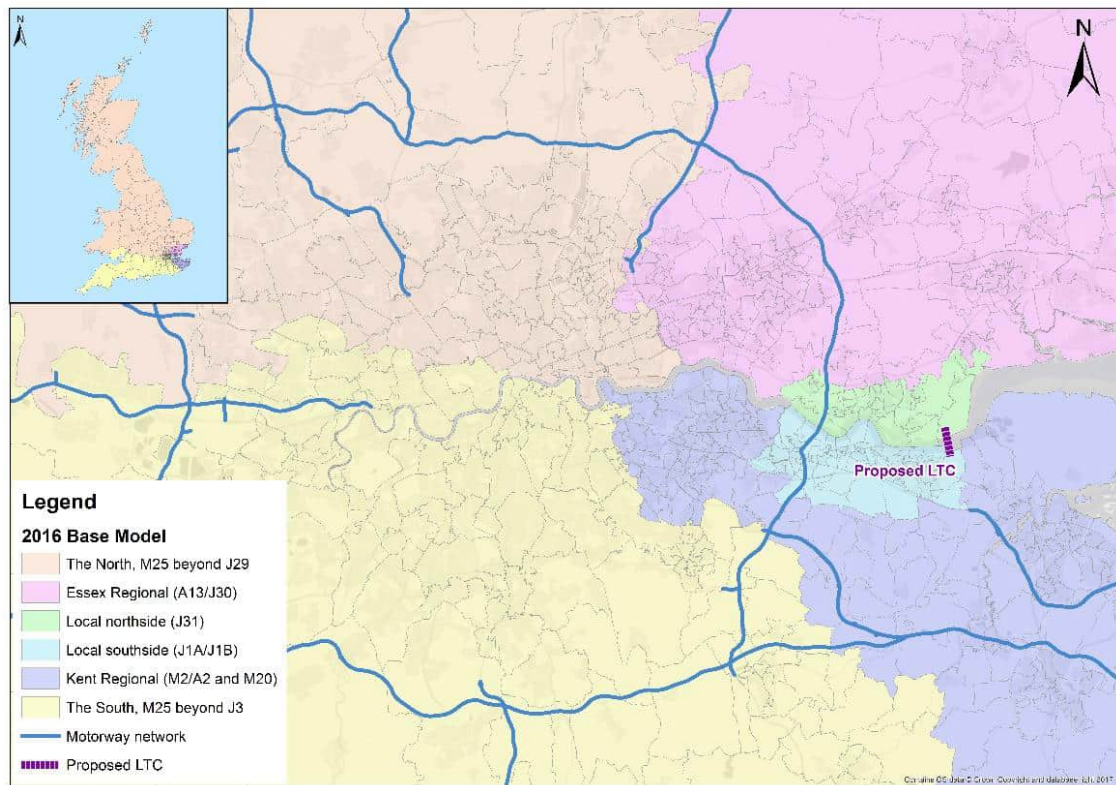
- 2.3.7 The areas referred to in Table 2.1 are shown spatially in Figure 2.3.

¹⁰ Lower Thames Area Model (Using the "Base 100" run: –The validated 2016 Base Year run used, and reported in the LMVR issued at Statutory Consultation in 2018)

¹¹ AM Peak figure is 8.8%, PM peak figure is 14.5%. Figures from LTAM using Base 100 run.

¹² The Lower Thames Area Model is a strategic highway model produced by Highways England to assess the impact of the Lower Thames Crossing on the highway network as well as provide traffic data for use in environmental and economic assessment of the project. Further details on LTAM are contained in the Economic Case, Section 2.3

Figure 2.3 Regions for traffic distribution analysis

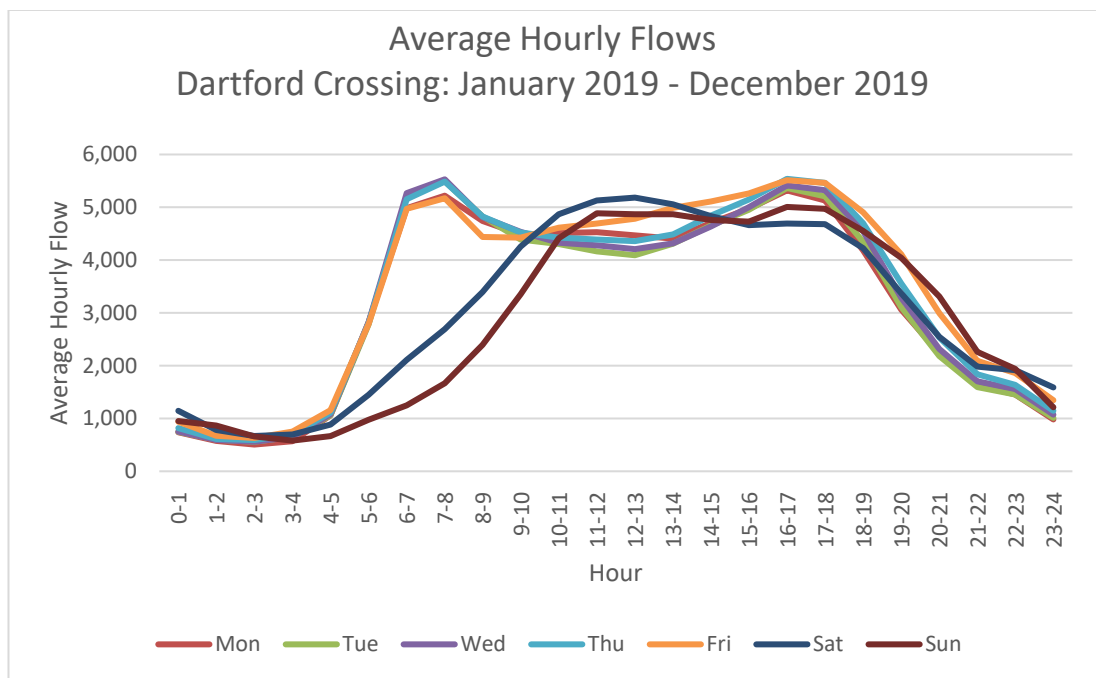


Traffic flow profiles

2.3.8

Figure 2.4 shows the hourly traffic flow profile at the Dartford Crossing over 24 hours on each day of the week. Traffic volumes between peak periods and at the weekend do not drop, as seen elsewhere on the SRN, due to the limited alternative routes across the Thames east of London. Because of these high volumes, speeds are reduced and there is an increased risk of incidents which leads to further congestion and poor reliability.

Figure 2.4 2019 Profile of daily traffic flows at the Dartford Crossing



Source: Highways England, Dart Charge

2.4 Dartford: current operational issues

Crossing operation

2.4.1 The incremental approach to increasing traffic capacity at the existing crossing has resulted in a sub-optimal configuration with many compromises compared to modern standards. The current layout is shown in Figure 2.5.

Northbound tunnels

2.4.2 The existing tunnels are of insufficient size and safety standards resulting in numerous operational constraints:

- No vehicles are permitted to queue in the tunnels. When incidents or congestion north of the Thames occur, traffic is halted outside the tunnels which causes further congestion on the surrounding network.
- The western tunnel geometry excludes vehicles over 4.8 metres high, so taller vehicles must use the eastern tunnel and cross traffic lanes to do so. This increases weaving, congestion and incidents.
- Due to the age and design of both tunnels, Dangerous Goods Vehicles (DGVs), such as fuel tankers, are required to be escorted through the tunnels. 2016 data¹³ shows that over 2,000 escorts¹⁴ took place every

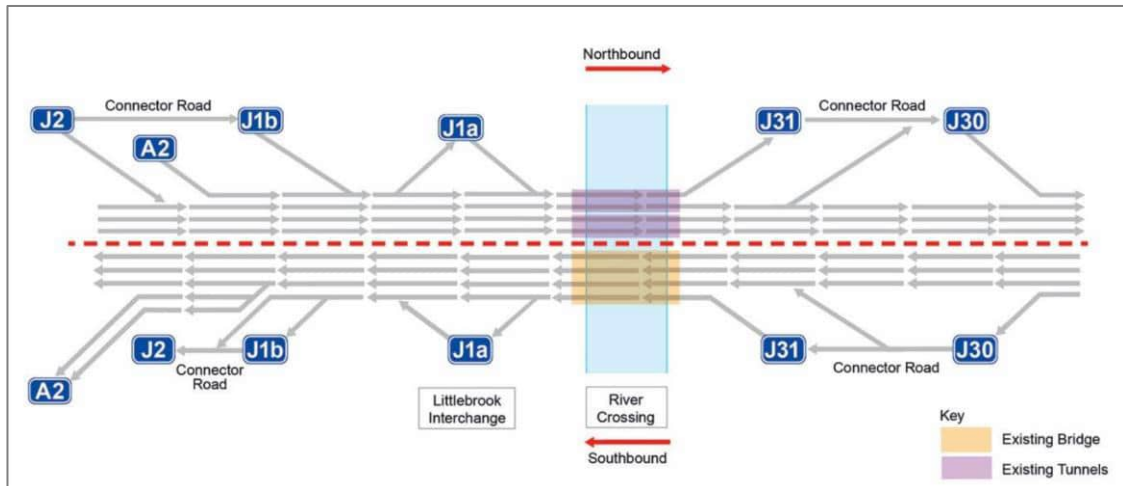
¹³ Dartford Dashboard. January 2017.

¹⁴ Escorts are where DGVs are led through the tunnel by a Highways England vehicle. General traffic is held outside the tunnel until the DGVs are clear. DGVs travel in convoys through the tunnel at least every 15 minutes.

month, with convoys of restricted vehicles dispatched approximately every 15 minutes during weekday peak and inter-peak periods.

- d. Escorts are predominantly dispatched via the western tunnel and each escort resulted in approximately 90 seconds of closure on average which equates to 5-7 minutes of closures each hour, leading to a loss of between 8-12% of capacity. The process of removing escorted vehicles from general traffic lanes can also result in additional disruptions and loss of capacity.

Figure 2.5 Existing road layout on M25/A282 corridor



Source: Post-Consultation Scheme Assessment Report (Volume 2), Highways England, March 2017

Southbound bridge

- 2.4.3 When the forecast crosswind speed exceeds 60mph or the headwind speed exceeds 70mph, the bridge is closed to all traffic for safety reasons. Southbound traffic is then routed through the eastern tunnel. While relatively rare, this can cause additional delay in both directions.

Junctions north and south of the crossing

- 2.4.4 There are junctions less than one mile apart north and south of the crossing.
 - a. These closely spaced junctions cause extensive weaving as users enter/exit the A282 and use the crossing. This impacts on traffic flow, reducing effective capacity and increasing the likelihood of incidents, which results in further capacity loss when these occur.
 - b. Drivers familiar with the local area leave the M25, and use local roads to avoid congestion, re-joining closer to the crossing, for example, re-joining at the head of the queue at J1a, or using parallel routes between junction 2 and junction 1b rather than the A282. This increases traffic on the local network and further exacerbates the issues with junctions and weaving.
 - c. Because of some of the above issues, junctions 1a, 1b and 2 have merge and diverge arrangements that are not appropriately configured to

accommodate the flows using them, which in turn cause further problems and constraint on the wider network as traffic is held both joining and leaving the SRN.

Traffic Management Cell

- 2.4.5 The Traffic Management Cell (TMC)¹⁵ is designed to optimise traffic flow but ultimately the requirement for extractions, escorts and metering of traffic places a lower limit on available capacity northbound through the tunnels compared to the QEII Bridge.
- 2.4.6 As set out in Section 2.2, the Dart Charge has been the only major improvement to the crossing since the opening of the QEII bridge. However, some minor incremental improvements have been, or are in the process of being, implemented as set out in Table 2.2. Given their scale these are not expected to resolve the operational issues set out above.

Table 2.2 Completed and planned incremental improvements to Dartford Crossing

Project/improvement	On-site completion	Strategic network improvement	Local network improvement
M25 Junction 30/A13 Congestion Relief Scheme	2017	Improved junction capacity	
Tunnel Upgrade to EUD Standards	2017	Resilience	
Dartford Collaborative Traffic Management	2018	Improved local/SRN integration	
Dartford Northern Crossovers	2021	Reduced traffic disruption	
A282 Jct 1a overbridge carriageway widening	2021		Additional capacity
A282 Jct 1b yellow box installation	2020	Reduce congestion during incidents	

Incidents

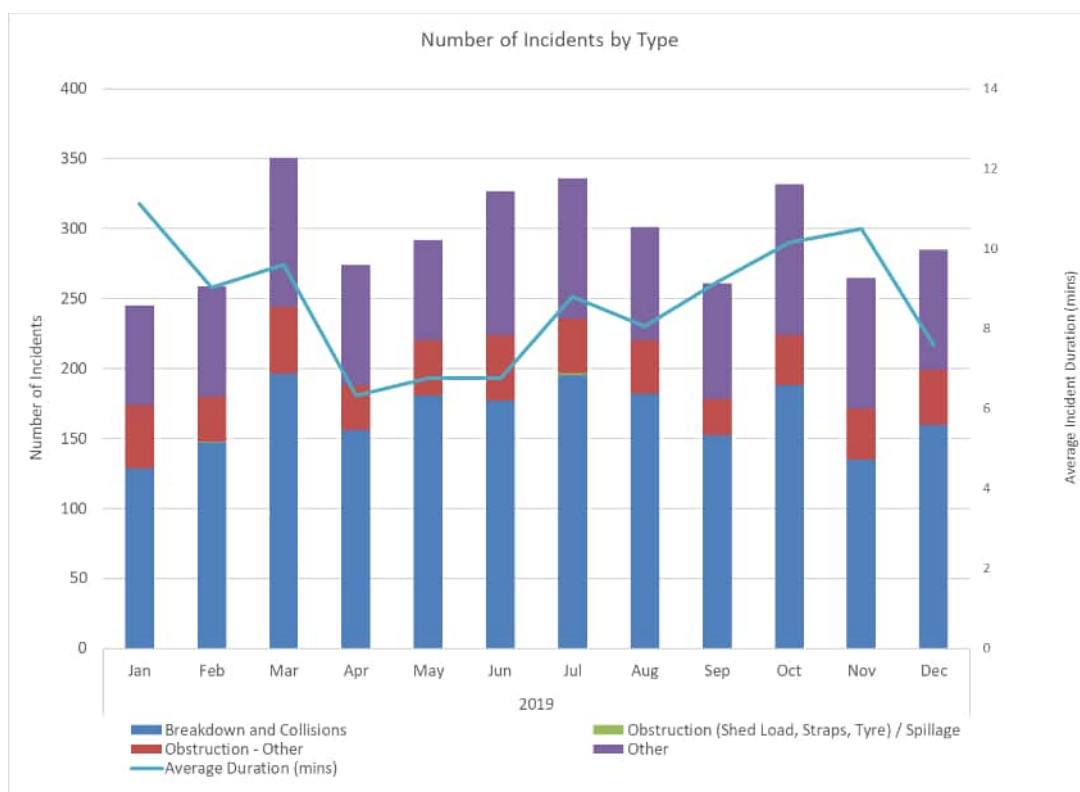
- 2.4.7 This section provides details of both incidents and accidents at the Dartford Crossing and the impact these have on its operation. Incidents are all events which impact upon the operation of the network, including breakdowns, shed loads/spillages, weather restrictions, over-height vehicles and accidents.

¹⁵ The TMC controls the passage of restricted vehicles, comprising over-height, over-width, over-length and dangerous goods vehicles, through the tunnels. Over-height and dangerous goods vehicles are detected using over-height sensors and Automatic Number Plate Recognition cameras capable of reading the hazardous load codes displayed on vehicles carrying such loads. The system is coordinated by the TMC control system, and upon detection of a non-compliant vehicle a system of traffic lights and physical barriers are used to stop the vehicle. A traffic officer vehicle is then dispatched to intercept and re-route the vehicle, before traffic held in the traffic management system is released.

Incidents

- 2.4.8 The congestion and delay problems arising from high volumes of traffic at the Dartford Crossing are made worse when incidents occur. Incident analysis has been undertaken for the A282. As shown in Figure 2.6, vehicle breakdowns and collisions are the most frequent type of incident.
- 2.4.9 In 2019 the average duration of lane closures following incidents was approximately 10 minutes. There are, on average, almost ten incidents resulting in lane closures each day, these cumulatively impact traffic flows at the Dartford Crossing for an average of almost 1.5 hours per day.
- 2.4.10 Due to the crossing frequently operating above capacity, closure in either a northbound or southbound direction, even for a relatively short time, can lead to significant additional congestion. Congestion of this magnitude results in thousands of lost hours for drivers, the quantitative impact of which has been assessed within the Economic Case.
- 2.4.11 When larger incidents occur, it can take up to five hours for typical operation to resume. During these incidents, journeys are severely disrupted and slow-moving traffic can extend back as far as junction 4 (over 9 miles) in the case of a northbound incident, and junction 29 (over 7 miles) with a southbound incident.
- 2.4.12 In the event of closures, there are limited options available to manage the impact. Each response requires time to implement and further reduces the total crossing capacity, leading to substantial delays to users, often causing 'gridlock' on both the surrounding strategic and local highway networks.

Figure 2.6 2019 Closure incident durations by incident type



Source: Highways England Incident Log

Accident records

- 2.4.13 Due in part to the high number of incidents at the crossing, the safety record on most of the sections of the M25/A282 in the vicinity of the crossing is worse than the national average. Table 2.3 shows how these sections of the M25/A282 compare to the national average on the basis of fatalities and weighted injuries (FWI) per billion vehicle miles calculated over the five-year period between 2011–15.

Table 2.3 Existing crossing safety

Section	FWI rate compared to national average
Junction 2 – Junction 3	30% higher
Junction 1b – Junction 2	456% higher
Junction 1a – Junction 1b	14% lower
Junction 1a – Junction 31 (crossing)	94% higher
Junction 31 – Junction 30	16% lower
Junction 30 – Junction 29	14% higher

Source: Highways England

- 2.4.14 The sections between M25 junction 1b and junction 2 and between junction 1a and junction 31 (the crossing itself) perform particularly badly. The former is significantly worse than the national average possibly because of the extreme proximity of these two junctions. Whilst two of the sections above have slightly better FWI rates when compared to the national average, it is likely that with traffic growth these rates will worsen.

Impact of incidents on network operations

- 2.4.15 Under free-flow conditions, the journey time on the M25 between junction 2 and junction 30 is approximately six minutes, which equates to an average speed of about 50 mph. However, during peak periods, northbound speeds can drop as low as 10 mph on the crossing approaches which results in journey times more than doubling over the same section.
- 2.4.16 Drivers using the crossing could expect their journey times to vary by up to nine minutes (35%), depending on volume of traffic. In addition, the impact of incidents creates a further, potentially significant variable affecting journey times over the crossing.
- 2.4.17 Figure 2.7 provides a graphical comparison of traffic speeds on a typical flow day versus a higher flow day on the M25/A282 (northbound). Time is presented horizontally (06:00 – 19:00) and sections of the network are shown vertically from junction 30 to junction 4. The Dartford Crossing itself is highlighted in blue on the left.
- 2.4.18 The figure shows that on a typical flow day (leftmost figure) traffic speeds reduce in the busy evening peak period, but most of the nearby SRN maintains good speeds. However, on a high flow day (rightmost figure) the wider impact of

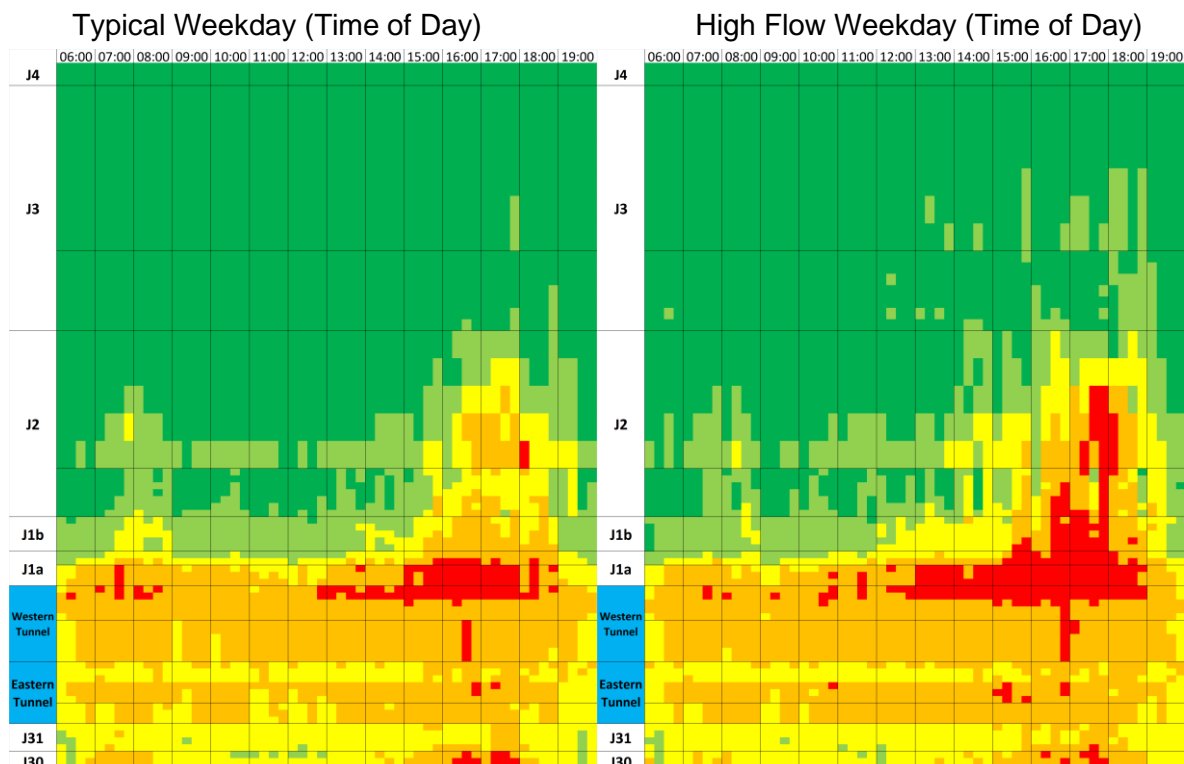
slower speeds at the crossing is much more pronounced, with traffic operating below 30 mph (shown in red) over a much wider area (vertically) and for a longer period (horizontally).

- 2.4.19 In addition, analysis of TrafficMaster data¹⁶ between junctions 29 and 5 shows that northbound 7% of journeys¹⁷ experienced a delay of 15 minutes or more above the mean in the AM peak¹⁸; in the PM peak this increases to 28%. Southbound, the percentage of journeys delayed by 15 minutes or more was 6% and 7% respectively.

Limited alternative routes

- 2.4.20 The closest alternative vehicle crossing to the Dartford Crossing is the Woolwich Ferry which is approximately 10 miles from the Dartford Crossing. The ferry does not provide a 24-hour service and has limited capacity.
- 2.4.21 The Blackwall Tunnel is the next closest alternative but is approximately 15 miles from the Dartford Crossing and unsuitable for HGVs. It is also on a heavily congested part of the road network.
- 2.4.22 The Silvertown Tunnel, was granted a development consent order (DCO) in 2018, is planned to open in 2025 to reduce congestion at the nearby Blackwall Tunnel. This is unlikely to be viable alternative traffic across Kent, Thurrock and Essex given its connectivity into an already busy highway network.

Figure 2.7 Northbound traffic speeds, March 2016



Source: Highways England

¹⁶ From the period September 2015 to August 2016 inclusive
¹⁷ Weekdays only
¹⁸ 07:00 – 08:00

2.4.23 Figure 2.8 shows the nearest alternative road crossings and their proximity to the Dartford Crossing.

Figure 2.8 Alternative road crossings



2.5 Current wider impacts of Dartford operations

2.5.1 The impacts of the traffic problems at the Dartford Crossing and its immediate approach roads are presented below aligned to the four main objectives of the government's Transport Investment Strategy¹⁹ (see Appendix A).

Economic context

2.5.2 The demographic and socio-economic characteristics of the Lower Thames area have been reviewed. This involved dividing the area into two sub-areas – a Local North area comprising the local authorities of Thurrock, Brentwood and Havering and a Local South area comprising Dartford, Gravesham and Medway. Data has been taken from the NOMIS and Office for National Statistics (ONS) websites in January 2020. The key conclusions of this review are:

- a. the rates of population growth in both Lower Thames local areas have exceeded those for England consistently over the decade to 2019²⁰
- b. employment rates for people living in the Local North area rose from 2012 to 2017, declining slightly in 2018 and 2019. The Local South area employment rate rose from 2012 to 2017, with continued minor growth thereafter. Unemployment rates in both areas have fallen from 2012. Based on years for which complete data is available, unemployment rates in the Local North area fell from 2012 to 2015, and also fell in the Local South area from 2012 to 2018²¹
- c. average wages for people living in the Local North area have been higher than average wages in England over the decade to 2018, average wages in

¹⁹ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/624990/transport-investment-strategy-web.pdf

²⁰ NOMIS – Population estimates - local authority based by single year of age

²¹ NOMIS – Annual population survey

the Local South area have generally been lower than the average in England over the decade to 2018²²

- d. in both local areas average resident earnings have been higher than average workplace earnings over the decade to 2019 which is likely to be due to high levels of commuting to London for higher paid jobs²³
- e. Gross Value Added (GVA) per worker per hour (which measures productivity) in the Local South area has been slightly above the average for England over the decade to 2016, but in the Local North area it has been above the average for England over the decade to 2019²⁴
- f. both local areas had lower rates of higher educational attainment than the average for England throughout the period 2012 to 2018²⁵
- g. compared to the average for England, the economic structure in 2018 of both local areas has a higher proportion of construction industry output and a lower proportion of service sector output²⁶.

2.5.3 Overall, the Lower Thames area sits within three of the wealthiest and most productive regions of England (South East, East of England and London). However, the regional statistics mask areas of deprivation variations in productivity and a dependency on commuting to London for higher value jobs.

2.5.4 The area suffers from low Gross Value Added (GVA) per head, lagging productivity and low skill levels. The statistics paint a picture of an area that has varied wealth with a dependency on commuting to London for higher value jobs. North Kent and south Essex have materially lower GVA than areas such as Berkshire, which is an equivalent distance from central London, which in part is linked to lower connectivity and economic productivity.

Productivity impacts

2.5.5 The poor connectivity, and lack of resilience due to the existing Dartford Crossing, fragments local labour and product markets, constraining economic growth in the region and contributing to the areas of deprivation mentioned above.

2.5.6 The Thames acts as a barrier between Kent, Thurrock and Essex, with negative impacts on regional business productivity extending across all days and time periods, and ultimately having an adverse impact on the national economy. This

²² NOMIS – Annual survey of hours and earnings - resident analysis

²³ NOMIS – Annual survey of hours and earnings – resident analysis, NOMIS – Annual survey of hours and earnings - workplace analysis

²⁴ ONS – Regional gross value added (balanced) by local authority in the UK
NOMIS – annual survey of hours and earnings - workplace analysis (average hours worked)
NOMIS – annual population survey - workplace analysis (number of employees)

²⁵ NOMIS – annual population survey

²⁶ ONS – Regional gross value added (balanced) by local authority in the UK

lack of transport connectivity across the Thames reduces labour market catchments, which:

- a. affects the ability to develop new clusters in emerging sectors of the economy
- b. reduces the ability of the population to find work, and of local employers to attract a skilled workforce

2.5.7 Moreover, the reliability impacts of congestion at Dartford Crossing have a disproportionate impact on the productivity of those sectors of the economy which cluster around the Thames Gateway, including transportation, distribution and food. Eddington (2006)²⁷ found that journey reliability is particularly important for:

- a. business sectors such as perishable goods and those that rely on Just in Time delivery
- b. more efficient management of freight movements (due to reduced inventories and optimisation of vehicle use)
- c. journeys to work and their impact on the effective working day

2.5.8 Overall, increased travel times and poor reliability reduces productivity for business, freight and logistics.

Trade impacts

2.5.9 High-performing transport networks are also a “crucial enabler” of the UK’s economic competitiveness, and transport corridors are the “arteries of domestic and international trade”²⁸.

2.5.10 The evidence base for Highways England’s Strategic Economic Growth Plan (SEGP) includes a review of international gateways and the SRN²⁹. The SEGP defines four economic roles for the SRN, one of which is to provide “efficient routes to global markets through international gateways”³⁰. Businesses across the country require good connectivity to access markets, suppliers and the labour market. The major international ports in Kent and Essex, including the Port of Dover, Port of Tilbury and London Gateway Port, are heavily dependent on the SRN at or near the Dartford Crossing. Moreover, the Channel Tunnel gateway plays an important complementary role in trade with the EU and contributes to HGV and Light Goods Vehicle traffic in the region.

2.5.11 Eddington (2006) provides evidence that rising congestion is particularly damaging to the economy where it impacts on the costs of doing trade, be it domestic or internationally. He argues that the combination of clear signs of economic success (eg, economic growth, high wages, high land prices) combined with congestion and unreliability provide a signal that lack of transport

²⁷ Eddington Transport Study 2006

²⁸ The Eddington Transport Study, December 2006, p3

²⁹ International gateways and the strategic road network, November 2016, accessed 23/07/2017, <https://www.gov.uk/guidance/highways-england-supporting-growth>

³⁰ The Road to Growth: Our strategic economic growth plan, March 2017

is holding back growth³¹. However, as yet, there is no commonly accepted methodology to estimate the benefits arising from increasing international trade and attracting globally mobile resources through transport investment³².

Social impacts

- 2.5.12 Appraisal of the Social Impacts of LTC is contained within the Economic Case, Economic Appraisal Report (EAR) and Distributional Impacts Appraisal (DIA) report.
- 2.5.13 An examination of the social impacts in and around Dartford will be included in the Level 3 Appraisal to be conducted (see Section 3.7 of the Economic Case).

User experience

- 2.5.14 The challenges outlined in the sections above lead to journeys that can be frustrating and that can limit road users' opportunities to access employment, education and leisure facilities, even if they are in close spatial proximity.
- 2.5.15 For those who need to use the Dartford Crossing for business trips, the existing issues result in longer commuting times, either through longer journey times in themselves or by building in additional time as a result of journey variability to ensure they reach their destination at the time originally intended. This in turn leads to a drop in productivity and can lead businesses to limit their operations to one side of the Thames.

Housing (development)

- 2.5.16 The Independent Transport Commission (Hall and Marshall, 2002)³³ found that new transport infrastructure is a necessary condition for regeneration in areas where "new infrastructure provides a significant step change in accessibility such as a river estuary crossing where previously separate economic systems merge" and where "there are bottlenecks in 'advanced' transport networks".
- 2.5.17 The Thames Estuary 2050 Growth Commission³⁴ confirms the need for investment and regeneration in the Lower Thames Area. In the Thames Estuary area, 1 million new homes are required to support economic growth by 2050. The case for the Lower Thames Crossing is based on development that is already committed (ie, certain or near certain).
- 2.5.18 Residential, employment and other development that has been assumed in LTAM is shown in Figure 2.9. The large employment site (200,000+ square metres) immediately west of the proposed LTC (north of the Thames) is a major new distribution park, and to the east of the proposed LTC (south of the Thames) is also a light industry and distribution park development. The large housing development (5,000+ dwellings) south east of the Dartford Crossing is the Ebbsfleet Development Area.
- 2.5.19 Responsibility for strategic planning in London is shared between the Mayor of London, London boroughs and the Corporation of the City of London. Under the legislation establishing the Greater London Authority (GLA), the Mayor must produce a spatial development strategy (SDS), which has become known as

³¹ *The Eddington Transport Study*, December 2006, p18

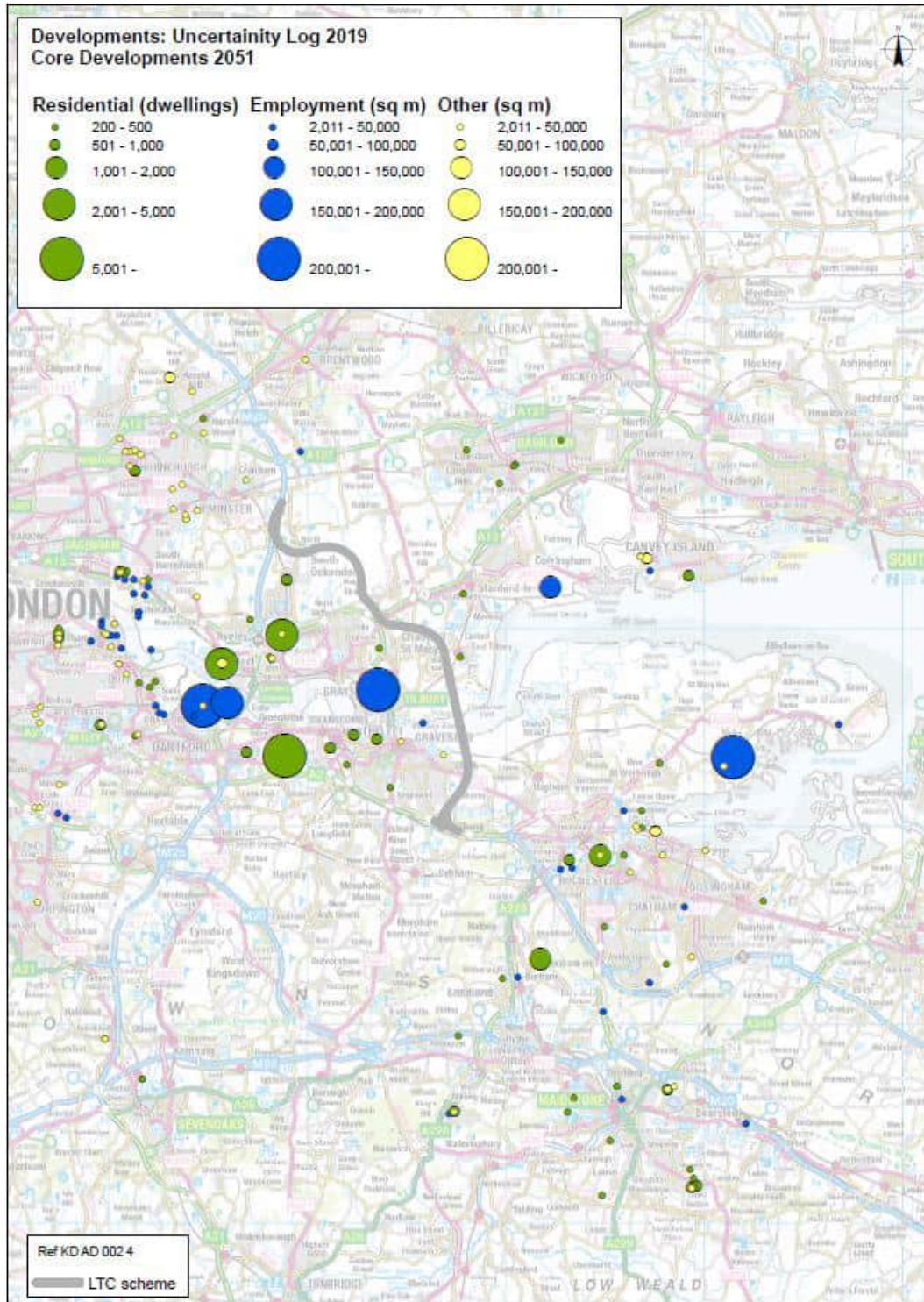
³² *The Eddington Transport Study*, December 2006, p36

³³ Independent Transport Commission – *The Effects of the 10 Year Plan*, 2002

³⁴ *2050 Vision*, Thames Estuary 2050 Growth Commission, June 2018

'the London Plan'. Anticipated increased growth in east London in line with the draft London Plan (2019) is expected to contribute to high population growth and acute housing pressures in the area.

Figure 2.9 Committed developments in the Lower Thames Area Model



2.5.20 The increasing pressures on the road network in Kent, Essex and Thurrock in part as a result of anticipated housing, population and employment growth are discussed further in Section 2.6.

Environmental impacts

- 2.5.21 This section describes the environmental issues arising from traffic congestion at the existing Dartford Crossing, specifically relating to air quality and noise. Further information can be found in the *Preliminary Environmental Information Report*³⁵, whilst an additional document, the *Environmental Impacts Update*³⁶ provides an update given the changes in design to the scheme as presented at Supplementary Consultation.

Air quality

- 2.5.22 Air quality close to the existing crossing and the approach roads is poor. As a result, Air Quality Management Areas (AQMA) have been designated by Dartford Borough Council on the M25 between junctions 1a and 1b and on the A282.
- 2.5.23 To the north of the river, Thurrock Council has also designated locations adjacent to the A282 and M25 as AQMA. AQMA are designated where levels of nitrogen dioxide and/or particulate matter smaller than 10 microns (PM10) exceed the Air Quality Strategy (AQS) objectives.
- 2.5.24 The high levels of traffic and congestion at the crossing are the key causes of exceedance of the AQS objectives. Congestion causes high levels of emissions and poor air quality. The situation is made worse by the proximity of receptors (including residential properties) close to the road.
- 2.5.25 This situation is forecast to further degrade as congestion increases despite anticipated improvements in vehicle emissions.

Noise

- 2.5.26 There are Noise Important Areas (NIAs) located throughout the study area. The results of the strategic noise mapping outlines where the 1% of the population that are affected by the highest noise levels from major roads are located.
- 2.5.27 With levels of noise a direct function of the volumes of traffic on the network, future increases in traffic volumes and timing (such as extended peak times) at the crossing have the potential to worsen noise levels in the current NIAs as well as extending their spatial coverage.

2.6 Future challenges

- 2.6.1 Section 2.5 has considered existing challenges to the safe and efficient operation of the SRN at and around the Dartford Crossing. In the future, without a Lower Thames Crossing, the challenges and their impact will worsen.
- 2.6.2 Traffic modelling indicates that traffic volumes on the Dartford crossing will increase by 20% in the period 2016 – 2026³⁷ to 166,000 vehicles per day (Annual Average Daily Traffic (AADT)). This additional demand will mean that

³⁵ https://highwaysengland.citizenspace.com/ltc/consultation/supporting_documents/LTC%201%20PEIR%20Volume%20One.pdf

³⁶ https://highwaysengland.citizenspace.com/ltc/consultation-2020/supporting_documents/BED20%200013%20LTC%20Environmental%20impacts%20update%20%20digital1.pdf

³⁷ 2026 is the future year modelled in LTAM that is closest to the planned opening date of the Lower Thames Crossing (2027). 2026 has been assessed as being representative of covering a range in opening years between 2025 and 2027.

queuing on the approaches to the Dartford Crossing, on the SRN and the local road network will extend both temporally and spatially, increasing journey times.

- 2.6.3 It is likely that the increased traffic flow will also result in a higher number of incidents, which as traffic numbers increase will have a larger impact. Indeed, analysis using MyRIAD³⁸ has shown that the cost of incidents on the SRN in the wider area around the Dartford Crossing will increase by 60% between 2016 and 2026.
- 2.6.4 Journey time reliability is expected to decrease significantly because of the increased volume of traffic, due to the increased number of incidents.
- 2.6.5 As a result of longer and more unreliable journey times, the catchment for labour on both sides of the Thames will reduce.
- 2.6.6 In economic terms, it is likely that the impact will be to reduce efficiency, impacting on existing industries and reducing the development of new clusters. On a wider basis, this will dampen wider economic growth and the competitive advantage of the region, and potentially the country, given the importance of the Dartford Crossing.

2.7 Stakeholder views

- 2.7.1 Since the first round of public consultation on LTC in 2013, we have built strong relationships with a wide range of stakeholders to help understand their views on the Dartford Crossing and the challenges it presents to business, the economy and local communities.
- 2.7.2 Over this nine-year period, hundreds of businesses and organisations across dozens of sectors have expressed their frustration at the unreliability of the existing crossing, which is frequently paralysed by accidents, incidents and the impact of inclement weather.
- 2.7.3 Businesses continue to speak with one voice about the lack of resilience at Dartford, the cost to their businesses, and the productivity losses. They say that unreliable journey times are constraining their ability to grow, to access new and existing markets, to reach key transport hubs, including the ports in the south east and major distribution centres in the midlands and the north. It also affects their ability to recruit and retain good quality staff.
- 2.7.4 Local councillors and MPs cite the gridlock on the local road network even when the smallest of incidents occurs, of the unacceptably high levels of pollution inflicted on residents and of parents being stranded, unable to collect children from school. The common theme is that the crossing is unable to cope and that it's damaging to human and environmental health.
- 2.7.5 Most local authorities in and around the Dartford Crossing agree on the need to solve the traffic issues it presents. The current situation is impacting on plans for economic growth, which is holding local authorities back from realising the levels of housing and business growth required. There are also concerns that the issues at the Dartford Crossing are damaging south Essex, north Kent and Thurrock's reputation as good places to do business.

³⁸ MyRIAD (Motorway Reliability Incidents And Delays) calculates the monetised reliability and incident delay impacts of trunk road improvement schemes which affect the speed profiles on carriageways or the duration and number of incidents such as accidents.

2.8 Summary of the issues and impact of no intervention

- 2.8.1 The Strategic Case has identified that congestion and the incidents at the crossing cause slow and unreliable journeys for a high number of vehicles for long periods, every day. This has severe economic, safety and environmental impacts on users and local communities.
- 2.8.2 A failure to progress LTC will have significant negative impacts on the future growth potential of the national economy and the prosperity of the local population. Without additional road capacity, the transport, economic and environmental problems will continue to worsen over time.
- 2.8.3 The whole transport network (including public transport) in the Lower Thames Area will continue to face increased congestion, economic pressures and adverse environmental impacts.
- 2.8.4 The consequences of not proceeding with a new crossing are that:
- a. congestion and delays will continue to worsen both at the crossing and on the local road network; journey times will increase, and journeys will be less reliable.
 - b. national, regional and local productivity and economic growth will be constrained and the cost of moving freight by road will increase.
 - c. there will be further deterioration of safety on the roads close to the existing crossing
 - d. increases in road traffic will increase congestion, noise and vehicle emissions in an area which already exceeds acceptable levels.
- 2.8.5 The opportunities to improve the situation at the existing crossing are very limited. Environmental standards are already being breached in many areas and without action, all known problems will worsen with increasing traffic levels.
- 2.8.6 The opportunities presented by a new crossing are covered in Section 3 below.

3 Objectives

3.1 Introduction

- 3.1.1 Transport infrastructure is often referred to as economic infrastructure as it enables achievement of broader government policies in relation to economic development, productivity, employment and accessibility.
- 3.1.2 It is imperative that major schemes such as the Lower Thames Crossing contribute to the achievement of government policies. This section presents our scheme objectives as developed with the DfT.
- 3.1.3 As set out in a further section of this document, we have carried out consultation in relation to the primary route options for addressing the problems with the existing Dartford Crossing. We have appraised these options against a common set of objectives.
- 3.1.4 Below we set out the scheme objectives for the Lower Thames Crossing agreed with DfT as part of the Client Scheme Requirements (CSR). We then explain how the delivery of the CSR will contribute to our key performance indicators (KPIs).
- 3.1.5 We also set out details of the long-term legacy of LTC and show how this legacy is reflected in our Vision and Strategic Goals which we are using to ensure we retain a clear focus on our long-term strategic objectives as we develop LTC.

3.2 Client Scheme Requirements (CSRs)

- 3.2.1 To provide specific focus for LTC, several key objectives have been agreed with DfT covering strategy, transport, charging and the environment.
- 3.2.2 The CSRs provide the basis for the scheme objectives which have been used to appraise the route options and develop LTC. They were included in the material provided to the public in the 2016 consultation materials and the pre- and post-consultation Scheme Assessment Reports. These are set out in Table 3.1.

Table 3.1 Scheme objectives

Scheme objectives These are the objectives against which the scheme is appraised	
Strategic	<ul style="list-style-type: none"> • To support sustainable local development and regional economic growth in the medium to long term by: <ul style="list-style-type: none"> – improving fixed cross-river road links for business and services – integrating with local development plans – encouraging housing growth in support of long-term government targets for new home construction – supporting both committed and known future plans for development (consistent with Highways England’s license obligations) – developing broad stakeholder and business consensus • To be affordable and provide value for money to both users and the taxpayer while also: <ul style="list-style-type: none"> – aligning with the December 2014 National Networks Policy Statement which requires funding to be provided in full, or in part, by charging integrated with a strategy for the existing crossing assets to optimize the Transport Objectives – being affordable to government – considering third party/local contributions – introducing a charging strategy that is cost effective and flexible to adapt and will reflect changes in future technology – minimising the whole life cost.

Scheme objectives	
These are the objectives against which the scheme is appraised	
Transport	<ul style="list-style-type: none"> • To relieve the congested Dartford Crossing and approach roads and improve their performance by providing free flowing north south capacity. • To improve resilience of both the proposed and existing crossing assets and approach roads to cope with planned and unplanned incidents. • Be of a design standard commensurate with the ambition and legacy of the scheme. • Facilitate economic and housing growth and wider benefits that the crossing will deliver. • Provide effective travel demand management through a combination of road user charging and strategic road space management. • Be part of an integrated asset strategy for the existing crossing assets taking particular account of the operational characteristics of the Dartford crossing. • Safely support the provision of public transport and the needs of non-motorised users. • Be compatible with other Thames crossings in the East of London when considered alongside Transport for London and Greater London Authority’s plans for future river crossings.
Community and Environment	<ul style="list-style-type: none"> • To minimise any adverse impacts on health and the environment and help reduce the impact of transport-related emissions thereby assisting the UK in meeting its climate change obligations. • Should preserve or enhance quality of life locally, including the amenity of both urban and natural environments (including but not restricted to the criteria in the WebTAG appraisal framework). • Must conform, or be demonstrably likely to confirm, to relevant UK legislation and EU directives, eg, with regard to air quality and impacts on protected species and habitats.

3.3 Contribution to Highways England KPIs

3.3.1 Highways England’s performance is measured against KPIs across the SRN. Table 3.2 outlines the contribution of LTC in meeting the performance requirements.

Table 3.2 Impact of Lower Thames Crossing on Highways England strategic outcomes

Outcome	KPI and target	Lower Thames Crossing contribution
Making the network safer	<p>Killed and seriously injured</p> <p>Target: 40% reduction by end of 2020</p>	<p>LTC will deliver an All Purpose Trunk Road (APTR) built to current high level safety standards and have free flow junctions at each end. The tunnel will be category A.</p> <p>As well as reducing congestion at Dartford, which increases accident rates, the new crossing will be considerably safer at both the tunnel and approaches compared to the existing Dartford Crossing.</p>
Improving user satisfaction	<p>Road user satisfaction</p> <p>Target: 90% by March 2017</p>	<p>LTC will contribute to improved road user satisfaction on the Strategic Road Network through:</p> <ul style="list-style-type: none"> • reducing congestion and improving journey time reliability for users of the Lower Thames Crossing and Dartford Crossing • offering a safe driving environment for users of the Lower Thames Crossing • integrating effective information provision systems

Outcome	KPI and target	Lower Thames Crossing contribution
<p>Supporting the smooth flow of traffic</p>	<p>Network availability</p> <p>Target: 97% lane availability in anyone rolling year</p>	<ul style="list-style-type: none"> LTC will be designed to minimise the impacts on lane availability from issues such as routine maintenance, major maintenance and traffic incidents. Availability of LTC will also enable revised approaches to planned works at the Dartford Crossing – improving delivery efficiency for planned works. LTC will have a category A tunnel and provide an alternative route for HGVs (including those carrying hazardous loads). This may enable a revised management approach, reducing the need for escorting trips at the Dartford Crossing. LTC will build on the experience of the Dartford Crossing in achieving this KPI and the operational management of LTC will be designed for rapid and efficient clearance of incidents.
	<p>Incident clearance</p> <p>Target: 85% of motorway incidents cleared within one hour</p>	<ul style="list-style-type: none"> LTC will build on the experience of the Dartford Crossing in achieving this KPI and the operational management of the LTC will be designed for rapid and efficient clearance of incidents.
<p>Encouraging economic growth</p>	<p>Average delay (seconds per vehicle mile)</p> <p>Target: No target set</p>	<ul style="list-style-type: none"> LTC provides additional capacity and new route options, which will improve travel times and reduce delays. Forecast journey times for users of LTC are significantly improved for the majority of journeys between Kent, Thurrock and Essex.

Outcome	KPI and target	Lower Thames Crossing contribution
<p>Delivering better environmental outcomes</p>	<p>Noise important areas mitigated</p> <p>Target: Mitigate at least 1,150 noise important areas by March 2020</p> <p>Improved biodiversity</p> <p>Target: Publish biodiversity action plan</p>	<ul style="list-style-type: none"> LTC will reduce congestion both at Dartford and the Lower Thames area, including local roads, thus reducing noise, including in a number of Noise Important Areas. LTC will be designed and built to minimise noise in surrounding areas.
<p>Helping cyclists, walkers and other vulnerable users</p>	<p>Number of new and upgraded crossings</p> <p>Target: No target set</p>	<ul style="list-style-type: none"> LTC will use reasonable endeavours to ensure the design does not sever any existing routes for walkers, cyclists and horse-riders unless an alternative route is provided which is better quality and/or part of a more coherent network.
<p>Achieving real efficiency</p>	<p>Capital expenditure savings</p> <p>Target: Total savings of at least £1.212bn on capital expenditure by March 2020</p> <hr/> <p>Progress of work, relative to Delivery Plan</p> <p>Target: No target set</p>	<ul style="list-style-type: none"> LTC is being developed in line with Highways England's policies. Highways England has established its Complex Infrastructure Programme to transfer best practice between its major projects and improve capital budget allocations relevant to the required delivery plan. LTC will also be delivered through an appropriate client delivery model dedicated to allocating risks throughout delivery, including operations and maintenance to deliver value for money. LTC will maintain an efficiencies register.

Outcome	KPI and target	Lower Thames Crossing contribution
<p>Keeping the network in good condition</p>	<p>Pavement condition</p> <p>Target: 95% of pavement requiring no further investigation for possible maintenance</p>	<ul style="list-style-type: none"> The entire project will be new construction, designed with consideration of whole life cost, operation and maintenance. This will include pavement design which minimises inspection and maintenance requirements.

3.4 Legacy and benefits

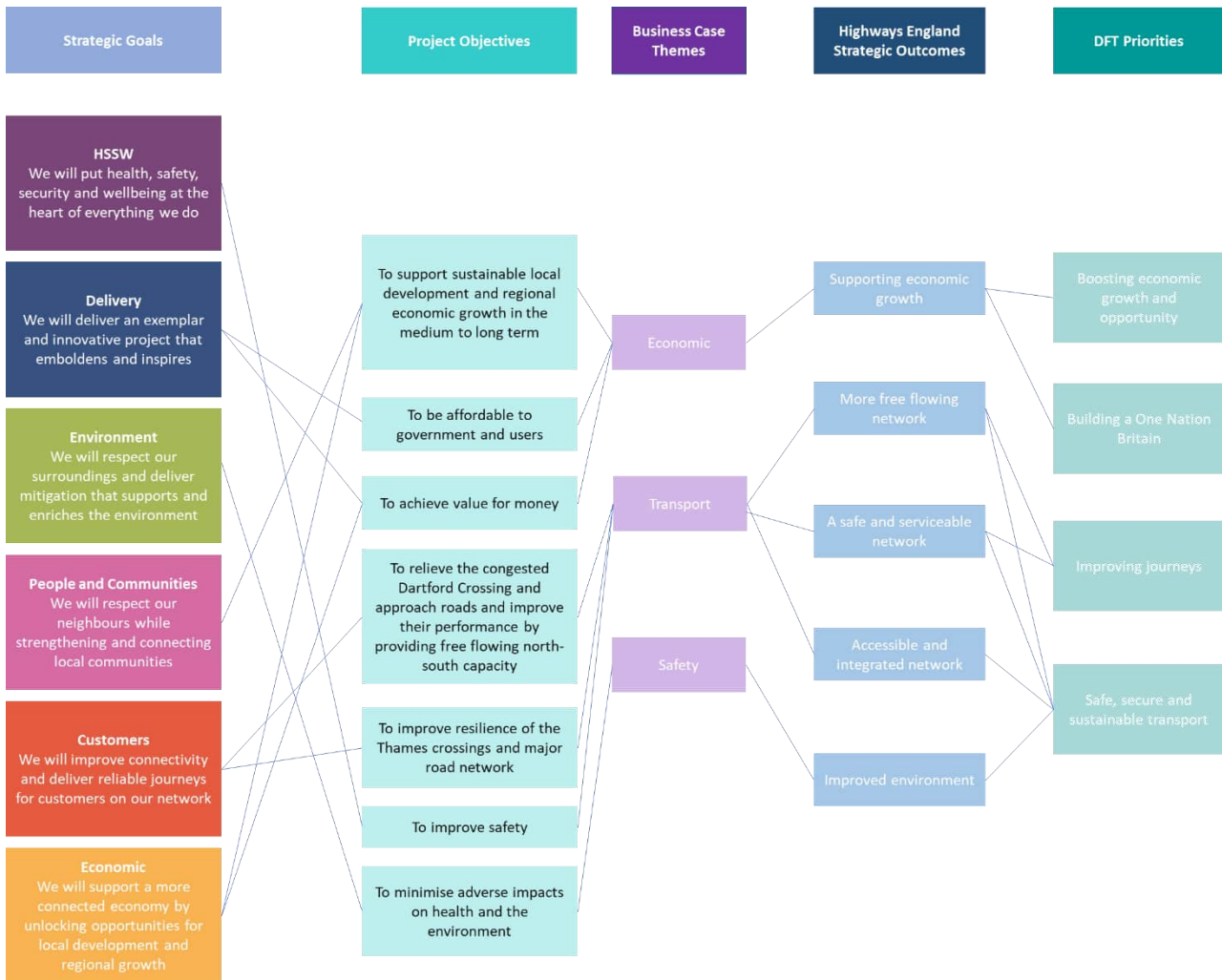
- 3.4.1 LTC will provide a wide range of benefits as a result of improved traffic flows within the Lower Thames Area such as improved journey times, enhanced connectivity and better journey time reliability. The Economic Case describes the full range of benefits that have been valued, as well as other benefits that have been appraised in line with DfT guidance but not expressed in monetary terms. In addition to these, LTC will generate other benefits which are described below.
- 3.4.2 We are committed to delivering best-practice benefits management that will enable LTC to achieve its long-term legacy, whether this be directly delivered through Highways England or through other public bodies. By undertaking a systematic approach to benefits management, LTC will achieve wide-reaching and sustainable social, environmental and economic impacts on the local area and beyond, while identifying who is accountable and responsible for ensuring those impacts are optimised.
- 3.4.3 A vision and set of strategic goals have been developed which expand on the Client Scheme Requirements and scheme objectives to provide a focus for the long-term legacy of LTC. These are shown in Figure 3.1.

Figure 3.1 LTC vision and strategic goals



- 3.4.4 Figure 3.2 shows how these strategic goals link through to the priorities of the DfT and Highways England.
- 3.4.5 The key benefits arising from the delivery of LTC described in the Economic Case will be monitored and evaluated after the delivery of LTC. Using the strategic goals as a basis, the realisation of additional benefits and opportunities, beyond those in the Economic Case, will be actively managed rather than just monitored and evaluated, providing LTC with the potential to prioritise its efforts based on input from stakeholders and the assessment of need.
- 3.4.6 The realisation of these benefits will enhance the legacy of LTC in areas not specifically linked to the infrastructure asset itself, such as skills, education or Highways England’s continuous capability improvement.

Figure 3.2 Links between strategic goals, Client Scheme Requirements, Highways England strategic outcomes and Department for Transport priorities



- 3.4.7 As realisation of some of the legacy benefits is outside Highways England’s corporate responsibilities, we will engage with the relevant government departments and other organisations to agree benefit realisation plans.

3.4.8 LTC’s Legacy and Benefits Strategy describes how legacy and benefits will be delivered and sets out who is accountable for these. Four categories have been developed as shown in Figure 3.3, which will be secured, and delivery incentivised through contractual KPIs.

3.4.9 Further detail on legacy and benefits is contained within Section 6 of the Management Case.

Figure 3.3 Benefit categories

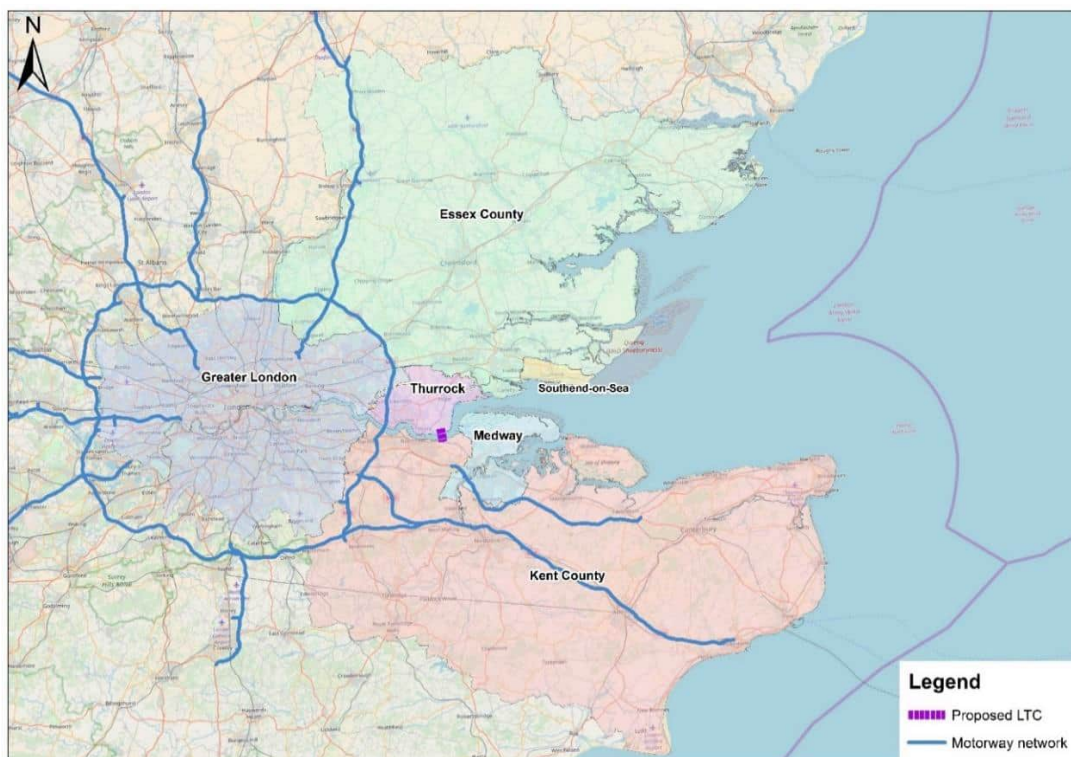
	Core project benefits		Wider project benefits	
Accountability	Lower Thames Crossing Senior Responsible Owner		DfT Senior Responsible Owner	Government / other public body Senior Responsible Owners
Responsibility	Highways England Project Director	CIP Project Sponsor	Transport related benefits. DfT funded or enabled. Delivery could be by DfT or agencies, or local authority.	Wider benefits such as housing, employment, place making. Delivered and funded by others. Linked to regional strategies.
Category	Category A	Category B	Category C	Category D
Description	Benefits delivered/ dis-benefits mitigated by HE and its supply chain to deliver the Client Scheme Requirements	Benefits delivered/ dis-benefits mitigated by HE in addition to the core project activities	Benefits delivered/ dis-benefits mitigated by DfT (or other transport bodies) in response to the LTC project	Benefits delivered/ dis-benefits mitigated by central and local government or other public sector bodies in response to the LTC project
Example Benefits	Create a better customer experience Reduced journey times and more predictable journeys	Dependent on level of benefit and activities funded by core project funding	Updates to network in areas surrounding the scheme (eg. Corridor development)	Activities supporting wider economic growth and jobs. Increased regional and local regeneration.
Budget	Benefits delivered within the c.£5bn LTC funding envelope	Benefits delivered through additional designated funding	Benefits delivered through external funding sources	

4 Strategic policy context

4.1 Overview

- 4.1.1 European, national, regional and local planning and transport policy context have been examined, relevant to the strategic need for a new river crossing east of Dartford. Full details are contained in Appendix A together with the status of relevant local authority planning documents and details of emergent plans.
- 4.1.2 How the Lower Thames Crossing is located in relation to the surrounding county and unitary authority boundaries is shown in Figure 4.1.

Figure 4.1 Map of surrounding counties and unitary authorities



- 4.1.3 National policy provides a supporting framework for investment in transport infrastructure. A new Thames crossing east of Dartford aligns with current government priorities relating to economic, social and environmental objectives, as detailed in the Transport Investment Strategy (TIS); details of how LTC meets these is also contained in Appendix A.
- 4.1.4 Regional and local policies show that local authorities in the area recognise the need to address the congestion-related problems at the existing crossing and the wider impacts on people, the economy and the environment.
- 4.1.5 Regionally, the South East Local Enterprise Partnership note in their Strategic Economic Plan that the Dartford Crossing increases pressure on the surrounding road network, particularly the M25, A13, A127 and the A2. In addition, the Thames Estuary 2050 Growth Commission has a vision based on moving “from an underperforming river region to a tapestry of productive places along a global river”. It specifically notes that a new Lower Thames Crossing is

an example of good investment in the economy and would support improved productivity.

- 4.1.6 Many local authority plans acknowledge the need to address congestion issues on the SRN in the region (albeit in different ways), and Kent County Council and Dartford Borough Council explicitly support LTC in their local planning policy documents. However, Thurrock County Council do not support LTC.
- 4.1.7 The 2018 London Mayor's Transport Strategy³⁹ (MTS) references the importance of the Government's Lower Thames Crossing as a strategic infrastructure priority, as part of the wider challenge to provide additional river crossing capacity to the east of London.
- 4.1.8 Within the MTS, the Greater London Authority makes it clear that Transport for London will only consider further highway crossings of the Thames once the Silvertown Tunnel, Docklands Light Railway extension to Thamesmead and the Lower Thames Crossing are constructed.
- 4.1.9 Therefore, the need to address the congestion-related problems at the Dartford Crossing as well as the potential benefits for the highway network in the surrounding region is recognised at all levels of policy and planning.

³⁹ <https://www.london.gov.uk/sites/default/files/mayors-transport-strategy-2018.pdf>

5 Option development and shortlisting

5.1 Introduction

- 5.1.1 This section provides details of the evolution of LTC from work in 2009 through to the proposed solution as presented at Statutory Consultation.
- 5.1.2 Firstly, details of the option development and assessment are presented, followed by the process which led to the selection of the preferred route.
- 5.1.3 This chapter explains the options that were identified and appraised and the outcome of those appraisals which led to the selected scheme.

5.2 Process

- 5.2.1 A structured process has been followed by DfT and Highways England to identify and assess potential options for LTC. A summary of the identified locations and the timelines associated with the assessment of each is provided in Appendix B.
- 5.2.2 A full description of the historic options considered during the option selection phase can be found within the *Approach to Design, Construction and Operation* report (Lower Thames Crossing, 2018)⁴⁰.

5.3 Summary of the assessment leading to the selection of the preferred route

- 5.3.1 DfT carried out a study in 2009 that reviewed six potential crossing locations, identified as A, B, C, D1, D2 and E (as shown in Figure 5.1). The locations included a link between the M2 and M20 at Bluebell Hill which was considered as a variation of location C with the potential to enhance benefits from LTC and was therefore known as C variant.
- 5.3.2 The DfT study also assessed modal options, considering both a heavy rail crossing of the Thames and a combined heavy rail and road crossing, serving passengers and rail freight. The report concluded that there was little justification for the inclusion of rail passenger services as part of any future Lower Thames crossing facility. It further concluded that the provision of rail freight facilities over any new crossing in the Lower Thames area would be unlikely to assist in addressing any shortage of freight paths on key rail routes. As a result of this study, provision of rail capacity at the Lower Thames Crossing was not considered further. Assessment of location D indicated that the option would not meet the traffic objective to relieve congestion at the existing Dartford Crossing and provide free flowing north-south capacity. It would have poor to low value for money, limited safety benefits, and have significant environmental impacts including on SSSI. It would also require substantial areas of flood compensation.
- 5.3.3 Assessment of location E indicated that the option would provide very limited relief to the existing Dartford Crossing and would have poor to low value for

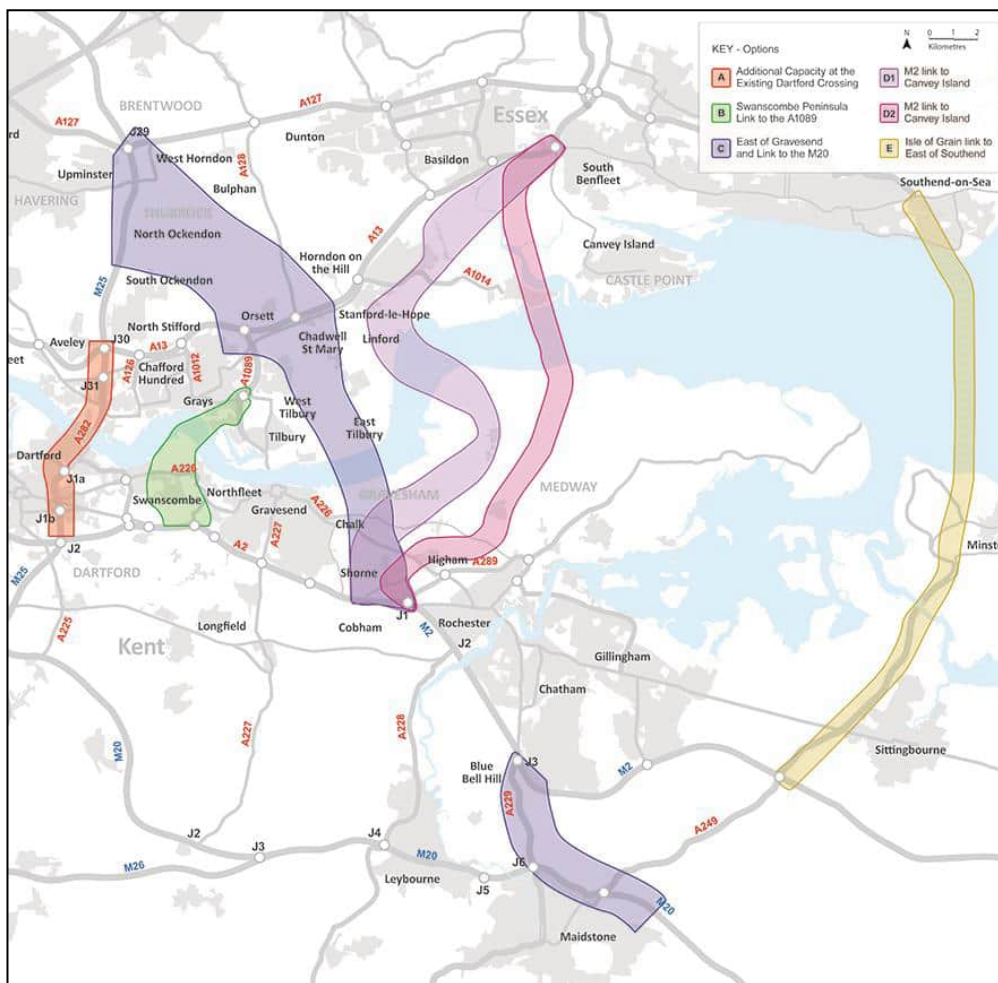
⁴⁰

https://highwaysengland.citizenspace.com/ltc/consultation/supporting_documents/LTC%203_4%20Design%20Consultation%20and%20Operations.pdf

money. There would be potential direct and indirect effects on a number of international and nationally important nature conservation sites including: Medway Estuary and Marshes Ramsar site and SSSI, Swale Ramsar site and SSSI, Foulness (Mid-Essex Coast Phase 5) Ramsar site and Special Protection Area (SPA) and the Foulness SSSI and the Essex Estuary Special Area of Conservation (SAC).

5.3.4 As a result of these assessments, the two location D and location E options were not selected for further assessment by DfT following the first stage of location identification and appraisal.

Figure 5.1 Six locations investigated in the 2009 DfT Study

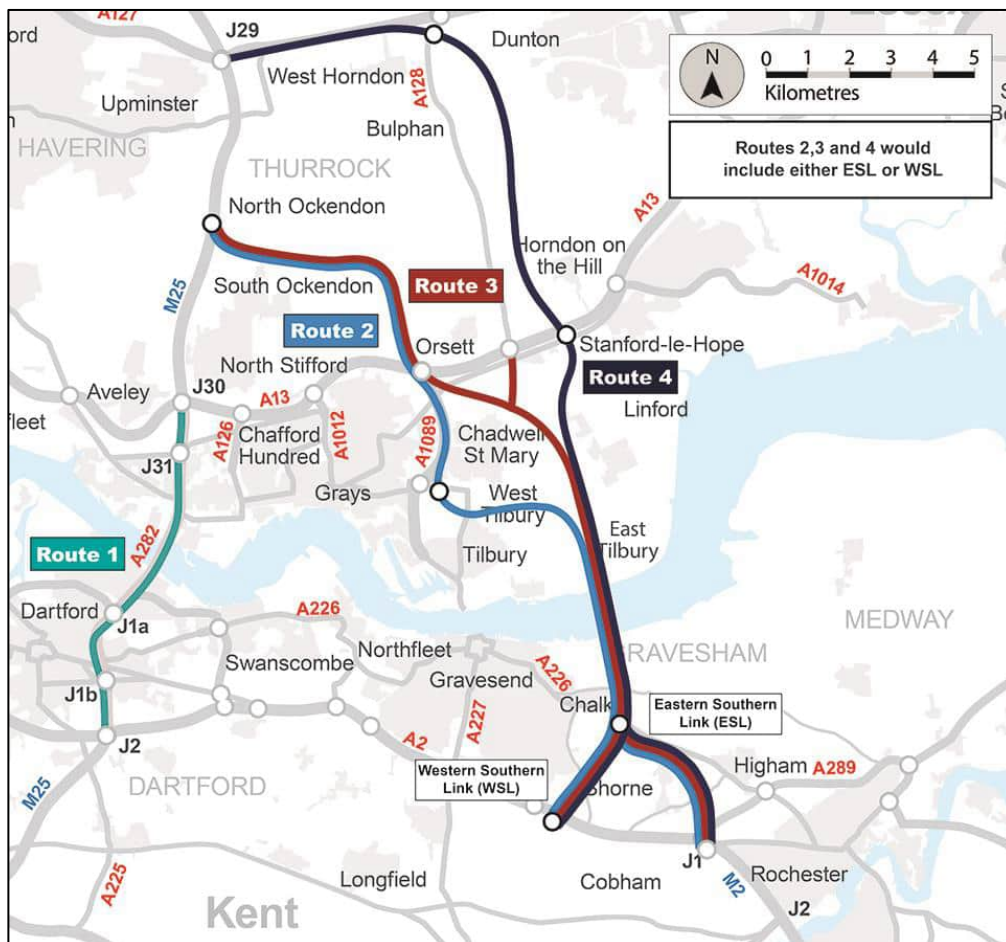


Key to Fig 5.1			
A	Additional capacity at the existing Dartford Crossing	D1	M2 Link to A130 via Cliffe/Pitsea
B	Swanscombe Peninsula Link to the A1089	D2	M2 to A130 via Canvey Island
C	East of Gravesend and Link to the M20	E	Isle of Grain Link to East of Southend

5.3.5 Further work was carried out by DfT in 2013 to consider three of the potential crossing locations in more detail, A, B and C. These crossing locations were presented at a non-statutory public consultation in 2013. Following the public consultation, location B was discounted due to the conflicts between the potential solutions and the local development plans, particularly with the Ebbsfleet Garden City and the Swanscombe Peninsula. Two crossing locations, A and C, were taken forward for further consideration.

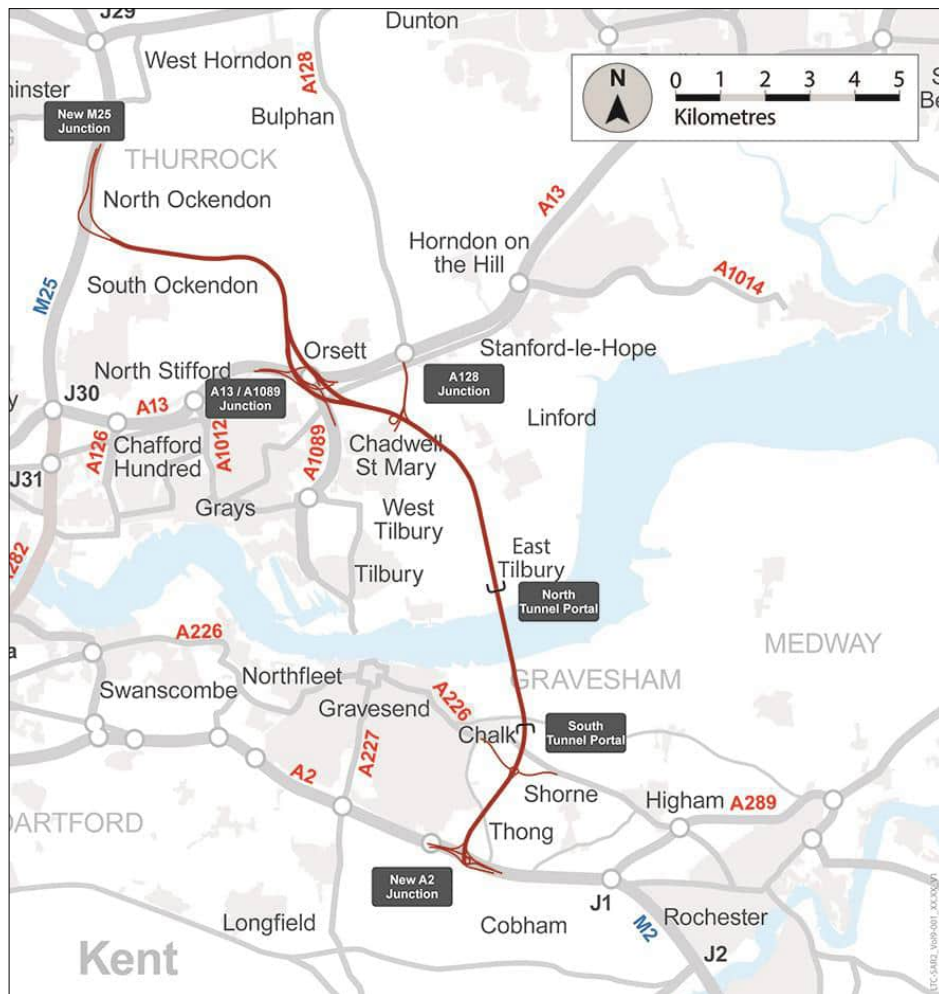
- 5.3.6 Highways England summarised the assessments in the Pre-Consultation Scheme Assessment Report (Highways England, 2016).
- 5.3.7 In 2014 Highways England started a further option identification and route selection process at crossing locations A and C. This study identified nine options at location A, six options at location C and four options for the C variant. The options assessed considered a variety of bridge, immersed tube and bored tunnel solutions.
- 5.3.8 Assessment of the C variant options determined that they did not help to transfer traffic from the existing Dartford Crossing on to the new route at Location C and had substantial impacts on the Kent Downs AONB. As a result, the C variant options were not considered further.
- 5.3.9 Location A could not be developed into a solution that met the scheme objectives. The identified solutions failed to relieve the congestion on the approaches to the Dartford Crossing as it did not provide a suitable alternative route for traffic travelling along the A2 and A13. Solutions that relied on the connection at junction 2 and junction 30 of the M25 failed to relieve congestion at or on the approaches to these key junctions, while solutions that did not include these connections failed to provide the necessary relief to Dartford Crossing itself. An optimised alternative at location A was identified as route 1 for detailed appraisal (see Figure 5.2). The appraisal found that the alternative did not to meet the scheme objectives, and consequently was not identified as a proposed route in the 2016 public consultation.
- 5.3.10 Alternatives considered at location C included considering a bridge, a bored tunnel, and an immersed tube tunnel. The assessment determined that there would be a risk of significant effects to European Sites with both bridge and immersed tube solutions. The bored tunnel was therefore the only viable crossing alternative at Location C as it was the least environmentally damaging alternative. The options at location C were refined, considering the performance against the scheme objectives and the environmental impacts, and were presented at a non-statutory public consultation in 2016. The routes presented at public consultation were identified as routes 2, 3 and 4 north of the River Thames, and western southern/eastern southern links south of the River Thames (see Figure 5.2).

Figure 5.2 Shortlisted routes considered in the 2016 study



- 5.3.11 A further appraisal was undertaken, considering the findings of the public consultation, and this resulted in the selection of the preferred route announced in April 2017. The preferred route was route 3 north of the River Thames, with a bored tunnel crossing under the River Thames east of Gravesend and Tilbury and a new road south of the river which will join the A2 east of Gravesend (the western southern link (see Figure 5.3).
- 5.3.12 The preferred route was announced in April 2017 by the Secretary of State for Transport based on the information obtained before, during and after the public consultation. This route met the scheme objectives, while having the lowest impact on several environmentally sensitive areas, particularly on the Thames Estuary and Marshes Special Protection Area and Ramsar site, ancient woodlands in the area, and the Kent Downs Area of Outstanding Natural Beauty (AONB), as well as on the communities close to the route. The assessment that resulted in the identification of the preferred route is presented in the Post-Consultation Scheme Assessment Report (Highways England, 2017).

Figure 5.3 The preferred route announced in April 2017



- 5.3.13 Following the Secretary of State for Transport’s announcement of the preferred route in April 2017, we have continued to develop our proposals and now have a more detailed picture of the project that we expect to take forward to DCO application. We have re-assessed the previous options appraisal process, conducting further studies where necessary. This appraisal has confirmed the selection of the preferred route, taking account of the changes made to the proposals for LTC following the announcement in April 2017.
- 5.3.14 As we have developed our proposals, we have continuously re-assessed the previous options appraisal process, conducting further studies where necessary. This assessment has confirmed the selection of the preferred route, taking account of the changes made to the proposals for LTC following the announcement in April 2017.
- 5.3.15 The proposed route is a Route 3 north of the Thames, a future-proofed twin-bored tunnel crossing of the river large enough to accommodate a dual three lane carriageway and the Western Southern Link south of the Thames (Figure 5.3). The reassessment of the work that led to the announcement of the preferred route has reconfirmed that this route remains the best solution. The further work we have carried out to develop our proposals has strengthened the benefits delivered by this proposed route.

- 5.3.16 This section provides a description of LTC, setting out the key elements including the route, tunnel construction, highway structures and ancillary works such as service and utility diversions, traffic forecasting and user charging.

Route alignment

- 5.3.17 The route connects the A2/M2 in Kent, east of Gravesend, crossing under the Thames through two bored tunnels, before joining the M25 south of Junction 29. The route alignment is presented in Figure 5.4.
- 5.3.18 The route is approximately 23km with 4.25km in a twin-bored tunnel. On the south side of the Thames, the new road will link the tunnel to the A2 and M2 in Kent. On the north side, it will link to the A13 and junction 29 of the M25 in the London Borough of Havering. The tunnel crossing is located to the east of the village of Chalk on the south of the Thames and to the west of East Tilbury on the north side. Junctions are proposed at following locations:
- a. new junction with the A2 to the east of Gravesend
 - b. modified junction with the A13/A1089 in Thurrock
 - c. new junction with north-facing slip roads on the M25 between junctions 29 and 30

Route

- 5.3.19 The route is mainly three lanes in both directions, using technology for lane control and variable speed limits. The southbound carriageway from the M25 to the junction with the A13/A1089 will be two lanes. The new route will have hard strips for most of its length with hard shoulders along modified sections of the M25 and the A2. Hard shoulders will be along modified sections of the M25 and the A2. The new route will have vehicle restrictions, emergency areas and technology providing lane control and variable speed limits.

Junction modifications

- 5.3.20 Widening works are required to both the M25 at the northern limits of the route and on the A2 at the southern end. This is required to safely merge high volume of traffic. The existing A13/A1089 junction also requires significant modifications to connect to the new crossing.

Vertical alignment

- 5.3.21 To the south of the Thames the route moves from being at grade to a deep cutting as it enters the southern portal. To the north, the alignment has been lowered as much as possible to reduce impact on the landscape. Where the route crosses the Tilbury floodplain, railway lines and the Mardyke flood plain, the route is elevated.

Side roads

- 5.3.22 All existing side roads affected by the route will be reconnected to provide the same connectivity as the current network, which will enable the same traffic to continue to use the roads in operation. In most locations, the affected side roads cross over the new route.

Tunnel

- 5.3.23 It is currently proposed that two tunnel boring machines (TBMs) will be used to construct the tunnel bores, one for each bore. A temporary sub-station would be needed to power these.
- 5.3.24 Emergency access and vehicle turn-around facilities will be provided at the tunnel portals. Cross passages connecting each tunnel would be provided for emergency evacuation as well as maintenance works. Tunnel portal structures will accommodate service buildings for control operations, mechanical and electrical, drainage and maintenance operations.

Highway structures

- 5.3.25 Approximately 60 significant new structures such as road bridges, underpasses and footbridges are required. In addition, widening and other modification of existing structures are required on the SRN.

Highway drainage

- 5.3.26 South of the Thames, drainage systems outfall to soakaways. North of the river drainage systems are generally piped systems out-falling into watercourses.

Safety and security

- 5.3.27 The new route will include the following:
- modern safety measures and construction standards with technology to manage traffic and provide better information to drivers
 - variable message signs to display travel information, hazard warnings and both advisory and mandatory signage to drivers
 - CCTV cameras to monitor, manage and investigate incidents, maintenance, asset protection, network usage and prevention and detection of crime
 - above ground traffic detection to control automatic traffic management systems (eg, variable speed limits) and to collect data on traffic flows

Pedestrians, cyclists and equestrians

- 5.3.28 Pedestrians, cyclists and equestrians, as well as slow-moving vehicles, will be prohibited from using the Lower Thames Crossing. Where the route affects existing Public Rights of Way and cycle routes, these will be reinstated with provision of under- or overbridges or a suitable diversion.

Environmental design

- 5.3.29 Highways England is required to “minimise the environmental impacts of operating, maintaining and improving its network and seek to protect the quality of the surrounding environment”.

Construction compounds

- 5.3.30 Construction compounds will be located along the alignment of the new route as well as alongside the junction between the new route and the A2. Larger

compounds will be required at the northern and southern tunnel portals to allow for tunnelling operations and materials management.

- 5.3.31 Welfare and accommodation hubs will also be located along the route.

Haulage routes and construction traffic management

- 5.3.32 Where there is no direct access from the SRN, the local road network would initially be used to access and establish construction compounds. Traffic management would be used to segregate the construction sites from road vehicles.

- 5.3.33 Haul roads will be constructed alongside the road alignment and connect to the SRN to minimise construction impacts on the local road network.

Demolition and land-take

- 5.3.34 LTC requires land on a permanent basis for the road and tunnel along with other operational infrastructure, utility diversions and ecological and flood compensation. On a temporary basis land is required for construction compounds and logistic areas.
- 5.3.35 Compensation and methods/procedures for assessing appropriate levels will follow the statutory Compensation Code. Consultation with relevant landowners, occupiers and agents remains an ongoing focus through the development phase of LTC.

Waste management

- 5.3.36 LTC's aim is to minimise the volume of waste generated by applying the waste hierarchy (reduce - reuse - recycle - responsible disposal).

Operations and maintenance

- 5.3.37 To carry out inspection and certain specified maintenance activities in the tunnel, a full closure of the relevant bore would be required periodically. These will be planned to minimise disruption, and where feasible lane closures will be used instead.

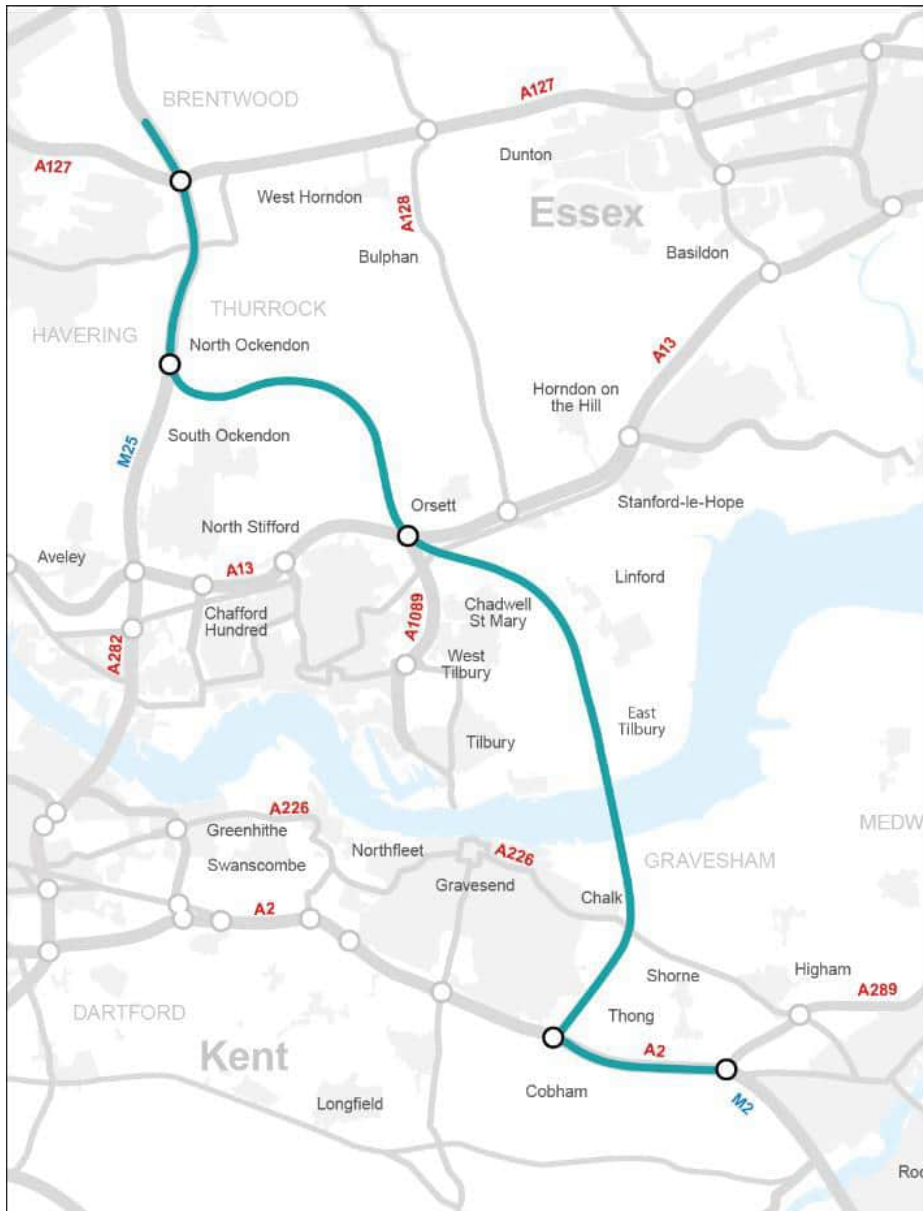
Services and utility diversions

- 5.3.38 The route will need diversion of overhead high voltage electricity transmission and distribution lines. Large high-pressure gas feeder mains will also need to be diverted, as well as a significant number of other utilities.

Road user charging

- 5.3.39 In December 2014, the Government stated in the National Policy Statement for National Networks (NPSNN) that the "Government will consider tolling as a means of funding new road capacity on the SRN. River and estuarial crossings will normally be funded by tolls or road user charges".
- 5.3.40 To align with NPSNN policy and to manage the performance of the SRN, it is proposed that a road user charge is levied but would only apply to vehicles using the new Lower Thames Crossing tunnel.

Figure 5.4 Lower Thames Crossing route alignment



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Lower Thames Crossing

Outline Business Case

Economic Case

Lower Thames Crossing

Outline Business Case: Economic Case

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1 Introduction

1.1 Purpose of Economic Case

1.1.1 This part of the Outline Business Case (OBC) sets out the Economic Case for the Lower Thames Crossing project (LTC). The purpose of the Economic Case is to assess the extent to which LTC provides Value for Money (VfM) based on an appraisal of its economic, social and environmental benefits, costs and revenues. The main benefits of LTC are journey time and productivity benefits. It also includes provision for walking and cycling infrastructure improvements, in line with Government transport priorities.¹

1.2 Structure of Economic Case

1.2.1 The Economic Case is structured into the following sections:

- Section 1. Introduction
- Section 2. Economic appraisal approach
- Section 3. Lower Thames Crossing costs and revenues
- Section 4. Level 1 benefits²
- Section 5. Level 2 benefits
- Section 6. Level 3 benefits
- Section 7. Sensitivity tests
- Section 8. Value for Money assessment

1.2.2 The Economic Case has been prepared in accordance with the Department for Transport's (DfT) Transport Business Case guidance.³ The modelling and appraisal of impacts follows the methods in DfT's Transport Analysis Guidance (TAG), which are consistent with HM Treasury's *Green Book* investment appraisal requirements.^{4,5} The Case does not include sensitivity tests based on the latest Office for Budget Responsibility (OBR) economic growth forecasts described in the July 2020 TAG Forthcoming Changes note.

1.2.3 All monetised impacts are expressed in 2010 market prices and discounted present values (denoted as 2010 prices and values) in order that the costs, revenues and benefits of LTC can be directly compared.⁶ The costs, revenues

¹ Department for Transport (2020): Decarbonising Transport, Setting the Challenge
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/876251/decarbonising-transport-setting-the-challenge.pdf

² Level 1, 2 and 3 benefits refer to DfT's categorisation of benefits in terms of their analytical maturity. They are defined in Section 2.

³ DfT (2017): Transport Business Case <https://www.gov.uk/government/publications/transport-business-case>

⁴ DfT Transport Analysis Guidance <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>

⁵ HM Treasury (2018): The Green Book: appraisal and evaluation in central government

<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>

⁶ The appraisal results presented in the tables in this Economic Case do not always sum exactly to the totals shown due to rounding.

and benefits are appraised over a standard 60-year appraisal period except for construction costs and construction-related traffic delay impacts that occur before LTC is opened to traffic. However, the economic appraisal also includes quantitative and qualitative information about impacts that cannot be monetised but are used to inform the VfM assessment.

- 1.2.4 The appraisal of monetised impacts is based on the following assumptions:
- a. the majority of impacts reflect the assured baseline (July 2020) scheme design, briefly described in Section 1.3, which is anticipated to be the scheme promoted for a Development Consent Order (DCO).⁷ These impacts comprise: transport user and provider impacts; greenhouse gas emissions; indirect tax revenues; accidents; construction-related traffic delays; wider economic impacts and journey time reliability. LTC costs are also based on this scheme design. Three impacts – noise, air quality and maintenance-related traffic delays – reflect the baseline (July 2018) scheme design which was the design included in the 2018 Statutory Consultation^{8,9}
 - b. all impacts reflect the difference between the ‘With Scheme’ and ‘Without Scheme’ scenarios
 - c. traffic impacts have been modelled using the Lower Thames Area Model (LTAM) based on a fixed land use assumption. The trip matrices are based on an opening date of 2026.¹⁰ However, the matrices have been adjusted to reflect a 2028 scheme opening year using TEMPro growth factors and DfT’s Road Traffic Forecasts 2015 (RTF15) growth rates, enabling benefits to be calculated for the 60-year period 2028 to 2087 to ensure consistency with the assured scheme costs
 - d. there are identical user charges at the Dartford Crossing and the Lower Thames Crossing with no real terms increase in charges, based on current charges, at either crossing over time
- 1.2.5 After the OBC is submitted to the Department for Transport’s Investment Portfolio Delivery Committee (IPDC), the traffic model and appraisal results will continue to be developed, refined and updated to support LTC’s DCO application and Full Business Case (FBC).
- 1.2.6 For the DCO, the traffic modelling and economic appraisal is described more fully in the Appendix D: Economic Appraisal Package of the Combined

⁷ A fuller description of the assured baseline (July 2020) scheme design is included in the Strategic Case.

⁸ Highways England Lower Thames Crossing Statutory Consultation <https://highwaysengland.citizenspace.com/ltc/consultation/>

⁹ The key features of the previous baseline (July 2018) scheme are described in *Lower Thames Crossing Your guide to consultation* https://highwaysengland.citizenspace.com/ltc/consultation/supporting_documents/LTC%208%20Consultation%20Brochure.pdf

¹⁰ When the LTAM traffic model was built in 2017, the planned LTC opening date at that time was 2026.

Modelling and Appraisal Report DCO application document.¹¹ The Economic Appraisal Package contains the following reports:

- a. *Lower Thames Crossing: Traffic Forecasting Report*¹²
- b. *Lower Thames Crossing: Economic Appraisal Report*¹³
- c. *Lower Thames Crossing: Distributional Impact Appraisal Report*¹⁴

1.3 Lower Thames Crossing appraisal

- 1.3.1 The preferred route for LTC was identified after the consideration of many crossing and route alignment options, with the preferred route announced in April 2017. Since then, Highways England has continued to develop the design and engage with stakeholders with the 2018 Statutory Consultation and a Supplementary Consultation and a Design Refinement Consultation held in 2020.^{15,16,17}
- 1.3.2 The Strategic Case includes an assessment of how the Dartford Crossing would perform in future in traffic terms if LTC was not built in order to demonstrate the rationale for the scheme.
- 1.3.3 The assured baseline (July 2020) scheme design is a route that connects the A2/M2 in Kent, east of Gravesend, crossing under the Thames through two bored tunnels, before joining the M25 south of Junction 29.
- 1.3.4 The route is approximately 23km with 4.25km in the twin-bored tunnel. On the south side of the Thames, the new road will link the tunnel to the A2 and M2 in Kent. On the north side, it will link to the A13 and junction 29 of the M25 in the London Borough of Havering. The tunnel crossing is located to the east of the village of Chalk on the south of the Thames and to the west of East Tilbury on the north side.
- 1.3.5 Junctions are proposed at following locations:
 - a. new junction with the A2 to the east of Gravesend
 - b. modified junction with the A13/A1089 in Thurrock
 - c. new junction with north-facing slip roads on the M25 between junctions 29 and 30
- 1.3.6 The route is mainly three lanes in both directions, using technology for lane control and variable speed limits. The southbound carriageway from the M25 to the junction with the A13/A1089 will be two lanes. The new route will have hard

¹¹ Highways England (2020): Lower Thames Crossing: Combined Modelling and Appraisal Report

¹² Highways England (2020): Lower Thames Crossing Traffic Forecasting Report

¹³ Highways England (2020): Lower Thames Crossing Economic Assessment Report

¹⁴ Highways England (2020): Lower Thames Crossing Distributional Impact Appraisal Report

¹⁵ Highways England (2020): Lower Thames Crossing Statutory Consultation

<https://highwaysengland.citizenspace.com/ltc/consultation/>

¹⁶ Highways England (2020): Lower Thames Crossing consultation 2020 <https://highwaysengland.citizenspace.com/ltc/consultation-2020/>

¹⁷ Highways England (2020): Lower Thames Crossing Design Refinement Consultation

<https://highwaysengland.citizenspace.com/ltc/design-consultation/>

strips for most of its length with hard shoulders along modified sections of the M25 and the A2. The new route will have emergency areas.

- 1.3.7 The route will be an All-Purpose Trunk Road (expressway) with green signs but will have additional vehicle restrictions imposed and managed through signage so that motorway traffic only is permitted to use the route.
- 1.3.8 To align with the National Policy Statement for National Networks policy (as described in Appendix A) and to manage the performance of the strategic road network, it is proposed that a road user charge is levied, but this will only apply to vehicles using the new Lower Thames Crossing tunnel.
- 1.3.9 If approved, construction of LTC would start in 2022 and it is planned to open to traffic by the end of 2028.
- 1.3.10 Figure 1.1 shows the route alignment of LTC.

Figure 1.1 Lower Thames Crossing route alignment



2 Economic appraisal approach

2.1 Introduction

2.1.1 This section describes the overall economic appraisal approach and assumptions, summarises the traffic modelling methodology and forecasts and describes the methods and tools used to appraise LTC's costs, revenues and Level 1, 2 and 3 benefits.

2.2 Economic appraisal approach and assumptions

2.2.1 HM Treasury's *Green Book* appraisal guidance recommends that public sector project and programme appraisals should be based on a social cost benefit analysis. Therefore, the appraisal of LTC includes information about a wide range of monetised and non-monetised impacts. These include not just the direct impacts on transport users and providers, but also impacts on the environment, wider society and government. These impacts are determined by forecast changes in traffic flows, travel times, delays, speeds, the distribution of traffic and mode choice between the 'With Scheme' and 'Without Scheme' scenarios produced by the LTAM traffic model (see Section 2.3). Some impacts are welfare impacts which have important effects on society and the quality of life although they are not included within Gross Domestic Product (GDP), whilst other impacts affect measured economic growth and are included within GDP.

2.2.2 The appraisal of LTC is based on three levels of impact analysis, defined in TAG Unit A2.1, that reflect differences in the maturity of the analytical techniques available for quantifying impacts:¹⁸

- a. Level 1 appraisal – this includes monetised benefits and disbenefits for transport users and providers and other economic, environmental and social impacts. These are all estimated using established traffic modelling and appraisal methods and include the key assumption that land uses remain fixed between the 'Without Scheme' and 'With Scheme' scenarios. The sum of the Level 1 benefits is called the Present Value of Benefits (PVB). The Level 1 appraisal also includes project costs and revenues, referred to as public accounts impacts. The sum of the costs less the revenues produces the Present Value of Costs (PVC). The ratio of the Level 1 PVB and PVC enables an Initial Benefits Cost Ratio (BCR) to be calculated
- b. Level 2 appraisal – this includes monetised journey time reliability and wider economic impacts. These are estimated using less established modelling and appraisal methods and are also both based on the assumption of fixed land uses. These impacts are added to the Level 1 PVB and, when compared to the PVC, enable an Adjusted BCR to be calculated

¹⁸ DfT Transport Analysis Guidance Unit A2.1 <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>

- c. Level 3 appraisal – this includes:
 - i. qualitative appraisals of environmental and social impacts
 - ii. the monetisation of landscape impacts
 - iii. an appraisal of distributional impacts
 - iv. an appraisal of option and non-use values
 - v. evidence about the undervaluation of freight impacts
 - vi. evidence about the potential for further Level 3 wider economic impacts based on variable land uses.

This Level 3 information is not used to further amend LTC's BCR, but it does inform the VfM assessment.

2.2.3 For all three appraisal levels, LTC has been modelled and appraised based on the following assumptions:

- a. most monetised impacts are based on the assured baseline (July 2020) scheme design. Three monetised impacts – maintenance-related traffic delays, noise and air quality – are based on the previous baseline (July 2018) design.¹⁹ Qualitatively appraised environmental and social impacts and the distributional appraisal of impacts are also based on the previous baseline scheme design. For the modelling and appraisal, the scheme is assumed to be open to traffic in 2028
- b. the costs reflect the Government's commitment to fully fund the scheme²⁰
- c. the modelling of daily traffic flows, travel times, delays, speeds, the distribution of traffic and mode choice is based on 10 time periods and a fixed land use assumption
- d. the same charges for users of the Lower Thames Crossing are assumed as those using the Dartford Crossing, both of which are assumed to increase annually in line with the Retail Price Index

2.2.4 Sensitivity tests have been undertaken to show how the BCRs for LTC vary under:

- a. different traffic growth scenarios
- b. a range of cost confidence levels

¹⁹ For this Economic Case it has not been possible to update the monetary values for maintenance-related traffic delays, noise and air quality impacts to reflect the assured baseline (July 2020) scheme design. These impacts, which reflect the baseline (July 2018) scheme design, require detailed modelling. However, as the values represent less than 1% of total scheme benefits, any updated values for the assured baseline (July 2020) scheme design will have no significant effect on the appraisal results

²⁰ HM Treasury (2020): Budget 2020, Delivering on our promises to the British People

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/871802/Budget_2020_Print.pdf

- c. high carbon prices
- d. the impact of using the Beta version of DfT's WITA 2 appraisal software to estimate Level 2 wider economic impacts.

2.3 Traffic modelling and forecasts

Introduction

- 2.3.1 This section explains the traffic modelling approach and forecasts that were developed for LTC using the LTAM.

Traffic modelling approach

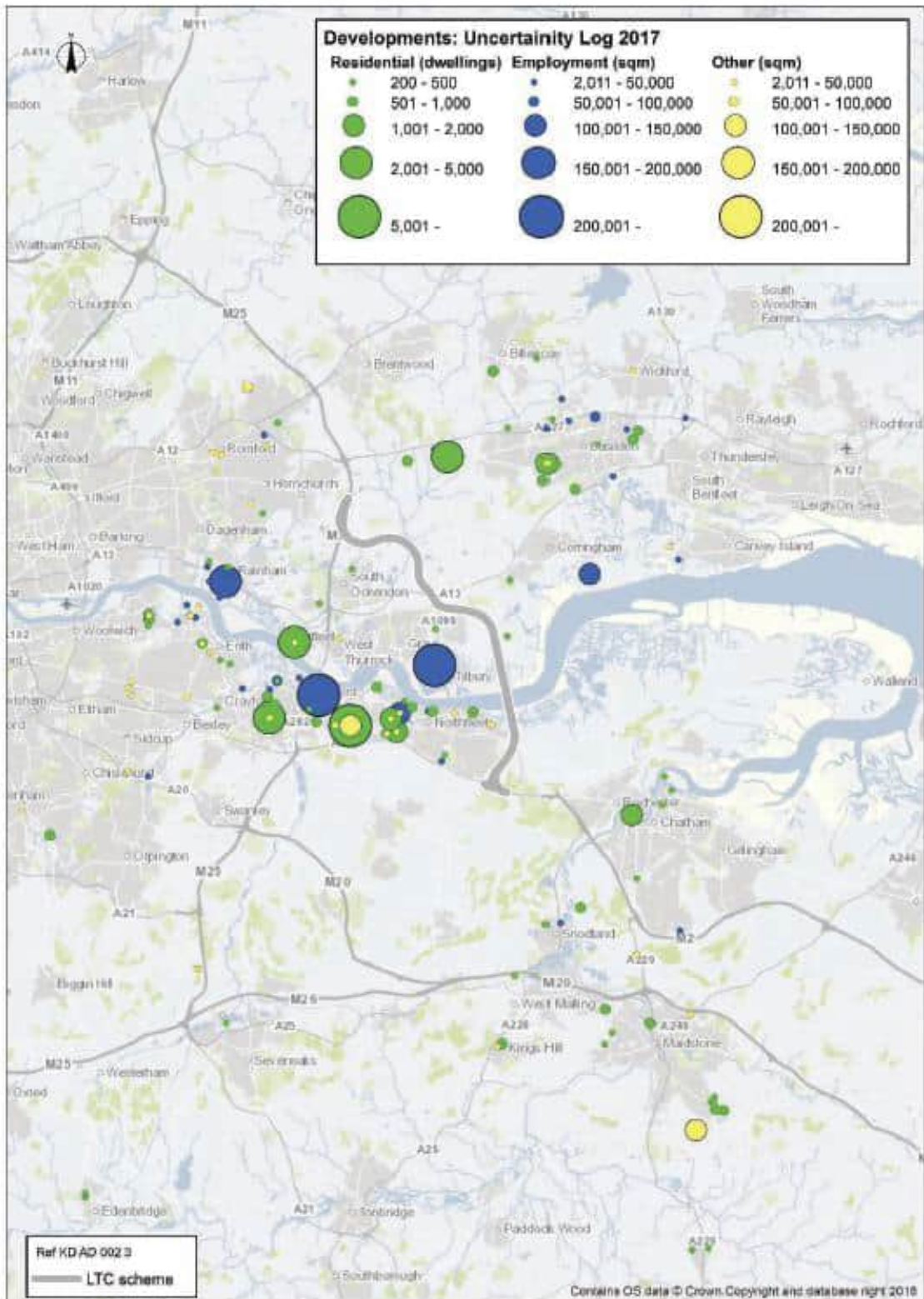
- 2.3.2 The LTAM traffic model is used to forecast the impact of the Lower Thames Crossing on the performance of the highway network. LTAM forecasts the changes due to LTC in traffic flows, travel times, speeds and levels of congestion on the road network. The model considers how users may change the route they use if the new crossing was available, as well as possible changes to the frequency with which they make their trips, the mode of travel they use, the time of day they travel and the destinations of their trips.
- 2.3.3 The model covers the whole of Great Britain so that the journey time and distance of the complete journey for trips that travel to, from, or through the Lower Thames fully modelled area is known. Appendix D shows that the fully modelled area also includes:
- a. the entirety of the M25 to ensure consistency in the modelling of journey times in both directions around the M25
 - b. the east of London up to, and around, the Silvertown Crossing as this will be the next crossing upstream from Dartford towards the west
- 2.3.4 Information on the current travel patterns used in the LTAM model came from the following sources:
- a. anonymised Highways England car data on the movement of mobile phones in England in 2015 collected for use in regional transport models²¹
 - b. light goods vehicle data from a DfT-owned TrafficMaster data set
 - c. heavy goods vehicle data from DfT's Base Year Freight Matrices
- 2.3.5 This data was then scaled to match information from over 1,000 live traffic count sites on the number of cars, light and heavy goods vehicles recorded at each count site for each hour of the day for at least a two-week period in March 2016.
- 2.3.6 The base year model reflects travel patterns and conditions on the road network in an average weekday in March 2016. The modelled hours are:
- a. AM peak hour (7.00-8.00)

²¹ 2015 was the latest year for which mobile phone data was available for use in the regional transport models.

- b. Average inter peak hour (9.00-15.00)
- c. PM peak hour (17.00-18.00)

- 2.3.7 Local adjustments are made to the model to reflect the proposed location of new housing and other developments (such as employment, retail and leisure sites) and planned transport schemes. All of these developments are independent of LTC. The main future development areas, either with planning permission or considered by the local planning authorities as likely to happen, are included in the model. These are shown in Figure 2.1.
- 2.3.8 Given that LTC would provide a new river crossing that will deliver significant travel time and distance savings for many trips, it is anticipated that significant benefits will be experienced in all hours of the day and night. Therefore, a method was adopted to provide trip matrices for unmodelled hours and realistic corresponding matrices of the time, distance and charges incurred for journeys, both with and without the new crossing. An examination of the variation in traffic counts and journey times in the study area led to the development of ten time periods, ie, an average weekday divided into seven time periods and an average weekend day divided into three time periods. Annualization factors were also applied to generate annual matrices that are used to estimate benefits in monetary terms.
- 2.3.9 The modelling of how people respond to changes in travel times and costs in the network, has been undertaken using the DfT's DIADEM software which uses information on the levels of travel demand, times and costs over the whole 24 hours of an average weekday.
- 2.3.10 LTAM uses SATURN highway modelling software to determine the route that vehicles take, journey times and traffic conditions on the network. The model allows for people to switch to and from rail in the future. The rail journey times and costs were taken from the Highways England rail model developed for its regional transport models which uses VISUM software.

Figure 2.1 Main future development areas included in LTAM model



Traffic forecasts

- 2.3.11 LTAM's forecasts of traffic flows, travel times, delays, speeds, the distribution of traffic and mode choice determine the nature and scale of the impacts from LTC. For this OBC, traffic forecasts were produced for:
- a 2016 base year – these forecasts were validated against actual traffic flows
 - an LTC opening year of 2028 – the traffic forecasts were initially based on a 2026 opening year. However, to ensure consistency of benefits with scheme costs, adjustments were made to the 2026 matrices to reflect a 2028 opening year. The process adopted to do this is set out in a technical note²²
 - other forecast years of 2031, 2041 and 2051.
- 2.3.12 For 2028 and the other forecast years, traffic forecasts were produced without LTC and with LTC for three traffic growth scenarios of Low, Core and High. The impacts of Low and High traffic growth on the BCRs are presented in Section 7.2.²³
- 2.3.13 The traffic forecasts include, for example, north-south movements across the River Thames and other routes, such as the A1089, and east west movements on key routes such as the A2, M25 and A13.
- 2.3.14 Table 2.1 shows the forecast changes in modelled traffic flows across the River Thames as a result of LTC. Specifically, it presents the change in two-way, hourly traffic flows, expressed in terms of passenger car units (PCU), using the Dartford Crossing and Lower Thames Crossing. The table shows:
- actual hourly flows for the AM peak hour, inter-peak (IP) hour and PM peak hour over the Dartford Crossing in 2016 and those forecast in 2028 and 2041 without LTC. Due to capacity constraints in the peak periods, growing peak period demand at Dartford is transferring to the interpeak period which is showing the largest increase in flows to 2041
 - forecast traffic flows (for the same hourly periods in 2026 and 2041) for the Dartford Crossing and Lower Thames Crossing, assuming the new crossing opens for traffic in 2028.
- 2.3.15 Table 2.1 shows that traffic using the Dartford Crossing in 2041 with LTC in place falls by 14% (AM), 24% (IP) and 20% (PM) compared to a 2041 scenario without LTC. However total traffic across the river in 2041 using the Dartford Crossing and Lower Thames Crossing increases by 41% (AM), 23% (IP) and 32% (PM).

²² Highways England (2020): Lower Thames Crossing 2028 opening year technical note

²³ The tables that present the traffic forecasts and appraisal results for the Core, Low and High traffic growth scenarios in this Case each include a note that states the model run identifiers for the Without Scheme and With Scheme model runs.

Table 2.1 Two way hourly traffic flows at Dartford Crossing and Lower Thames Crossing (passenger car units per hour)

	AM			IP			PM		
	(peak hour 07:00-08:00)			(average hour 09:00-15:00)			(peak hour 17:00-18:00)		
	2016	2028	2041	2016	2028	2041	2016	2028	2041
DC (without LTC)	13,940	15,986	16,237	11,215	13,986	15,396	12,780	15,310	16,017
DC (with LTC)		12,337	13,957		9,986	11,626		11,510	12,883
<i>Traffic reduction at DC</i>		-23%	-14%		-29%	-24%		-25%	-20%
LTC		7,831	8,879		6,058	7,242		7,283	8,250
Total DC and LTC		20,167	22,836		16,044	18,868		18,793	21,133
<i>Increase in crossing flows</i>		26%	41%		15%	23%		23%	32%

Note: Traffic flows are based on the assured baseline (July 2020) scheme design and traffic model runs: Without Scheme CML, With Scheme C9O

2.4 Costs and revenues

- 2.4.1 The costs of LTC include the capital costs of work to construct the project (CAPEX) and the annual costs of operating, maintaining and renewing the tunnel and roads (OMR). The revenues included in the appraisal include user charge receipts collected at LTC, as well as the change in receipts at the Dartford Crossing and within the London Congestion Charge area and those collected at the Silvertown and Blackwall Tunnels.
- 2.4.2 The CAPEX plus OMR less revenues, all expressed in 2010 prices and values, provides an estimate of LTC's PVC, which is the denominator in the calculation of a BCR.²⁴

2.5 Level 1 benefits

- 2.5.1 The Level 1 appraisal includes two groups of monetised benefits:
- transport user and provider benefits which provide a measure of LTC's impact on the efficiency of the transport network
 - other Level 1 economic, environmental and social benefits
- 2.5.2 The sum of these monetised benefits represents the Level 1 PVB which is the numerator in the calculation of the Initial BCR.

²⁴ LTC costs and revenues are expressed in 2010 prices and values using version 1.9.13 of DfT's TUBA software.

Transport user and provider impacts

- 2.5.3 There are three types of transport user and provider benefits:
- a. transport user and provider benefits over 60 years during the normal operation of LTC
 - b. construction delay impacts during LTC's construction period
 - c. maintenance delay impacts over 60 years during planned maintenance periods for LTC

Transport user and provider benefits (normal operation)

- 2.5.4 Using time, distance and charge matrices produced by the LTAM traffic model, estimates were calculated for the following transport user and provider impacts over a 60-year appraisal period from LTC opening:
- a. journey time savings – these are LTC's largest benefit
 - b. vehicle operating cost savings
 - c. user charge disbenefits – these take account of road user charges at Dartford, Lower Thames Crossing, Silvertown and Blackwall Tunnels and in the London congestion charge area
- 2.5.5 These impacts are calculated for business users, commuters and other users.²⁵

Construction delay impacts

- 2.5.6 There will be some disruption to the journey times and possibly the journey distances of some road users during LTC's construction period. This is a consequence of slow running through roadworks and/or additional time taken to travel via an alternative route. The latter is most likely to occur during any road closures when the new road is joined to the existing road network. An interim allowance for this impact has been included in this Economic Case.

Maintenance delay impacts

- 2.5.7 There will be some disruption to journey times and possibly the journey distances of some road users during planned maintenance work as a result of lane or full road closures. The economic impacts of traffic delays during maintenance periods have been estimated and valued over the 60-year appraisal period.²⁶

Other economic, environmental and social benefits

- 2.5.8 Other Level 1 impacts of LTC include accidents, greenhouse gas emissions, air quality, noise and indirect tax revenues. The approaches to appraising these impacts are briefly described below.

²⁵ Transport user and provider impacts are expressed in 2010 prices and values using TUBA 1.9.13.

²⁶ Maintenance delay impacts are estimated and expressed in 2010 prices and values using Highways England's QUADRO2019 software.

Accidents

- 2.5.9 LTC is expected to impact the number of accidents that occur and the severity of those accidents. The overall accident costs were determined by multiplying the forecast number of accidents by severity for the 'With Scheme' and 'Without Scheme' scenarios using the DfT's standard statistical values of the cost of each casualty by severity of injury and the non-casualty costs of accidents. The difference in costs between the scenarios provides a monetary estimate of the impact of LTC on accidents.²⁷

Greenhouse gas emissions

- 2.5.10 As the total number of miles driven rises, drivers burn more fuel which results in higher emissions of greenhouse gases. Changes in greenhouse gases – as measured by the net change in carbon dioxide equivalent emissions – due to LTC, compared to those without LTC, have been estimated and valued in monetary terms.²⁸
- 2.5.11 The value placed on changes in greenhouse gas (GHG) emissions is currently under review, now the UK has increased its domestic and international ambitions. Accordingly, current central carbon values are likely to undervalue GHG emissions, though the scale of undervaluation is still unclear. The potential impact of placing a higher value on GHG emissions can be illustrated by using the existing high carbon values series, in addition to the prescribed central values. HMG is planning to review the carbon values during 2020.
- 2.5.12 Values are reported based on Central and High untraded carbon prices.

Air quality

- 2.5.13 The change in traffic patterns due to LTC will impact on emissions of nitrogen oxide and the concentration of particulate matter. Using traffic flow and speed data extracted from the LTAM traffic model, the air quality impacts of LTC, compared to those without LTC, have been estimated and valued in monetary terms.²⁹

Noise

- 2.5.14 Changes in traffic patterns and volumes can impact traffic noise pollution experienced by local communities. Using traffic flow and speed data extracted from the LTAM traffic model, the noise impacts of LTC, compared to those without LTC, have been estimated and valued in monetary terms.³⁰

Indirect tax revenues

- 2.5.15 Indirect taxes are levied on goods and services. One such tax that would be impacted directly by LTC is fuel duty, because the amount of fuel consumed will vary according to how fast road users travel and the length of their journeys. This impact has been valued in monetary terms.³¹

²⁷ Accident impacts are estimated and expressed in 2010 prices and values using version 2013.2 of DfT's COBALT software.

²⁸ Greenhouse gas emissions are estimated and expressed in 2010 prices and values using TUBA 1.9.13 in line with TAG guidance.

²⁹ Air Quality impacts on NO_x and PM₁₀ are estimated and expressed in 2010 prices and values using the December 2015 version of TAG's air quality workbook.

³⁰ Noise impacts are estimated and expressed in 2010 prices and values using TAG's noise workbook.

³¹ Indirect tax revenues are estimated and expressed in 2010 prices and values using version TUBA 1.9.13.

2.6 Level 2 benefits

- 2.6.1 The appraisal of Level 2 impacts comprises journey time reliability and wider economic impacts, both of which have been estimated for the core traffic growth scenario. The addition of these Level 2 impacts to the Level 1 PVB enables an Adjusted BCR to be calculated.

Journey time reliability

- 2.6.2 Journey time reliability includes the impact of Incidents on the road network and Travel Time Variability (TTV). Users of the Dartford Crossing, which include a high percentage of freight users for whom reliability is very important, currently experience substantial delays and uncertainty due to the large number of incidents and high levels of day-to-day variability in journey times. Therefore, LTC has the potential to provide significant journey time reliability benefits.
- 2.6.3 Journey time reliability impacts are estimated and expressed in 2010 prices and values using DfT's MyRIAD 2017 software.

Incidents

- 2.6.4 The level of user delays due to incidents experienced on the Strategic Road Network (SRN) was estimated for a study area covering the Dartford Crossing, Lower Thames Crossing and their link roads in the 'Without Scheme' and 'With Scheme' scenarios.
- 2.6.5 MyRIAD 2017 provides a robust method for estimating the impact of incidents on users of the trunk road network. We have selected a study area which aligns with the COBALT area of impact used to appraise accidents, ensuring that we capture both the positive and negative impacts of LTC.

Travel Time Variability

- 2.6.6 Unlike Incident Delay, day-to-day variability depends on the characteristics of an individual journey rather than a link. An improvement, such as LTC, which reduces journey time variability over a set of links has a greater proportionate impact on the whole route journey time variability for a short distance trip compared to a long-distance trip, because journey time variability at other points along the long-distance route remain unchanged and will reduce the proportionate impact from variability reductions due to LTC.
- 2.6.7 Reflecting this issue, the appraisal of Travel Time Variability (TTV) requires a range of data to estimate the TTV of trip elements outside the study area. The modelling and appraisal approach used captures this data using 'Feeder Links' to represent approximate journey characteristics (length, road type and flow) for trip elements outside the study area. Variability benefits are very sensitive to the characteristics of these feeder links and a degree of uncertainty remains associated with the TTV estimates. In addition, the approach does not specifically allow for variations in trip length distribution which may occur between the 'Without Scheme' and 'With Scheme' scenarios.

- 2.6.8 Whilst theoretically sound, the appraisal of TTV benefits is more uncertain than that for Incidents for two reasons:
- While the analytical approach uses the incident delay results as an input to the process, it also requires a number of approximations covering journey time variability outside the study area.
 - A key parameter, the 'Reliability Ratio', has been subject to significant revision in recent years.

2.6.9 Notwithstanding the inherent level of uncertainty around the calculated benefits, it is possible that they are an underestimate because the diversionary impacts on to local roads has not been appraised to date.

2.6.10 The functionality for assessing this diversionary impact has recently been introduced into the MyRIAD software. This will be used to provide updated appraisal results before the DCO submission which take account of the diversionary impact on to local roads.

Wider economic impacts

- 2.6.11 Economic theory indicates that under hypothetical conditions of perfect competition, a fully specified appraisal of a transport scheme would accurately estimate all benefits. In practice, however, most markets are not perfectly competitive. Therefore, transport user impacts may be complemented by the inclusion of wider economic impacts. These wider impacts can be large and are therefore an important part of the overall appraisal of a transport scheme.
- 2.6.12 The text below summarises the impacts included in the calculation of Level 2 wider economic impacts, which are also based on the assumption of fixed land uses. The *Lower Thames Crossing: Economic Appraisal Report* will provide more detail about the approaches used to calculate wider economic impacts.^{32,33}

Agglomeration

- 2.6.13 Agglomeration is a measure of the effects of the concentration of economic activity in an area. Where a transport scheme facilitates a reduction in journey times, it will alter the accessibility of firms in an area to other firms and workers. As a result, the concentration of economic activity in an area increases which results in additional impacts on productivity due to better knowledge and technology synergies from business proximity, and the existence of deeper business and labour markets.
- 2.6.14 Agglomeration impacts, based on static clustering, are not directly correlated with journey time benefits and reflect the potential for businesses to interact with one another, rather than reflecting the actual pattern of trip making. Agglomeration benefits represent the second largest benefit after time savings.

³² Highways England (2020): Lower Thames Crossing Economic Assessment Report

³³ A Python script was used to estimate agglomeration impacts based on static clustering and labour supply impacts based on the 31st May 2019 TAG guidance and wider economic impacts dataset. A sensitivity test using DfT's WITA 2 Beta software was also carried out.

Output impacts

- 2.6.15 A reduction in the costs of transport allows businesses to operate more efficiently and increases their output. This allows for additional benefits to be captured as part of the wider economic impacts' appraisal. The additional benefit is a result of an imperfectly competitive market where businesses tend to set prices greater than their marginal cost of production and therefore the additional output is valued more highly by consumers than the cost of producing this output. In line with TAG guidance, output impacts were valued at 10% of business user benefits.

Labour supply impacts

- 2.6.16 Decisions about whether to take a job are assumed to be taken based on the combination of wages and commuting costs. As the costs of commuting change, then these decisions can change and, as a result, the supply of labour may increase or decrease. Reductions in commuting 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 changes in tax revenue that result from the labour market impacts are not included in user benefits and are included separately as a Wider Economic Impact.

2.7 Level 3 benefits

- 2.7.1 The following Level 3 impacts have been appraised. These have all been qualitatively appraised. In addition, landscape impacts have been monetised. These appraisals are all captured within the final VfM judgement of LTC. However, the results of the Level 3 appraisals have not been used to further adjust the BCRs.

Environmental and social impacts

- 2.7.2 Non-monetised qualitative appraisals, based on TAG guidance, have been conducted to assess the environmental and social impacts of LTC. The results of these are considered alongside monetised impacts to inform decision makers about the impact trade-offs that arise from LTC.
- 2.7.3 The environmental appraisals, which are based on a natural capital approach, comprise landscape, townscape, historic environment, biodiversity and water environment.
- 2.7.4 Landscape impacts have also been monetised based on DfT's *Supplementary Guidance on Landscape*.³⁴ In agreement with DfT, a central case monetary valuation and a sensitivity test valuation have been produced. The latter uses lower values and reflects the evolving nature of the evidence on landscape values. Whilst neither valuation has been used to further adjust the BCR, they are considered in the VfM assessment of LTC in a manner which is in accordance with DfT's forthcoming Landscape Monetisation advice note.³⁵

³⁴ DfT (2016): Value for Money: Supplementary Guidance on Landscape
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627487/value-for-money-supplementary-guidance-on-landscape.pdf

³⁵ DfT (2019): Advice Note on Landscape Monetisation (forthcoming)

- 2.7.5 The social appraisals comprise physical activity, journey quality, personal security, affordability and severance.

Option and non-use values

- 2.7.6 A qualitative appraisal of the option and non-use value of LTC for road users and in respect of development land has been undertaken.

Distributional impacts

- 2.7.7 In line with TAG guidance, an appraisal has been undertaken of the impact of LTC on the distribution of some monetised and non-monetised impacts across vulnerable social groups. This is currently based on the baseline July 2018 scheme design.

Landscape values

- 2.7.8 A monetary valuation of the impact of LTC on landscape was undertaken. Following TAG guidance, the valuation is not included in the BCR, but it is taken into account in the VfM assessment of LTC.

Level 3 wider economic impacts

- 2.7.9 Evidence has been gathered on the potential for LTC to change land uses and generate Level 3 wider economic impacts such as enabling land to be put to more productive uses, people moving to more or less productive jobs and agglomeration based on dynamic clustering. The evidence gathered to date for these impacts is summarized in Section 6. Further evidence will be gathered to support the DCO application and FBC.

Resilience

- 2.7.10 LTC would provide an alternative route east of the Dartford Crossing for local, regional and national traffic. This would give people more choice when deciding how they want to cross the Thames, and in combination with demand management measures, is expected to improve the resilience of the road network in the event of a catastrophic closure of the Dartford Crossing. TAG does not provide guidance on how this impact should be appraised and therefore it has not been quantified in this Economic Case. However, this expected impact is considered in the Value for Money assessment.

Freight values of time

- 2.7.11 LTC is expected to carry a higher percentage of freight users than is typical on the SRN. Highways England plans to conduct primary research to address concerns that the current estimates for values of time and reliability do not reflect the full value that freight users place on these impacts.
- 2.7.12 The hypothesis on values of time is that because the current values are primarily based on the value of the driver's time and ignore the impacts of late delivery, they underestimate the journey time impact for freight users.
- 2.7.13 For reliability, a fixed Reliability Ratio is used to value reliable journeys. However, it is likely there is a non-linear relationship in which a small amount of unreliability is tolerable and has a relatively low valuation, whereas greater levels of unreliability would have more serious impacts on a business. In

addition, goods which need to arrive at a fixed time would have a lower tolerance and freight which is destined for a warehouse would have a higher tolerance.

- 2.7.14 A study from the Netherlands in 2012 sought to identify values for both freight time and freight reliability and found that the value of freight time is greater than would be implied by driver's time and operating cost alone. Should the Highways England study similarly find the value for time for freight is undervalued this would be significant for the LTC Economic Case.

3 Lower Thames Crossing costs and revenues

3.1 Introduction

- 3.1.1 The section describes how LTC's costs and revenues have been estimated and presents the latest assured estimates.³⁶ The costs and revenues are both based on the assured baseline (July 2020) scheme design.
- 3.1.2 The costs of LTC comprise those incurred during its planning and construction phase, referred to as capital costs (CAPEX), and its operating, maintenance and renewals costs (OMR). The costs have been estimated on the basis of the Government's commitment to publicly fund the scheme.
- 3.1.3 The revenues include user charge receipts collected at LTC as well as the change in receipts at the Dartford Crossing, within the London Congestion Charge area and those collected at the Silvertown and Blackwall Tunnels.
- 3.1.4 This section presents:
- a Most Likely estimate of CAPEX costs
 - a Central estimate of OMR costs
 - revenues based on Core traffic growth forecasts produced by the LTAM traffic model.
- 3.1.5 The costs have been estimated at 2016 Q1 prices in line with Highways England guidance and are assured. They have then been inflated to outturn prices which represent the financial resources that are needed to construct, operate, maintain and renew LTC.
- 3.1.6 For the economic appraisal both the costs and revenues have been expressed in 2010 prices and discounted present values using DfT's TUBA version 1.9.13 appraisal software. The costs less the revenues constitute the PVC, which is the denominator of the BCR.
- 3.1.7 Section 7 includes sensitivity tests based on different cost confidence levels for the CAPEX costs and Low and High traffic growth scenarios which change the revenues.
- 3.1.8 Appendix E includes more details about the costs and presents the Most Likely annual CAPEX and OMR cost profiles.

3.2 CAPEX costs

CAPEX estimation approach

- 3.2.1 The CAPEX costs were estimated and profiled over LTC's planning and construction period and are based on an October 2028 opening date.

³⁶ The costs and revenues also provide the basis for the Financial Case.

- 3.2.2 The estimate of CAPEX costs was prepared by the LTC project team in accordance with Highways England's capital cost estimating process for major projects.³⁷
- 3.2.3 The estimate has been assured by Highways England's Commercial Service Division (CSD) team.
- 3.2.4 The CAPEX costs are split into:
- a Base Cost, which represents the costs of work to build LTC and includes Non-Recoverable VAT (NR VAT)
 - additional costs for Project Risk, Uncertainty, Inflation and Portfolio Risk
- 3.2.5 A base cost estimate was produced for LTC and was converted to a probability distribution, expressed at outturn costs, by running a Monte-Carlo simulation on both the forecast schedule and cost outcomes. The Most Likely costs, which reflect the statistical mode of the range of costs, represent a 43% cost confidence level (P43). A range of costs at different confidence levels have also been produced and their impact on the BCRs is reported in Section 7.
- 3.2.6 A qualitative, top down, assessment of Project Uncertainty has been carried out and LTC has developed a Risk and Opportunity Register to enable quantitative analysis to be undertaken.
- 3.2.7 More information about the development of the CAPEX costs is included in Appendix E.

CAPEX estimates

- 3.2.8 The Most Likely assured Base Cost is £4,453m (outturn). The inclusion of Risk, Uncertainty, Portfolio Risk and Inflation increases this to £6,752m (outturn).

Table 3.1 CAPEX costs, Most Likely costs (outturn)

Cost category	£m	% of total
Options	28	0
Development	407	6
Lands	212	3
Construction	3,215	48
Non-recoverable VAT	591	9
Base cost	4,453	66
Risk and Uncertainty	475	7
Inflation	1,428	21
Portfolio Risk	396	6
Risk, Inflation & Portfolio Risk	2,299	34
Total	6,752	100

³⁷ Highways England (2018): Commercial Services Division Major Projects Cost Estimation Manual version 3.2.35

3.2.9 The estimates for Base Costs and Additional costs are apportioned to four contracts – Highways North, Highways South, Tunnels and Other – and Highways England Portfolio Risk, as shown in Table 3.2. The Tunnels account, by far, for the largest share of CAPEX costs – 39% of Base Costs and 37% of Total Costs.

Table 3.2 CAPEX outturn costs by contract (£m, Most Likely)

Cost category	Highways North	Highways South	Tunnels	Other contract	Portfolio Risk	Total
Options, Development & Pre-Enabling Works	0	0	0	456	0	456
Lands	0	0	0	214	0	214
Construction, NR VAT and Other Costs	1,401	564	1,722	96	0	3,783
Base Cost	1,401	564	1,722	766	0	4,453
Risk, Uncertainty & Third Party Infrastructure	60	29	135	252	0	475
Inflation	492	199	663	73	0	1,428
Total	1,953	792	2,520	1,090	396	6,752
<i>Percentage of total</i>	<i>29</i>	<i>12</i>	<i>37</i>	<i>16</i>	<i>6</i>	<i>100</i>

3.2.10 When expressed in 2010 prices and values, the Most Likely CAPEX cost included in the assured PVC is £3,167m. This excludes historic sunk costs (ie, all costs incurred on LTC to the end of December 2019) and NR VAT.

3.3 OMR costs

OMR estimation approach

3.3.1 A Central estimate of the OMR costs was estimated and profiled over a 60-year operational period from 2028 to 2087.

3.3.2 The estimate of OMR costs was prepared by the LTC project team in accordance with Highways England's OMR cost estimating process for major projects.³⁸

3.3.3 The OMR costs include three cost packages:

- a. Highways
- b. Tunnels
- c. Road user charging (RUC) costs

³⁸ Highways England (2018): Commercial Services Division Operations Estimation Manual

OMR estimates

Highways

3.3.4 Table 3.3 presents Most Likely Highways OMR (2016 Q1 prices), split by cost category across all segments. Table 3.4 shows the costs for each segment.

Table 3.3 Highways OMR costs over all segments, Most Likely costs (2016 Q1 prices)

Cost category	Cost element	£m
Highways Assets	Routine operation and maintenance	27
	Renewals	185
Structures	Routine operation and maintenance	97
	Betterment/Renewals	-4
Technology	Routine operation and maintenance	45
	Renewals	42
Severe weather		34
Non-operational costs		19
Total		445

Table 3.4 Highways OMR costs by segment, Most Likely costs (2016 Q1 prices)

Segment	£m
A2 and LTC Junction	104
A13 Junction	103
Chadwell St Marys Link	33
Gravesend Link	14
M25 and LTC Junction	74
Ockendon Link	68
Tilbury Crossing Approach	49
Total	445

Tunnels

3.3.5 The Most Likely Tunnels OMR costs (2016 Q1 prices) are shown in Table 3.5.

**Table 3.5 Tunnels OMR costs, Most Likely costs
(2016 Q1 prices)**

Cost category	Cost element	£m
Maintenance	Pavements	11
	Fabric and finishes	1
	Air monitoring system	14
	HVAC and ventilation systems	18
	Hydraulic Treatment, Stormwater & Drainage	3
	High Voltage Electrical Distribution and Control	6
	Low Voltage Electrical Distribution and Control	3
	Uninterruptable Power Supply	6
	Lighting	26
	Electronic signage systems	13
	Fire detection and suppression system	18
	Roadside furniture and fencing	8
	Monitoring and control system	43
	Surveillance and detection	17
	Telephone, communication and public address	23
Total	210	
Operations	Staff, overheads, premises and energy	385
Total		595

Road user charging

3.3.6 The Most Likely RUC costs (2016 Q1 prices) are shown in Table 3.6.

**Table 3.6 Road user charging OMR costs, Most Likely costs
(2016 Q1 prices)**

Cost category	£m
Fixed costs	551
Variable costs	53
Renewals costs	22
Total	625

Total OMR costs

3.3.7 Table 3.7 reports the Most Likely OMR costs for the three cost packages. These sum to £1,665m in 2016 Q1 prices and £4,654m in outturn prices.

Table 3.7 Total OMR costs, Most Likely costs

Cost category	2016 Q1 £m	Outturn £m
Highways	445	1,368
Tunnels	595	1,778
Road user charging	625	1,508
Total	1,665	4,654

3.3.8 When expressed in 2010 prices and values, the Most Likely OMR costs included in the two central case PVCs is estimated to be £434m.

3.4 Revenues

3.4.1 The revenues included in the PVC reflect the change in user charging revenues, over 60 years, at the Dartford Crossing, Lower Thames Crossing, the Silvertown and Blackwall Tunnels and in the London Congestion Charge area. The revenues assume that user charges at the Lower Thames Crossing will be the same as users pay at the Dartford Crossing and charges at both crossings rise in line with inflation.

3.4.2 The revenues are estimated using TUBA 1.9.13 and represent the change in revenues for the core growth scenario between the CML Without Scheme traffic model run and C9O With Scheme traffic model run. When expressed in 2010 prices and values, the revenues for the core traffic growth scenario that will be included in the central case PVC is estimated to be £645m.

3.4.3 Whilst the revenues included in the Economic Case and Financial Case are both based on outputs from the LTAM traffic model and have been estimated over 60 years, the revenue numbers differ between the two cases reflecting the cases' different nature. The reasons for these differences are that the estimates of revenue in the Financial Case:

- a. only include receipts from Dartford and LTC
- b. are expressed in outturn prices
- c. include enforcement income, ie, penalties from non-payment of the user charge. This enforcement income is excluded from the Economic Case.

3.5 PVC

3.5.1 The PVC is calculated by adding the CAPEX and OMR costs and deducting user charge revenues. Table 3.8 shows that this is £2,956m.

**Table 3.8 PVC, Most Likely costs
(2010 prices and values, core traffic growth)**

PVC components	£m
CAPEX	3,167
OMR	434
Revenues	-645
PVC	2,956

Note: Revenues are based on traffic model runs: Without Scheme CML, With Scheme C90

4 Level 1 benefits

4.1 Introduction

4.1.1 This section presents the core traffic growth appraisal results for the Level 1 benefits, which comprise transport user and provider benefits and other Level 1 benefits based on the assured baseline (July 2020) scheme design.

4.2 Transport user and provider benefits

4.2.1 Transport user and provider benefits include impacts during the normal operation of LTC, during planned maintenance periods and during construction of LTC.

Transport user and provider benefits

4.2.2 Transport user and provider benefits during the 60-year normal operation of the scheme include travel time savings, vehicle operating cost and user charge disbenefits. These are estimated for three user classes – commuters, other users and business users. All benefits are expressed in 2010 prices and values.

4.2.3 Table 4.1 shows that the most significant of these benefits is travel time savings which are estimated to be £2,455m. There are a further £129m of vehicle operating cost savings and -£61m of user charge disbenefits. These sum to £2,523m. Impacts on business users are the largest component accounting for 61% of these benefits.

4.2.4 A spatial disaggregation of user benefits across local authority areas shows that those areas closest to LTC receive the largest benefits.

**Table 4.1 Transport user and provider benefits
(£m, 2010 prices and values, core traffic growth)**

	Commuters	Other users	Business users	All users
Travel time savings	447	868	1,140	2,455
Operating cost savings	-35	-270	434	129
User charge disbenefits	-4	-19	-38	-61
Total	408	579	1,536	2,523

Note: Impacts are all based on traffic model runs: Without Scheme CML, With Scheme C90

Construction delays

4.2.5 An interim allowance of a -£200m disbenefit (2010 prices and values), split evenly between commuters, other users and business users has been included in the appraisal to reflect the impact of traffic delays on users during LTC's construction period (see Table 4.2). This value has been prudently estimated based on an early piece of analysis during LTC development.

**Table 4.2 Construction delays
(£m, 2010 prices and values, core traffic growth)**

	Commuters	Other users	Business users	All users
Construction delays	-67	-67	-67	-200

4.2.6 LTAM modelling and appraisal of these delays, based on information about the construction programme and traffic management measures to be implemented on the M25, A13 and A2, is currently being undertaken to provide additional assurance. A more robust estimate will be included in the FBC.

Maintenance impacts

4.2.7 Table 4.3 includes a breakdown of impacts during planned maintenance periods for LTC over 60 years. User delays and operating cost savings are estimated for each of the three user classes. Other impacts are estimated for all users. These impacts sum to -£21m.

**Table 4.3 Planned maintenance impacts
(£m, 2010 prices and values, core traffic growth)**

	Commuters	Other users	Business users	All users
User delay	-3	-4	-7	-13
Fuel operating cost	0	-1	-4	-5
Non-fuel operating costs	0	-1	-2	-3
Greenhouse gas emissions				-3
Accidents				-1
Indirect tax revenues				3
Total				-21

Note: Impacts are based on the baseline July 2018 scheme design and traffic model runs: Without Scheme CM6, With Scheme C8E

4.2.8 Table 4.54 shows that all transport user and provider impacts sum to £2,302m.

**Table 4.4 Transport and user provider impacts
(£m, 2010 prices and values, core traffic growth)**

	All users
Travel time savings	2,455
Vehicle operating costs	129
User charge disbenefits	-61
Construction delays	-200
Maintenance impacts	-21
Total	2,302

Note: Travel time savings, vehicle operating costs and user charge disbenefits are based on traffic model runs: Without Scheme CML, With Scheme C9O. Maintenance delays are based on the baseline July 2018 scheme design and traffic model runs: Without Scheme CM6, With Scheme C8E

4.3 Other Level 1 benefits

4.3.1 Other Level 1 benefits comprise noise, air quality, greenhouse gases, accidents and indirect tax benefits. Table 4.5 shows that these benefits sum to -£124m over the 60-year appraisal period.

4.3.2 A qualitative assessment of the impact of the latest version of the TAG air quality guidance, published in May 2019, indicates that there is likely to be a small increase in the disbenefit valuation of air quality. An updated air quality value will be calculated for DCO and reported in the FBC.

**Table 4.5 Other Level 1 benefits
(2010 prices and values, core traffic growth)**

Benefit	£m
Noise	-12
Air quality	-5
Greenhouse gases	-45
Accidents	-76
Indirect tax benefits	13
Total	-124

Notes:

Greenhouse gases and indirect tax benefits based on the following traffic model runs: Without Scheme CML, With Scheme C9O. The greenhouse gas valuation is based on the central non-traded prices of CO₂ equivalent taken from the TAG May 2019 Databook.

Noise and air quality impacts are based on the baseline July 2018 scheme design and traffic model runs: Without Scheme CM6, With Scheme C8E

4.4 Level 1 PVB

4.4.1 The sum of transport user and provider benefits and other Level 1 impacts provides the Level 1 PVB of £2,178m, as shown in Table 4.6.

**Table 4.6 Level 1 benefits
(2010 prices and values, core traffic growth)**

Benefits	£m
Transport user and provider benefits	2,302
Other Level 1 benefits (incl. maintenance delays from accidents)	-124
PVB (Level 1)	2,178

Note: Benefits valued using TUBA 1.9.13 are based on the following traffic model runs: Without Scheme CML, With Scheme C9O

4.5 Initial BCR

4.5.1 Table 4.7 presents the Initial BCR for LTC which is 0.74.

**Table 4.7 Initial BCR, Most Likely costs
(2010 prices and values, core traffic growth)**

	£m
PVB (Level 1)	2,178
PVC	2,956
Initial BCR	0.74

Note: Benefits valued using TUBA 1.9.13 are based on the following traffic model runs: Without Scheme CML, With Scheme C90

5 Level 2 benefits

5.1 Introduction

5.1.1 This section presents the core traffic growth appraisal results for the Level 2 benefits – journey time reliability and wider economic impacts – based on the assured baseline (July 2020) scheme design.

5.2 Journey time reliability benefits

5.2.1 Table 5.1 presents the split of journey time reliability benefits for the core traffic growth scenario for Incidents and TTV benefits between commuters and other users, and business users. The total benefit is estimated to be £443m.

**Table 5.1 Journey time reliability benefits
(£m, 2010 prices and values, core traffic growth)**

Reliability impacts	Commuters and other users	Business users	All users
Incidents	126	116	242
Travel Time Variability	105	96	201
Total	231	212	443

Benefits are based on the following traffic model runs: Without Scheme CML, With Scheme C90

5.3 Wider economic impacts

5.3.1 Table 5.2 presents the estimates of wider economic impacts for the core traffic growth scenario produced using the Python script. In total these benefits total £1,692m and represent 39% of the total monetised benefits of LTC.

5.3.2 Agglomeration benefits (£1,475m) are by far the largest type of wider economic impact accounting for 87% of total wider economic impacts.

**Table 5.2 Wider economic impacts
(2010 prices and values, core traffic growth, Python)**

Type of wider economic impact	£m
Agglomeration	1,475
Output impacts	154
Labour supply impacts	63
Total	1,692
Agglomeration as % of total wider economic impacts	87%
Wider economic impacts as % of total benefits	39%

Benefits are based on the following traffic model runs: Without Scheme CML, With Scheme C90

5.4 Level 2 PVB

5.4.1 The sum of journey time reliability and wider economic impacts produces a Level 2 PVB of £2,135m as shown in Table 5.3.

**Table 5.3 Level 2 benefits
(2010 prices and values, core traffic growth)**

	£m
Journey time reliability	443
Wider economic impacts	1,692
PVB (Level 2)	2,135

5.5 Adjusted BCR

5.5.1 Table 5.4 presents the sum of Level 1 and Level 2 benefits for the core traffic growth scenario, which is £4,312m (2010 prices and values). The ratio of the Level 1 and 2 PVB against the PVC, based on Most Likely/central costs, produces an Adjusted BCR of 1.46.

**Table 5.4 Adjusted BCR, Most Likely costs
(2010 prices and values, core traffic growth)**

	£m
PVB (Level 1)	2,178
PVB (Level 2)	2,135
PVB (Level 1 and 2)	4,312
PVC	2,956
Adjusted BCR	1.46

Note: Benefits valued using TUBA 1.9.13 are based on the following traffic model runs: Without Scheme CML, With Scheme C90

6 Level 3 benefits

6.1 Introduction

- 6.1.1 The Level 3 appraisal undertaken to date includes:
- interim non-monetised appraisals of environmental impacts, plus the monetisation of landscape impacts
 - non-monetised appraisals of social impacts
 - option and non-use values
 - a distributional appraisal of some impacts on vulnerable social groups
- 6.1.2 These Level 3 impacts are considered alongside the monetised impacts of LTC in order to inform decision makers about all LTC impacts and trade-offs.
- 6.1.3 A summary is provided of the evidence gathered to date of the potential for Level 3 wider economic impacts based on variable land use.
- 6.1.4 A quantified appraisal of the impact of LTC on the resilience of the road network has not been undertaken, although LTC is expected to improve the strengthen the resilience of the network in the event of a catastrophic closure of the Dartford Crossing.
- 6.1.5 Lastly, it is recognised that current values of time upon which the appraisal is based are likely to underestimate the benefits of LTC for freight users.
- 6.1.6 All of the Level 3 impacts and evidence are considered in the VfM assessment.

6.2 Environmental impacts

Introduction

- 6.2.1 A substantial amount of environmental appraisal work has been carried out.
- 6.2.2 It should be noted that a precautionary environmental appraisal has currently been carried out based on the *Lower Thames Crossing: Preliminary Environmental Information Report* that was prepared to support the Statutory Consultation held in Autumn 2018.³⁹ Through ongoing LTC development, which will take account of the findings of environmental surveys and stakeholder consultation, mitigation measures will be identified to offset the adverse impacts where possible. The appraisal will be updated accordingly, once mitigation commitments are confirmed.
- 6.2.3 For landscape and biodiversity impacts, it is likely that additional mitigation measures will need to be considered and weighed against the additional cost to LTC's budget as part of the VfM assessment, given the importance of the Area of Outstanding Natural Beauty and ancient woodland respectively.

³⁹ Highways England (2018): Lower Thames Crossing: Preliminary Environmental Information Report
<https://highwaysengland.citizenspace.com/ltc/consultation/>

Landscape

- 6.2.4 There would be adverse impacts on the landscape character in the Kent Downs Area of Outstanding Natural Beauty and areas of green belt. However, mitigation has not yet been finalised and therefore the appraisal has taken a precautionary approach and assessed these as a Large Adverse impact.
- 6.2.5 Mitigation measures are being developed including landscape screening and green bridges.
- 6.2.6 The landscape impacts of LTC have been monetised using the DfT's Value for Money Supplementary Guidance on Landscape. In agreement with DfT, a central case monetary valuation due to LTC was produced of -£694m (2010 prices and values). To reflect the evolving nature of the evidence on landscape values, a sensitivity test valuation has also been produced using the emerging values which, following a DfT Review, were estimated to be 76% lower than the central case values. This produced a monetary valuation due to LTC of -£166m (2010 prices and values). Appendix H provides more details.
- 6.2.7 In accordance with DfT's requirements, these valuations have not been used to alter the BCRs, but they have been considered in the VfM assessment of LTC in a manner which is in accordance with DfT's forthcoming Landscape Monetisation advice note.
- 6.2.8 Any significant landscape mitigation measures have yet to be designed. Once mitigation measures have been designed, we would expect the residual landscape disbenefit to reduce further.

Townscape

- 6.2.9 There would be adverse impacts on the townscape character of Thong and Baker Street, both of which are designated conservation areas. However, mitigation has not yet been finalised and therefore the appraisal has taken a precautionary approach and assessed these as a Large Adverse impact.
- 6.2.10 Mitigation measures are being developed including architectural and landscape design and they may be sufficient to reduce the current appraisal score.

Biodiversity

- 6.2.11 There would be direct and indirect adverse impacts on Thames Estuary and Marshes Special Protection Area, Ramsar site, Claylane Wood and Shorne Sites of Special Scientific Interest and local wildlife sites. However, mitigation has not yet been finalised and therefore the appraisal has taken a precautionary approach and assessed these as a Large Adverse impact.
- 6.2.12 Mitigation measures, reflecting LTC's expenditure budget, will include, but not be limited to, replacement and compensatory planting and translocation.

Historic environment

- 6.2.13 There would be adverse impacts on scheduled ancient monuments, two listed buildings, archaeological remains, a registered park and conservation areas. However, mitigation has not yet been finalised therefore the appraisal has taken a precautionary approach and assessed these as a Large Adverse impact.

- 6.2.14 Mitigation for above-ground heritage assets will include landscape screening and architectural design. For below ground assets, mitigation will be by record and the extent that the current appraisal score can be reduced will be dependent on the outcomes of surveys.

Water environment

- 6.2.15 There would be adverse impacts on groundwater levels and the proposed drainage solution may result in road salting and accidental spills impacting on water quality. There could be potential construction impacts on the River Thames and the loss of floodplain storage. However, mitigation measures have not yet been finalised therefore the appraisal has taken a precautionary approach and assessed this as a Slight Adverse impact.

6.3 Social impacts

Introduction

- 6.3.1 Qualitative social impact appraisals have been undertaken of the following impacts of LTC.

Personal security

- 6.3.2 LTC is expected to have a neutral impact on the personal security of drivers and vehicle occupants in the tunnel and along the link roads and on all road users at crossing points.

Physical activity

- 6.3.3 LTC would result in slight improvements in pedestrian, cyclist and equestrian infrastructure through new footbridges and underpasses. However, these are not expected to lead to a significant modal shift towards non-motorised modes.

Journey quality

- 6.3.4 LTC would lead to large beneficial impacts on journey quality through improved views and reduced stress for a large numbers of road users.

Personal affordability

- 6.3.5 There is a slight positive impact from LTC on personal affordability because Gravesham residents' journeys would be proportionally cheaper than in a scenario without LTC as they are assumed to be eligible for a local residents' discount when using LTC.

Severance

- 6.3.6 The majority of routes severed by LTC will be re-instated and therefore limited direct severance would be experienced. A small increase in traffic-related severance in some areas would be expected.
- 6.3.7 Two social impacts – accessibility and options values – were not appraised because TAG guidance for these impacts is for public transport schemes.

Summary of non-monetised impacts

6.3.8 Table 6.1 summarises the non-monetised environmental and social impact appraisal scores for LTC. The environmental scores are pre-mitigation.

Table 6.1 Non-monetised impacts appraisal scores

Impact category	Impact	Appraisal summary score
Environmental	Landscape	Large Adverse
	Townscape	Large Adverse
	Biodiversity	Large Adverse
	Historic environment	Large Adverse
	Water environment	Slight Adverse
Social	Personal security	Neutral
	Physical activity	Slight Positive
	Journey quality	Large Positive
	Affordability	Slight Positive
	Severance	Slight Adverse

6.4 Option and non-use values

6.4.1 The Lower Thames Crossing would provide valuable options in two respects: first for road users in the Lower Thames area who would have a second option to cross the Thames; and secondly in terms of the development of new areas of land adjacent to the LTC route for housing and employment. These options have a value, even if they are never exercised. The appraisal of these option values for LTC is based on the principles set out in TAG Unit 4.1.

Road users

6.4.2 At present road users in the Lower Thames area wanting to cross the Thames are only able to use the Dartford Crossing. When traffic flows at Dartford are disrupted, the only alternative choices to cross the river involve significant detours via the Blackwall Tunnel or westbound around the M25. When LTC is built, road users in the Lower Thames area would have the option of using two crossings of the Thames: Dartford and LTC.

6.4.3 It is not possible to place a monetary value on this option. However, traffic volumes using the Dartford Crossing currently average 50 million trips a year and total volumes across the Thames (Dartford and LTC) would increase to 75 million with LTC in place. Therefore, this option would be available to a large number of road users. Therefore, the option value for road users has been qualitatively assessed as Large Positive.

Development land

6.4.4 The construction of LTC across areas of land that have not previously been developed opens up the possibility that areas adjacent to the route and close to LTC's junctions may be developed for housing and employment. There is no certainty that such development will occur. This will depend on local planning

policies, the granting of planning permission and the presence of environmental constraints which may constrain such development. However, the construction of LTC provides decision makers and developers with options about whether to develop land adjacent to the route.

- 6.4.5 The owners of some plots of land adjacent to the LTC route have already entered into agreements with developers providing retainers to potentially develop the land if LTC is built. Work is ongoing to estimate the area of land covered by the development agreements. In addition, landowners of other plots of land not covered by development agreements will also have the option whether or not to develop land. It is not possible to easily value this potentially developable land because land values depend on whether or not each plot of land has been granted planning permission. However, given the length of the LTC route, the option value for development land has been assessed as Large Positive.

6.5 Distributional impact appraisal

- 6.5.1 A distributional appraisal of LTC, based on the baseline July 2018 scheme design, on vulnerable people groups has been undertaken in relation to a number of impacts of LTC. The aim is to understand the extent to which impacts have uniform effects on socially vulnerable groups. It is important that people in these groups are not disadvantaged by receiving a disproportionately low share of LTC’s benefits or a disproportionately high share of its disbenefits.
- 6.5.2 Following a screening exercise, Table 6.2 presents the matrix of people groups and impacts that have been appraised in terms of the distributional impacts.

Table 6.2 Scope of distributional appraisal

	User benefits	Noise	Accidents	Severance	Personal affordability
Income distribution	X	X			X
Children under 16		X	X	X	
Young adults			X		
Older people 70+		X	X	X	
People with a disability				X	
Households without access to a car				X	

User benefits

- 6.5.3 User benefits reflect the change in travel time costs, fuel and non-fuel operating costs and user charges. There is a net beneficial impact from the LTC on user benefits with net user benefits arising across all income quintiles.⁴⁰ The distribution of user benefits is within 5% of the population share for each income quintile and based on TAG guidance this has been assessed as ‘even’. There is

⁴⁰ An income quintile divides a population into five income groups (from lowest income to highest income) so that approximately 20% of the population is in each group.

a moderate beneficial impact of LTC for each income quintile. User benefits were valued using TUBA 1.9.11.

Noise

- 6.5.4 There is a net large adverse impact of the LTC on residential noise levels.
- 6.5.5 The distribution of noise impacts against income quintiles is assessed as 'uneven'. Adverse noise impacts are higher than expected in the most deprived (20%) and least deprived (100%) income quintile groups. Overall there is a Large Adverse impact.
- 6.5.6 There are more net increases in noise greater than 1dB in those areas with higher than average proportions of children under 16, compared with the regional study area.⁴¹ Overall there is a Large Adverse impact.
- 6.5.7 There are more net increases in noise greater than 1dB in areas with higher than average proportions of people aged 70 and over, compared with both the regional study area and England and Wales. Overall there is a Large Adverse impact.
- 6.5.8 The majority of schools and care homes would receive no change in noise level. Overall there is a neutral impact for these receptors.

Accidents

- 6.5.9 The distributional impact of LTC on accidents is neutral. There is one location which is predicted to have a decrease in casualties due to a decrease in traffic flows and one location predicted to have an increase in casualties due to an increase in traffic flows. There is no distributional impact by any of the vulnerable user groups analysed (under 16, 16 to 25 males, over 75s) for either location, compared with the regional study area and Great Britain.

Severance

- 6.5.10 A design aim for LTC is that as far as reasonably practicable all routes that are severed during the construction phase will be re-instated by means of bridges or underpasses as appropriate, with no additional impediment. There is therefore likely to be no direct permanent severance.
- 6.5.11 Overall, there is likely to be an increase in traffic related severance in a small number of locations potentially affecting less than 1% of the population within the regional study area. The distribution of increased traffic related severance is 'uneven' with respect to car-ownership as there is likely to be a smaller than expected impact of traffic related severance because the proportion of non-car owning households in the vicinity of each of the affected links (ie, within 800 metres) is lower than that for either the regional study area or alternatively England and Wales. As a result, the distributional impact of severance for these links has been assessed as Slight Adverse rather than Moderate Adverse.
- 6.5.12 The distributions of traffic related severance on children aged under 16, people aged 70 and over and for people with a limiting long-term illness are 'even' because they are similar to the regional study area and England and Wales.

⁴¹ The regional study area for the Distributional Impact Appraisal is comprised of Thurrock, Medway, Essex, Kent, Greater London, Southend-on-Sea, Surrey, East Sussex, West Sussex, Brighton and Hove, Reading, Wokingham, Bracknell Forest, Windsor and Maidenhead, Buckinghamshire and Hertfordshire.

Overall, the impacts for all three groups have been assessed as Moderate Adverse.

Personal affordability

- 6.5.13 Generally, personal affordability will not be affected by LTC as the ‘Without Scheme’ travel routes and operating costs will still be available. There is therefore a neutral impact of LTC on personal affordability.
- 6.5.14 Journeys by Gravesham residents to and from destinations north of the Thames will be proportionately cheaper than without LTC as cross-river road user charges will be reduced through a user charge discount. Around 100,000 Gravesham residents would benefit from a reduction in the cost of travel across the Thames. The distribution of personal affordability impacts is even across all income quintiles. Overall, the distribution of changes in personal affordability is Moderate Beneficial for Gravesham residents.
- 6.5.15 Table 6.3 presents the distributional impact appraisal scores that are reported in the AST.

Table 6.3 Distributional impact appraisal scores

	User benefits	Noise	Accidents	Severance	Personal affordability
Income distribution	Moderate beneficial	Large Adverse			Moderate Beneficial*
Children under 16		Large Adverse	Neutral	Moderate Adverse	
Young adults			Neutral		
Older people 70+		Large Adverse	Neutral	Moderate Adverse	
People with a disability				Moderate Adverse	
Households without access to a car				Slight Adverse	

* For Gravesham residents only

6.6 Evidence for Level 3 wider economic impacts

- 6.6.1 The estimates of TAG Level 1 and 2 transport user benefits and wider economic impacts reported in this Economic Case are based on fixed land use over the 60-year appraisal period. However, LTC is likely to enable Level 3 wider economic impacts, such as land use change, people moving to more or less productive jobs and agglomeration based on dynamic clustering, in the Lower Thames local area and wider region.⁴² Such impacts can be expected to increase productivity as businesses benefit from agglomeration through dynamic clustering, better job matching and lower costs due to the re-organisation of their business activities. LTC may also encourage the development of new homes and additional employment spaces. More productive use of land would lead to increases in land values (net of private and

⁴² Dynamic clustering refers to businesses moving closer to each other

public sector planning costs) which reflect the welfare benefits. These impacts may arise through mechanisms that bring markets closer together, facilitate changes in business behaviour, encourage trade and inward investment, strengthen labour markets and enable land use change.

- 6.6.2 A range of modelling, contextual and stakeholder evidence has been gathered to assess the potential for LTC to generate Level 3 wider economic impacts.

Modelling evidence

- 6.6.3 Forecasts from the LTAM traffic model, based on fixed land use, show that, compared to the Without Scheme scenario, people living in North Kent travelling on business would use the Lower Thames Crossing to cross the river and travel further to secure economic opportunities. This suggests that LTC has the potential to increase economic connections across the estuary and help develop a more vibrant single market across the Lower Thames area.
- 6.6.4 Modelling has also been undertaken using Highways England's Economy Model which is a variable land use transport interaction (LUTI) model. Such modelling, which produces estimates of impacts on employment, Gross Value Added (GVA) and Level 3 wider economic impacts, is based on complex and iterative relationships between land uses and transport changes about which there is uncertainty.⁴³
- 6.6.5 Two limitations of the Economy Model are that it does not take account of long-distance travel responses and is unable to take account of changes in physical accessibility to the transport network. As a result, early estimates of Level 3 wider economic impacts from the Economy Model are relatively modest and further work is ongoing to refine them. However, the modelling validates the conclusion that LTC is likely to support economic growth in the Lower Thames area, although some of this growth may be displaced from other areas, especially London.

Contextual evidence

- 6.6.6 Contextual evidence for potential Level 3 wider economic impacts includes:
- lessons about wider economic impacts from other estuarial road crossings^{44,45}
 - the economic history of the Lower Thames area and current socio-economic indicators^{46,47}
 - the identification of existing business clusters in the Lower Thames area based on ONS data and a literature review⁴⁸

⁴³ GVA is a measure of the regional contribution to GDP; nationally GDP = GVA plus taxes on products minus subsidies

⁴⁴ Highways England (2020): Lower Thames Crossing: Review of wider economic impacts of other estuarial road crossings

⁴⁵ Highways England (2020): Lower Thames Crossing Summary of Severn Bridge economic impacts study

⁴⁶ Highways England (2020): Lower Thames Crossing: Economic history of the Lower Thames area

⁴⁷ Highways England (2020): Lower Thames Crossing: The socio-economic context

⁴⁸ Highways England (2020): Lower Thames Crossing: Identification of business clusters in the Lower Thames area

- d. a review of the freight and logistics cluster in the Lower Thames area⁴⁹
- e. a review of LTC's alignment with national, regional and local plans and land use policies

Lessons from other estuary crossings

- 6.6.7 The review of lessons from other estuarial road crossings categorised them into two groups:
- a. first, or only, road crossings (Forth; Humber; and Severn); and
 - b. additional or replacement road crossings (Second Tyne Tunnel; Second Severn Crossing; Mersey Gateway; Queensferry Crossing; Queen Elizabeth II bridge; and Silvertown Tunnel)
- 6.6.8 The key lessons from these crossings are that:
- a. the realisation of wider economic impacts is dependent on the historic and current socio-economic context of the local area
 - b. the extent to which new economic relationships develop when a new crossing is provided is strongly influenced by the historic economic relationships between areas
 - c. where such impacts have occurred, the actual level of economic change was often far greater than that originally predicted

Economic history of the Lower Thames area

- 6.6.9 The Lower Thames area has been a key supplier of goods and labour for London, and the key portal for Britain's overseas trade, for hundreds of years. The linkages between the Lower Thames area and London grew much stronger thanks to the development of railways in the 19th century. However, as road traffic began to dominate movements of people and goods, the development of cross-river economic relationships was constrained by the limited number, and latterly the capacity, of fixed vehicular links.
- 6.6.10 The closure of London's docks saw port activity move down river and the subsequent redevelopment of the former docks centred around Canary Wharf created an agglomeration of high value financial services accompanied by strong population growth. Manufacturing industries located in the Lower Thames local authority areas to the north and south of the river have declined to be replaced by the growth of services, especially retail and distribution activities. These areas have evolved separately and have not attracted high-tech, high value industries, in part due to the lack, and constrained nature, of the physical links between them. However, there is evidence of slightly stronger linkages between businesses on each side of the estuary to the west of the Lower Thames area than to the east.

⁴⁹ Highways England (2020): Lower Thames Crossing: Review of the freight and logistics cluster

Current socio-economic context of the Lower Thames area

- 6.6.11 LTC is located within the area covered by the South East Local Enterprise Partnership (SELEP), which encompasses Kent, Essex, East Sussex, Thurrock, Medway and Southend. This area has a population of over 4 million people and an annual economic output of almost £90bn. On both measures, the area is broadly equivalent to that of a medium sized European country such as Slovakia.⁵⁰
- 6.6.12 Within this broader area, the socio-economic character of the Lower Thames economy has been shaped by two key features:
- a. its proximity to, and historical development as an industrial area serving, London along the two sides of Thames. Whilst de-industrialisation has seen some local industries decline, new industries are developing and London's growth, largely in the east, is spilling over into the Lower Thames area
 - b. its location along the UK's key trade route between its manufacturing heartlands and Channel ports, bisected by the Thames. This makes the need to address the congestion problems at Dartford an issue of national significance, particularly in a post-Brexit world
- 6.6.13 In recent years the Lower Thames area has experienced:
- a. strong population growth supported by high levels of commuting into London
 - b. employment growth and low unemployment in line with national trends
 - c. together these factors have more than offset the area's poor underlying competitiveness, which in part may be due to its deteriorating road connectivity caused by growing congestion
 - d. a mixed demographic profile in terms of deprivation levels, with higher wealth and reducing levels of deprivation to the north of the River Thames compared to south of the River, but overall low educational attainment levels across the whole area
 - e. economic development to the north and south of the river that has resulted in similar types of service sector activity, although there has been some specialisation in primary and manufacturing sectors
 - f. greater relationships and trade flows between businesses north and south of the River Thames to the west of the Lower Thames area, closer to the Dartford Crossing, than to the east of the area

⁵⁰ South East Local Enterprise Partnership (2018): Economic Strategy Statement
http://kmep.org.uk/documents/SELEP_StratEconState_v10-low.pdf and EU Eurostat
<https://ec.europa.eu/eurostat/web/regions/data/database>

- g. relatively low levels of housing growth, despite ambitious housing targets.⁵¹

Existing business clusters

- 6.6.14 Much of the economic growth and increased employment that LTC is expected to generate is likely to occur in existing business clusters in the Lower Thames area. A range of quantitative analytical techniques using ONS economic data and a literature review have been used to identify existing business clusters to the north and south of the Lower Thames area.
- 6.6.15 Four key clusters have been identified based on their intensity, size, proximity, growth and likelihood that they will be positively impacted by LTC. These key clusters, together with their geographic areas, are listed below:
- freight and logistics (Thurrock and Dartford)
 - construction (Lower Thames area)
 - creative industries (Thames estuary)
 - agriculture and forestry (Kent and Essex)
- 6.6.16 Four other clusters have been identified that show some strong signs of being important clusters, but less so than the key clusters. These are:
- maintenance and sale of motor vehicles (Lower Thames area)
 - robotics and advanced manufacturing (Lower Thames area)
 - ceramics (Lower Thames area)
 - financial and insurance services (Brentwood and Havering)
- 6.6.17 There was also some evidence that life sciences are emerging as a cluster to the south of the Thames and environmental technology is growing to the north.

Freight and logistics cluster

- 6.6.18 The existing freight and logistics cluster is one of the main drivers of economic activity in the Lower Thames area, particularly in Thurrock and Dartford. As well as desk research, the project team has undertaken an extensive engagement exercise with key freight and logistics sector stakeholders to seek to understand how the creation of LTC might affect these businesses. The key messages are summarised below.
- 6.6.19 Businesses in the freight and logistics sector benefit from:
- access to the ports along the Thames and Medway
 - their location on the key corridor between the UK's industrial heartlands and the continent

⁵¹ Thames Estuary 2050 Growth Commission (2018): Technical Report
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718793/Technical_Report.pdf

- c. their proximity to London.
- 6.6.20 Therefore, it is unsurprising that Lower Thames areas to the north and south of the river are favoured for logistics businesses and businesses dependent on good road, rail and river accessibility.
- 6.6.21 The River Thames, with its one existing crossing in the area, is viewed as a barrier to freight movements. As a result, Kent and Essex tend to be seen as two separate markets. For example, most supermarkets have distribution centres on both sides of the river. LTC will lead to two significant improvements for the freight and logistics sector:
- a. reduced journey times on most routes
 - b. a significant reduction in the impact of major disruptions at the Dartford Crossing
- 6.6.22 Feedback from businesses and other research suggests that, of these, the ability to avoid lane closures at the existing crossing will be the most significant benefit. It is likely that the economic costs of major disruptions to freight generally is underestimated in the normal appraisal process – an issue currently being addressed by Highways England through a study.
- 6.6.23 Even though LTC is a strategic route and has limited local access points, the improvement in connectivity that it provides is likely to encourage freight businesses to relocate to prime sites close to the new crossing. The ability of firms to do this depends largely on the availability of suitable sites and access to an available workforce. North Kent, in particular, has a number of industrial parks with capacity to expand and feedback from our stakeholder engagement suggests this area is viewed more favourably than Essex in terms of an available workforce.

Alignment of LTC with national, regional and local plans

- 6.6.24 The future economic development and transformation of the Lower Thames area is supported by a number of local strategic and economic plans.^{52,53} These plans align with the Economic Strategy Statement recently published by the South East Local Enterprise Partnership (SELEP) showing how the South East region needs to increase its productivity levels and by 2030 to bridge the gap, compared to the rest of the UK in terms of GVA per filled job.⁵⁴ The Statement explains how SELEP aims to focus on:
- a. tackling housing shortages
 - b. relieving pressure on infrastructure
 - c. improving workforce skills.

⁵² Thames Estuary 2050 Growth Commission (2018): 2050 Vision
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718805/2050_Vision.pdf

⁵³ South East Local Enterprise Partnership (2017): South East LEP (SELEP) Strategic Economic Plan Evidence Base https://www.southeastlep.com/app/uploads/SouthEast_LEP_Strategic_Economic_Plan_Evidence_Base_FINAL.pdf and Transport for the South East (2019): Transport Strategy <https://transportforthesoutheast.org.uk/transport-strategy/>

⁵⁴ South East Local Enterprise Partnership (2018): Economic Strategy Statement:
http://kmep.org.uk/documents/SELEP_StratEconState_v10-low.pdf

- 6.6.25 Achieving these goals over the next five years will enable the LEP to deliver on the Government's National Industrial Strategy and set a pathway towards developing a robust Local Industrial Strategy for the South East.
- 6.6.26 A review of Lower Thames local authority local plans and land use strategies has found evidence that authorities are willing to allow land use changes of the sort associated with Level 3 wider economic impacts. Specifically, the review found that all Lower Thames local authority areas (except Dartford) have:
- growing populations
 - significant plans to increase housing provision
 - aims to increase employment
 - spatial strategies that seek to focus housing and employment growth in key areas away from the Green Belt.

Stakeholder evidence

- 6.6.27 A range of evidence from stakeholders about the potential for LTC to generate wider economic impacts has been gathered.
- 6.6.28 In a Federation of Small Businesses survey in 2018 about the Lower Thames Crossing.^{55,56}
- 50% of respondents thought that LTC would provide better access to new customers
 - 39% said that it would provide better access to transport hubs and
 - 29% believed it would secure better access to new markets
- 6.6.29 The British Chamber of Commerce 2019 Infrastructure Survey found that whilst there was a low awareness of LTC among its members nationally, of those businesses who had some, or a lot of, knowledge of the project, the biggest wider economic impacts due to LTC were as follows:⁵⁷
- increased access to new or existing customers (28% of respondents with an awareness of LTC)
 - increased access to sea ports (22%)
 - increased efficiency or productivity of their business (20%)
 - increased access to new or existing suppliers (21%)
 - increased access to airports (20%)

⁵⁵ Highways England (2018): Lower Thames Crossing Your guide to consultation
<https://highwaysengland.citizenspace.com/ltc/consultation/>

⁵⁶ Federation of Small Businesses (2018): Lower Thames Crossing will bring better access to customers, survey shows
<https://www.fsb.org.uk/first-voice/regional-voice/lower-thames-crossing-will-bring-better-access-to-customers-survey-shows>

⁵⁷ British Chamber of Commerce (2019): UK road and rail networks not meeting business needs
<https://www.britishchambers.org.uk/news/2019/11/uk-road-and-rail-networks-not-meeting-business-needs>

6.6.30 The LTC project team is continually engaging with a wide range of businesses and industry stakeholders and their views about the potential for LTC to transform the Lower Thames economy provide powerful further evidence:

[REDACTED]: *“The Lower Thames Crossing almost creates a new economy between Essex and Kent and the opportunity to travel to work between the two counties and travel to learn between the counties much more than currently happens is truly exciting.”*

[REDACTED]: *“The Lower Thames Crossing could help our business firstly by providing us the confidence to enter new markets where we are not currently well established. And also I think it would improve the employment opportunities in Kent and Essex directly and further afield indirectly. If the Lower Thames Crossing didn’t go ahead, it would just be a great opportunity lost. And it would stifle economic growth in the country more broadly. It’s been long overdue and it’s something that has to be stood behind by all parties.”*

6.6.31 The project team is continuing to seek evidence of the potential for Level 3 wider economic impacts as we talk with stakeholders and read their responses to LTC’s public consultations.

Conclusions

6.6.32 The conclusion from the evidence gathered to date is that LTC has the potential to generate significant Level 3 wider economic impacts. This is based on the findings that:

- a. the improved connectivity provided by LTC, both cross-river and east-west, has the potential to strengthen the area's local economic performance and skills base, which will improve productivity and strengthen its competitiveness. This may result in people moving to more productive jobs
- b. the similarity of the area's services sectors, where there are already key clusters such as the Creative Industries, and road-using clusters, such as freight and logistics and construction, should encourage cross-river competition and dynamic clustering when LTC opens
- c. LTC is part of a programme of infrastructure improvements that will support the wider proposed development of the area.

6.6.33 More evidence will be collected before DCO and FBC that addresses issues such as:

- a. the scope for national supply side impacts that are not due to displaced economic activity from other areas of the country
- b. the significance of inter-firm transactions
- c. the importance of international trade for the Lower Thames area

- d. the relative significance of supply side factors, such as planning constraints, and demand in relation to housing growth and other land use change

6.6.34 All the Level 3 evidence gathered will be used to inform the LTC's VfM assessment, but will not be used to change the BCR calculation. The results of any further Level 3 appraisal will be included in the DCO submission and reported in LTC's FBC.

7 Sensitivity tests

7.1 Introduction

- 7.1.1 Sensitivity tests have been undertaken to show how the BCRs for LTC vary under:
- different traffic growth scenarios
 - a range of cost confidence levels
 - high untraded carbon prices
 - the impact of using the Beta version of DfT's WITA 2 appraisal software to estimate Level 2 wider economic impacts.

7.2 Traffic growth

- 7.2.1 The impact of national uncertainty in the traffic forecasts on the economic appraisal of LTC has been assessed following guidance in TAG Unit M4. This involved running low and high traffic growth scenarios in the LTAM model.
- 7.2.2 TUBA version 1.9.13 was then used to estimate the impact on the Level 1 PVB from changes in user benefits (travel time savings, vehicle operating costs and user charge disbenefits), greenhouse gas emissions and indirect tax revenues. These scenarios also impact on the PVC via changes in user charge revenue which is also estimated using TUBA 1.9.13.
- 7.2.3 Python was also used to estimate the impact on Level 2 wider economic impacts.
- 7.2.4 All other impacts included in the Low and High growth scenarios were unchanged from those in the Core growth scenario.⁵⁸
- 7.2.5 Table 7.4 presents the Initial BCRs and Adjusted BCRs based on different traffic growth scenarios. All costs are held at Most Likely CAPEX and central OMR estimates. Table 7.4 shows that:
- the Initial BCR ranges between 0.51 (Low Growth) and 1.00 (High growth) and is 0.74 based on Core growth
 - the Adjusted BCR ranges between 1.14 (Low Growth) and 1.77 (High growth) and is 1.46 based on Core growth.

Table 7.1 BCRs for different traffic growth scenarios

	Low	Core	High
Initial	0.51	0.74	1.00
Adjusted	1.14	1.46	1.77

⁵⁸ The Low traffic growth results are based on the LML Without Scheme model run and L90 With Scheme model run. The High traffic growth results are based on HML Without Scheme model run and H90 With Scheme model run.

7.3 Costs

CAPEX

- 7.3.1 A probabilistic Monte-Carlo simulation approach was applied to LTC’s cost estimating structure to develop the following cost confidence estimates – P2.5, P10, P30, Most Likely (P43), P50, P70, P90, P97.5. As an example, P10 represents costs for which there is a 10% probability that the costs will be lower than this level.
- 7.3.2 The cost estimates at each end of the range (e.g. P2.5 and P97.5) reflect the distribution of CAPEX risks. A narrow range in the absolute cost numbers for these P values would indicate a limited range of cost risks. As a project matures the range should reduce as more information is gathered and uncertainty about the likely costs reduces. The P50 value is the mean estimate of the costs that takes account of all possible outcomes modelled in the cost distribution and reflects a single ‘risk neutral’ position on the cost distribution where the sum of all cost variances from the mean are equal on both sides of this point. The Most Likely estimate is the modal estimate that reflects the combination of probabilities across the risk factors.
- 7.3.3 For LTC, the Most Likely P value of P43 indicates that there are a higher proportion of upside CAPEX risks.
- 7.3.4 Table 7.2 presents the range of assured outturn CAPEX costs.

Table 7.2 Range of outturn CAPEX costs £m

P2.5	P10	P30	Most Likely (P43)	P50	P70	P90	P97.5
4,677	5,273	6,219	6,752	7,007	7,846	9,018	9,912

OMR

- 7.3.5 Uncertainty around OMR costs has been assessed in line with guidance from Highways England Commercial Services Division. Table 7.3 presents the range of outturn OMR costs.

Table 7.3 Range of outturn OMR costs £m

Low	Central	High
3,726	4,654	5,890

- 7.3.6 Table 7.4 presents the Initial BCRs and Adjusted BCRs based on different cost confidence levels for CAPEX. OMR costs are held at the Central estimate. The BCRs all reflect core traffic growth. Table 7.4 shows that:
- the Initial BCRs range from 1.10 (P2.5) to 0.49 (P97.5)
 - the Adjusted BCRs range from 2.18 (P2.5) to 0.97 (P97.5).

7.3.7 Highways England is seeking funding for LTC at the level of the P70 costs which is associated with an Adjusted BCR of 1.24.

Table 7.4 BCRs for different costs

	P2.5	P10	P30	Most Likely	P50	P70	P90	P97.5
Initial	1.10	0.97	0.81	0.74	0.71	0.62	0.57	0.49
Adjusted	2.18	1.92	1.60	1.46	1.40	1.24	1.12	0.97

7.3.8 More information is provided in Appendix G about how changes in traffic growth and CAPEX impact on the BCRs.

7.4 High untraded carbon prices

7.4.1 Table 7.5 shows the impact on the BCRs (based on core traffic growth and Most Likely costs) of high untraded carbon prices based on BEIS values contained within DfT's TAG databook.

Table 7.5 BCRs for central and high untraded carbon prices (Core traffic growth, Most Likely costs)

	Central untraded carbon prices	High untraded carbon prices
Initial BCR	0.74	0.73
Adjusted BCR	1.46	1.45

7.5 Level 2 wider economic impacts estimated using WITA2 Beta software

7.5.1 In line with DfT TAG guidance, the Level 2 wider economic impacts for agglomeration and labour supply for the core traffic growth scenario were estimated as a sensitivity test using a Beta version of DfT's WITA 2 wider economic impact appraisal software. As for the central case appraisal, Output impacts were valued at 10% of business user benefits.

7.5.2 These impacts are set out in Table 7.6. The broad similarity of the WITA 2 Beta results to those based on the Python script (see Table 5.2) provides confidence about the estimates of Level 2 wider economic impacts.

Table 7.6 Level 2 Wider economic impacts estimated using WITA 2 Beta (2010 prices and values, core traffic growth)

Type of wider economic impact	£m
Agglomeration	1,820
Output impacts	154
Labour supply impacts	17
Total	1,990
Agglomeration as % of total wider economic impacts	91
Wider economic impacts as % of total benefits	46

Note: Benefits are based on the following traffic model runs: Without Scheme CML, With Scheme C90

- 7.5.3 The inclusion of the WITA 2 Beta estimates for Level 2 wider economic impacts increases the central case Adjusted BCR (core growth, Most Likely costs) as shown in Table 7.7.

Table 7.7 Adjusted BCR with Python and WITA2 Beta wider economic impacts (2010 prices and values, core traffic growth)

	£m
PVB (Level 1 and 2) – based on Python script estimates of wider economic impacts	4,312
PVC	2,956
Adjusted BCR	1.46
PVB (Level 1 and 2) – based on WITA 2 Beta estimates of wider economic impacts	4,611
PVC	2,956
Adjusted BCR	1.56

8 Value for Money assessment

8.1 Introduction

8.1.1 The Value for Money (VfM) assessment takes account of all impacts of LTC, including those expressed in monetary terms, those that are quantified but not monetised, and those that have been qualitatively appraised.

8.2 VfM assessment

- 8.2.1 The main benefits of LTC are travel time savings and wider economic impacts which, under the core traffic growth scenario, account for 96% of total LTC benefits (Level 1 and 2 PVB). The ratio of the Level 1 and 2 PVB to the PVC (based on Most Likely costs) yield an Adjusted BCR of 1.46. This represents Low Value for Money based on DfT's VfM categories.⁵⁹
- 8.2.2 While no housing or residential development has been assessed as being dependent on LTC, analysis has identified significant planned developments in the Lower Thames area which are likely to drive additional traffic to the route. Under the High traffic growth forecast the BCR would rise to 1.77 (Medium value for money). The Adjusted BCR for the Low traffic growth scenario is 1.14 (Low value for money).
- 8.2.3 LTC has the potential to have a substantial impact on the local economy as movements between the adjacent local authorities are currently constrained because there is only one highly congested cross river link between them. LTC is expected to create new opportunities for businesses to collaborate or to reach new customers. It might also allow more commuters to live or work on different sides of the river, getting a better match between skills and jobs. Most of these benefits are captured in the appraisal of wider economic impacts (agglomeration, output changes and labour supply impacts) based on static clustering. However, there is evidence that further wider economic impacts from dynamic clustering, such as the movement to better jobs, are likely to arise. Additional modelling and appraisal to capture these impacts is planned and the results will be reported in LTC's FBC, but these effects are unlikely to ever be included in the BCR due to the difficulties in quantifying their monetary impact.
- 8.2.4 In addition, LTC provides valuable options for road users, who will have the choice of a second crossing, and in respect of new areas of development land who could be used for housing and employment.
- 8.2.5 Through ongoing LTC development, mitigation measures will be further developed to offset, where possible, the adverse impacts on landscape, biodiversity, townscape, historic environment and water environment and the appraisal will be updated accordingly once mitigation commitments are confirmed. For landscape and biodiversity impacts, it is likely that additional mitigation measures will need to be considered and weighed against the additional cost to LTC's budget as part of the VfM assessment, given the importance of the Area of Outstanding Natural Beauty and ancient woodland

⁵⁹ DfT (2015): Value for Money Framework

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/630704/value-for-money-framework.pdf

respectively. The costs of the additional measures would reduce the Initial and Adjusted BCRs and will need to be balanced against LTC's benefits.

- 8.2.6 There are predicted to be safety disbenefits of -£76m. This is because, while there are fewer accidents per vehicle km, there is more traffic crossing the Thames and travelling on the surrounding road network, which leads to an increase in accidents overall.
- 8.2.7 The results of CAPEX cost sensitivity tests for LTC are that the Adjusted BCRs range from 2.18 (P2.5) to 0.97 (P97.5). Highways England is seeking funding for LTC at the level of the P70 costs which is associated with a BCR of 1.24.
- 8.2.8 The provision of LTC is also expected to improve the resilience of the road network in the event of a catastrophic closure of the Dartford Crossing, although it is not possible to monetise this impact.
- 8.2.9 LTC also includes provision for a programme of walking and cycling infrastructure improvements to support the Government's transport priorities.
- 8.2.10 Taking account of all these factors, LTC was judged on 17th July 2020 to represent Medium Value for Money (VfM) with a significant risk of moving to Low VfM, subject to changes in TAG.

Lower Thames Crossing

Outline Business Case

Commercial Case

Lower Thames Crossing Outline Business Case

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1 Introduction

1.1 Purpose of the case

- 1.1.1 This Commercial Case demonstrates how we will deliver the Lower Thames Crossing project (LTC) outputs that support the benefits identified in the Economic Case, within the financial constraints identified in the Financial Case and to the programme set out in the Management Case. It sets out our strategy for:
- a. attracting the best contractors in the market by offering well-structured and commercially balanced contracts
 - b. creating competitive tension through well designed procurement processes that encourage bidders to present high quality submissions, which are keenly priced
 - c. delivering the right outputs to generate the outcomes and benefits set out in this business case by specifying our requirements well
 - d. encouraging contractors to perform above benchmark standards in the areas that benefit our business and/or stakeholders
 - e. building delivery confidence through transparent risk management and commercial alignment to delivery within our budget and schedule commitments.
- 1.1.2 The Commercial Case also confirms we will procure LTC in accordance with the Public Contract Regulations 2015 (PCR 2015) and EU principles of transparency, equal treatment, and non-discrimination to minimise the risk of any legal challenge to the procurement process succeeding.
- 1.1.3 The management arrangements for delivering this Commercial Case are addressed in the Management Case.
- 1.1.4 The Commercial Case has been developed in accordance with Her Majesty's Treasury (HMT) and Department for Transport (DfT) guidance and has been subject to independent legal and commercial assurance review.
- 1.1.5 The key features of the approach outlined in the Commercial Case reflect feedback received from potential suppliers through a programme of market engagement events. This programme is described in Section 4 Market Engagement.

1.2 Summary

- 1.2.1 The works required to deliver the Lower Thames Crossing have been split into Early Works and Main Works.
- 1.2.2 The Early Works packages are required to facilitate delivery within the project timetable set out in the Management Case and will enable the earliest practicable commencement of the Main Works packages.

Early Works

- 1.2.3 The Early Works comprise relatively small but programme critical packages including:
- a. surveys to provide improved site and geotechnical data to inform the design and planning of utilities diversions, protected species translocations and future archaeological investigation
 - b. archaeology
 - c. habitat creation and protected species translocation
 - d. site establishment
 - e. provision of utilities connections to site

Main Works

- 1.2.4 The Main Works required for LTC have been split into the following three packages, aligned logically with the type of work required:
- a. Roads North (circa £1,107m)
 - b. Tunnels and Approaches (circa £1,760m)
 - c. the A2/M2 Connections (circa £442m)
- 1.2.5 The Tunnels and Approaches package includes the responsibility for the end-to-end control system engineering sits in this package. As the package is principally offline highway works with no junction, we anticipate that this will make it attractive to specialist tunnelling contractors. Strong interest from specialists is particularly important given the technical challenges posed by constructing two of the largest diameter bored tunnels in the world.
- 1.2.6 The two road packages (Roads North and A2/M2 Connections) are generating interest from a wider range of general contractors. This will increase interest and competition between competent firms. Splitting LTC into three separate contracts reduces our reliance on a single entity while maintaining sufficient package size to attract interest from the biggest contractors.
- 1.2.7 The transport and other benefits that underpin the Economic Case will result directly from the availability of the additional network capacity and connections provided by the crossing. The capacity and connections will be fixed before the start of procurement. Minimum availability requirements will be included in the draft contractual specifications used for procurement. However, bidders will improve their scores in evaluation if they can evidence higher levels of availability through their proposals. We are also driving a high level of availability with a Design Management Strategy which sets out which assets will be specified on a performance basis and which will be specified by standards that we know achieve or exceed the required performance.
- 1.2.8 Contractors will be subject to a performance management regime to incentivise compliance with contractual obligations throughout the term of the contracts.

- 1.2.9 The dominant feature of LTC is its scale and complexity relative to the rest of our portfolio. In response to this, our commercial and procurement approach has been developed to secure confidence in delivery within our budget and programme as early as possible.
- 1.2.10 The Tunnels and Approaches package will be procured using the Competitive Dialogue (CD) procedure, as set out in Section 6.5. Bidders will be provided with a reference design and our associated cost, schedule, and risk model at the start of the CD. The risk quota will be proposed at the start of dialogue. This represents the financial provision to address the delivery risks associated with the contract, regardless of traditional allocation. Dialogue will focus on the areas of most significant method related risk and opportunity. Bidders will be required to submit their tenders, including their design, cost estimate, schedule, evidencing any betterment against our benchmark. Evaluation will be weighted to reward bidders who can evidence the most deliverable proposal and therefore greatest certainty of delivering value within our Target Budget and handover date. The winning bidder's forecast of defined cost and fee will be added to the risk quota to form a Target Budget that the contract must be delivered within.
- 1.2.11 The A2/M2 Connections package will be procured as a two-stage contract, using the Competitive Procedure with Negotiation (CPN). The package is dominated by its complex junction with a busy part of the network which will be constructed in a major utilities corridor with significant environmental constraints from the Kent Downs Area of Outstanding Natural Beauty (AONB) and areas of natural woodland.
- 1.2.12 The key to successful delivery of the A2/M2 package lies in traffic management and utility diversion work. This means it is preferable to get the construction partner on board at an earlier stage in the process (than is possible under CD) to reduce risk by undertaking critical planning, design, and utilities consenting. The approach delivers value by maturing the methodology, phasing and design in order to reduce risk, before reaching a final agreement on the cost of delivering the package. The extent of the third party interfaces on this package mean that this is not possible during a procurement process and must be carried out in Stage 1 of the contract.
- 1.2.13 Recent market feedback suggests that interest in A2/M2 has grown since the adoption of a two-stage contract and that appetite for Roads North as a single stage contract procured through CD has declined to the point where we cannot be confident in securing three bidders. We are therefore moving to a two-stage contract for Roads North using a CPN.
- 1.2.14 The key to successful delivery of Roads North is planning around the delivery of the complex box under tunnel at the M25, the design of the Mardyke aqueduct for productivity and the overall earthworks balancing strategy. The approach for the two-stage contract will be finally tested with the market on August]
- 1.2.15 The Main Works contracts will be based on the NEC4 ECC form of contract. The terms will encourage delivery within the Target Budget and before the handover date. Compensation events will be restricted to a limited number of defined risks and the fee will be fixed at contract award. To secure profit greater than that included in the fee, contractors will have to mitigate risk and secure opportunities to avoid spending the risk quota and complete the contract within

the Target Budget. Should costs exceed the Target Budget, contractors will be liable for a share of the cost overrun, up to a proportion of the fee. The incentive model for the A2/M2 connections and Roads North packages will be developed to align as closely as practicable with the other main works packages.

- 1.2.16 Early completion would reduce contractors time related costs, contributing to savings against the Target Budget. A further incentive payment will be available if all contracts complete ahead of LTC's committed road opening date.
- 1.2.17 In addition, there are two key services packages to be procured. These are:
- a. Integration Partner
 - b. Road user charging

Integration Partner

- 1.2.18 The Integration Partner is a client-side role and this organisation will support us throughout the Delivery Phase of LTC. Their scope will include:
- a. provision of management capability and capacity to ensure that we deliver on our obligations in contract and under our consents
 - b. supporting us in our role as the integrator, managing cross package interfaces, identifying risk and opportunity at the interfaces, and resolving issues to maintain progress
 - c. supporting our focus on a high availability asset via quality management, assurance, system integration and testing and commissioning and the handover to the Operations Directorate at the end of the project.
- 1.2.19 The scope of the Integration Partner services and our approach to the procurement of the Integration Partner is presented in detail in the Integration Partner Acquisition Strategy – an Annex to the Commercial and Procurement Strategy (see Appendix C).

Road user charging systems

- 1.2.20 The road user charging systems will be procured through the road user charging service provider. This aligns with the Dartford Charge which is currently being reviewed. The same provider for the road user charging system will be used on LTC as used on the Dartford Charge.

2 Packaging to promote competition

2.1 Introduction

- 2.1.1 Our market engagement has confirmed that LTC is too large to procure competitively through a single contract. We have therefore split it into appropriately sized packages. This section explains the packaging strategy, how we will manage the interfaces between the packages during the construction phases and how we will integrate the separate packages into a single asset ready to be integrated into the strategic road network.
- 2.1.2 The approach to packaging was partially reappraised following the decision not to utilise the PF2 financing model. This allowed the tunnel package to be expanded to incorporate the immediate approach roads (but no junctions), simplifying the logistics and physical interfaces.

2.2 The packaging approach

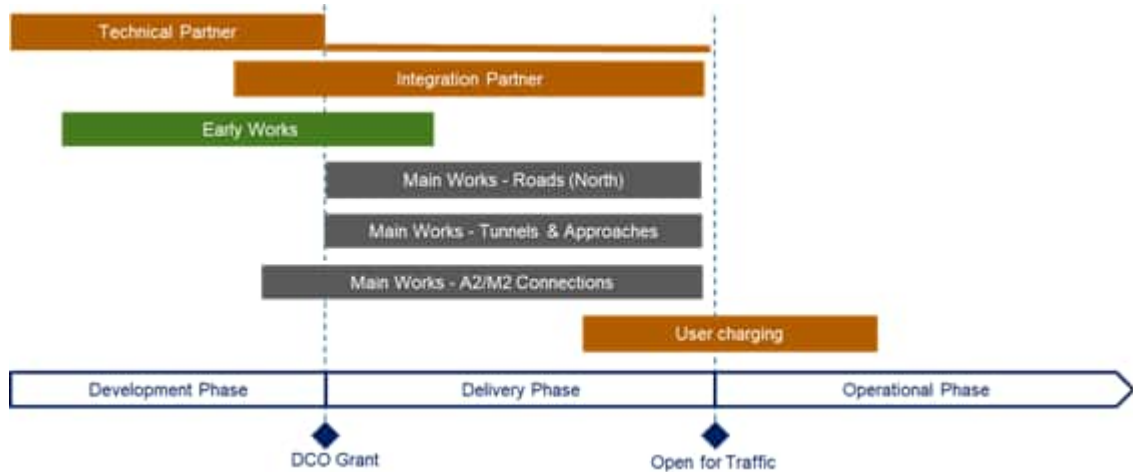
- 2.2.1 The key works and services packages to be delivered by LTC are set out in Table 2.1.

Table 2.1 Key packages

Name	Approximate Value (£mn)	Description
Early Works	123	Several small packages including surveys (to provide improved site and geotechnical data to inform the design and the planning of utilities works, protected species translocations and heritage protection) archaeology, protected species, and site establishment.
Main Works - Roads North	1107	Section from the M25 to Tilbury Loop railway line
Main Works - Tunnels and Approaches	1760	Section from Tilbury Loop railway line to Thong Lane
Main Works - A2/M2 Connections	442	A2/M2 junction connections from Thong Lane
Technical Partner	290	DCO, technical, commercial and procurement, project management and other tasks
Integration Partner	202	Project and programme management throughout the Delivery Phase
User charging	28	Operational phase contract
NB: the contract value figures are stated as outturn costs. See Financial Case for further details of these estimates.		

- 2.2.2 Responsibility for operational control and maintenance of the road is likely to be discharged through the Area 4 Asset Delivery (AD) contracts, following handover to the Operations Directorate. Our Operations Directorate is also developing a Strategic Tunnel Operating Model (STOM) to provide a regional Tunnel Control Management System (TCMS) capable of operating numerous tunnels from a single system as well as a new operating model for all our current and new tunnels including those delivered by LTC.
- 2.2.3 The packages and the high-level chronological relationship between the delivery of the packages, grant of the Development Consent Order (DCO), and achieving the Open for Traffic (OfT) commitment are illustrated in Figure 2.1 below.

Figure 2.1 Package diagram



2.3 Rationale for works packaging strategy

- 2.3.1 The key drivers of the proposed packaging approach are:

Market appeal

- 2.3.2 The geographical split between the Main Works packages provides a good alignment of work type. It is anticipated that the Tunnels and Approaches package will be attractive to tunnelling specialists who may have had less appetite for the package, had any of the complex junctions been included within it. The A2/M2 connections package is focussed on the road construction without the significant cutting running down to the tunnel portal. Based on market engagement to date, it is anticipated that the Tunnels and Approaches package will attract significant interest from international contractors including new entrants to the UK. The A2/M2 Connections package is likely to be attractive to both UK and international contractors. Market engagement has shown that both packages are likely to have enough bidders to promote a competitive procurement process (see Section 4).
- 2.3.3 The Roads North package has attracted less interest to date. The cost of bidding such a large package, together with a market expectation that the consortium currently delivering the A14 project would compete strongly led to weaker initial interest. The relative attractiveness of a 2-stage contract for A2/M2 has resulted in a further decline of interest in Roads North. We have

considered splitting the package, but this would create an earthworks imbalance, add significant complexity to the interfaces and require changes to the DCO to support a new logistics plan. We will now adopt a 2-stage contracting approach (see Section 10.2) and will finally test market acceptability of this in August 2020.

Scale and concentration risk

- 2.3.4 There is limited market appetite for a single package of c£6.7bn. A package of such high value would be prohibitively big for the market and would introduce an unacceptable concentration risk. It could also attract a significant risk premium or fail to attract sufficient bidders. The contract management of smaller JVs, as opposed to one super JV was considered less risky and potentially less challenging.

Construction logistics and interface

- 2.3.5 The package boundaries have been defined to allow each contractor independent logistics access to their own sites from the existing road network. The design interfaces have also been minimised by selecting natural boundaries in construction methodology, e.g. the design of the temporary and permanent works required to get in and out of the tunnel is included within the Tunnels and Approaches package. In addition, the whole of the deep cutting to the south of the tunnel is included in this package.

Customer

- 2.3.6 The A2/M2 junction is the most critical interface with the existing operational road network. There are extensive online works here with many phases of traffic management (the M25 and A13 junctions have much more opportunity for offline construction). Separating out the A2/M2 connections as a stand-alone package provides focus on our customers and protecting the existing operation of the strategic road network and local roads. The route-wide technology package provides a coherent control concept, operational and customer experience.

Programme

- 2.3.7 The Early Works will secure the earliest possible start on site and reduces risk to the Main Works packages by allowing archaeology, site establishment and environmental work to be undertaken before the Main Works contractors mobilising to site.

3 Procurement programme

3.1 Introduction

3.1.1 This section explains the relationship between the procurement programme and the overall project programme. It focusses on how our procurement approach has been shaped by the constraints of our publicly committed Open for Traffic date and how we are responding to the risks that creates.

3.2 Procurement timetable

3.2.1 Following issue of a combined Prior Information Notice (PIN) in December 2017 (see paragraph 4.2.1 below), we issued a new PIN on 1 February 2019 and are currently in a period of market engagement, before the launch of our procurement process.

3.2.2 We commenced procurement for an Integration Partner in July 2020 and aim to award the contract by December 2020. Once mobilised, the Integration Partner will primarily be focussed on preparing for delivery. This includes consent discharge post DCO; main contract mobilisation; developing the programme and project management environment; design and planning for utilities and other early works; and preparing for the move to site. The current Technical Partner will continue to support us with responding to the DCO examination and with the technical aspects of the Main Works procurements.

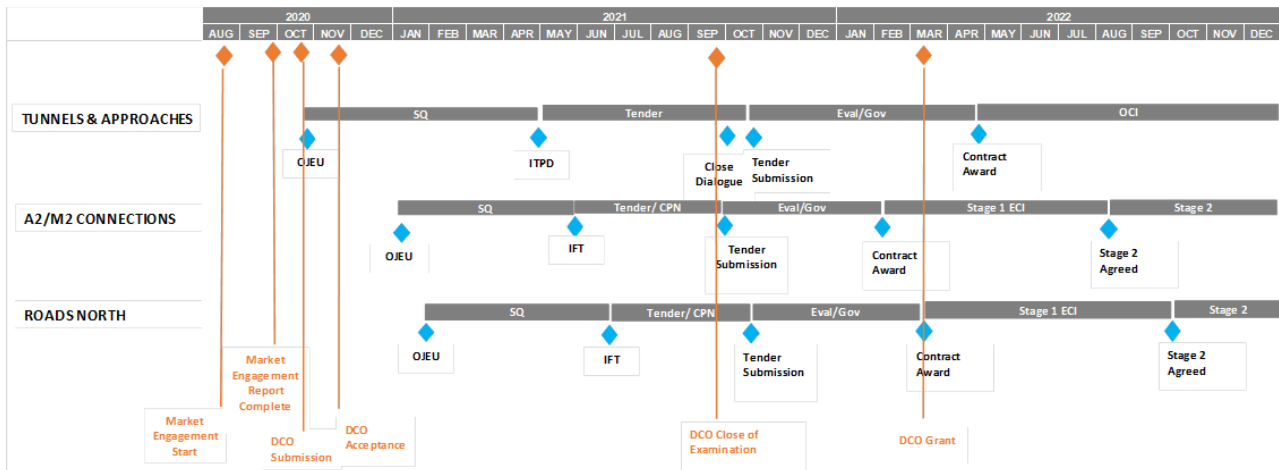
3.2.3 We have allowed circa 18 months for procurement of the Tunnel and Approaches package being procured under Competitive Dialogue, i.e. from contract notice to contract award. This is consistent with other significant public procurements that have used or are using the same procedure, including A303 Amesbury to Berwick Down (Stonehenge).

3.2.4 Where a two-stage design and build contract, strategy is adopted (A2/M2 Connections and Roads North), the procurement process will take circa 12 months depending on the extent of any negotiation. Stage 1 of the contract will then be between 6 and 12 months. The principal aim of Stage 1 is to mature the delivery plan and reduce risk so that the cost incentivisation target for the contract can be confidently finalised at an ambitious level. The contractor will work on the detailed design, securing consent, mobilisation, design and planning for utilities diversions and the construction phasing during Stage 1.

3.2.5 We are currently undertaking a review of the procurement timeline following the update to the commercial approach on Roads North. Our best-case date is targeted for end of November [give year] and the feedback from the final market engagement ending in September 2020 is critical to support this.

3.2.6 Our long stop date is February 2021 which still allows us to maintain programme without impacting critical path.

Figure 3.1 Scheduled durations of Main Works procurement processes



3.2.7 The Tunnels and Approaches contract has a 9 to 10-month mobilisation (or Optimised Contractor Involvement) phase between contract award and a “Ready for Construction” (RfC) milestone. Similar to the A303 Amesbury to Berwick Down (Stonehenge) project, this is a post-contract phase which is not part of the procurement but is designed to further increase confidence in contractors’ plans before significant physical works starting on site.

3.3 Delivering procurement in parallel to DCO

- 3.3.1 The DCO submission provides sufficient scope certainty on when to start procurement and we plan to place our contract notices as soon as possible after the DCO submission.
- 3.3.2 It is common in infrastructure mega-projects for procurement to overlap the consenting process. This has been our approach for the A303 Amesbury to Berwick Down (Stonehenge), however there is much greater overlap proposed here, in order to maximise the time available to our contractors.
- 3.3.3 Where we adopt a two-stage contract for A2/M2 and Roads North), contract award is planned towards the end of DCO Examination. If the DCO Examination has resulted in substantive changes, we could extend the procurement with a negotiation stage, before final tender and a contract award 8-12 weeks later.
- 3.3.4 Where we use the CD procedure to secure a single-stage contract for Tunnels and Approaches, the dialogue period is planned to close after close of DCO Examination. This means that bidders will understand any concessions that we may have made through the DCO Examination process before finalising and submitting their tenders.
- 3.3.5 It is unlikely that the consenting process will result in significant changes to the scheme itself, but different conditions could be introduced by the Planning Inspectorate or the Secretary of State that impact the way in which it is delivered, e.g. working hours or environmental mitigations. If these changes are required after Examination, they would need to be addressed post-contract.
- 3.3.6 There are residual risks with running the procurements in parallel to the DCO process:

- a. Resource intensity required to simultaneously support three major procurements and the consenting process is significant.
- b. Commercial and procurement risk due to changes introduced between the close of DCO Examination and DCO grant.
- c. Delays to the DCO process will impact procurement.

3.3.7 We believe that these risks can be managed, and we are developing our plans accordingly. No significant concerns have been raised in market engagement to date, relating to the relative timing of DCO and procurement.

3.4 Early Works packages

3.4.1 Some of the Early Works packages are either already let or in procurement. These are relatively low value packages, primarily intended to secure better information on the site to inform our other procurements and the DCO.

3.4.2 The Early Works packages are predominantly being delivered through frameworks or by statutory undertakers. There is very limited opportunity to commence work on site ahead of the DCO being granted. However, design, procurement, planning and land acquisition will be started, together with some reversible work, e.g. habitat creation. The award and subsequent mobilisation of the Integration Partner at the end of 2020 provides us with the necessary management capacity to support Early Works a year ahead of DCO for this preparation. Where a two-stage Main Works contract is adopted, this creates the opportunity for the Main Works contractor to deliver a greater proportion of Early Works.

3.4.3 We will draft a Final Business Case (FBC), based on the Target Budgets that we set for our contracts and the OfT date. Tender submissions will be received in autumn 2021 and, after a full evaluation, a recommendation to award report will then be put forward for governance approval.

3.4.4 A period of 2 months has been allowed for governance between the end of tender evaluation and before contract award. FBC approval is planned, before Contract Award for single stage contracts and before Notice to Proceed for two-stage contracts.

4 Market engagement

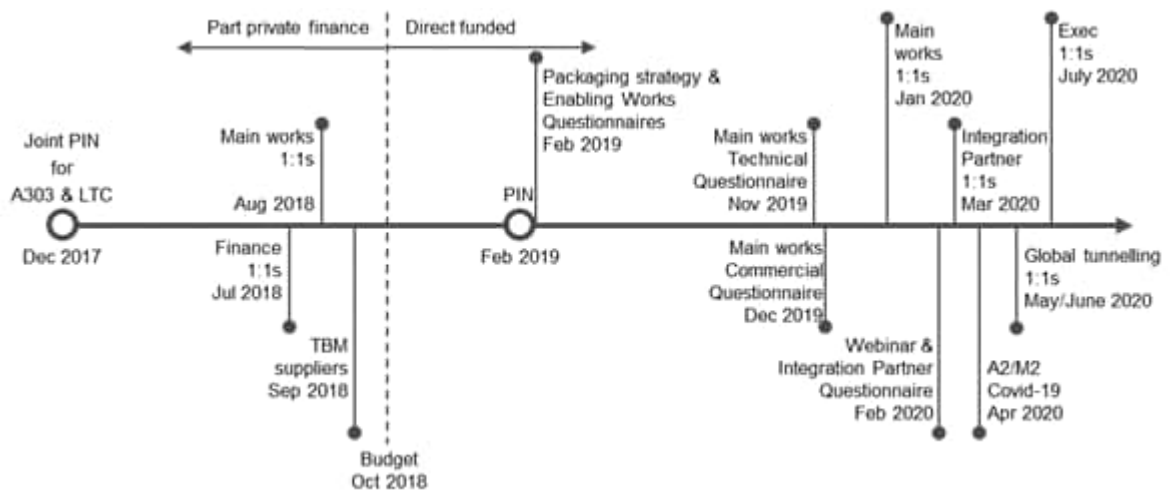
4.1 Introduction

- 4.1.1 Our market engagement strategy is designed to:
- stimulate interest in the market for our contracts
 - test our commercial and procurement approach
 - mobilise and prepare participants ahead of contract notices being raised.
- 4.1.2 This section explains our timetable for market engagement activities and our current assessment of the market response.

4.2 Market engagement history

- 4.2.1 We first issued a combined Prior Information Notice (PIN) for both the A303 Amesbury to Berwick Down (Stonehenge) project and the Lower Thames Crossing project in December 2017¹. Engagement was paused, as the strategy was revised, following the decision not to pursue PF2 in October 2018. It was reinvigorated with a new programme of engagement, starting in the autumn of 2019.
- 4.2.2 We use a range of media to engage, including supplier engagement events; information packs with written questionnaires; 1:1 meetings; webinars; pre-tender launch events; and LTC website. The significant events to date are illustrated in the Figure 4.1 below.

Figure 4.1 Market engagement history



4.3 Global interest

- 4.3.1 We have had a good level of response to our market engagement activities on both Main Works and Integration Partner. They have provided us with valuable feedback as we develop our approach.

¹ A new PIN was issued in February 2019 following the decision not to utilise private financing for the project.

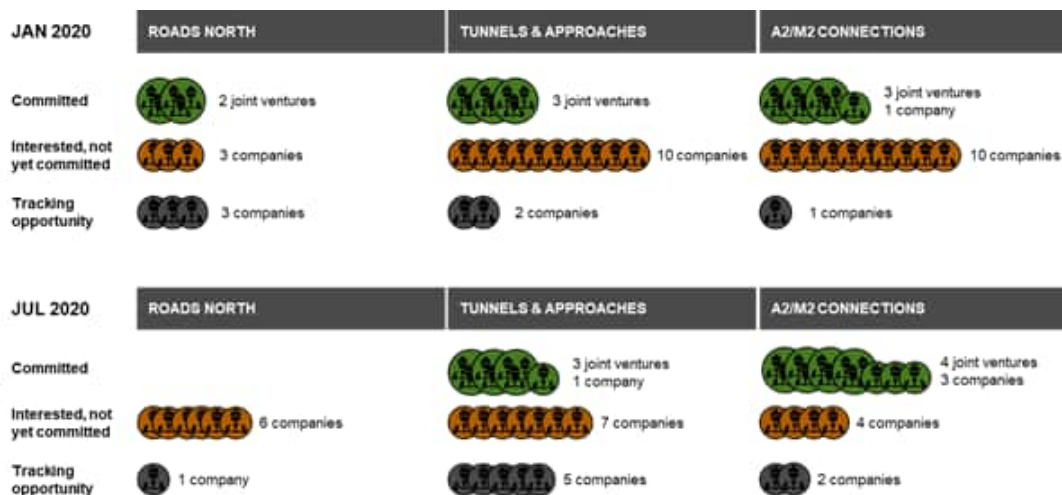
- 4.3.2 There is significant interest in main works from the UK and the EU with most of the major construction companies represented. This includes four European companies that are not currently well established in the UK.
- 4.3.3 The scope of the Tunnels and Approaches package is more specialized, and we have sought to encourage participation by firms based in East Asia where much of the global experience in large diameter bored tunnels has been gained.
- 4.3.4 A targeted approach was developed for reaching this market. Plans were well advanced for a series of meetings in Singapore with 10 large companies from that region, in addition to a knowledge sharing event with the Singapore Land Transport Authority and a presentation to the Tunnelling and Underground Construction Society of Singapore (TUCSS).
- 4.3.5 The emergence of Covid-19 in the region led to the imposition of travel restrictions and the cancellation of these events. We conducted Exec level 1:1s by video-conference instead. Feedback to date suggests that these companies remain interested but are concerned that they will be unable to establish a supply chain in the UK while Covid-19 related restrictions remain. We have offered them support in looking for JV partners and with arrangements for travel to the UK.

4.4 Market feedback and analysis

Market landscape summary

- 4.4.1 Interest in the Tunnels and Approaches contract has remained strong though there have been shifts in the joint venture groupings over the last six months. There is very strong interest in a two-stage A2/M2 contract but interest in Roads North has declined to a critical level. This is presented in more detail in the Roads Packages section below.

Figure 4.2 Market landscape January 2020 and July 2020



- 4.4.2 There still appears to be some fluidity in the market with a number of potential bidders still speaking to several potential partners. When we polled bidders in April about Covid-19, they identified practical rather than strategic issues, particularly potential challenges with meeting joint venture partners, travel and timescales for responding to procurement. Our assessment is that it is now

having an impact, accelerating an existing trend towards a more conservative approach both to bidding and to the contract terms that bidders are prepared to enter into.

Packaging strategy

4.4.3 Potential participants strongly supported the proposed packaging approach when this was tested in early 2019 and confirmed that:

- a. the scale of the packages was manageable for participants
- a. the alignment of packages to the different expertise required was attractive to the market.

4.4.4 All the packages attracted interest at that stage with most respondents expressing interest in bidding for more than one package.

Tunnels and Approaches package

4.4.5 We anticipate that there may be several other UK tunnelling projects being procured and/or delivered concurrently with the Lower Thames Crossing. These include:

- b. HS2 Phase 1 Main Works Civils Contracts
- a. Thames Tideway Tunnel – Main Works
- b. Silvertown Tunnel
- c. A303 Stonehenge²

4.4.6 Tunnelling capability in the UK has developed significantly in recent years³ in response to this pipeline and predecessors such as Crossrail. However, there is little or no UK experience of boring large-diameter tunnels at the hydrostatic pressure that we expect to encounter below the Thames Estuary. Indeed, there are relatively few companies in the world with the technical and financial capability to deliver the Tunnels and Approaches package. These companies will see the Lower Thames Crossing as one of several similar opportunities around the world when considering whether to bid. Our market engagement activities for this package are being developed to reach this global contracting market.

4.4.7 Interest in this package is predominantly from European contractors, many with global tunnelling experience. The technical challenges associated with delivering a large bore tunnel at the hydrostatic pressures anticipated under the Thames Estuary were recognised but respondents were confident that these were comparable to other tunnels delivered globally. This view was also supported by TBM suppliers who have taken up our offer of a 1:1 to discuss LTC.

² Our strategy is to maintain a c12 month gap between the OJEU for the A303 Amesbury to Berwick Down (Stonehenge) Project and the OJEU for the Main Work packages for the Lower Thames Crossing.

³ Through projects including Crossrail, Thames Tideway Tunnel, the Lee Tunnel, National Grid Gas, Northern Line extension and the London Power Tunnels.

Tunnel Boring Machines

- 4.4.8 The Tunnel Boring Machines (TBMs) will be procured by the Tunnels and Approaches contractor. There is currently no schedule or other advantage to procuring them separately. However, the TBMs are a critical resource and we have investigated this aspect of the tunnelling market specifically.
- 4.4.9 There are only a few suppliers in the world able to meet the requirements of LTC. This includes a small number of European suppliers, which traditionally serve the UK and European markets, and a few Asian (principally Chinese and Japanese) manufacturers who would be keen to supply the TBMs, particularly where an Asian contractor is part of the winning consortium.
- 4.4.10 We have had one-to-one engagement with several TBM suppliers which has shown us that although the TBM market is small, there are enough potential participants to allow a competitive process. We only require two TBMs which is not significant relative to global manufacturing, support, and servicing capacity. TBMs of this scale are likely to be manufactured in a facility developed for the purpose so the production line constraints that can impact the procurement of smaller TBMs may not be so significant for LTC.

Roads packages

- 4.4.11 The change from private to public financing for the roads packages shifted the market landscape, with much greater interest from UK contractors but reduced interest from international players who had been attracted to bidding the privately financed roads packages as an entry route to the UK.
- 4.4.12 There was a further shift in interest towards the A2/M2 Connections package between the packaging questionnaire in February 2019 and the 1:1s in February 2020. This was in part due to a market expectation that the consortium currently delivering the A14 project would compete strongly for Roads North. That consortium also tied up three strong UK highways contractors, reducing the joint venture opportunities for EU and international bidders.
- 4.4.13 The adoption of a 2-stage contract for A2/M2 has further increased the attractiveness of this package, relative to Roads North. We have completed a further round of market engagement and targeted the engagement at Roads North due to a recognised weakness in market. Through this engagement we identified several causal factors that have driven the proposed change in our commercial approach. These factors are:
- a. The market had assumed that as the A14 Integrated Delivery Team (Costain, Skanska, Balfour Beatty) were bidding for Roads North, even with a fair competition, their chances of a successful bid were low. It has since been confirmed that the A14 will not bid as a Joint Venture (JV) nor that BB will JV with Skanska.
 - b. The impact of Covid-19 has changed the sector by draining businesses of cash reserves and increasing boardroom concern as to the risk of partner failures. This has:

- i. strengthened resistance to the cost of a single stage tender Design and Build (D&B) procurement
 - ii. initiated a reluctance from financially strong organisations to form JVs as these require cash to be retained within the JV until all parties agree to its release, while retaining cash to be held as an insurance of partner failure. Some corporate accounting rules don't allow recognition of this cash holding in JVs.
 - iii. boardrooms want to use cash in the business to sustain the business and look for lower risk contracts to invest in.
- c. In an industry landscape of competing projects, the HS2 MWCC "recovery deal" has changed the traditional contracting landscape for the near to medium term and is seen by the market as a better, almost risk-free approach to contracting in the current market.
 - d. Market engagement exercise concluded that without a change in procurement strategy there would not be a competition and may not even have a single bidder. We have concluded that a 2-stage contract, aligned to the A2/M2 approach is our preferred option, given our schedule constraints.

Commercial approach

- 4.4.14 The intent of the commercial model was broadly supported. Common discussion points included:
- a. pain cap at profit was considered essential by some, preferable by others
 - b. limit of liability at the greater of 25% Target Budget or £100m was accepted
 - c. fixed fee likely to result in higher tendered fee levels to provide recovery on any unexpected works
 - d. support for early declaration of a designer as a key sub-contractor but not for other sub-contractors as this would reduce competitive tension in the supply chain
 - e. request for clear and targeted OCI with a defined end date
 - f. strategic risk events and the treatment of change in law (including Brexit); inflation and forex; ground conditions; non-insurable, high impact, low probability events; impact of the DCO as granted
 - g. understanding the likely quantum and basis of the Risk Quota pre-OJEU was seen as key to assessing the attractiveness of the contract
- 4.4.15 The detail of the commercial approach will be tested in our final round of market engagement in August and September 2020.

Procurement approach

- 4.4.16 The CD procedure was felt to be appropriate for Tunnels and Approaches and Roads North, though cost of bidding was raised as a concern by many participants and appears to be significant factor in the loss of appetite for Roads North. Common areas of discussion included:
- a. use of a qualitative component in the commercial evaluation was supported
 - b. quantitative evaluation of the risk quota could create a “race to the bottom”
 - c. a fee collar may prevent gaming of this element of the bid
 - d. dialogue should be targeted to keep bid costs down
 - e. bid cost recovery/stipend to bidders
- 4.4.17 The adoption of a two-stage contract with a relatively short and inexpensive procurement procedure for A2/M2 was welcomed by the market.

Integration Partner

- 4.4.18 We conducted a separate programme of market engagement for the Integration Partner contract. There was strong interest in the contract from organisations including large professional services firms, engineering, project and programme management consultancies and construction companies. It is likely that several bidders will form joint ventures or use key sub-consultants in order to provide the full spectrum of services. There has been both UK and international interest.

4.5 Further engagement

- 4.5.1 We have a final round of Main Works market engagement planned for August and September 2020. This is intended to:
- a. update the market on the changes we have made in response to what we have heard from them
 - b. provide more detail on the proposed financial tests, commercial arrangements and our view of the cost and schedule to deliver the scheme.
- 4.5.2 A change to a two-stage approach for Roads North will require consideration of the following:
- a. Additional market engagement during August and September 2020. It is to be recognised that no bidders currently have agreement in principle to tender for the northern contract. Any proposed JV arrangements are not as developed as they would normally expect to be at this stage.
 - b. Before formal detailed market engagement is undertaken it is proposed that an additional round of executive 1:1s is undertaken to “warm” the market at the earliest opportunity and that ongoing Executive level support will be needed.

- c. The detailed market engagement and OJEU are likely to need to be delayed to enable the market to engage effectively and to bring the desired competition. However, the shorter duration for the two-stage approach should enable an Integration Partner to be engaged in enabling works no later than a CD process despite the delayed OJEU.
- d. The contract should be as standard as possible and recognisable as a Highways England contract. There is opportunity to standardise across contracts to reduce cost of entry. Supplier Qualification and other contract, commercial elements should be common across the A2/M2 contracts and reuse other Highways England contracts where possible.

5 Specifying to secure the benefits

5.1 Introduction

5.1.1 This section explains how the benefits set out in the Strategic and Economic Cases have informed our approach to specifying our requirements to the supply chain.

5.2 Connectivity and connections

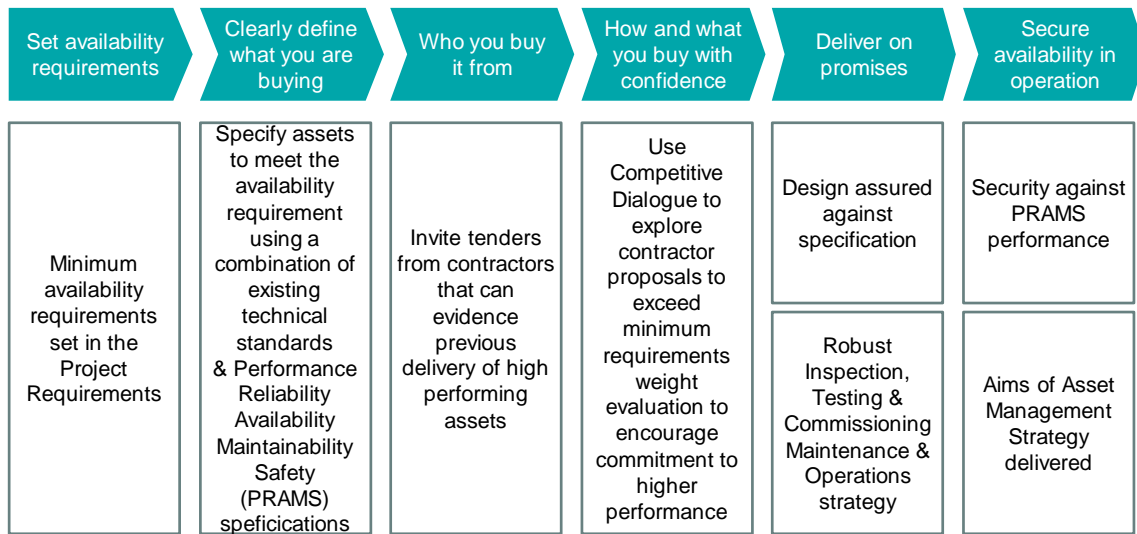
5.2.1 The transport and other benefits that underpin the Economic Case for LTC are driven by the capacity and connections provided by the new route and by its availability once in operation. The capacity and connections will be fixed before going to market and are defined by the core scope of the scheme:

- a. two 2.5 mile (4.25 km) tunnels, one for southbound traffic, one for northbound traffic providing new capacity crossing the Thames Estuary
- b. approximately 14.5 miles (23km) of new roads connecting the tunnels to the existing road network
- c. mainly three lanes in both directions with variable speed limits
- d. free-flow connections to M25, A2/M2 and A13/A1089
- e. a free-flow charging system, where drivers do not need to stop but pay remotely, similar to the Dartford Crossing
- f. new structures and changes to existing ones (including bridges, buildings, tunnel entrances, viaducts, and utilities such as electricity pylons) along the length of the new road

5.3 Availability

5.3.1 The minimum availability requirement for the new road is fixed in the Project Requirements. See Figure 5.1

Figure 5.1 Availability requirements



- 5.3.2 Our Design Management Strategy⁴ sets out how every asset type will be specified. In general, we will use Performance, Reliability, Availability, Maintainability, Safety (PRAMS) specification where we see significant opportunity for contractor optimisation (e.g. pavements) or where we have less experience (e.g. tunnel systems). Where we already have a deep understanding of the relationship between lane availability and asset design, we will use our existing technical specifications.
- 5.3.3 We will use the procurement process to seek commitment from contractors to outperform the minimum availability requirement. The Selection Questionnaire will identify bidders that can evidence previous delivery of high performing assets.
- 5.3.4 Bidders will receive higher scores in evaluation if they can provide specific proposals to deliver better value through higher levels of availability and are prepared to commit to these as part of their bid.
- 5.3.5 Through design, construction and commissioning, the assets will be assured against their specification. Our contracts will require security against the attainment of the specified PRAMS performance once in operation.

5.4 Balanced scorecard

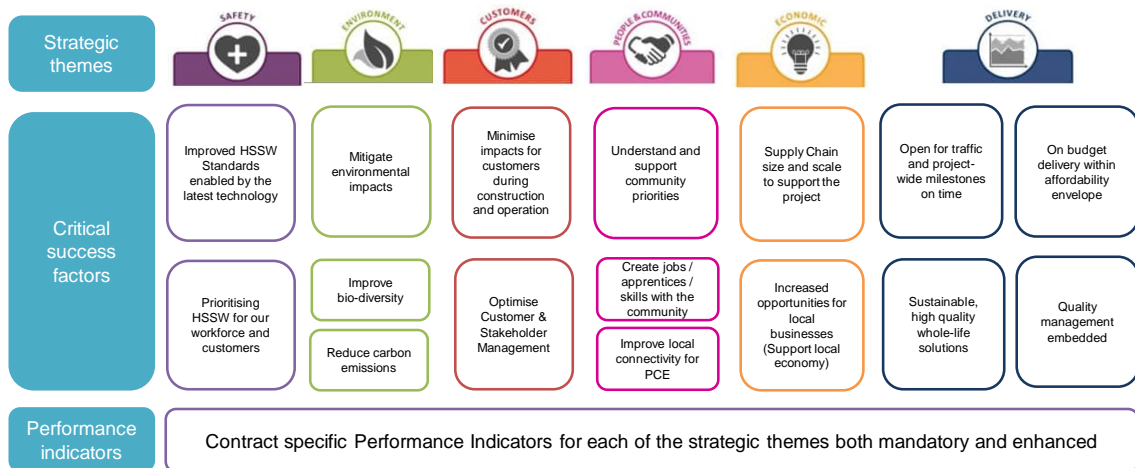
- 5.4.1 The broader benefits that we are targeting through delivery of LTC are represented in our balanced scorecard. It has been developed in accordance with Crown Commercial Services (CCS) guidance⁵ and will ensure that we communicate consistently to our supply chain about what is valuable to us starting at market engagement, through procurement and contract delivery.
- 5.4.2 The Critical Success Factors (CSFs) are summarised in Figure 5.2 categorised by the Strategic Themes identified in the LTC’s Vision and Strategic Goals:

⁴ HE540039-CJV-GEN-GEN-STRPRO-00030

⁵

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/560246/Balanced_Scorecard_PPN_09_16.pdf

Figure 5.2 The critical success factors



5.4.3

The minimum performance level required against each area of the scorecard will be fixed for each of our contracts. Where there is opportunity for contractors to differentiate themselves significantly by exceeding the minimum standard, this will be rewarded during tender evaluation and the new level of commitment secured at contract award. An incentivised performance management regime will operate to drive compliance with contractual obligations throughout the term of the contract.

6 Enhancing value through procurement

6.1 Introduction

- 6.1.1 This section sets out how our procurements are being designed to progressively build confidence in delivery within our budget and schedule commitments while seeking greater value where there are good opportunities to do so.
- 6.1.2 The balance of these elements is different for every scheme. The A303 Amesbury to Berwick Down (Stonehenge) project for example is dominated by its location within a World Heritage Site. This means that the sensitivity of contractors' designs and methodology could significantly enhance the scheme and the procurement and evaluation approach reflects this. The dominant feature of LTC is its scale and complexity relative to the rest of our portfolio. Our procurement and evaluation approach for LTC is therefore more focused on cost and programme certainty than enhanced value.

6.2 Route to market

- 6.2.1 The nature of work required for the Tunnels and Approaches package is outside the scope of our existing frameworks. Our frameworks were considered for the two roads packages. However, the combined value of the packages would breach the framework threshold. The Regional Delivery Partner (RDP) incentive mechanism is also designed for a single package structure with a multi project pipeline of work and assumes that contractors will be engaged early in the development of a project, ahead of DCO. Use of RDP has therefore been discounted. All three main contracts will be procured through new procurements under the Public Contracts Regulations 2015 (PCR).

6.3 Choice of procedure

- 6.3.1 The PCR offer three procedures appropriate for the Main Works Packages, i.e. the Restricted Procedure, Competitive Dialogue (CD) and Competitive Procedure with Negotiation (CPN).
- 6.3.2 We have applied the Crown Commercial Service's guidance in selecting our preferred procedure as summarised below.

Table 6.1 Preferred Procedure Selection

Package	Procurement procedure
Tunnels and Approaches	Competitive Dialogue
(D&B)	Competitive Procedure with Negotiation
Roads North	Competitive Procedure with Negotiation

Single stage contracts

- 6.3.3 We have selected CD for the Tunnels and Approaches single stage contract. This is because it allows us to:
- gain confidence that participants' developing proposals will meet our requirements, before tender. This includes the interfaces between contracts

- b. address areas of significant method related risk or uncertainty before tender
- c. seek proposals in targeted areas that offer greater value against our one of our critical success factors.

6.3.4 The use of the CD procedure also partly mitigates risk associated with the consenting process. If the DCO examination reveals areas of unexpected challenge, requiring significant concessions, we could choose to extend the dialogue phase to address this before tender. There is also potential to provide clarification of consenting constraints, even after tenders have been submitted, if this clarification is not material to the evaluation.

6.3.5 The contractor selection process under the CD procedure comprises three principal steps:

- a. selection of participants
- b. participation in CD
- c. tender evaluation

6.3.6 Use of the CD procedure is more resource intensive and carries greater risk of an administrative or procedural failure than a simple procedure (e.g. open or restricted). We recognise this and have started detailed planning including our governance and assurance approach, conflict of interest processes, resourcing, training, processes, and systems. We will also have the opportunity to benefit from learning from the A303 Amesbury to Berwick Down (Stonehenge) project, which is using the same procedure, a year ahead of LTC.

6.3.7 In line with lessons learnt from other projects such as HS2, Thames Tideway and from market engagement feedback, the procedures will be c12 months from the start of Selection Questionnaire (SQ) to tender submission, with 5 months allowed for tender evaluation. This duration offers a balance between effectiveness of the dialogue and the cost to bidders in terms of time and resource. It is important to get this balance right so that the project remains attractive to the market, particularly when some potential participants have indicated interest in more than one package.

Two-stage contracts

6.3.8 We have selected CPN for our two-stage contracts, A2/M2 and Roads North. This is because it allows, but does not commit, us to have discussions with bidders on topics such as:

- a. material changes to Contract Terms
- b. the definition of Strategic Risk Events (as proposed in the commercial model)
- c. potential for additional compensation events during Stage 1 of the contract, including accommodation of DCO changes if necessary.

- 6.3.9 It is more flexible than the Restricted Procedure but does not impose the same resource burden as the CD process. In conjunction with a two-stage contract, it offers:
- a. Earlier contract award allowing the construction partner to develop design and construction phasing in consultation with utilities and other third parties.
 - b. A reduction in overall procurement complexity and associated demand peaks for our team.
 - c. An opportunity for the construction partner to commence work sooner.

6.4 Selection of participants

- 6.4.1 Participants will be selected through the evaluation of their responses to a SQ for all main works contracts. This questionnaire will test applicants' capacity, capability, and proven track record in delivering projects of a similar nature, scale, and complexity.
- 6.4.2 Economic and financial standing tests will be included in the SQ to determine whether the prospective bidders have the appropriate level of financial capacity and balance sheet strength to deliver a project of this scale and complexity.

6.5 Competitive Dialogue (single stage contract)

- 6.5.1 We intend to issue an Invitation to Participate in Dialogue (ITPD) to three participants. This would provide sufficient competition without being excessively costly for us or for the market.
- 6.5.2 There will be no "down-select" during the dialogue stage, but we will seek interim submissions that allow us to understand developing proposals and to clarify areas of interface risk across the contracts.
- 6.5.3 We will provide participants with a data model for the scheme with the ITPD. This will comprise a three-dimensional model (BIM/GIS) and associated cost estimate, schedule, and risk assessment. This will provide a common reference point from which participants' proposals can be developed. It will aid understanding and transparency throughout the procurement process and into construction, with key project information being viewed in a consistent way by all parties. The risk quota and handover date for each contract will be specified in the ITPD, based on our data model.
- 6.5.4 The first part of each dialogue will focus on gaining confidence that participants' proposals will meet our requirements. We will explore aspects of the commercial model, the approach to risk and opportunity management and how participants propose to deliver the Performance, Reliability, Availability, Maintainability and Safety (PRAMS) specifications. We will also check for compatibility of participants' approaches at the interfaces between contracts.
- 6.5.5 We will then address some of the specific areas of method related risk and uncertainty.
- 6.5.6 The Tunnels and Approaches package features the most significant engineering challenges. The tunnel and portal design, methodology, boring machine specification and logistics are interrelated, and different options to achieve the

requirements are possible. The risk profile is significant and influenced by methodology as well as interpretation of data on ground conditions.

- 6.5.7 The results from the third phase of our ground investigation will be made available to all participants after ITPD. Dialogue may be necessary on the specific issues identified, or in respect of ground risk in general.
- 6.5.8 Participants' proposals will be presented as an update to the data model, so that cost savings due to design and method related innovation can be clearly evidenced and distinguished from a commercial position. Where participants offer proposals that do offer significantly greater value than set out in the requirements, these will be secured by either raising the relevant performance target in the balanced scorecard or by incorporating the proposal into the contract as contractor's scope.
- 6.5.9 We are developing our priority topics and approach to dialogue for each contract and these will be set out in the ITPD. Given market feedback about the cost of bidding through this procedure, we will also test appetite for a shorter dialogue, addressing critical areas only.

6.6 Competitive Procedure with Negotiation (two-stage contracts)

- 6.6.1 The SQ will be consistent with that used for CD but an Invitation for Tender (IfT) will be issued to three bidders, following SQ. Tenderers will be asked to provide an initial tender to include:
- a. Quality. A quality statement including design management plans and organisation. Stage 1 execution plan, including risk reduction and opportunity realisation plan. Programme for acceptance for Stage 1 of the contract and an outline programme, demonstrating compliance for Stage 2 of the contract.
 - b. Commercial. A price or target for Stage 1. Fee percentage for Stage 2. Rates for all items required by the scope and populated into our pricing model. A maximum risk profile.
- 6.6.2 If bids are compliant and the procurement remains aligned to the DCO and other procurements, bids will be evaluated and a recommendation to award prepared.
- 6.6.3 If there is a need to negotiate, the areas for negotiation will be confirmed to all bidders, structured negotiations will be held, followed by a request to submit final tenders.

6.7 Tender evaluation

- 6.7.1 Contracts will be awarded to the participant that has submitted the Most Economically Advantageous Tender (MEAT) as assessed by the Contracting Authority and as stated in the relevant tender documents.
- 6.7.2 The process will ensure that everything that is given value in evaluation is enforceable through the contract. This will include capturing certain tender

proposals as “contractor proposals” and incorporating these into the contractual scope.

- 6.7.3 Tender submissions will first be evaluated for compliance with our requirements. Bidders will identify how their tender submission meets these requirements and may be eliminated from the process if they fail to comply. Acceptance of the Target Budget will be one of the compliance tests.
- 6.7.4 A number of quality evaluations will be carried out. The key elements being:
- a. **Deliverability.** The confidence that the bidder can deliver the proposals contained within their submission, with the resources included in their data model.
 - b. **Risk.** Our commercial model is intended to focus our contractors on securing greater profit by avoiding risk during delivery of the contract. Participants’ risk management proposals will therefore be a key part of the quality evaluation.
 - c. **Targeted extra value.** The areas of targeted extra value against our balanced scorecard will be bespoke to each contract. An example of this would be a commitment to a higher level of network availability on the A2/M2 junction through optimising the construction method and phasing.
- 6.7.5 The commercial evaluation for a single stage contract will score bidders’ forecast of defined cost and fee on a quantitative basis. This will form the price evaluation. The tendered price will be added to the risk quota to form the Target Budget for the contract, against which the incentive mechanism will operate.
- 6.7.6 The commercial evaluation for a two-stage contract will score bidders’ price/target for Stage 1, fee percentage and item rates for Stage 2.

6.8 Combining price and quality

- 6.8.1 Our priority in the Main Works procurements is to secure sustainable proposals that increase our confidence in delivering LTC within our operational baseline commitments. Our evaluation will therefore be weighted to quality over price. The detailed weightings will be specific to each contract, including the relative weightings within the quality component.

7 Commercial alignment to secure delivery

7.1 Introduction

7.1.1 This section explains how our Main Works commercial model has been developed to secure delivery of LTC within our cost and schedule constraints. It responds to the productivity and collaboration challenges highlighted by the Farmer Review⁶ (and earlier Latham⁷ and Egan⁸ reports) by creating the conditions for collaboration to achieve common goals. This is through a simple incentive regime, overlaid on a collaborative form of contract well known to us and to the market.

7.2 Form of contract

7.2.1 We reviewed the standard forms of contract and concluded that the NEC suite of contracts is the most suitable for LTC. Other forms of contract such as ICE, JCT and FIDIC are either rarely used in the United Kingdom for civil engineering projects of a similar scale and complexity or have resulted in poor delivery outcomes.

7.2.2 The NEC has been the Government's preferred form of contract for large infrastructure projects and is recommended as best practice. There is wide acceptance and familiarity of NEC type contracts domestically and we anticipate that it will attract the widest possible bidder interest. This has been supported by our market engagement to date.

7.2.3 NEC4 is the successor to the NEC3. It does not change the fundamental principles of the NEC3 but aims to place more emphasis on better contract management through more collaborative relationships. It has been adopted for the A303 Amesbury to Berwick Down (Stonehenge) project and our RDP frameworks. We have adopted it as our contract of choice for all new procurements on LTC.

7.3 Main Works Contract Model

7.3.1 We reviewed all the standard main options available under NEC4. Options B and D require a developed design and Bill of Quantities and are not suitable. Option E, Cost Reimbursable, offers very little price certainty and its use would likely give the wrong message to the market that outturn costs are not important to us. The market has already responded through engagement that an Option A, Lump Sum would not be attractive. This negativity could result in low interest in the procurement and/or poor value for money due to bidders including significant provisions for contractor risk.

7.3.2 Option C, Target Cost with Activity Schedule offers the strongest approach for LTC because it encourages both parties to reduce costs and to manage risks openly and jointly. This should provide greater confidence in risk mitigation and therefore the outturn cost forecast. It is the option most used on major UK construction projects.

⁶ <https://www.gov.uk/government/publications/construction-labour-market-in-the-uk-farmer-review>

⁷ <http://constructingexcellence.org.uk/wp-content/uploads/2014/10/Constructing-the-team-The-Latham-Report.pdf>

⁸ http://constructingexcellence.org.uk/wp-content/uploads/2014/10/rethinking_construction_report.pdf

- 7.3.3 While Option C has many strong features, it can result in some unintended behaviours that make the delivery environment challenging. Bidders may bid a low Target Cost during procurement and seek to increase the Target Cost by claiming compensation events during contract delivery. In this scenario contractors tend to focus resources on evidencing entitlement to Target Cost increases or extensions of time and do not readily share information on opportunities to deliver the works more efficiently. In a complex project, with multiple, interfacing contracts, this lack of transparency and motivation to work efficiently hinders coordination across the project and erodes value. We are seeking to address this through a procurement approach focused on the deliverability of proposals, rather than price and through our approach to the target arrangement.
- 7.3.4 Our approach includes some key elements that are already being used in the DIP Frameworks. The target for our contracts (Target Budget) will be fixed at the level of funding available, inclusive of shared risk, the “risk quota”. Contractors that deliver their scope under the Target Budget will share in the savings, those that exceed the budget will share the burden of overspend. This arrangement means that many risks that are traditionally considered “client” risks and the subject of negotiated “Compensation Events” are included within the contract. The contractor’s share of overspend will be limited to a proportion of the fee to prevent excessive risk pricing.
- 7.3.5 We expect our contractors to recover their business overhead and adequate profit in their fee. This will be fixed at contract award so that our contractors are focused on securing greater profit by avoiding risk during delivery of the contract. This is a key feature of the commercial approach and bidders’ risk management proposals will be a key part of the quality evaluation.
- 7.3.6 There will be provision in the contracts for making changes to the Target Budget but only in exceptional circumstances. These would include high impact, low probability risks specifically excluded from the model and client led change in the fundamental project requirements. All the common delivery risks will be included within the Target Budget, e.g. ground risk; access; third party disruption.
- 7.3.7 Incentivisation will operate around the Target Budget with any savings or cost overrun shared 50:50. Contractor share of cost overrun will be limited to a proportion of the fee.
- 7.3.8 Our original market engagement on commercial models suggested a strong preference for risk sharing and limited appetite for fixed price, lump sum contracts. We anticipate that the bespoke model we are proposing will be attractive as it provides contractors with clear visibility of the available budget from the outset and therefore the risk and profit opportunity in the deal. They will be fairly rewarded for managing risk but not exposed to the full financial impact when risk events occur.

7.4 Time

- 7.4.1 An incentive for timely completion will operate in a similar manner. A bonus share will be available if the road is opened early and delay damages will apply if it is opened late.

- 7.4.2 The incentive will be paid as follows:
- a. a share when Ready for Construction/Notice to Proceed is achieved
 - b. a share when the individual contract completes its work on time
 - c. a share when all three Main Works contracts complete their integrated testing and commissioning on time and the client takes over the works
 - d. a share when the asset has successfully completed a minimum of 26 weeks fault free running in live operation.

7.4.3 The allocation to each contract will be pro-rata in accordance with the Target Budgets and will be included in the procurement documents and confirmed at the Contract Date.

7.4.4 It is intended that the incentive dates be fixed and will not move even if completion dates change at the individual contract level.

7.5 Two-stage contracts

7.5.1 A two-stage contract has been adopted for the A2/M2 Connections and Roads North packages. The key characteristics of the A2/M2 connections package (predominantly on-line working, strategic utilities assets to be diverted within the same footprint, site constrained by HS1, AONB and Ancient Woodland) mean that construction planning will lead design to an unusual degree. For example, one structure will be constructed in three phases and will need to be self-supporting in each of these temporary states. The Main Works contractor's methodology will be critical to securing value for money for this package and can only be substantively developed through engagement with utilities owners and other third parties. This is impractical in a tender environment where multiple bidders would wish to engage with these third parties. We have therefore adopted a two-stage contract model.

7.5.2 A two-stage contract is our preferred option for the Roads North package. Our recent market engagement has suggested that there may be insufficient bidders for a single stage contract. The cost of bidding, scale and risk profile, together with the relative attractiveness of the two-stage model for A2/M2 have all contributed to loss of appetite for Roads North.

7.5.3 Complexities in the Roads North package that will benefit from a two-stage approach include the design of the construction methods for the boxed-under tunnel for the connection to the main M25, the design of the A13 junction and ensuring to maximise productivity opportunities with the design of the Mardyke aqueduct. The decision to move from single-stage to two-stage is primarily a market driven decision.

7.5.4 Two-stage contracts will share the same basic contract model as the single stage contracts. The Target Budget will however be finalised at the end of Stage 1 and not at Contract Award.

7.5.5 A similar process to that used in our RDP framework will be used to set the Target Budget. We will provide a cost model to bidders that sets the "operational baseline" for the contract. Rates secured in competition, together

with the design, construction methodology, programme and risk assessment developed during Stage 1 of the contract will then be applied to our cost model to set the Target Budget.

- 7.5.6 There will be a commercial incentive for the construction partner to set the Target Budget lower than the operational baseline. Subject to market testing, we are considering an approach where all or a significant part (50%) of the Stage 1 fee is at risk if the Target Budget exceeds the operational baseline but the Stage 2 fee could be enhanced if the Target Budget is more than 5% below the operational baseline.
- 7.5.7 Stage 1 of the contracts is likely to be up to 12 months and will be managed through a series of gateways, culminating in the "Ready for Construction" milestone, including confirmation of the Target Budget. In addition to design, consent discharge, planning and budget setting for Stage 2, it is likely that some early, enabling, and temporary works will be conducted during this stage.
- 7.5.8 We will look to lock costs down for Stage 1 by using lump sum costs and fee and we will identify our we can lock parts of the final Target down during Stage 1 as we progress through the gateways to minimise the risk on the scale of the final negotiation. Stage will be fully open book.
- 7.5.9 To summarise the critical success factors for successful delivery of two-stage contracts are:
- a. Creating an incentive model that drives the right behaviours and early conclusion of the end of Stage 1 so we minimise the risk of HS2 type delays and cost escalation utilising existing Highways England cost models and fixing cost items where possible at initial tender submission.
 - b. That the market understands they must deliver a Target Budget within the affordability envelope in a timely manner. They could be incentivised through their cash flow, which is a highly effective incentive in the current market conditions.
 - c. The baseline level which will be given to the Main Works contractors as the baseline envelope and the maximum level of downside risk (pain).
 - d. Having predefined contractual control gates, throughout Stage 1. where we manage the cost plan and ensure opportunities are embedded in the Target Budget.
 - e. Locking down costs as we go through Stage 1 so we minimise the risk on the quantum of the final negotiation.
 - f. Making sure Stage 1 has a fixed length and costed ECI elements where any cost overruns are a risk held by the contractor to control the risk of Stage 1 being extended.
 - g. Ensuring that we align to the overall Main Works commercial approach in delivery for LTC with an agreed Target Budget and risk quota.

7.5.10 The risks of adopting a two-stage approach are recognised and detailed in the Section 10, Commercial Risks. The selection of the right Integration Partner coupled with the close management of the ECI, the established cost base and these core principles will significantly mitigate these risks. Stage 2 of the contracts will include any remaining design, construction, testing and commissioning.

7.6 Optimised Construction Partner Involvement (OCI)

7.6.1 Optimised Construction Partner Involvement (OCI) provides the opportunity for a structured commercial mobilisation of our contracts before the full mobilisation of resources to site. The primary purpose of the OCI on this project is to develop any proposals that require co-ordination across contracts and any significant value engineering or enhancement proposals in order to provide a stable platform for delivery. It is not a separate contract stage but rather a process that will run in parallel with other activities like mobilisation, design and discharge of consents.

7.6.2 It is expected that the following will be achieved within the OCI period:

- a. Interface matrix populated with signed off ICDs (both parties) for each line item
- b. VE and Z108 enhancement proposals finished
- c. Designs approved at interface in line with ICDs
- d. Buying decisions made/asset harmonisation
- e. Testing and commissioning (T&C) plans agreed

7.6.3 This concept will apply to all our contracts, adapted to single or two-stage models. It will end when we sign off the contractor's achievement of the Ready for Construction milestone.

7.7 Performance management

7.7.1 The contracts will include our standard Collaborative Performance Framework (CPF) and a "Quality Management Points" regime is envisaged for the management of the construction partner's day-to-day performance during the course of the works.

7.7.2 Quality Management Points provide an additional tool for us to ensure delivery of the obligations under the contracts. They are an integral part of the quality management process and will reflect any tender promises that have not otherwise been incorporated into the scope of the contract.

8 Early Works

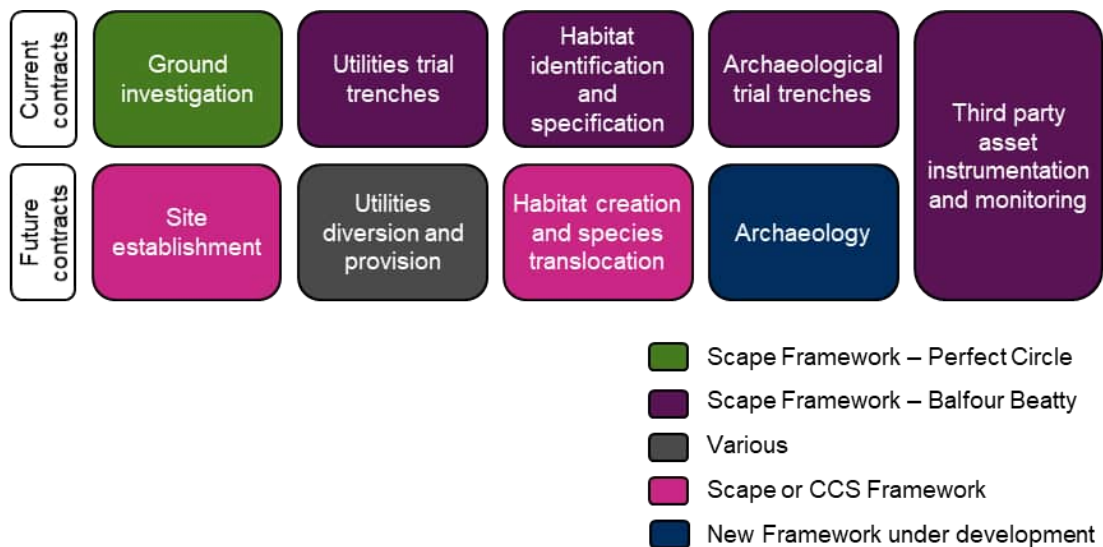
8.1 Introduction

- 8.1.1 The Early Works packages have been developed so that programme critical activities can be undertaken before the Main Works contracts being awarded. They also reduce risk to the main contracts by securing better site information or addressing critical interfaces. This approach significantly reduces the risk of late delivery of the construction programme.
- 8.1.2 In this section we set out the scope of the Early Works and the delivery route for each element.

8.2 Scope of Early Works

- 8.2.1 A programme of Early Works has been initiated to increase design, schedule, and cost certainty. The Early Works will be delivered in two tranches. The first tranche is currently under way and is primarily intrusive survey activity that provides the information that we require to support the DCO and procurement/design. The second tranche is critical path activity that we want to initiate before Main Works contract award.

Figure 8.1 Early Works



9 Integrate to realise benefits

9.1 Introduction

9.1.1 The Management Case explains how we will manage delivery of the whole project and realisation of benefits through integrating our works packages and subsequently handing the assets over to operations. This section of the Commercial Case outlines how we are supporting that strategy through our commercial and procurement approach.

9.2 Integration capacity and capability

9.2.1 We will provide both management and design integration across all work packages. This will be delivered with the support of the Integration Partner as part of the Highways England IMT

Figure 9.1 Package integration



9.2.2 The role of the IMT team is to provide:

- c. project management for our main contracts
- a. programme management and integration across the whole project
- b. retained functions including land and property, stakeholder management and communications.

9.3 Integration Partner route to market and contract model

9.3.1 The scope and risk profile of the Integration Partner has been well defined, and market tested before procurement. This is a relatively simple procurement and the Open Procedure was selected because it offers the shortest time to award. Market engagement suggests there will only be between three to seven bidders for the Integration Partner role so there is no need to spend additional time on a selection questionnaire stage.

9.3.2 All bidders will need to pass the qualification submission compliance test demonstrating that they can deliver the required service. The quality assessment will be completed against those bidders that pass the qualification submission. The quality assessment will link to the eighteen service requirements which have been condensed into six key areas.

9.3.3 The bidders will provide a resource-loaded budget for delivery phases one to five along with the lump sum estimate for all systems and the all-in staff rates which apply to the resource loaded-budget and their profit margin. The proposed resource-loaded budget, the proposed lump sum for all systems and

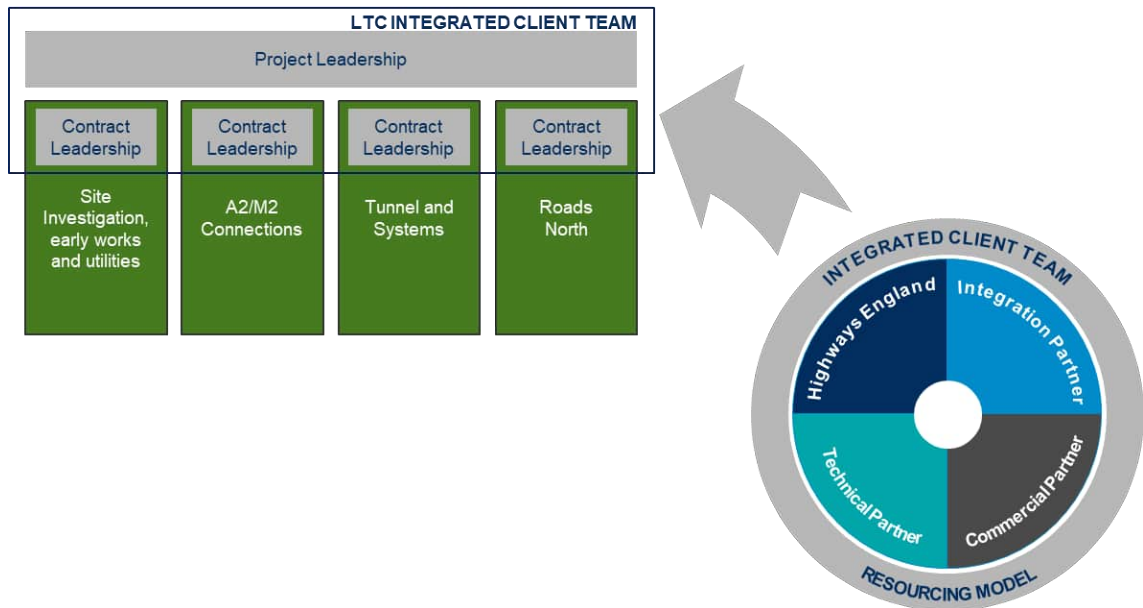
the all-in staff rates will be evaluated as part of total baseline cost review. A 70:30 quality to price ratio has been adopted.

- 9.3.4 The Integration Partner contract will be an NEC4 Professional Services Contract. This will be adapted to allow separate task orders to be awarded on a lump sum, target cost or cost reimbursable basis. Task orders will be agreed with the Integration Partner before commencing each delivery phase. These will be awarded as:
- a. Lump Sum Price – this option will be used for simple, easy to define, commoditised services where resources are not shared with other tasks (e.g. systems provision).
 - b. Target Cost – with zero pain/gain and a Key Performance Indicator (KPI) based incentive model instead. KPIs include both long term measures of overall project performance and phase specific measures relating to the Integration Partner's performance. This option will be used for most task orders; or
 - c. Cost Reimbursable – this option will be used as an optional service to second staff into Highways England roles under our management control.

9.4 Interface management

- 9.4.1 There are more contractual interfaces on the Lower Thames Crossing than we see on the majority of our projects. There are also interfaces with the existing road network, other infrastructure owners, landowners, operations, and maintenance, statutory bodies, and other stakeholders, many of which are being formalised in legal agreements.
- 9.4.2 Our high level operating model for delivery provides each of our Main Works contracts with its own client team with full responsibility for delivery of the scope, not only of the Main Works contract but the other components required for success, e.g. land acquisition, communications. Even the A2/M2 Connections at c£442m is a large project in its own right and we will resource these teams with the right capabilities to be largely self-sufficient.
- 9.4.3 The high level operating model is illustrated in Figure 9.2

Figure 9.2 Operating Model Summary



- 9.4.4 At project level, there will be a leadership team and supporting organisation with a set of responsibilities distinct from those at contract level. These are primarily about integration across the project and will include:
- a. testing that the Main Works contractors’ designs integrate together to deliver the operational outcome.
 - b. brokering and instructing interface deals between the construction partners and/or third parties where one or more may incur greater cost, schedule, or other impacts.
 - c. maintaining strategic relationships with utilities and other third-party infrastructure owners.
 - d. maintaining the programme management systems, processes and tools required to manage information sharing and coordination, e.g. the integrated schedule, overall financial forecast.
 - e. driving pan project opportunity realisation
 - f. allocating responsibility for discharge of consents; and leading the customer and safety agenda.

9.5 The Design Authority

- 9.5.1 Our contractors will have an obligation to work together and coordinate their designs, so they interface. With the support of the Integration Partner and Technical Partner, we will undertake a Design Authority role to ensure that obligation is being met and that our project and system-wide strategies are being followed so that the packages integrate to deliver a coherent scheme.

9.6 Technology

- 9.6.1 We have an established corporate approach to the procurement of technology. This provides consistency in both products and systems architecture.
- 9.6.2 Technology includes the following:
- a. telecommunications
 - b. ITS systems
 - c. ITS devices
 - d. tunnel safety and maintenance systems
- 9.6.3 The technology scope will be delivered through our Main Works contracts, existing technology frameworks or discreet contracts. The Commercial and Procurement (CPS) sets out the details of this approach (see Appendix C).
- 9.6.4 In general, the Main Works contractors will procure, install and prove in testing and commissioning phase, equipment, specified and approved by us, together with local connections to a specified input/output (I/O) connection point from which the networks specialists will pick up and integrate into the wider strategic road network. Network infrastructure will be delivered through NRTS2 and its planned successor, NRTS3.
- 9.6.5 Operational protocol coding will be through Common Highways Agency Rijkswaterstaat Model (CHARM) - Advanced Traffic Management System (ATMS) or its successor.

9.7 Handover to Operations

- 9.7.1 An enhanced testing, commissioning and handover period is planned. The Operations Directorate and our maintenance contractors will witness the testing and commissioning of the assets, particularly mechanical, electrical and systems components. The Operations Directorate will then lead a series of operational readiness trials to test the normal and contingent operation of the route. Handover of operations and maintenance responsibility will not take place until road system has been proven through these trial operations.
- 9.7.2 Handover to operations and maintenance responsibility will be at a Sectional Completion date, ahead of the LTC's OfT date. A defects period of at least two years will apply; however, there will be no retentions. The operational control and maintenance activity is likely to be discharged through the Area 4 Asset Delivery contracts. The preferred approach at this stage is to establish relationships with certain original equipment manufacturers (OEMs) of specialist mechanical and electrical equipment where such assets create high availability.

Such assets are expected to include, but will not be limited to, tunnel ventilation fans and ventilation control systems. A relationship must be established between our Operations Directorate team and those specified critical OEMs that endures beyond the construction phase into the operational phase. This is a key lesson from A3 Hindhead tunnel project.

10 Commercial risks

10.1 Contract risk allocation

- 10.1.1 In line with the commercial model proposed for the Main Works contracts (as shown in Appendix C), risks arising under the Main Works contracts will comprise three distinct categories:
- d. risks that sit solely with Highways England (e.g. a change in Project Requirements, and any other 'Fundamental Change')
 - a. risks that sit solely with the contractor (e.g. components that are deemed to be included in the Fee, Disallowed Costs, Damages and Losses)
 - b. other risks that are jointly owned and managed within the envelope of the risk quota
- 10.1.2 The financial impact of risks in the third category or 'risk quota' will be jointly owned and managed by Highways England and the contractor within the overall financial envelope for each contract described as the Target Budget.
- 10.1.3 Contractors are motivated to secure contract outcomes that fall within their respective financial envelopes and if successful the contractor(s) will share in any residual amounts between the defined cost spent and the Target Budget. If the contractor eats into the risk quota it is merely eating into its opportunity to secure a share in the residual. As the commercial model caps the amount payable for fee, the securing of gain share is significantly more attractive to the contractor than merely managing more spend as the spend generates no additional fee.
- 10.1.4 Opportunity realisation (i.e. value engineering) will be fully explored to offset the impact of risks if and when they impact. Securing such opportunities provides more headroom in the Target Budget. Opportunity realisation means finding ways of reducing the contractors' spend whilst still delivering the scope to the contracted specification. Reducing spend means that there is more opportunity for the contractors to secure a share in the residual.
- 10.1.5 Further work is ongoing to confirm which risks sit:
- e. solely with the contractor and as such are to be included within the contractors' pricing to be submitted with the tender
 - a. those which are to be accommodated within the risk quota (and therefore Target Budget)
 - b. those which sit solely with the Highways England
 - c. those that are to be insured
- 10.1.6 This definition and clarity of allocation is important to ensure a common understanding exists at tender stage.

10.1.7 Risks held in LTC’s Risk Register “Xactium” will form the basis of this quantification of the risk quota and Client Held Risks. The resulting risk quota and basis/assumptions will be fully shared with bidders/contractors.

10.2 Two-stage contracting

10.2.1 We recognise the challenges of running a two-stage contract with an ECI phase. These challenges include:

- a. strict control of the evolution of the Target Budget through stage one
- b. not been able to agree the Target Budget at the end of stage one
- c. loss of competition at the point of contract award
- d. limited options to control poor performance at the end of stage one
- e. having resilience in the procurement process
- f. having an extended and protracted negotiation to set the Target Budget

10.2.2 The key mitigations to these risks are defined in our approach in Section 7.5

10.3 Procurement risk

10.3.1 The main procurement risks, or those risks which will be driven by the procurement process, along with their proposed mitigation, are shown in Table 10.1 below.

Table 10.1 Main procurement risks and the mitigation plans

Risk	Detail	Mitigation	Risks outside of project control
Market appetite	Lack of market appetite for LTC	Frequent market engagement to provide assurance on the LTC’s deliverability and overall procurement approach and ensure that the approach to project delivery remains attractive to the market	Other competing projects in the UK and overseas Economic uncertainty makes LTC unattractive to bidders
Market appetite	A303/Lower Thames Crossing overlap reduces market interest – bidders forced to back one project	Procurement of Main Works for each project staggered by a minimum of 9 months	Government decisions drive a parallel delivery programme
Market appetite	The approach to use of risk quota reduces market interest	Ability to understand and assess risk quota as a viable alternative to Compensation Events.	

Risk	Detail	Mitigation	Risks outside of project control
Market appetite	Interface risks reduce market interest	Ability to demonstrate a strong proposal for managing interfaces and clear definition of those interfaces	
Compliance	Procurement challenge	Robust tender and evaluation procedures Allowing sufficient time for the procurement process to be robust External legal input and assurance of the processes	Potential speculative challenge from bidder(s) which we seek to reduce through management of the procurement process.
Compliance	Tender process drives undesirable outcome – unaffordable or not enough bidders qualify	Evaluation criteria stress tested before use Market engagement to identify all the critical information bidders require in order to submit compliant tenders Evaluation designed to avoid a race to the bottom on price Overall Target Budget controlled by Highways England	
Compliance	HSE fails to provide derogation for High Pressure Compressed Air Working (HPCW) proposals for tunnelling	Support and approval in principle sought by Highways England for proposed approach Ongoing fruitful dialogue with HSE, but exemption cannot be formally obtained by Highways England, it is only obtainable by the tunnelling contractor	Procurement cannot fully manage this risk but will probe HPCW
Commercial	Contractor failure during delivery Bidder withdrawal during the tender process	Financial resilience assessments of bidders at each bidder selection stage Tender process optimised to reduce costs to bidders	Other competing projects in the UK and internationally for main crossing
Commercial	Unfamiliarity with commercial model	Engagement with market on model and specific terms	

Risk	Detail	Mitigation	Risks outside of project control
Schedule	Three Main Works procurement processes concurrent with DCO	Dedicated teams. Early, detailed planning. Publish at ITPD, the process by which we will manage any change to the scope as a result of the other processes	
Schedule	Procurement of long lead items	Early supply chain engagement Early procurement of critical items Collaborative planning and schedule risk analysis during CD	
Organisational	Capability and capacity to deliver a robust procurement	Timely identification of the resources required Timely capability assessment followed by training where required Early buy-in of additional resources where required	National shortage of skilled resources
Compliance	DCO decision frustrates, delays, or stops procurement (or results in abortive work in Stage 1 of two-stage contracts)	Early submission of DCO Aligning OJEU and procurement process with DCO and its process Engagement with stakeholders	Extension in decision period by Secretary of State impacting on LTC programme Failure of DCO process Additional requirements which are inconsistent with the procurement process/bids
Compliance	Risk of procurement challenge Risk of judicial review	Robust audit trail, eg, minuting meetings Project team awareness of high possibility of litigation/challenges Cautious approach	Potential challenges from landowner/environmental groups, local councils etc.

10.4 Insurance

- 10.4.1 We intend to seek an Owner Controlled Insurance Policy (OCIP) for the Project, via a PCR compliant procurement. This will need to be placed before award of the Main Works contracts but will not be secured before ITPD so bidders will be asked to seek their own insurances as an option should the OCIP not be secured.
- 10.4.2 OCIPs have been adopted by many recent UK infrastructure programmes. They ensure consistent provision across the whole project. This can provide helpful clarity for third party infrastructure owners, landowners and other parties, in addition to Highways England and our construction partners. They can also

simplify resolution in the event of a claim involving more than one party and may offer better cover.

Lower Thames Crossing

Outline Business Case

Financial Case

Lower Thames Crossing Outline Business Case

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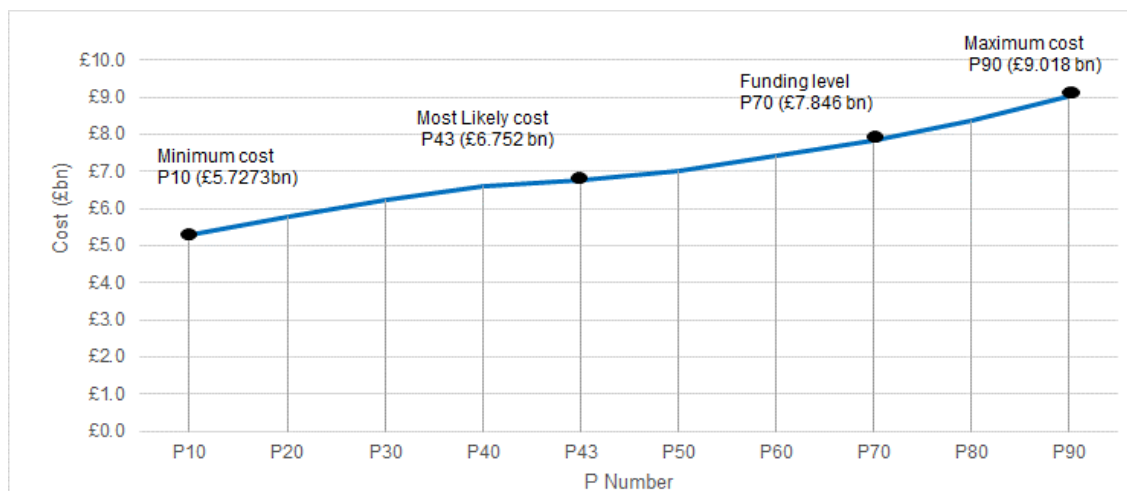
1 Introduction

1.1 Background

1.1.1 This section of the Outline Business Case (OBC) sets out the Financial Case for the Lower Thames Crossing project (LTC). It sets out the basis of the capital costs, the funding requirements and implications for budget and project affordability.

1.1.2 Figure 1.1 below shows the cost range estimates for LTC and the required funding.

Figure 1.1 LTC cost range and funding



1.1.3 The estimated capital cost (most likely) for LTC including allowances for risk and uncertainty is £6.752bn (outturn prices) with a P43 cost confidence level. As LTC is different in terms of scale and complexity compared to the wider Highways England’s capital portfolio, it has been agreed that LTC is funded at a P70 level and the additional contingency, equivalent to the difference between the Most Likely cost and P70 forecast is held by Treasury.

1.1.4 At P70 level, LTC will require funding of £7.846bn.

1.1.5 In March 2020 funding of £7.2bn was allocated to the project split between Highways England RIS2 funding, assumed Highways England RIS3 funding and HMT Risk Reserve. There is therefore a difference £0.633bn between the current forecast and allocated funding.

1.1.6 The Financial Case also includes an initial analysis around the operating cost of LTC once open, and the extent to which the incremental charge revenue from LTC is likely to cover the operating cost. It also sets out the net revenue and cost of LTC for Department for Transport (DfT).

1.1.7 The Financial Case is structured as follows:

- Section 2 Capital cost estimate
- Section 3 Funding requirements and affordability
- Section 4 Budgets and funding authority

- Section 5 Operations, maintenance and renewal cost
- Section 6 Revenue from road user charge
- Section 7 Net cost of LTC to the

2 Capital cost estimate

2.1 Overview

- 2.1.1 The capital cost estimate has been built bottom up, based on the project scope and design as set out in the Strategic Case and on our knowledge of the land required, topography and ground conditions.
- 2.1.2 The estimation methodology is in accordance with Highways England capital cost estimating process for major projects.¹
- 2.1.3 The capital cost comprises:
- a. base costs, which represents the cost of planning and development and costs of work to build LTC
 - b. additional costs for project risk, uncertainty, non-recoverable Value Added Tax (NR VAT), inflation and portfolio risk
- 2.1.4 The cost of work has been estimated separately for each of the main contracts – Enabling works, Roads North, A2/M2 and Tunnel to allow for specifics such as preliminaries, contractor fee and productivity rates to be factored appropriately.
- 2.1.5 The estimated capital cost of LTC including portfolio risk is £6.752bn.
- 2.1.6 Below provides a summary of the capital cost broken down by the key cost categories. The estimation approach is explained in more detail in Section 2.3 below and the base cost and the additional cost are explained in Section 2.4 and Section 2.5 accordingly.

¹ Highways England (2018): Commercial Services Division Major Projects Cost Estimation Manual version 3.2.35

Table 2.1 LTC development and construction costs (Most Likely £m)

Cost categories	Base cost	Opportunities	Net base cost includes opportunities	Risk and uncertainty	NR VAT	Total
Options phase (including pre-options)	28		28			28
Development phase	324		324			324
Lands	235	-32	203	95		298
Pre-enabling works	115		115	31	21	167
Integration Partner	132	-9	123	48	30	202
Enabling works	117	-13	104		19	123
Statutory undertakers	318		318	41	66	425
North Roads	893	-102	791	153	163	1107
A2/M2	356	-43	313	67	62	442
Tunnel	1330	-103	1227	248	285	1760
Technology (Highways England framework contracts)	24		24	5	4	34
Subtotal: LTC cost excluding inflation	3872	-302	3570	688	651	4910
Inflation	1064		1064	203	186	1446
Subtotal: LTC cost including inflation	4936	-302	4634	891	837	6356
Portfolio risk						396
Total cost Most Likely	4936	-302	4634	891	837	6752

Notes:

Land and development phase are in outturn prices

Roads north, Tunnel and A2/M² - These are not the contract values as the base cost includes cost for insurance which will be procured separately and does not include contestable element of statutory undertakers cost which will be procured under the main works contract.

2.2 Review and assurance

- 2.2.1 Our capital cost of £6.752bn follows from a comprehensive re-baseline of cost, schedule and benefits. The re-baseline exercise was supported by peer reviews, independent experts and our own internal assurance process.
- 2.2.2 The Commercial Services Division (CSD) within Highways England have carried out an internal assurance of the project estimate.

2.3 Estimating approach and methodology

- 2.3.1 Cost estimates have been calculated using a three-point estimating technique. Cost, risk and uncertainties are estimated at three points – Minimum, Maximum and Most Likely point. The three-point estimates are then converted into a probability distribution using Monte Carlo simulation to give a P10 to P90 range. The Most Likely total estimate is the sum of all the Most Likely points.
- 2.3.2 Where practical, a detailed, first principle estimating approach has been adopted to mitigate the substantial levels of uncertainty related to LTC's complex works. The prices, or rates, for an item or piece of work have been built up considering all the parts and activities needed to put it together.
- 2.3.3 The majority of the road construction works have been measured and priced with rates drawn from the Highways England's cost database (containing first principles resource build ups) as well as other detailed estimates derived from external sources and professional experience.
- 2.3.4 The land and development costs are estimated in outturn prices, ie, year of expenditure. All other cost including NR VAT and project risk and uncertainty are in Q1, 2016 price base. Forecast inflation has been applied to the year of expenditure to produce an outturn forecast in nominal prices. The forecast inflation for 2016 to 2019 is based on actuals.
- 2.3.5 The risk and uncertainty allowance have been calculated from an assessment of the identified project risks and the financial impact and probability assessment of them occurring (the Quantitative Risk Assessment (QRA)).
- 2.3.6 Project risks include both employer and contractor owned risks. The estimated costs of agreed risk mitigation measures are included in the base estimate with the residual estimated exposure included in the project risk part of the cost build up.
- 2.3.7 Project specific uncertainty adjustments are included where the risks are difficult to quantify with any precision. These are included in the estimates for the individual capital items and are specific to items that are difficult to estimate, based on the information and level of detail currently at this point of time.
- 2.3.8 The portfolio risk allowance is to cover risks which are outside LTC control but would affect LTC if they are realised.
- 2.3.9 The methodology for the provision of project risk and uncertainty and portfolio risk has replaced the previous costing methods that included optimism bias adjustments.
- 2.3.10 The following key milestones for delivery are assumed for the cost estimation
- a. construction start –

b. Open for Traffic (OfT) – October 2028

2.3.11 The full procurement programme is set out in the Commercial Case at Section 2.2.

2.4 Analysis of the base costs

2.4.1 This section explains the elements that make up the base cost of £3,872m.

Options phase (£28m)

2.4.2 This is the actual cost for the options phase. It excludes the cost for early DfT studies.

Development phase (£324m)

2.4.3 This covers the cost of developing LTC, securing the DCO and procurement of the contracts to deliver LTC.

2.4.4 The majority of the spend during the development phase is on technical partners resources. Other cost include cost for planning lawyers, QC services, land costs (up to March 2019), Integration Partner cost (up to March 2022) commercial contract management and payments to local authorities and Statutory Environmental Bodies (SEBs) for DCO-related work.

2.4.5 The current spend rate together with detailed bottom up analysis of LTC deliverables and required resources form the basis of the forecast. Table 2.2 below shows the breakdown of the development cost by key cost categories:

Table 2.2 Development cost (in outturn prices)

Cost categories	Description	£m
Project Management (Highways England)	Interim Project Management services	12
	DCO legal support	5
Assurance Services (Highways England)	Commercial and contract assurance	10
Technical Partner resources (Cascade JV)	DCO, technical, commercial and procurement, project management and other tasks	228
Non-resource cost procured by Highways England	Planning Performance Agreement/Ground Investigations/stats	10
Non-resource cost procured by Technical Partner	Non-resource cost procured by Technical Partner	20
PFI	Finance & legal advisory services	1
Land	Property and compensation	27
Sub Total: Total cost before risk		313
Risk		11
Total development phase spend		324

2.4.6 Of the £324m estimated development phase spend, £230m has been spent up to March 2020, and the balance of £94m is forecasted over FY 2020/21 to FY 2022/23. A reconciliation of the development phase cost with the approved funding including the PFI advisor funding is included in the budgets and affordability Section 4.

Land (£235m)

2.4.7 The land estimate includes the cost of acquiring temporary and permanent land, compensation, blight, and part 1 claims including allowances for stamp duty and fees. The land take is based on the red line boundary defined for the DCO and book of reference. The values are those provided by the District Valuer and include allowance for inflation.

2.4.8 Table 2.3 below summarises the estimated land spend by key categories

Table 2.3 Estimated land spend (includes inflation) in £m

Description	£m
Blight	93
Part 1 claims	18
Land acquisition	124
Inflation	Inc
Total land cost for LTC	235
Less: Blight payments for FY19/20	-23
Future land cost (April 20 onwards)	212

2.4.9 The Blight payments of £27m up to March 2019 have been funded out of the development phase and are included within £324m of development phase cost. These are therefore excluded from total land cost.

2.4.10 There is potential opportunity from disposal of surplus land (including discretionary purchases), which is currently not netted off against the cost of land for the project. Further work is underway to assess the likely values of surplus land and these will be netted off against the land cost for Final Business Case (FBC).

Pre-enabling works (£115m)

2.4.11 Pre-enabling works are required to de-risk the DCO submission and the procurement process. De-risking these activities allows a greater degree of certainty to be given to achieving the overall programme and OfT date.

2.4.12 Table 2.4 below summarises the pre-enabling spend by key cost categories. These works are ongoing and are expected to conclude in FY 2020/21.

Table 2.4 Pre-enabling spend

Costs categories	£m
Ground Investigations	77
Ecology and trial trenches (archaeology and utility)	7
Instrumentation and Monitoring	5
Utilities design & co-ordination	21
Prelim Allowance (for above)	1
Risk mitigation cost	4
Total: Pre-enabling works	115
Less: payments up to March 2020	-71
Future Pre-enabling works cost (April 2020 onwards)	44

2.4.13 Of the £115m estimated pre-enabling works, £71m was spent up to March 2020 and the balance of £44m will arise in FY 2020/21.

Integration Partner (£115m)

2.4.14 As set out in the Commercial Case at Section [9.3], the Integration Partner contract will run from late 2020 to the end of construction and will provide management support for consent discharge post DCO: main contract mobilisation, programme and project management, design and planning for utilities and other enabling works.

2.4.15 The Integration Partner is expected to be largely a resource cost. The estimate is based on a top down assessment of the organisation structure and mix of average Full Time Employee (FTE) rates from our other Commercial and Technical assurance contracts. The average rates have been uplifted for the location and complexity of LTC.

Enabling works (£117m)

2.4.16 Enabling works will begin after the DCO is granted and continue into the construction phase. Table 2.5 below summarises the enabling spend by key cost categories.

Table 2.5 Enabling spend

Costs categories	£m
Advanced Compound set up costs	2
Civil works	10
Archaeology	50
Ecological translocations	2
Preliminaries including site compounds	43
Contractor fee	10
Utilities design & co-ordination	0
Total: Enabling works spend	117

Costs categories	£m
Less Opportunity	-13
Total: Enabling works spend	104.0

2.4.17 The enabling works are top down assessments and benchmarked against other schemes.

Statutory Undertakers (£318m)

2.4.18 The spend on Statutory Undertakers (SU) works is significant. Non-contestable costs are based on C3 estimates received from SU providers. The contestable costs are a mix of top down estimates and quotes received from the SU providers. A full breakdown of SU works by is provided in Table 2.6 below.

Table 2.6 Statutory Undertakers

Particulars	Contestable works £m	Non-contestable works £m	Total £m
Power – Underground	0	45	45
Power – Overhead	0	45	45
Telecommunications	35	0	35
Water	33	10	43
Gas	0	150	150
Total	68	250	315

Roads North and A2/M2 Connections (£893m and £356m)

2.4.19 The roads packages are to be delivered through two main works packages: Roads North and the A2/M2 Connections Table 2.7 below provides a breakdown of the cost of each package.

Table 2.7 Roads base cost

Cost categories	Roads North £m	A2/M2 £m	Total £m
Preliminaries	273	79	352
Cost of works	546	248	794
Contractors fee	74	29	103
Total	893	356	1249
Less Opportunity	-102	-43	-145
Total	791	313	1104

2.4.20 The preliminaries include overheads and method related costs and have been produced from first principles using a bespoke Preliminaries model. The estimate for preliminaries has been built for each main package of works by geographical location and subsequently split into contract packages. A

summary of the preliminaries by key cost components and contract packages is included in the Appendix I.

- 2.4.21 A contractor's fee of 9% has been applied to all construction costs for Highways contracts. The contractor's fee includes allowances for insurance. The fee percentage has been benchmarked against the Highways England Major Projects.
- 2.4.22 The cost of works has been built up for each of the highway segment using the standard breakdown structure for highways works and Highways England's Major Projects approved rate libraries. A detailed breakdown of the cost of works by segment for Roads North and A2/M2 is included in Appendix I.
- 2.4.23 These rate libraries are at Q1, 2016 prices. The most recent audit was undertaken in February 2019 where the rates were checked against the cost intelligence data captured from the recent tenders and jobs. Therefore, an element of benchmarking factored automatically in the process with the use of rate libraries.
- 2.4.24 Where appropriate, we adjusted the library rates to consider the efficiency that can be achieved because of the scale of works within LTC. For example, bespoke structures rates have been developed specifically for each structure and these have been used in place of more generic deck-area rates.

Tunnel (£1330m)

- 2.4.25 Table 2.8 shows key cost components of the tunnel estimate. Table 2.9 shows a summary of the tunnel/crossing section by key cost components.

Table 2.8 Tunnel cost summary

Cost description	£m	Direct Works
Preliminaries	192	-
Approach Ramps and Portals works	285	1017
Tunnel works	732	
Contractor's fee	121	-
Total	1130	-
Less Opportunity	-103	-
Total	1227	-

Note Contractor's fee of 10% has been applied to Tunnels and Approaches

Table 2.9 Key cost components of the crossing section

Particulars	£m
Tunnel Boring Machine (TBM) costs x2	70
Pre-cast segments/road deck	147
Tunnel excavation	179
Procurement (other than TBMs)	0
Hyperbaric interventions	30

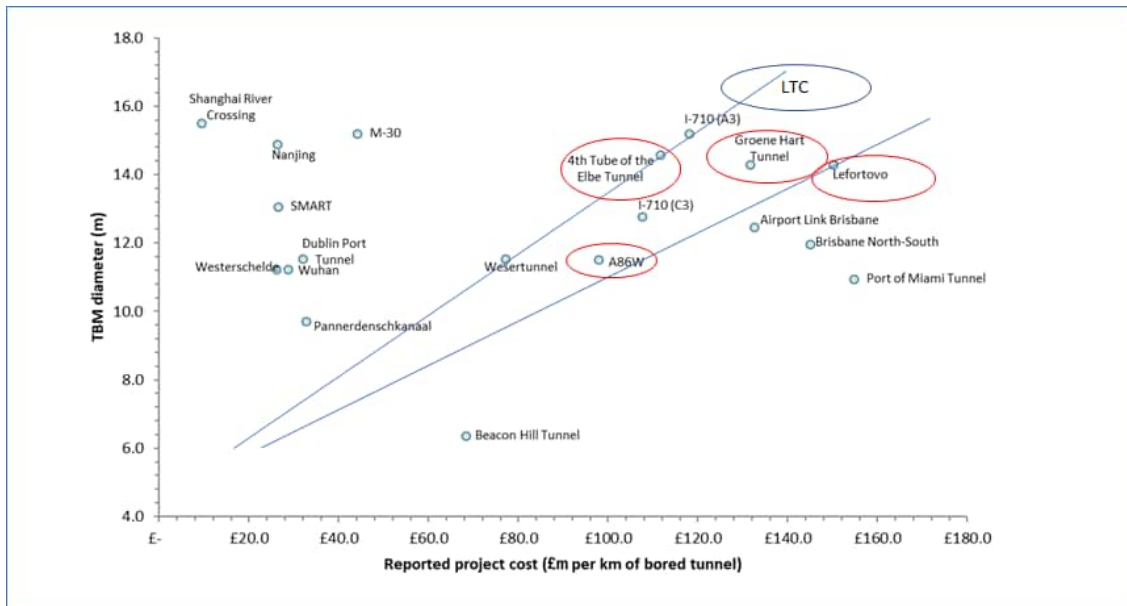
Particulars	£m
Cross passages	42
Tunnel finishes	1
Engineering services	147
Tunnel Road Finishes	10
Tunnels Temporary Works Requirement (Specific on Costs)	105
Plan Lay Down & Hardstands Areas	12
South Portal	71
North Portal	203
Total	1017

- 2.4.26 The cost for the civil engineering works for the tunnel approach ramps and portals have been estimated using our standard rates library.
- 2.4.27 However, there are no comparable Tunnelling rates in Highways England's database and there are few precedents worldwide for tunnelling works of this scale. Therefore, a parallel estimating approach has been adopted, with separate estimates produced by the project team, our CSD and by [REDACTED], who is a visiting Professor at the University of Warwick and specialises in Tunnelling.
- 2.4.28 These parallel estimates have been reviewed and reconciled to within 5% to agree the appropriate estimated costs.
- 2.4.29 We have also undertaken extensive benchmarking against other notable Tunnelling projects, both at a granular level for the key cost drivers and for the overall cost. This level of benchmarking is needed as tunnel prices tend to vary significantly depending on the tunnel size, the geology of the area and the associated groundwater.
- 2.4.30 Notable major projects in UK have been reviewed such as high-speed railways and large diameter water pipelines projects and we have also drawn on the technical partners global Tunnelling experience for benchmarking and cost estimate.
- 2.4.31 At a granular level we have benchmarked the following key cost drivers for the tunnel, which together account for more than c.50% of the tunnel cost base:
- a. Tunnel production rate
 - b. TBM cost
 - c. Tunnel excavation and lining cost
 - d. Precast concrete segments
- 2.4.32 The results of this benchmarking are included in Appendix K. The benchmarking shows that LTC estimated rates are close to the average rates/cost across the benchmarked data, thus providing a degree of assurance on the individual cost components.

2.4.33 We have also undertaken a high-level benchmarking of tunnel cost with the Infrastructure Cost Review² metrics. This is shown in Figure 2.1 below

2.4.34 It shows a comparison of the LTC estimated Tunnelling cost compared to other major tunnels. The examples circled are most comparable to LTC as they relate to the use of slurry/mix shield TBMs. The Groene Hart tunnel is a rail tunnel, but the others are road tunnels. The ground conditions vary. It shows that LTC tunnel estimate of c.£130m per km excluding the fixed cost, portals etc is comparable to other similar-sized tunnels assumed in benchmark range.

Figure 2.1 BTS data on tunnel costs



Opportunities (£302m)

2.4.35 The estimate includes £302m value of assured base cost reduction, with each opportunity individually assessed to arrive at the estimated value.

2.4.36 The areas of opportunity and potential cost savings are set out in Table 2.10 below.

2.4.37 The £302m is an adjustment to the base cost and therefore the impact on inflation and NR VAT needs to be considered.

² <https://www.gov.uk/government/publications/infrastructure-cost-review>

Table 2.10 LTC Project Opportunities

Cost Categories	Opportunities	Comments
North Roads	102	<p>Challenge to the design and programme and cost to reflect actual constructability. Key ones include:</p> <ul style="list-style-type: none"> • Simplification of the A13 ,Chadwell St Mary's, Ockendon Link and M25 structures • Use of a top down construction method for the two A13 Jack Box Structures • Structures removed as a result of A13 amendment of Vertical braiding • Reduction in the length and height of Retaining Wall Solutions • Optimisation of the earthworks strategy - retaining surplus material, optimising the design in areas of soft ground • Moving the OHV loops location • Reduction in the Markdyke delivery programme
Tunnel	103	<p>Challenge to the design and programme and cost to reflect actual constructability. Key ones include:</p> <ul style="list-style-type: none"> • Increase in TBM production rates from 240m/mth to 280m/mth • Redesign of the North Portal to a Caterpillar Design • North Portal - combining temporary and permanent structure • Cross Passages (mechanisation of construction) • South Portal Bore Separation • Ventilation (reduction in design fire to on basis of FFFS provision as at A3030 and STT) • Madrid Method (simplified modular road deck)
A2/M2	43	<p>Challenge to the design and programme and cost to reflect actual constructability. Key ones include:</p> <ul style="list-style-type: none"> • Simplification of the A2 /M2 structures • Revised Retaining Wall Solutions • Optimisation of the earthworks strategy - retaining surplus material and optimising the design in areas of soft ground
Lands	32	Reduced land take through detailed assessment and detailed review of risk allowances allowed within the district valuers estimate.
Others	23	Integration Partner and enabling works
Total	302	

- 2.4.38 There is a risk of understating cost and funding requirements if these opportunities are not realised. However, these opportunities have been reviewed and internally assured by Commercial Services Division (CSD) within Highways England, thus providing a degree of comfort on inclusion of these within the cost estimate. The list of opportunities will evolve as the cost and design mature and some of these may drop off and new ones may emerge. On a project of this scale, a 5%-7% cost savings target is reasonable.

2.5 Analysis of the additional cost

Risk and uncertainty (£688m)

- 2.5.1 The cost estimate includes an allowance of £688m for project risk and uncertainty. The risk provision is a top down assessment of the individual risks for specific elements of the scope beyond the variations already accounted for in the cost range. A project specific adjustment has been included in the uncertainties where the risks are difficult to quantify with any precision.
- 2.5.2 Of the £688m, the uncertainties allowance is £55m and the balance of £632m is the risk provision. Table 2.11 below summarises the risk and uncertainty by key cost elements.

Table 2.11 Risk and uncertainty breakdown

	Risk value (£m)	Uncertainty value (£m)	Total risk and uncertainty (£m)	Base cost (£m)	Risk and uncertainty %
Options phase (including preliminaries)	0	0	0	28	0%
Development phase	0	0	0	324	0%
Lands	95	0	95	235	40%
Pre-enabling	34	-3	31	115	27%
Integration Partner	48	0	48	132	36%
Enabling works	0	0	0	117	0%
Statutory Undertakers	41	0	41	318	13%
Roads North	126	27	153	893	17%
A2/m ²	52	15	67	356	19%
Tunnel	232	16	248	1,330	19%
Technology (Highways England Framework)	5		5	24	20%
Total base cost	632	55	688	3,872	

Risk quantification

- 2.5.3 A detailed review has been undertaken to identify risks that may impact schedule and or the cost. A series of workshops have been held with the project teams to understand their view of where LTC risks lie, drawing on experience and lessons learnt from other projects.
- 2.5.4 An estimated monetary value (EMV) has been calculated for each risk by multiplying the average of the three-point estimate for that risk by the probability of occurrence of the risk. The sum of the individual EMVs totalled £632m in 2016 prices for the cost estimate.
- 2.5.5 Quantified Cost Risk Analysis (QCRA) has been undertaken to produce a cumulative likelihood distribution of risk using Monte Carlo simulation. The estimated monetary value of £632m (in 2016 prices) equates to the mode on this distribution curve.
- 2.5.6 The estimated monetary value for prolongation risk, a top project risk, has been generated from a Quantified Schedule Risk Analysis (QSRA). The QSRA maps risks to activities in the programme with probabilities of occurrence and a three-point time impacts. For LTC, the QSRA generated a P50 date of 29 weeks delay. The output of this delay has been quantified using the average weekly preliminaries cost. The prolongation risk has been modelled in the cost model (QCRA) using the standard approach of 100% probability with a min cost of delay associated with the P5 QSRA output, the most likely as the P50 and the max value as the P95. An allowance for the inflation impact associated with the prolongation has been included in the uncertainties.
- 2.5.7 The quantified risk includes all risks relating to LTC other than the High Impact Low Probability (HILP) risks, strategic risks and portfolio risks. The key cost risks for LTC include:
- potential increases in provision for land acquisition and compensation – for example, from uncertain movement in land prices and unknown value of business impacted by LTC
 - cost associated with potential delays, ie, prolongation – for example, the planning consent process could take longer than anticipated, leading to increase in direct cost and inflation
 - cost increases due to unknown ground conditions along the tunnel – for example, the chalk layer may contain flint leading to increased time and cost deal
 - cost increases due to close interfaces with existing assets – for example, unknown ground conditions for works in proximity to HS1 may cause vibrations and HS1 may seek additional cost
- 2.5.8 Appendix M shows the top 10 risks which represent % of the total of the risk provision together with the risk mitigation plans. As the contracts are procured, mitigation of the risk will be shared by client and contractor depending on which party is best placed to enact mitigation of the risk.

Uncertainties quantification

- 2.5.9 Uncertainties are top down specific adjustments identified by the project team following a review of the base cost and risk provision, for items which are difficult to quantify with any precision. These also include a small number of cost savings which are difficult to quantify with any precision. Appendix N provides a breakdown of the uncertainty provision.

Risk not included in the quantified project risk and uncertainties

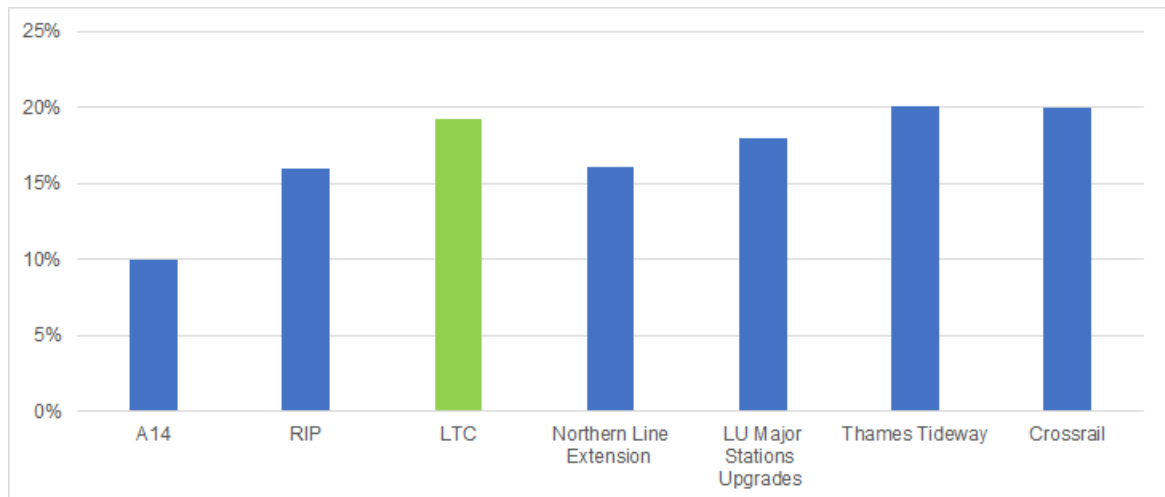
- 2.5.10 The portfolio risks sit outside the project risk and uncertainty quantification as a separate cost element.
- 2.5.11 The strategic risks are those that if occurred would fundamentally change the project nature. These risk by their nature cannot be quantified. These are reviewed regularly and escalated, if required but not quantified.
- 2.5.12 The HILP risks are those that if occurred, would have such a significant impact that it would almost certainly utilise all risk and contingency, including Treasury reserves. The project insurance will cover some of the HILP risks up to a defined value. In the event that these risks impact outside of the project insurance and value, additional cover will be sought from Treasury. This approach is line with other major infrastructure projects such as Thames Tideway. The top 3 project HILP risks are as below but are not limited to the tunnelling contract:
- a. Tunnel floods – relating to internal and external factors
 - b. Tunnel spoil management causes environmental contamination to the Ramsar
 - c. Tunnelling meets an unexpected cavern of greater than 25m diameter

Total quantified risk and uncertainties

- 2.5.13 The risk and uncertainty provision totals to 18% of the base cost. As seen in the Table 2.11 above, most of the risk and uncertainty relates to the three main construction contracts, land and enabling works. The development phase base cost includes risk and hence no separate allowance has been made for this cost element.
- 2.5.14 The approach to cost estimation and risk quantification varies from project to project, which makes it difficult for a direct and like for like comparison of the reasonableness of the risk provision.
- 2.5.15 We have however compared the risk and uncertainties provision on LTC against available data from other schemes within Highways England and with other infrastructure projects that involve an element of tunnelling as a high-level guide. The quantum of project risk as a percentage of the construction cost has been compared.
- 2.5.16 As the underlying data sets come from projects at different stages of their life cycle, with different approaches to estimation and probability analysis, any comparison and conclusion should be viewed with those limitations.

2.5.17 The Highways England projects are at most likely estimate, which average around the P40 confidence level and the non-Highways England projects are at P80 confidence level. The graph in Figure 2.2 below shows that overall the risk provision on LTC is broadly of a similar scale to other comparable projects.

Figure 2.2 Risk as a percentage of capital cost



2.5.18 Figure 2.2 shows that overall the risk provision on LTC is broadly of a similar scale to other comparable projects

2.5.19 The risk exercise undertaken is appropriate for the scale of LTC and the need to have a detailed understanding of quantification and mitigating actions for risks. The process undertaken is compliant with the Green Book methodology in risk categorisation and quantification, and is also in the process of continual refinement of risk definitions and amounts.

Non-recoverable VAT (£652m)

2.5.20 Highways England is subject to HMRC's Contracted Out Services regulations. Under these regulations for new road schemes, the amount of VAT that can be recovered is limited to the road works within the existing highway boundary. This means for LTC where there is a significant amount of new land required to be added to the highway boundary there is a high proportion of NR VAT.

2.5.21 NR VAT on construction cost has been assessed separately for the Roads North, tunnel and A2/M2 sections. The VAT on the tunnel including the approach ramps and portal is non-recoverable. For the highways, we have assessed the proportion of the works outside the existing highways boundary on the individual sub sections against the key cost components. Table 2.12 below provides a breakdown of NR VAT.

Table 2.12 Non-recoverable VAT assessment

Cost categories	NR VAT %	NR VAT (£m)
Pre-enabling Works	92%	21
Integration Partner	92%	30
Enabling works	92%	19
Statutory Undertakers	92%	66
North Roads	90%	163
A2/M2	85%	62
Tunnel	100%	285
Technology (Highways England framework contracts)	92%	4
Total NR VAT		651

Inflation (£1,446m)

- 2.5.22 The costs are estimated at Q1 2016 prices and inflation is applied using the RP2 inflation profile contained in Table 2.13 below. The inflation is applied to the base cost, risk and uncertainty and NR VAT.
- 2.5.23 The RP2 inflation profile is a bespoke index developed by Royal Institution of Chartered Surveyors Building Cost Information Service (BCIS) for Highways England for estimating capital enhancement works.
- 2.5.24 The inflation assumptions within this profile are the same as those agreed with ORR/DfT for the RP2, except for assumptions up to 2019/20, which are based upon actuals (highlighted in the Table 2.13 below) These are based on actuals in the RP2 profile adopted on LTC.

Table 2.13 RP2 inflation profile (Financial Year)

Financial Year	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Inflation Profile														
MIN %	3.30%	2.10%	3.00%	2.65%	2.41%	2.75%	3.57%	3.25%	2.53%	2.19%	2.32%	2.43%	2.53%	2.61%
MOST LIKELY %	3.30%	2.10%	3.00%	3.65%	3.41%	3.75%	4.57%	4.25%	3.53%	3.19%	3.32%	3.43%	3.53%	3.61%
MAX %	3.30%	2.10%	3.00%	4.65%	4.41%	4.75%	5.57%	5.25%	4.53%	4.19%	4.32%	4.43%	4.53%	4.61%

Portfolio risk (£396m)

- 2.5.25 Portfolio risk covers the consideration and management of risks which present a threat to the successful outcome of all projects in a specific portfolio. Examples of portfolio risks include changes in government policy, air quality policy changes, extreme events (such as foot and mouth disease, civil unrest, etc.). While this is titled 'portfolio' risk as the risks are not specific to a particular project it is calculated at project level. The allowances in various stages are fixed and the mode of calculation does not vary by project.
- 2.5.26 In accordance with the recognised inverse relationship between increased project maturity and decreased exposure to the impact of uncertain events, the 'allowance' for portfolio risk decreases as projects progress through the development lifecycle. Portfolio risk is high during the early stages and reduces as a project gets closer to delivery.
- 2.5.27 The level of portfolio risk included in the LTC cost estimate is £396m. As LTC matures and gets closer to delivery, this number will reduce.

2.6 Cost profile

- 2.6.1 Table 2.14 below shows the annual profile of outturn capital costs for LTC, based on the schedule included in the Appendix Q – Level 0 Programme.

Table 2.14 Annual profile for LTC estimate (£m) outturn prices

Cost categories	Historic Pre 19/20	Historic 2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	Total
Options phase (Including pre-options)*	28												28
Development phase*	160	70	50	25	19	0	0	0	0	0	0	0	324
Land*		23	45	77	72	0	0	0	0	0	18	0	235
Pre-enabling works		71	42	2	0	0	0	0	0	0	0	0	115
Enabling works			4	0	62	31	8	5	5	1	0	0	117
Statutory Undertakers (inc TPI Cost)			20	56	81	115	39	6	0	0	0	0	318
Integration Partner			5	12	23	15	20	20	17	15	5	0.44	132
Technology (HE framework contracts)			0	0	1	1	2	2	9	4	4	0	24
Roads North			5	2	72	178	245	242	138	11	0	0	893
A2/M2			0	0	39	74	78	74	55	37	0	0	356
Tunnel			0	0	167	229	263	330	263	79	0	0	1330
Risk			51	95	87	82	111	97	68	33	8	0	633
Uncertainty			0	12	28	4	4	2	2	4	0	0	55
Opportunities			-7	-35	-50	-51	-54	-47	-44	-14	-1	0	-302
Inflation			12	21	165	241	294	340	267	98	8	0.31	1446
NR VAT			26	12	83	127	134	138	98	32	1	0.08	652
Subtotal: LTC cost including inflation	188	164	254	280	849	1046	1144	1209	878	301	43	0.83	6356
Portfolio risk			11	15	75	70	71	76	56	17	4	0.05	396
Total cost	188	164	265	295	925	1115	1215	1284	934	318	47	0.88	6752

3 Funding requirements and affordability

3.1 Forecast funding

3.1.1 Table 3.1 below shows the cost estimate range for LTC, with the lower end representing the P10 point, the upper end representing the P90 point and the most likely estimate approximating to a P43 point on the probability distribution curve.

Table 3.1 Cost estimate range (£m)

Confidence levels	P10	P20	P30	P40	P43 (Most Likely estimate)	P50	P60	P70	P80	P90
Estimate in outturn prices	5,273	5,790	6,219	6,616	6,752	7,007	7,410	7,846	8,350	9,018

3.1.2 Highways England typically funds projects at the Most Likely estimate and manages risks and the potential for higher or lower costs across its Capital Portfolio.

3.1.3 For LTC the cost and risk profile is materially different from the wider Highways England's Capital Portfolio in terms of scale, complexity and the level of impact any potential change, in either the cost or the risk provision, would make. The scale of the project is such that if it were funded wholly within the RIS then it would unbalance the portfolio as any changes to the cost would have a disproportionate effect and potentially mean that other projects might have to be cancelled should LTC risks materialise. In line with Government guidance, a different level of contingency is recommended for LTC.

3.1.4 Highways England has agreed with HMT that P70 is an appropriate level of funding. This funding level provides an appropriate allowance for contingency and changes to costs while also protecting against the potential for wastage if the funding level is set too high, and costs not controlled. In addition, to help avoid against this, it has been agreed that funding up to P70 is held by HMT with Most Likely funding allocated to Highways England.

3.1.5 It was also confirmed in the Budget Statement in March 2020 that LTC funding would be ringfenced. The management and reporting of contingency is under discussion with DfT and HMT as is the position with regards to annual flex available for LTC to utilise to maximise efficiency. The position on these points will be of particular relevance during the delivery phase and will therefore be agreed and signed off prior to the Full Business Case submission.

3.1.6 Based on the cost estimate in this OBC this would mean overall funding of £7.846bn should be allocated made up of a contingency/Risk Reserve of £1.094bn held by HMT and £6.752bn project funding held by Highways England.

3.1.7 Table 3.2 below shows the forecast annual funding profile.

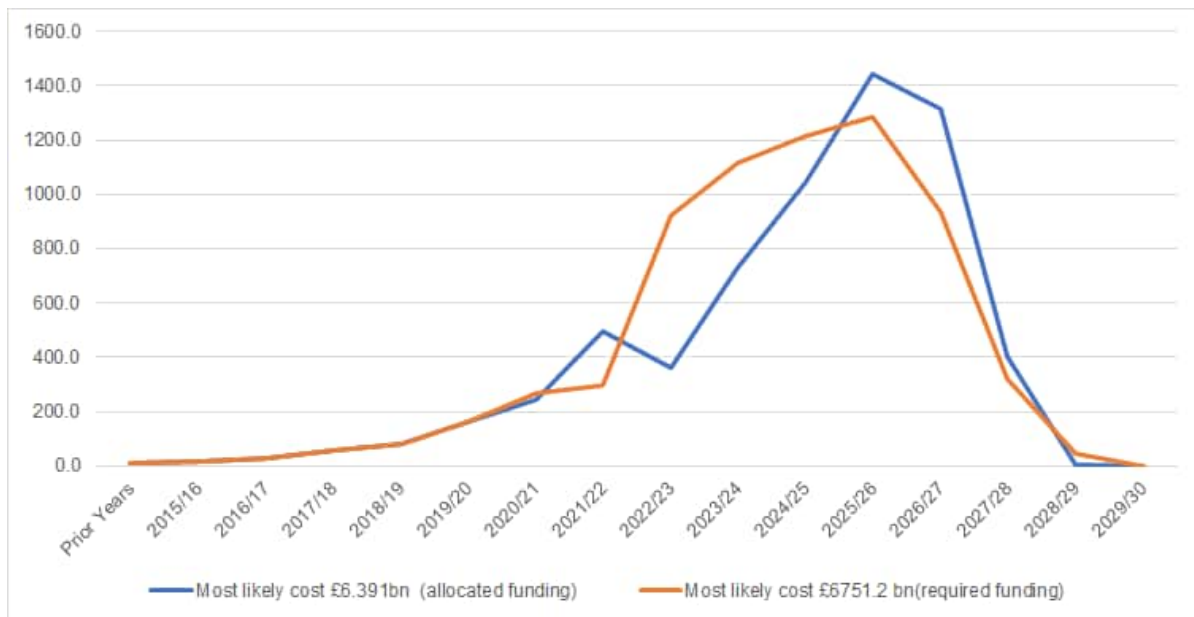
Table 3.2 Forecast annual funding requirement profile (£m) outturn prices

Financial Year	Historic costs	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	Total
Particulars													
Most Likely cost (P43)	188	164	265	295	925	1,115	1,215	1,284	934	318	47	1	6,752
Add: additional contingency	0	0	45	50	158	191	208	220	160	54	8	0	1,094
Total: Funding requirement (P70)	188	164	310	346	1,083	1,306	1,423	1,504	1,094	373	55	1	7,846

3.2 Funding and affordability analysis

- 3.2.1 In March 2020 of £7.2bn was allocated to the project split between Highways England RIS2 funding, assumed Highways England RIS3 funding and HMT Risk Reserve as shown in Table 3.3. This funding aligned to the 2019 OBC.
- 3.2.2 The updated cost forecast would suggest that this level of funding will be insufficient and that if funding is allocated on the same basis as that in March 2020 total funding of £7.8bn will be required, as shown in Table 3.3. In addition, the annual profile of the current forecast expenditure profile differs from the March 2020 funding as indicated by Figure 3.1.

Figure 3.1 Allocated funding vs forecasted funding



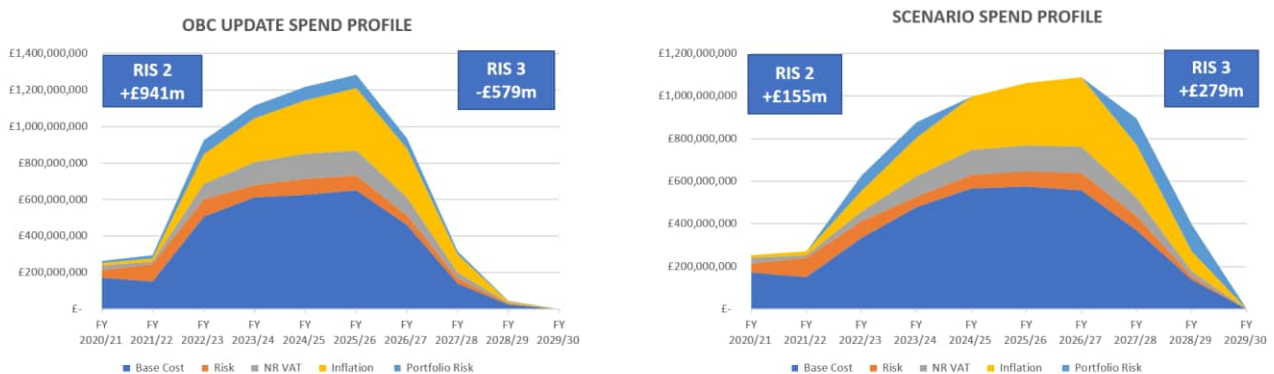
- 3.2.3 The overall spend profile has shifted to the left, with peak spend now forecasted in the later years of RP2 period as compared to the previous assumption of peak expenditure in early years of RP3 period. There is also a small element of reprofiling in the early years of RP2 and therefore the funding requirement in FY 2021/22 is slightly below the RP2 allocation.

Table 3.3 Revised forecast and allocated funding by year (£m)

	Pre RIS	RIS	RIS2					RIS 2 Total	RIS	Total
			2020/21	2021/22	2022/23	2023/24	2024/25			
Most likely cost (ML)	10	342	265	295	925	1115	1215	3815	2585	6751
Additional contingency with Treasury (P70 less ML)	0	0	45	50	158	191	208	652	442	1094
Total: Required funding	10	342	310	346	1083	1306	1423	4467	3026	7845
Allocated funding/ (commitment for RP2)										
Highways England RIS (ML)	10	344	245	495	359	728	1,047	2,874	3,164	6,391
Treasury risk reserve (P70 less ML)			41	41	17	17	17	131	690	822
Total: Allocated funding / (commitment for RP3)	10	344	286	536	376	745	1,063	3,006	3,854	7,213
Gap between current forecast and allocated funding										
Highways England RIS (ML)		2	-20	200	-566	-387	-168	-941	579	-360
Treasury risk reserve (P70 less ML)		0	-5	-10	-141	-174	-191	-521	249	-272
Total: Gap in allocated funding / (commitment for RP3)	0	2	-25	190	-707	-561	-359	-1462	827	-633

- 3.2.4 The RIS2/RIS3 boundary falls close to start on site (SoS) making it a particularly volatile time for the project cashflow, as the speed of ramp up/mobilisation has disproportionate impact on the final two years of RIS2. The cash flow presented in Table 7 reflects the earliest mobilisation and a high level of risk expenditure within the RIS2 period.
- 3.2.5 The project team have therefore specifically considered whether further funding is required within RIS2. The team have run several scenarios, testing the cashflow in RIS2 whilst maintaining the DCO grant and opening dates, and have reached the conclusion that the project can keep within the current Budget allocation.
- 3.2.6 As with any major project of this scale, focusing on segments of the cashflow is problematic, and the project team will continue working this issue up to FBC, but the basis of our conclusion and management levers to do so are as set out below:
- 3.2.7 The profile of risk (both cost and schedule) has a major impact on the overall cost profile during construction. We have therefore considered when & where risks are likely to materialise and have modelled this in the scenario shown in Figure 3.2 below and compared it to the profile included in the updated OBC.

Figure 3.2: Comparison of spend profile between the OBC update and scenario



3.2.8 The two profiles differ in 4 ways as shown in Table 3.4 below:**Table 3.4: Differences between profile and scenario**

	OBC Update [Earliest possible mobilisation with high level of early risk expenditure]	Scenario [Most likely mobilisation and benchmarkable approach to risk]	RIS2 Impact
Schedule Activities	Activity period = Base + Duration Uncertainty	Activity period = Base + Duration Uncertainty + Risk	£-550m
Project Risk	Risk linked to associated activity	Risk lagging on “bow wave” profile	£-79m
Ringfenced LTC contingency	Flat annual %	Back-end loaded	£-97m
Inflation	HE approved profile	2019/20 inflation changed to “actual”	£-91m
Remaining RIS2 overspend			£+155m +5%

Schedule Activities:

3.2.9 In the updated OBC baseline we have aligned the base costs to associated activities in accordance with the planned schedule and then allowed for duration uncertainty.

3.2.10 In the scenario we have included duration risk (at most likely) to each of the activities which extends the period over which the costs are profiled. This gives a more aligned representation as it accounts for both the risk costs and the risk of delay on the same basis.

Risk Profile:

3.2.11 Risks are linked to associated activities but an observed feature on all major projects is that there is a time lag between the activity and materialisation of costs associated with risk events. This has therefore been adjusted for in the modelling for the scenario shown. This has therefore been adjusted for in the modelling for the scenario shown

Ringfenced LTC contingency:

3.2.12 In the OBC estimate this has been profiled as a flat percentage of project spend in each year. The scenario modelling takes account of the fact this risk will always be back end loaded as we would not seek to request permission to use this until project risk has been used up

Inflation

3.2.13 An adjustment has been made to account for the “actual” inflation rate for 2019/20

Overall

3.2.14 The net impact of the adjustments described is that the projected project overspend in RIS2 has reduced to c £155m against a total RIS2 approved budget of £2.8BN is +5%.

3.2.15 The associated cash flow is shown in Table 3.5

Table 3.5 – Cashflow updated for revised cash flow scenario

Project profiles (£m):	Prior Years	Roads Period 2					RP2	RP3	Total Project
		20/21	21/22	22/23	23/24	24/25			
Most Likely (including HE Risk Reserve)									
Agreed Funding	353.2	245.0	495.4	359.1	728.1	1046.6	2874.2	3163.5	6390.9
Latest Forecast	352.0	254.1	282.3	616.5	877.3	998.9	3029.1	3442.9	6824.0
Surplus / (Shortfall)	1.2	(9.1)	213.1	(257.4)	(149.2)	47.7	(154.9)	(279.4)	(433.1)

3.2.16 Although the total project cost in this scenario is more than the £6,752m due to a slight inflationary increase – it is not suggested the cost estimate be changed at this time and the difference of £72m will be treated as a cost pressure.

3.2.17 At this stage of the project with high levels of fixity on scope and design, ahead of engaging with an increasingly competitive market it is felt that this is within acceptable margins of error.

3.2.18 However, should an overspend manifest there are several key levers that the project can use to manage an overspend of this nature which include:

- Adjusting delivery timeframes not on the critical path:

For example: The construction of Roads North is not on the critical path and it has been estimated that this could be delayed by up to one year without an impact on the project cost or schedule. There is therefore an option to delay this work, if required, to enable the project to manage within its budget. Reduced impact on RIS2 cashflow would be c £300m.

- Adjusting start or peak expenditure:

At its peak, the monthly project spend will be c £100m. A slight delay in activities could therefore be used to manage an overspend of this order of magnitude, with limited impact on the opening date.

3.2.19 Following the FBC, all the main works contracts will be awarded, and we will have expenditure plans based on the contractor's construction programmes. In addition, any conditions stemming from the DCO will also be included. At this time, we will have a much more accurate view of the annualised funding needs of the project.

3.2.20 The modelling has given us confidence that we have sufficient opportunities to manage spend in the latter part of RIS2 to enable us to ensure that this profile does not exceed the Budget allocation in this period. But it does highlight the need for continued focus on affordability overtime as well as on total cost and time.

4 Budgets and funding authority

4.1 Overview

- 4.1.1 Highways England is proposing to charge for the use of LTC for long term network performance management and, as such, the charge is expected to continue for a foreseeable future.
- 4.1.2 A summary of LTC's current authorised funding and future points is summarised in Table 4.1 below.

Table 4.1 Funding authorisations, £m outturn costs

Approved	Prior years	RP1					RP2					RP3					Total
		2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	
Options phase	10	17	1														28
Development phase			27	55	78	70	50	25	19								324
Lands						23	45	7									75
Enabling works						71	170										241
Total: Approved funding	10	17	28	55	78	164	265	32	19	0	0	0	0	0	0	0	668
Approval in 2020/21																	
Lands								49	25								74
Enabling works								188	50								238
Highways England Risk Reserve								26									26
Total: Approval sought 2020/21	0	0	0	0	0	0	0	263	75	0	0	0	0	0	0	0	338
Approval at FBC																	
Lands									47						18		65
Construction works									709	1045	1144	1208	878	300	25	1	5310
Highways England Risk Reserve									75	70	71	76	56	18	4		370
Total: Approval sought at FBC	0	0	0	0	0	0	0	0	831	1115	1215	1284	934	318	47	1	5745
Treasury Risk Reserve								96	158	191	208	219	160	54	8		1094
Total: Funding for LTC	10	17	28	55	78	164	265	295	925	1115	1215	1284	934	318	47	1	6751

4.2 Authorised funding reconciliation

4.2.1 The total approved funding for LTC is £668m. This comprises of £28m for options phase, £324.4m for the development phase and £316m for land and early enabling works for 2019/20 and 2020/21. A summary of the actual spend is included in Table 4.2 below.

Table 4.2 Actual spend against the funded authority, £m outturn costs

Funding authority	Authorised funding to date	Actuals to March 2020	2020/21 forecast	Remaining funding authority	Comments
Options phase	28	28			Actual
Development phase	324	230	50	44	Reallocate funding for PFI advisory towards other services
Land and pre-enabling works for 2019/20 and 2020/21	316	94	215	7	Forecast spend is in line with authorised funding
Total	668	352	265	51	

4.3 Development phase reconciliation

4.3.1 In June 2017, Highways England's Investment Decision Committee (IDC) endorsed the full development phase expenditure of £324.4m, including £12.3m for land, £38.5m for PF advisory and contingency totalling to £32.5m.

4.3.2 Leading up to the Government's policy change in October 2018³ on the use of PF2, we have spent £1.1m on PF financial and legal advisors. The PF advisory activity has been stopped. While we do not envisage spending any further on the PF advisors, there has been a need to increase our forecast spend in several areas relating to our technical partner spend. The increased Technical Partner costs are mainly due to:

- commercial and procurement activities for developing three public funded contracts
- programme delay of 10 months to the DCO submission
- iterations of the design and additional consultations and surveys to address the Statutory Bodies and key stakeholder concerns

4.3.3 We have also spent more than expected on Statutory Blight. The reduced PF legal and financial advisors forecast of £37.4 m is therefore required to balance the increased Technical Partner and land spend.

4.3.4 Table 4.3 below sets out the actual and proposed spend of £324.4m development phase budget approved in June 2017.

³ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/752173/PF2_web_.pdf

Table 4.3 Development phase budget approved in June 2017 (£m)

£M	Approved funding June 2017	Total
Interim Project Management services		12.12
DCO legal support		4.64
Project Management (Highways England)	8.20	16.77
Assurance services (Highways England)	17.90	9.95
Project Management, controls and office management		50.67
Highways and structures engineering		28.86
Tunnel engineering		22.97
Procurement & Commercial management inc, cost planning		25.83
Traffic & Economics		10.18
Construction logistics		16.81
DCO preparation and response		11.63
Environment		5.88
Stakeholder engagement, comms & external affairs		25.02
Geotechnical		13.23
Health, safety & welfare		4.04
Third party infrastructure, land & property services		11.36
Benefits & Legacy		1.26
Sub total: Technical Partner (Cascade JV)	174.50	227.74
Non resource cost procured by Highways England	11.20	10.23
Non resource cost procured by Technical Partner	25.20	19.95
Advisory services: Finance & Legal)	4.10	
Advisory services: PFI	38.50	1.13
Sub-total	279.60	285.76
Land costs for development phase	12.30	27.34
Project Risk and Uncertainty provision	23.40	10.58
Portfolio Risk provision	9.10	0.00
TOTAL FOR DEVELOPMENT PHASE	324.4	323.69

5 Operations, maintenance and renewal cost

5.1 Overview

- 5.1.1 We need to provision £20m per annum, plus inflation for operations, maintenance and renewal (OMR) from the OfT date in 2028.
- 5.1.2 Table 5.1 below shows the OMR cost estimate likely to be incurred over a 60-year operating period in real and outturn prices.

Table 5.1 Real and nominal OMR

Operations, Maintenance and Renewal costs	Total cost over the 60-year assessment period (2016 prices) £m	Total cost over the 60-year assessment period (outturn prices) £m
Highways	461	1,523
Tunnel	602	1,892
Total	1,063	3,415

- 5.1.3 The OMR inflation rates are based on HECMI index and consistent with OMR inflation rates across the portfolio of highway schemes. The OMR cost will form part of our operational budget and any risk allowance on the cost will be dealt with through Highways England central budgeting process.

5.2 Highways

- 5.2.1 OMR estimates for the highways has been produced on an incremental basis considering the extensive work on the existing highway corridors. Estimates are structured as operations (fixed annual operating costs) and routine annual maintenance, periodic asset reviews and betterment (from the renewal or removal of aged assets within the existing maintenance burden).
- 5.2.2 LTC impacts the existing maintenance areas of the M25 DBFO and Area 4. For the purposes of the estimate, we have assumed that the works on the M25 mainline, LTC-M25 junction and A13 will be incorporated into the M25 DBFO contract incurring a premium on operation and maintenance rates up to the end of the M25 DBFO concession period.
- 5.2.3 The estimated costs of periodic assets renewals for highways are based on the standardised renewal frequencies used across the strategic road network (SRN).
- 5.2.4 It is assumed that the Asset Delivery model will be used for operations. Estimated costs therefore assume a level of service consistent with the proposed Asset Delivery Cyclical and reactive maintenance delivery plan, Severe Weather Plan and Incident response plans for the SRN.

5.3 Tunnels and Approaches

- 5.3.1 For the tunnel, an assumed schedule of assets has been developed to quantify the routine operation and maintenance activities, the energy load and the periodic asset renewals using assumed renewal/refurbishment frequencies as

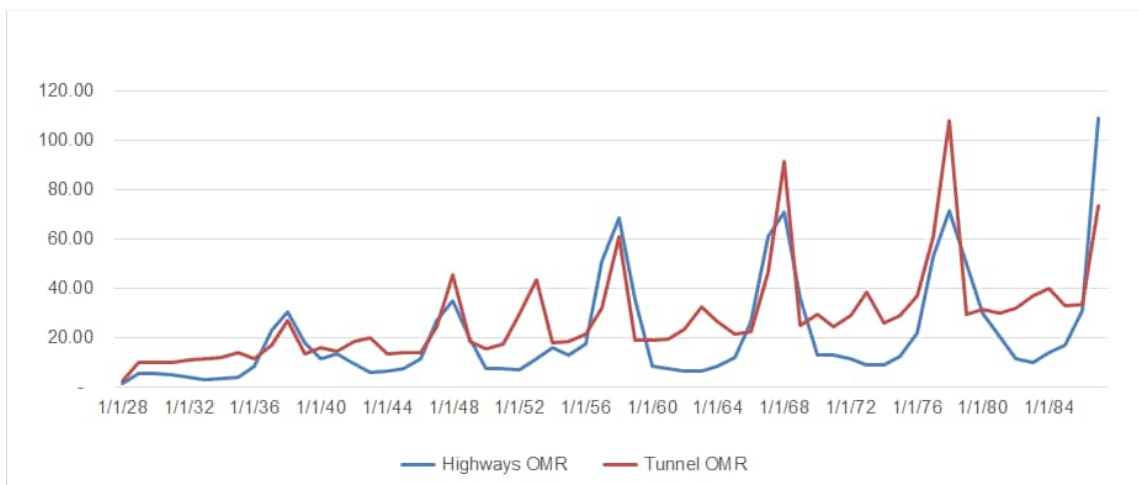
the tunnel Mechanical, Electrical, Instrumentation, Controls, Automation (MEICA) systems are not yet fully designed.

5.3.2 Energy cost are included within the Tunnel OMR

5.3.3 There is limited data available for operation and maintenance costs for tunnels of this scale. Costs have been benchmarked versus A3 Hindhead data and captured cost data for existing D3AP tunnels in Sydney; but are inherently more uncertain than the highways sections, particularly pending the full design development of tunnel MEICA systems

5.3.4 The annual profiling assumptions of the above costs are shown in Figure 5.1. The higher levels of maintenance and renewal in some years relate to specific renewal periods of discrete highway and tunnel assets.

Figure 5.1 Tunnel and Highway OMR (in outturn cost, £m)



6 Revenue from road user charge

6.1 Overview

- 6.1.1 Highways England is proposing to charge for the use of LTC for long term network performance management and, as such, the charge is expected to continue for a foreseeable future.
- 6.1.2 As set out in detail in the Section 3.4 of the Economic Case, equal charges will apply to LTC and Dartford Crossing. The assumption is that the current charges at Dartford Crossing will apply, subject to inflation.
- 6.1.3 Highways England currently manages the revenue from Dartford on a protocol basis with the revenue it collects being returned to the DfT. A similar arrangement is being assumed for the LTC which means that user charge revenue and the related charge collection cost would accrue to the government and not Highways England.
- 6.1.4 Table 6.1 below shows the charge revenue to the Government from LTC and Dartford Crossing Charging Schemes on an absolute and incremental basis over the 60-year assessment period. It also shows the forecasted reduction to charge revenue from Dartford Crossing as some of the traffic using Dartford would move to LTC when LTC opens.

Table 6.1 Forecasted net charge revenue (£m)

Forecasted net charge revenue £ in m		RIS3					Future RIS Years			Total
		FY 2025-26	FY 2026-27	FY 2027/28	FY 2028/29	FY 2029/30	FY 2031/40	FY 2041/50	FY 2051/60	
Total revenue from LTC and Dartford Crossings	a (b+c)			0	109	227	2713	3695	27250	33995
Lower Thames Crossing	b			0	40	84	1011	1388	10297	12821
Dartford Crossing (with LTC)	c			0	69	143	1702	2306	16954	21174
Change in Dartford revenues										
Change in Dartford revenues	d (b-e)			0	-19	-37	-354	-322	-1691	-2424
Dartford Crossing (with LTC)	b			0	69	143	1702	2306	16954	21174
Dartford Crossing (without LTC)	e			0	88	180	2056	2629	18645	23598
Incremental revenue to the Government										
Incremental revenue to the Government	f (a-e)			0	22	47	657	1066	8606	10397
Total revenue from LTC and Dartford Crossings	a			0	109	227	2713	3695	27250	33995
Dartford Crossing (without LTC)	e			0	88	180	2056	2629	18645	23598

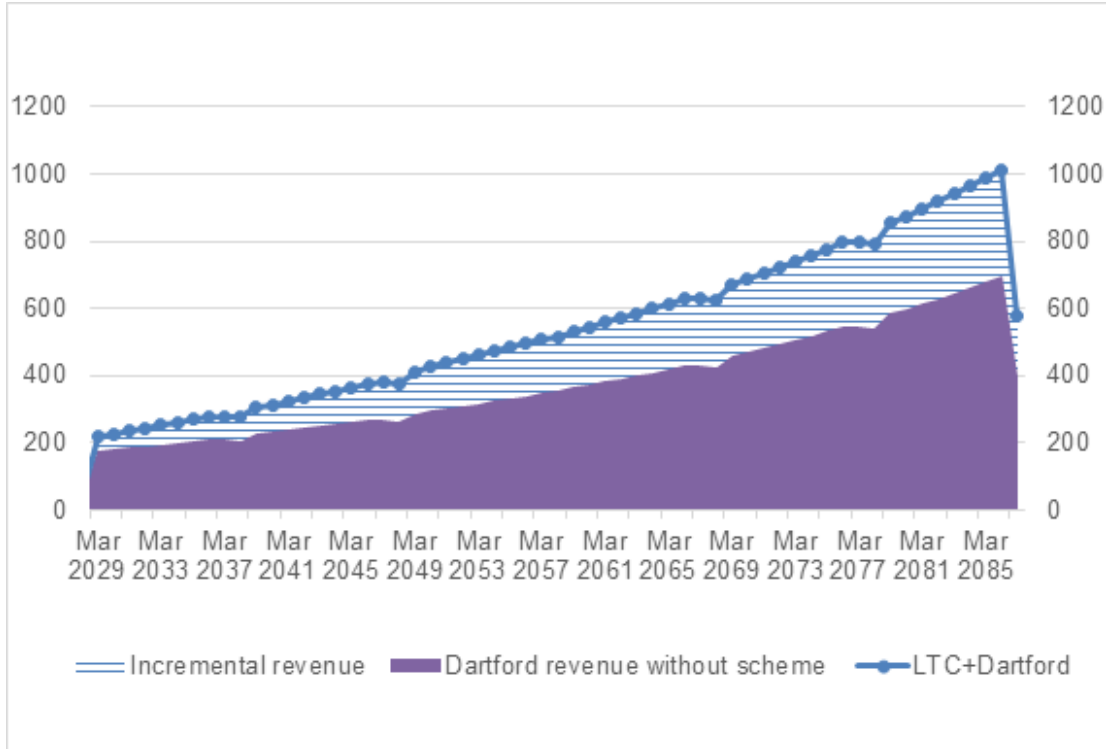
Note: Financial Years 2025/26 to 2027/28 of RIS3 do not attract any revenue as the road is not open

Net charge revenue includes collection costs and enforcement income and enforcement cost.

This analysis is based on an Open to Traffic date of October 2028, the 60-year assessment period covers October 2028 to September 2088.

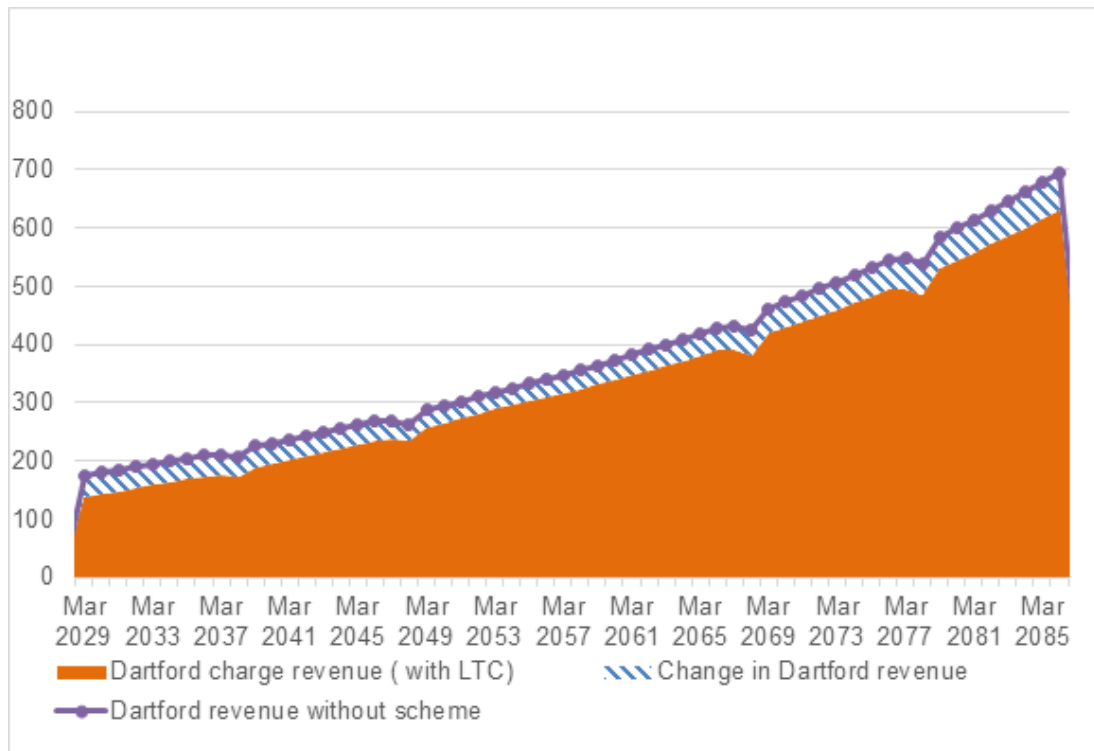
6.1.5 Figure 6.1 and Figure 6.2 below illustrate change in Dartford revenue over the 60-year assessment period and the build-up of incremental revenue to the government.

Figure 6.1 Incremental charge revenue to the Government with LTC (£m)



Note Small reduction in net charge revenue in some years relates to renewal of specific user charging assets such as cameras

Figure 6.2 Change in the charge revenue from Dartford Crossing as result of LTC (£m)



Note Small reduction in net charge revenue in some years relates to renewal of specific user charging assets such as cameras

6.2 Key assumptions

6.2.1 The revenue is a function of traffic forecast and charge. The key assumptions underpinning the revenue forecast are explained below.

Charge revenue

6.2.2 The current charge at Dartford crossing will apply to LTC.

6.2.3 The Dartford Charge will remain unchanged from today's prices except for an assumed annual RPI inflation increase.

6.2.4 The traffic modelling and the revenue forecasts are based on average Dartford Charges. The average Dartford Charge has been calculated by adjusting the published Dartford Charge for expected proportion of account holder and non-account holder, prepayments, discounts and differences in vehicle classification.

6.2.5 Table 6.2 below sets out the present Dartford Charge and the average Dartford Charge for different vehicle classes.

**Table 6.2 Dartford Charge and average Dartford Charge
for different vehicle classes**

Particulars	Present Dartford Charge per trip (£)		Average Dartford Charges per trip (£)
	One-off payment	Account payment	Assumption for traffic modelling and revenue forecast
Car	2.5	2.00	1.78
LGC (Van)	3.00	2.63	2.41
HGV (Lorry)	6.00	5.19	4.26

6.2.6 The traffic forecast for LTC and Dartford up to 2051 is set out in detail in the Section 2.3 of the Economic Case. No growth in traffic is assumed beyond 2051.

6.2.7 Most of the users are expected to comply with the scheme and pay the relevant charge. Fines and penalties are enforced for late payment or no payment. The forecasted charge revenue recovered through enforcement is circa £0.08 pence per trip. Forecasted revenue from fines is circa £0.64 per late or no payment is based on the averages observed at Dartford. This has been included in the revenue forecast.

Collection cost

6.2.8 Collection costs are based on the existing Dartford Charge collection contract. Much of the collection cost is variable with only a small element of fixed cost associated with supplier overheads.

6.2.9 The average variable collection cost is £0.32 per trip and the annual fixed cost under the Dartford Charge contract is c.£3m. It is assumed that the incremental traffic can be accommodated within the collection contract and therefore the total fixed costs remain unchanged.

6.2.10 The cost for processing and recovering fines (also referred as enforcement cost) sits outside the collection cost. The variable enforcement cost is c.£0.23 pence per trip and the fixed enforcement cost is £1.5m based on averages seen at Dartford Crossing.

6.2.11 Compliance rates on Dartford Crossing have improved in recent times. This combined with a more efficient approach taken towards enforcement processes has the potential to increase average charge revenue and lower the enforcement collection cost.

Inflation

6.2.12 The charges are expected to increase annually by Retail Price Index (RPI). The collection cost is assumed to increase by Consumer Price Index (CPI), this is also the current inflation mechanism on Dartford collection contract.

6.2.13 The short-term forecast for RPI and CPI are taken from published material by Office for Budget Responsibility (OBR). We have assumed a long-term RPI forecast of 2.5% and CPI forecast of 2%.

6.3 Sensitivities to charge revenue

- 6.3.1 The Economic Case presents the traffic forecasts under high and low economic growth scenarios based on the TAG Data Book⁴. Table 6.3 below shows the impact on the net user charge revenue under these two scenarios, compared to the central traffic scenario considered for the OBC. The results are in +3 to -6 range for the user charge revenues under high and low growth forecasts respectively.
- 6.3.2 The key assumption here is that the user charges across the different growth scenarios remain the same, which provides a foundation for a comparative assessment.

Table 6.3 Revenue generated via Dartford and Lower Thames Crossing road user charging schemes; traffic volume sensitivity (£m)

Forecasted net change revenue from LTC and Dartford Crossings (£m)	RIS3					Future RIS years			Total
	FY 2025-26	FY 2026-27	FY 2027-28	FY 2028-29	FY 2029-30	FY 2031-40	FY 2041-50	FY 2051-88	
High growth	-	-	-	114	237	2835	3832	27953	34971
Central growth	-	-	-	109	227	2713	3695	27250	33995
Low growth	-	-	-	104	215	2562	3495	25812	32187

⁴ <https://www.gov.uk/government/publications/tag-data-book>

7 Net cost of LTC to the Government

7.1 Net cost and revenue

7.1.1 Under the arrangements outlined in Section 6, the charge revenue from LTC will accrue to the Government which means from a Highways England perspective it cannot assume this revenue will be available to fund the ongoing OMR costs.

7.1.2 However, to assist decision making and long-term financial planning across Government, the cost of LTC has been assessed against the charge revenue from LTC on both an absolute and an incremental basis.

7.1.3 Figure 7.1 below shows that the incremental net charge revenue to the Government would cover LTC's OMR cost on an annual basis. On a cumulative basis over a 60-year assessment period, the incremental net charge revenue would also cover LTC's capital cost. The total cost and revenue numbers are included in Table 7.1 below

Figure 7.1 Net cost and revenue to the Government (£m)

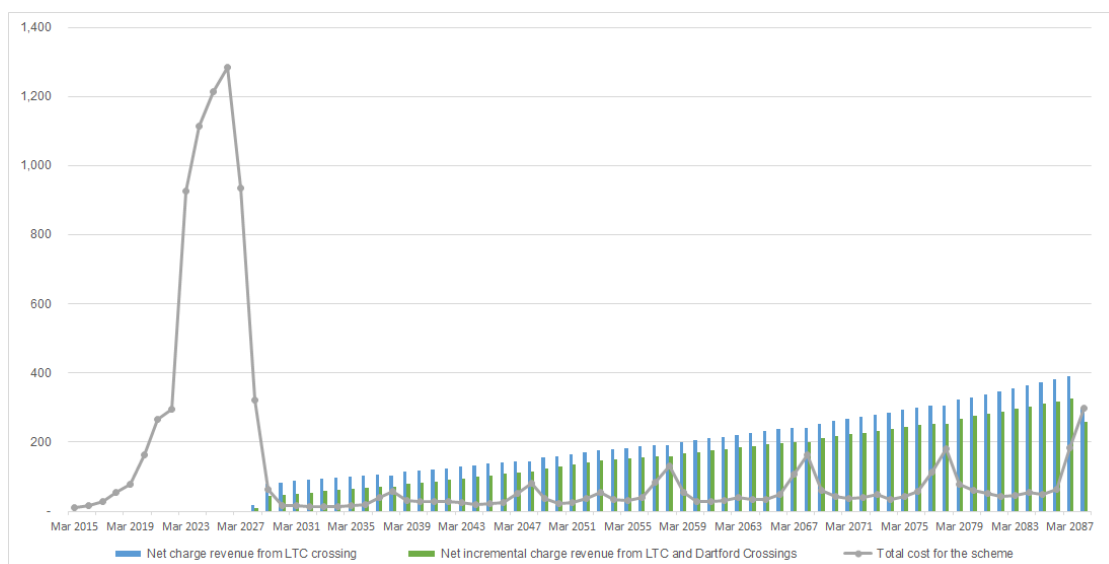


Table 7.1 Net cost and revenue to the Government (£m)

Net flows to the Government (£m)	Prior years	RIS1	RIS2	RIS3 FY 2025/26 – FY 2029/30	Future years FY 2030/31 – FY 2087/89	Total
Capital cost for the scheme	10	343	3815	2,585	0	6752
Operating, maintenance renewal cost for the scheme	0	0	0	23	3392	3415
Total cost for the scheme	10	343	3815	2607	3392	10157
Net charge revenue from LTC crossing	0	0	0	124	12696	12821
Net incremental charge revenue from LTC taking into account change in Dartford flows due to LTC	0	0	0	68	10329	10397

Lower Thames Crossing

Outline Business Case

Management Case

Lower Thames Crossing Outline Business Case

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1 Introduction

1.1 Purpose of the Management Case

- 1.1.1 This section of the Outline Business Case (OBC) presents the Management Case for the Lower Thames Crossing project (LTC), setting out how the project will be controlled and governed through the development phase.
- 1.1.2 This phase includes development of the project design, submission and examination of the development consent order (DCO), procurement of the main works contracts and delivery of most of the early works.
- 1.1.3 The proposed approach to the construction phase, is also set out at a high level. This phase includes construction, commissioning, handover and close out. The detailed approach to the management of this phase will be presented in the Final Business Case (FBC). The FBC will also set out, in detail, the arrangements for post project evaluation of outcomes and efficient long-term management of the asset.
- 1.1.4 The purpose of this Management Case is to demonstrate:
- a. robust management arrangements for programme, cost, change, contract, risk and benefits management showing these are in accordance with recognised programme and project management methodologies
 - b. we have the appropriate organisational arrangement and supporting operating model to economically and efficiently deliver the works
 - c. we are running the procurement of the works in accordance with recognised good practice and subject to effective governance
 - d. we have the capacity and capability to deliver LTC successfully, maximising the benefits it will deliver across a range of objectives
 - e. the arrangements for monitoring of progress
 - f. the approach to assurance and approvals through the life of the project.
- 1.1.5 In January 2016, a Strategic Outline Business Case (SOBC) was approved by the Department for Transport (DfT) and HM Treasury (HMT) confirming that the proposed crossing at Location C (See Strategic Case Figure 5.1) would meet the policy and strategic objectives of government and Highways England.
- 1.1.6 In December 2019 the OBC was approved by DfT. A review of cost and schedule was undertaken from January to June 2020. It was agreed that if this resulted in material change to schedule or cost or BCR that the OBC should be updated. The OBC has been updated accordingly and has also been updated to reflect:
- a. Changes to the procurement strategy following feedback from independent reviews and market feedback following the outbreak of the COVID-19 pandemic.
 - b. Development of the role of the Integration Partner and the Integrated Client Team approach
 - c. Confirmation by HMT of full public funding of the project following the Chancellor's decision not to partially use private funding. HMT have also confirmed that LTC

grant will be ring-fenced and the project will be funded at a P70 level, with the difference between Most Likely and P70 to be held as a Treasury Reserve.

- d. Proposed changes to the governance and operating model following the decision that LTC will be its own Directorate within HE. The approval of these changes is occurring in parallel with the OBC.
- e. further public consultation processes

1.1.7 The Management Case is structured as follows:

- Section 1 – Introduction
- Section 2 – Organisational structure and roles
- Section 3 – Operational model development
- Section 4 – Governance and assurance
- Section 5 – Managing key activities
- Section 6 – Benefits realisation management
- Section 7 – Communications and stakeholder management
- Section 8 – Project management
- Section 9 – Post project close out – ongoing management

1.2 Project outputs

1.2.1 LTC is described in full in the project description¹. In summary it will deliver:

- a. approximately 14.5 miles (23km) of new roads connecting the tunnel to the existing road network
- b. three lanes in both directions, for most of the route, with a maximum speed limit of 70mph
- c. improvements to the M25, A2 and A13, where LTC connects to these roads
- d. new structures and changes to existing ones (including bridges, buildings, tunnel entrances, viaducts and utilities such as electricity pylons) along the length of the new road
- e. two approximately 2.5-mile (4km) tunnels, one for southbound traffic, one for northbound traffic crossing beneath the river

¹ The full project description is included in the Preliminary Environmental Information Report - an element of the documentation produced for the DCO application.

https://highwaysengland.citizenspace.com/ltc/consultation/supporting_documents/LTC%201%20PEIR%20Volume%20One.pdf

- f. a free-flow charging system, where drivers do not need to stop but pay remotely, like the system at the Dartford Crossing.

1.2.2 These outputs will be handed over by the project team to the Operational Directorate to operate to deliver the outcomes and benefits defined in the Client Scheme Requirements (CSR)².

1.3 Project dependencies

1.3.1 The successful delivery of LTC is not dependent on the completion of any other project and nor is any other project dependent on the completion of LTC.

1.3.2 LTC may affect traffic flows on adjacent parts of the strategic road network (SRN) in such a way that there is a case for undertaking additional works, outside the LTC project, to mitigate the impact. However, whilst the business case for such works may depend on the completion of the LTC our ability to complete those projects is independent of the completion of LTC and hence they are not strictly a project dependency.

1.4 Contingency planning

1.4.1 There is no alternative plan for delivering LTC outcomes and benefits.

1.4.2 If LTC is not completed, there is no practical strategy to relieve the congested Dartford Crossing and the inhibiting impact on local and national economic growth will continue.

1.5 Evidence of similar projects

1.5.1 Highways England has experience of delivering major road infrastructure projects of significant scale, scope and complexity. Examples include: the A3 Hindhead Tunnel, the M25 DBFO and the ongoing delivery of the A14 Huntingdon to Cambridge project. Table 1.1 provides some further details of these projects.

² HE540039-CJV-GEN-GEN-REQ-PMG-00001 CSR

Table 1.1 Projects successfully managed by Highways England

Project name	Description	Works date	Delivered to time?	Approximate value	Delivered on budget?	Comments
A3 Hindhead	A 1.2-mile twin bored tunnel built in the Surrey Hills Area of Outstanding Natural Beauty	2008 – 2011	Yes	£400m	Yes	The tunnel project was delivered to time and on budget. It met its objective to successfully remove the A3 from the historic Devil's Punch Bowl Site.
M25 DBFO contract	30-year design, build, finance and operation contract	2009 – 2012 (first two sections)	Yes	£6bn	Yes	Two sections of works (J16 to J23 and J27-J30 works - £850m) were completed 2 months ahead of schedule before the 2012 Olympics.
A14 Cambridge to Huntingdon	21 miles new build construction and on-line widening	2017 – 2021	On programme	£1.5bn	On budget	The A14 project sits within the Complex Infrastructure Programme allowing continual transfer of learning from A14 to LTC.

1.6 Lessons learned

- 1.6.1 Throughout the life of LTC lessons learned are identified, reviewed, and appropriately recorded. The Governance and Assurance project manager maintains a lessons learned log and ensures key lessons are captured in the end of stage report prepared at the end of each stage of LTC (as defined in Section 4.3).
- 1.6.2 The LTC, A303, A14 and A428 projects are managed within the Complex Infrastructure Programme (CIP) and overseen by the same Senior Responsible Owner (SRO) and Programme Sponsor ensuring the sharing of good practice and experience as a regular and ongoing activity. Lessons learned from our previous projects (such as A3 Hindhead) are regularly assessed to ensure knowledge and experience is successfully transferred.
- 1.6.3 Within the project team is extensive experience of developing and delivering major projects such as London 2012, Crossrail, the Thames Tideway Tunnel and HS2. This experience is informing the way the team works and supports robust management of LTC. It has also been applied directly to:
- a. the development of the Commercial and Procurement Strategy
 - b. the Design Management Strategy
 - c. the approach to the DCO
- 1.6.4 In developing LTC, we have engaged a Technical Partner with specialist knowledge of tunnelling large diameter bored tunnels, challenging ground conditions, and the development of road tunnels which are safe in their construction and operation as well as having high customer availability. The senior staff employed on LTC bring with them lessons learned from performing both client and contractor roles on recent bored tunnel projects in the UK such as Silvertown, Jubilee Line Extension, HS1, HS2, Crossrail and Thames Tideway Tunnel, as well as further extensive experience on overseas tunnelling projects.
- 1.6.5 We started the procurement of an Integration Partner in July 2020 to boost the team's capability and capacity in relation to the delivery of the Main Works including the challenge of ensuring all outputs are fully integrated.
- 1.6.6 The project team has also looked beyond Highways England to gain knowledge and learn lessons from other projects. Contact has been made with major tunnel projects both in and outside the UK, other river crossing projects, and large-scale infrastructure projects in the UK. The projects have been assessed and the relevant lessons learned detailed in Appendix O.
- 1.6.7 In addition, LTC has a dedicated Lean, Value Management and Innovation (LVMI) team which focuses on knowledge management and learning lessons. It continuously shares knowledge within the project team through the preparation of case studies on lessons learnt at the completion of key activities. These are also communicated broadly across Highways England.
- 1.6.8 At a project level lessons learned are being shared through 'learn at lunch' sessions, the production and recording of case studies and international site visits, eg, the Western Harbour Crossing in Hong Kong and the M30 ring road in Madrid.
- 1.6.9 We are aware of difficulties that have arisen in connection with some other recent, large and high-profile public procurements. Such issues related to proper governance and decision making, the over-complexity of evaluation criteria, the proper documentation of evaluation decisions, and proper, effective staff resourcing. LTC will

continue to take account of the lessons learned from these procurements which are highlighted in:

- a. the National Audit Office's review of the Magnox procurement³
- b. the interim recommendations of the same procurement by the Holliday Inquiry⁴
- c. the Laidlaw Inquiry⁵ on lessons learned from the DfT's Intercity West Coast procurement.

1.1.2 Our learning activities and a high-level description of lessons learned which are relevant to the LTC at its current stage are shown in Appendix O.

1.1.3 Some specific lessons learned in relation to the roads contracts are:

- a. Promote collaboration – a balance between well drafted contracts with a clear specification and a problem-solving collaborative culture is required. Over-reliance on just one of these approaches is sub-optimal.
- b. Prioritise safety – early engagement with safety stakeholders including the emergency services is critical in delivering a design that can be built and operated as safely as possible.
- c. Engage early with the operator – it is important that the operators' requirements are sought and factored into the project development from an early stage.
- d. Anticipate demands of DCO process – as shown on the A303 process, a comprehensive approach to the assessment of environmental issues is critical for a smooth passage through the DCO process.
- e. Intelligent use of IT – the innovative use of Client Relationship Management (CRM) software to manage the responses to the statutory consultation process was highly successful and is now being mirrored on the A428 project.
- f. Cost estimating – in a break with Highway's England normal practice the cost estimates for LTC has been built from the bottom up with specifically sourced cost data instead of relying on a central database of rates. This has generated a more accurate cost estimate with a higher degree of confidence.

1.1.4 Similarly, some key lessons learned in relation to Early Works are:

- a. Use separate contracts – experience on the 2012 Olympics and Thames Tideway projects showed that putting early works on the critical path into separate contracts that can be let and delivered in advance of the main works can deliver considerable programme advantages.
- b. Keep scope flexible – defining the scope of the Early Works contracts flexibly to allow for a transfer of scope from the Main Works contracts in the event those

³ The Nuclear Decommissioning Authority's Magnox contract, Department for Business, Energy & Industrial Strategy (Comptroller and Auditor General), October 2017

⁴ Magnox Inquiry - Interim Report, Department for Business, Energy & Industrial Strategy (Steve Holliday), October 2017

⁵ The Laidlaw Inquiry – Initial Findings Report, DfT, October 2012

contracts are awarded later than scheduled mitigates the impact on the overall schedule.

- c. Benchmark – we have bench-marked the scope and cost of the Enabling Works against the A14 project.
- d. Proactively manage contractual interfaces – experience on the A14 has shown that most management challenges during delivery related to the interfaces between contracts and the development of a detailed approach to managing these interfaces should be given the highest priority from an early stage.
- e. Engage with landowners early – completion of early works that lie on the critical path often require accesses to land owned by third parties. Early engagement with those landowners is needed to secure access on schedule.

2 Organisational structure and roles

2.1 Highways England organisational structure

- 2.1.1 The LTC currently sits within Highways England's Complex Infrastructure Programme (CIP) which is one of four programmes in the Major Projects directorate (the others being the Smart Motorways, Regional Investment North and Regional Investment South).
- 2.1.2 To ensure the project receives more direct and detailed oversight from Highways England's senior leadership it is proposed that LTC will be established as a discrete directorate within Highways England from autumn 2020. This will involve changes to both the operational model and the governance arrangements.
- 2.1.3 This section describes the LTC operational model as it currently stands. The impact of LTC becoming a directorate of Highways England in autumn 2020 is described in Section 3. The governance implications of the change are addressed in Section 4.

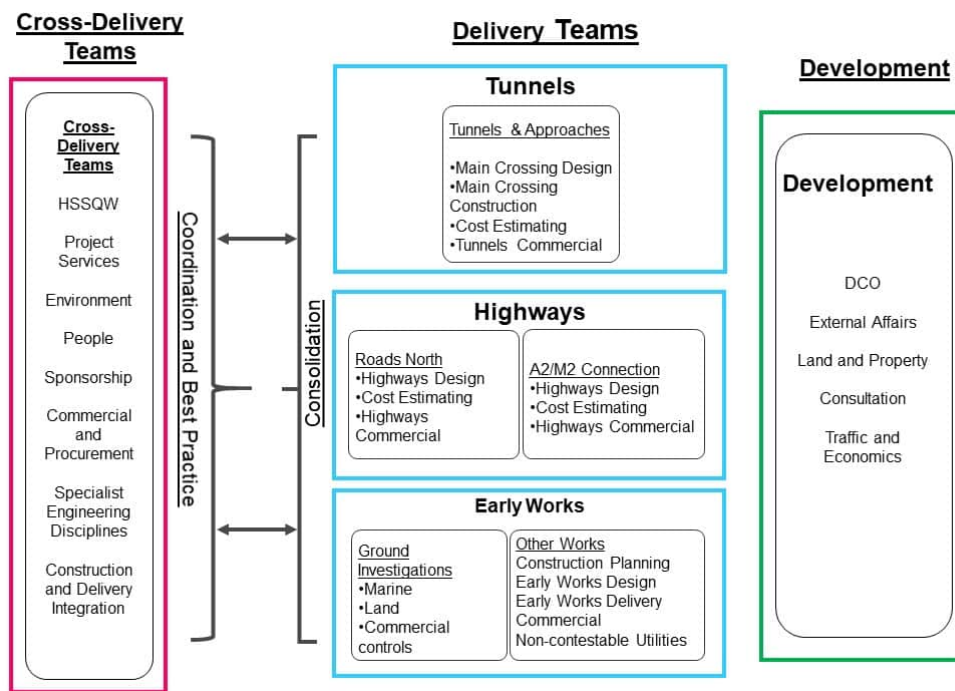
2.2 Technical Partner

- 2.2.1 In 2016 we engaged a Technical Partner to develop the design, obtain approval, procure suitable contractors to construct LTC and monitor work through to Open for Traffic (OfT).
- 2.2.2 Following a competitive tender, we appointed Cascade – a joint venture (JV) comprising Jacobs, Arcadis and COWI – for a ten-year period to the anticipated OfT date. Cascade are contracted under a bespoke multi-disciplinary professional services contract.
- 2.2.3 We selected Cascade based on their organisational capability as well as the skills and experience of key team members assigned to LTC. As a result, the project team now directly benefits from extensive personal experience of the development and delivery of major projects such as London 2012, Heathrow, Crossrail, London Underground and upgrades and line extensions, Silvertown tunnel, Thames Tideway Tunnel and HS2.

2.3 Lower Thames Crossing operating model

- 2.3.1 To manage LTC effectively during the next phase, we have put in place the operating model illustrated in Figure 2.1.

Figure 2.1 Operating model



- 2.3.2 The operating model will evolve as LTC advances. The next major step change is scheduled for autumn 2020 when the LTC will be established as a discrete division within Highways England. This operating model is designed to be in place throughout the stage when we will be running the procurement of the main works and the DCO process in parallel. The proposed new arrangements are described in Section 3.
- 2.3.3 Given the size of LTC (in terms of capital value it is over three times the size of Highways England's next largest project in development or delivery), the complexity and different engineering challenges, the operating model is based on a programmatic approach. Hence each of the main works contracts are largely treated as separate projects with dedicated delivery teams.
- 2.3.4 Each delivery team is managed with separate budgets, schedules and risks. A central project office consolidates the information across the delivery areas and the other centralised services. Lessons learnt have also been applied specifically to the different delivery areas given the difference in benchmark information available for the roads, early works, utility diversions and tunnelling work.
- 2.3.5 Whilst each delivery area has its own support structure, designers, cost estimators, risk managers, schedulers etc, functional leads will ensure consistency and the use of best practice across LTC.
- 2.3.6 The design of the model shifts the emphasis from technical directorates developing LTC to delivery teams aligned to the key procurement packages. These delivery teams are led by technical experts with clear accountability for successful product delivery and their early formation in advance of the delivery stage is designed to mitigate key risks.
- 2.3.7 These teams will work together to shape the DCO submission, mitigating the risk that DCO once granted is undeliverable. This approach will also ensure that lessons learned from other major projects are captured in the procurement process and tender documentation. Each team will have accountability for all deliverables, cost and opportunities and responsibility for schedule and risk within their remit.

- 2.3.8 Governance, the Programme Management Office (PMO), assurance and commercial and procurement teams continue to be led by key Highways England personnel under this model, with a designated lead accountable for retaining focus on future operations, the customer and any residual commitments and liabilities for Highways England.
- 2.3.9 This model supports the maturing relationship between the CIP Business Partners and the project team, clarifying more detailed roles and responsibilities as required.
- 2.3.10 The role of the multi-disciplinary delivery teams is to develop reference designs and the Works Information for the procurement process, advise on commercial negotiations, lead the technical dialogue and technical evaluation of tenders and manage the procurement and then the contracts for the relevant packages. These teams will be supported in that role by various cross delivery teams which will focus on ensuring the work of delivery teams is integrated across LTC.
- 2.3.11 The role of the cross-delivery teams is set out in Table 2.1 below:

Table 2.1 Role of cross delivery teams

Cross delivery team	Role
Project Services	<ul style="list-style-type: none"> • To ensure the effective and efficient delivery of LTC using project control systems, processes and techniques recognised by the industry to deliver to safety, cost, quality and time targets (see Section 8 for further details of our approach). • To own the financial management of LTC including the cost estimating function. • To take responsibility for information management and document control and to manage the reporting and assurance processes. • To support recruitment and organisational development for LTC.
Health, Safety Security Quality and Welfare	<ul style="list-style-type: none"> • To execute the Health Safety and Welfare Strategy and inputs, CDM Principal Designer role. • To ensure the project team adopts best practice in relation to quality and knowledge management.
Commercial and Procurement	<ul style="list-style-type: none"> • To design and manage the procurement processes for all packages, including the Competitive Dialogue and negotiation phase for the Main Work packages. • To establish and define how all works and services will be procured, how and where risk will be transferred and ensure that the final commercial contract represents value for money. • To establish and generate the contractual performance specifications, maintenance requirements and incentivisation provisions. • To develop the Commercial and Procurement Strategy.
People	<ul style="list-style-type: none"> • To support the resourcing and people management, team development and retention, organisational change, internal communications and engagement, day to day management of

Cross delivery team	Role
	accommodation and facilities and office administration support.
Environment	<ul style="list-style-type: none"> • To provide the environmental input to the design process, stakeholder engagement. • To support public consultations. • To support the procurement process.
Specialist Engineering Disciplines	<ul style="list-style-type: none"> • To support the delivery teams in relation to geotechnical engineering, design integration, information management, architecture and other specialist engineering disciplines.
Construction and Delivery Integration	<ul style="list-style-type: none"> • To support the delivery teams in identifying and managing interfaces, considering constructability, developing methodology and phasing to ensure LTC achieves consistent, cohesive, efficient, timely and cost-effective solutions.

2.4 Project Sponsor

2.4.1 The project team also benefits from support from the CIP Sponsor team whose functions include:

- a. interface with Central Government including DfT, HMT, Infrastructure and Projects Authority (IPA) and cabinet office
- b. managing external governance and assurance processes – including producing the Business Case
- c. stakeholder and communications management
- d. legacy and benefits realisation management
- e. implementing customer strategy
- f. economics assurance

2.4.2 There is a dedicated full time Sponsor who as well as being directly responsible for external governance and assurance, co-ordinates all sponsorship activity. The Sponsor reports to the CIP Sponsorship Director who reports directly to the Senior Responsible Owner (SRO).

2.4.3 Both the Sponsorship Director and the Project Sponsor support the Project Director and are intimately involved in the project, being members of key committees and steering groups including the Project Committee. The Sponsor is physically located with the project team in the joint Highways England/ Technical Partner office.

2.5 Lower Thames Crossing project team structure

2.5.1 We have established a dedicated project team to deliver the LTC. The team is based in its own project office plus satellite offices to promote a strong focus on delivery.

2.5.2 The project team is led by a full-time Project Director and combines teams staffed by Highways England staff and by our Technical Partner, Cascade.

- 2.5.3 There are multiple interfaces between the project team and directorates and programmes within the Highways England organisation including:
- a. Safety, Engineering and Standards
 - b. Operational Directorate
 - c. Finance
 - d. Commercial & Procurement etc

2.6 Oversight of the Lower Thames Crossing project

2.6.1 The keys roles and responsibilities for overseeing LTC are set out in Table 2.1.

Table 2.1 Key roles and responsibilities

Organisation	Role	Responsibility
DfT	Client Sponsor (CS)	Champion of LTC. Overall responsibility for commissioning LTC. Owns the vision, outcomes and creates strategic alignment to deliver benefits, including wider benefits. Manages political relationships and defining/setting of policy.
Highways England	Senior Responsible Owner (SRO)	The SRO is responsible for the successful delivery of the project vision. The SRO ensures that LTC maintains its business focus based on clear levels of authority for key decisions. Under the proposed new structure the SRO role will be taken on by the Executive Director LTC.
	Programme Sponsorship Director (PSD)	The PSD reports to the SRO and is responsible for securing investment, maintaining alignment to the CSR and ensuring that the optimum outcomes are identified and achieved. The PSD also manages relationships with central government and other key stakeholders.
	Project Director (PD)	The PD reports directly to the SRO and is responsible for ensuring the project team delivers LTC in accordance with our policies and licence obligations, the CSR and the business case. The PD is the principal link between the Project Committee and the project team (Section 4 details the role of the Project Committee).
	Senior User (SU)	Responsible for representing the user interest in the design, operations and maintenance of LTC. The Senior User role is represented on the Project Committee by our Executive Director for Operations and at Steering Group level by the direct involvement of both the Asset Development Manager and the Regional Sponsor for the M25

2.6.2 Appendix R contains the names of individuals currently performing those roles, as well as the leadership roles in the project team.

2.7 Project team

- 2.7.1 The project team is managed using a 'One Team' approach, involving our staff working in a collaborative integrated team environment with staff from the Technical Partner. The structure and composition of the senior element of the Project Team will change from Autumn 2020 when the new operational model designed in Section 3 is fully implemented. This section describes the core current arrangements which are not expected to change.
- 2.7.2 Highways England staff, our Technical Partner's team and our specialist advisors work together in a dedicated project office, and several satellite offices, as an integrated team. Through the length of contracts in place and their promotion of collaborative working, an efficient and consistent approach to resourcing has been put in place.
- 2.7.3 This approach secures capability and builds it through familiarity with LTC and learning gained through day-to-day experience. Where required, the Technical Partner provides additional resources to advise on complex functions in design and delivery.
- 2.7.4 When new skillsets/roles are required, necessary resources are quickly and efficiently secured. When a skillset or role is no longer required the resources can be promptly and efficiently demobilised.
- 2.7.5 We are up-skilling our staff on LTC by:
- a. facilitating knowledge management and transfer from the Technical Partner and specialist advisors
 - b. facilitating on the job learning by our staff working in the project team alongside advisors within directorates as an integrated team
 - c. providing technical and behavioural training and coaching, examples being in competitive dialogue (CD) roles
 - d. using succession planning to retain skills through structured handover between members of staff
 - e. improving staff retention through career progression planning and the approach to reward and recognition which places emphasis on personal development of skills and experience
- 2.7.6 More specifically and in recognition of the scale and technical requirements of LTC and the nature of contractors that will bid for its construction, the commercial and procurement strategy, as set out within the Commercial Case, has identified the following areas where the skills and experience of the procurement team will be required, especially having regard to CD for two of the Main Works packages :
- a. managing dialogue meetings with highly experienced specialists from the bidder teams
 - b. ensuring consistency of the procurement process
 - c. ensuring consistency in recording dialogue meetings and issues
 - d. ensuring everyone understands the dialogue strategy

2.7.7 We have also taken the opportunity to develop capability and capacity in procurement by inviting input from wider government stakeholders (DfT and the IPA) through the Procurement Steering Group (PSG).

2.8 Business partners

2.8.1 Specialist CIP business partners together with business partners supporting Highways England as a whole, provide challenge to the project. Their main responsibilities are described in Table 2.2.

Table 2.2 CIP and Highways England business partners

Business partner	Main responsibilities
Commercial and procurement	<ul style="list-style-type: none"> To create the commercial and procurement strategy at the start of LTC's lifecycle and ensure the strategy is implemented. To manage the whole procurement process to support LTC delivering the investment outcome in line with the management plan. To understand and challenge LTC costs. To create the commercial contract that delivers LTC's requirements and objectives.
Finance and business services	<ul style="list-style-type: none"> To provide month end financial guidance and analysis. To ensure accuracy and assurance around LTC's forecast and actual spend.
Property and compensation	<ul style="list-style-type: none"> To provide property advice at all stages of LTC's lifecycle, including options identification, risk identification and mitigation as well as overseeing the compulsory acquisition requirements of the DCO process.
Safety Engineering and Standards (SES)	<ul style="list-style-type: none"> To drive improvements to safety and standards. To identify and realise opportunities to enable the best solution and innovation with project delivery and supply chain at all stages of LTC's lifecycle.
DCO and statutory processes	<ul style="list-style-type: none"> To guide project teams through the requirements of consultation, submission of the DCO application, the DCO examination, decision and post-decision/pre-construction activities.
Customer	<ul style="list-style-type: none"> To develop and manage the CIP customer plan and advise on project customer plans, to support a customer focused culture in the CIP team and across LTC.
Business improvement	<ul style="list-style-type: none"> To develop and maintain the overarching vision, mission and values for CIP. To identify business improvement opportunities and efficiencies using the defined service level metrics.
Legal – General Counsel	<ul style="list-style-type: none"> To provide clear, practical and business-focused legal advice to support the management and delivery of LTC.

Business partner	Main responsibilities
Corporate affairs and communications	<ul style="list-style-type: none"> • To tell the story of Highways England to external and internal audiences. • To build the company’s profile and promote the business’s capabilities and achievements to our customers, key stakeholders and supply chain. • To protect our reputation and make sure our voice is heard.
Human resources and organisational development	<ul style="list-style-type: none"> • To provide guidance for Highways England staff on LTC, keeping them connected to the company and ensuring their pastoral care, line management and personal performance are delivered to HE standards and processes. • To explore possibilities of how to leverage Highways England training and development for supply chain. • To provide a guiding mind for Equality, Diversity and Inclusivity initiatives for use within LTC as well as part of the procurement process.
Information technology	<ul style="list-style-type: none"> • To support Highways England and transform the way it operates by delivering digital, data and technology services from frontline to back office, in a modern and efficient way. • To develop integrated information and technology that empowers colleagues and provides real time information to our customers, integration with intelligent vehicle and transport systems as they develop, to improve journey safety and reliability.
Operations	<ul style="list-style-type: none"> • To ensure our customers have safe and reliable journeys by keeping the roads open for business. • To ensure the network we manage is fit for purpose today and for the future. • To ensure that everyone has a clear line of sight between what they do, what this is measured on and how it helps us to deliver service now and in the future. • To continue putting customers at the centre of the business, growing and developing our business by providing training and coaching and ensuring safety remains our number one priority.

2.8.2 The proposed new Governance arrangements bring the Business Partners within the LTC, ie, their primary line management will be within the project with a dotted line to their functional directorate.

2.9 Specialist advisers

2.9.1 We employ specialist advisers to provide the legal services set out in Table 2.3.

Table 2.3 Services provided by specialist advisers

Organisation	Role	Services
DLA Piper	Legal assurance advisers	<ul style="list-style-type: none"> • To provide specialist legal knowledge of contract law and practice and provide the overall assurance of the Design and Build contract. • To provide full assurance of the procurement process and provide specialist advice on the competitive dialogue to enhance Highways England’s capability.
BDB Pitmans	Planning legal advisers	<ul style="list-style-type: none"> • To provide specialist legal knowledge of planning law and practice, providing resource and advice in support of the DCO application and the subsequent examination. • To build capability of Highways England’s in-house resources.

3 Operational model development

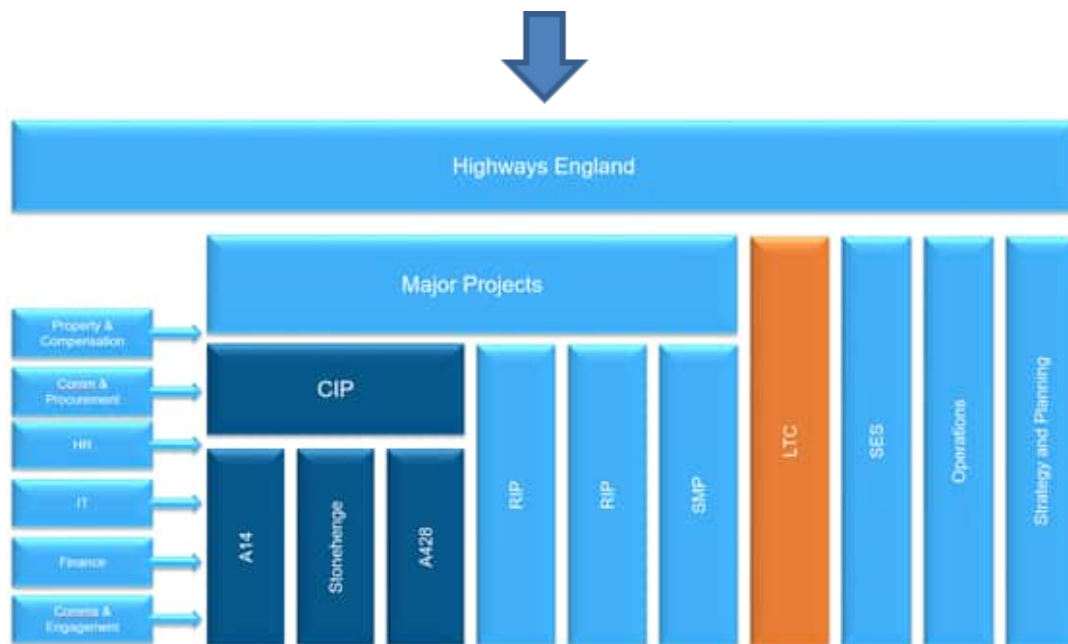
3.1 Introduction

- 3.1.1 We recognise the need for the governance, oversight and project team to flex in terms of size, composition and structure to reflect changing requirements over the project lifecycle. Structures, skills and capabilities needed at early stages of the project will not be required at later stages, when delivery and contract management will be the focus. Accordingly, we have developed a strategy which recognises distinct phases in LTC’s operating model while ensuring all Highways England’s policies continue to apply to LTC throughout.
- 3.1.2 The next step change will occur in Autumn 2020 when LTC will transition from being a project managed within the CIP to being a separate directorate within Highways England. This change, which is designed to ensure the project receives more direct oversight from the senior leadership team in Highways England is described below.

3.2 Designed to Deliver model

- 3.2.1 To meet the governance and organisational challenges of the LTC project team becoming a delivery organisation, a separate directorate will be established within Highways England dedicated solely to oversight of the LTC project. This proposed change is illustrated in Figure 3.1 below.

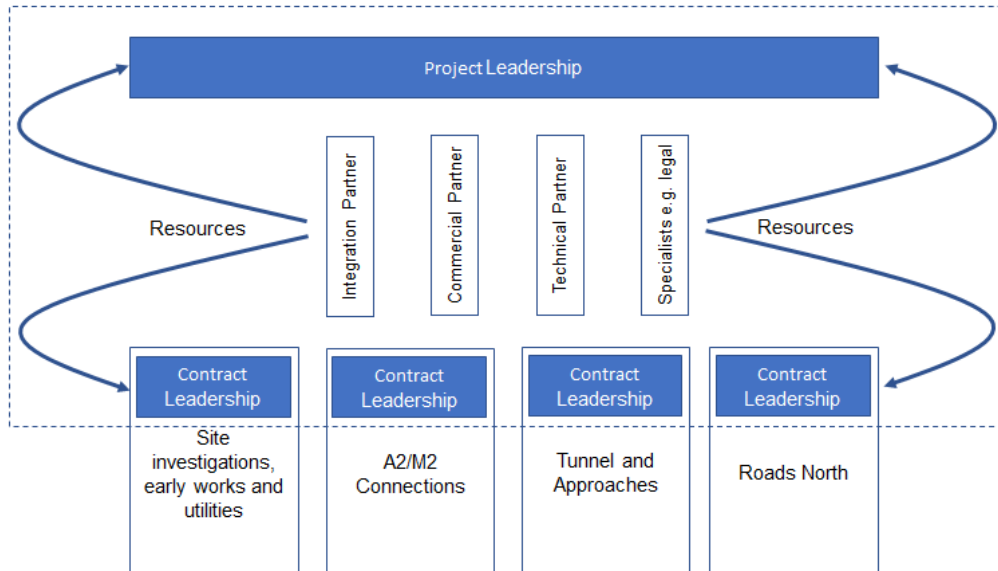
Figure 3.1 Proposed change in Highways England's Organisational Structure



- 3.2.2 The LTC Directorate will be headed up by a newly appointed Executive Director with a high degree of authority. The Executive Director will be a member of the Highways England executive reporting directly to the CEO. They will act as the SRO for the project.
- 3.2.3 LTC requires delivery of three major and largely stand-alone Main Works contracts to deliver the project. There is also significant early works needed to de-risk the delivery of the Main Works. To be an effective client, our operating model must allow us to lead

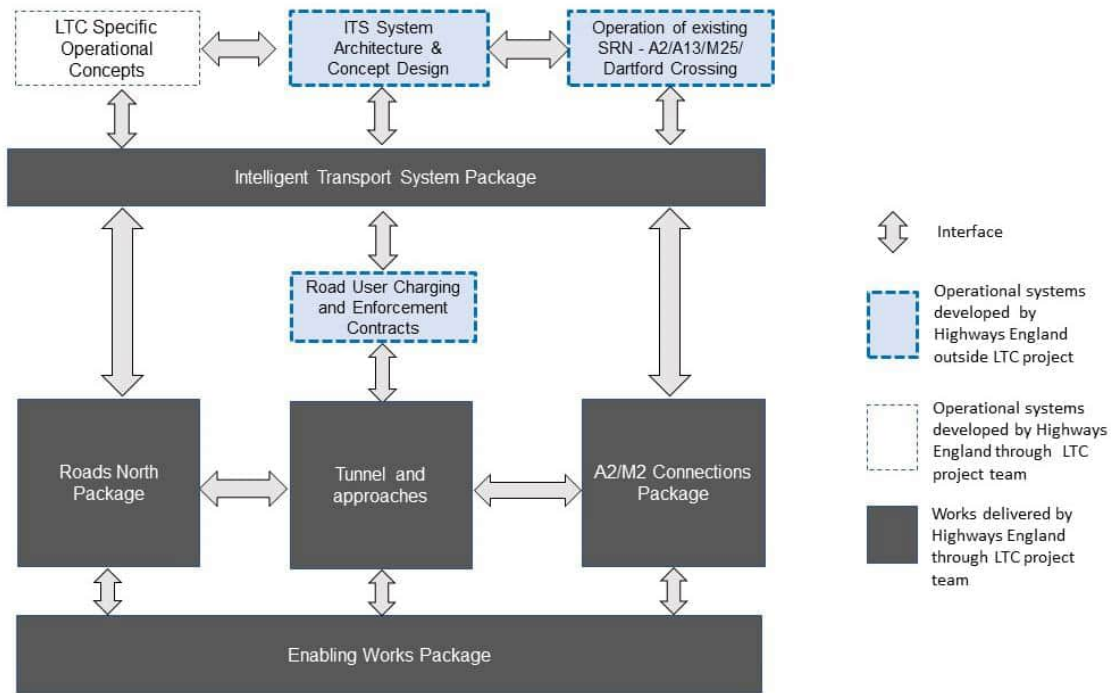
both the contract delivery, as we are doing on the A14 and A303, as well as the project as a whole. To do this our operating model is based on three main support contracts – the Technical Partner (Cascade), the Commercial Partner and the Integration Partner (currently being procured) – as illustrated in Figure 3.2 below.

Figure 3.2 LTC Operating Model



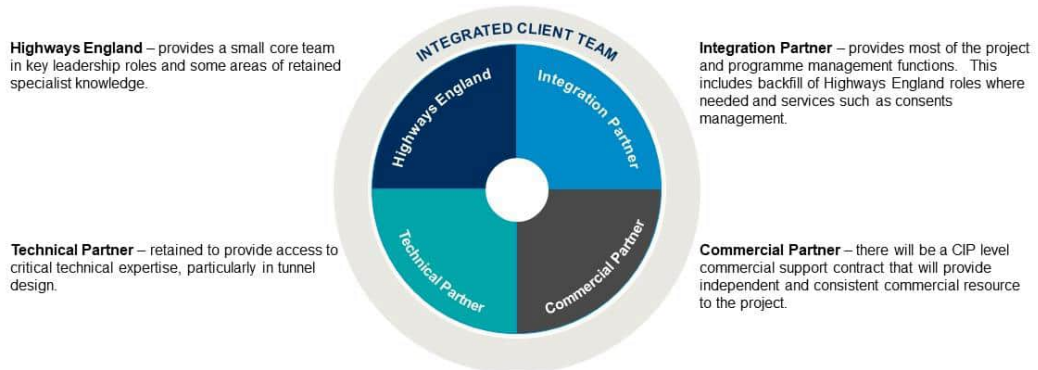
- 3.2.4 The LTC project team will include individuals sourced from across Highways England’s business functions (e.g. commercial and procurement). These individuals will report directly up to the LTC Executive Director rather than through their business functions as previously.
- 3.2.5 The operating model will retain and build on the product-focused teams. It will focus on ensuring the organisation has the capability to simultaneously:
- secure the DCO
 - manage the Main Works contractors efficiently
 - resolve interface issues arising between the contractors and other parties
 - discharge DCO consents
 - complete the land acquisition programme
 - support Highway England’s Operational Directorate preparations for the handover of an asset ready to operate.
- 3.2.6 The model will ensure the team is focused on managing the interfaces between the Early Works, the Main Works contracts, the Road User Charge contract and the existing SRN. As illustrated in Figure 3.3 below, these interfaces are numerous in the delivery phase and regardless of contractual risk allocations, the ultimate responsibility for managing interface will remain with Highways England.

Figure 3.3 Interfaces in the delivery phase



- 3.2.7 Development of the model will draw on Cabinet Office guidance published in Sept 2012 as part of Government Construction Strategy, ie, “Delivering alignment of design and construction with operation and asset management”.
- 3.2.8 The Operating Model will be based on the core principle of an Integrated Client Team, as illustrated in Figure 3.4, which will operate as a single entity where individuals self-identify as representing Highways England.

Figure 3.4 Integrated Client Team



- 3.2.9 Within the ICT the role of the Commercial Partner is to provide:
 - a. independent commercial and cost management expertise to the Highways England Commercial Director
 - b. the commercial management of the Integration Partner, the Technical Partner, PEW and other Highways England contracts in connection with the Project

- c. commercial assurance services including responsibility for confirming the achievement of contract milestones which cannot be done by the Integration Partner as that would require the Integration Partner to evaluate its own work.

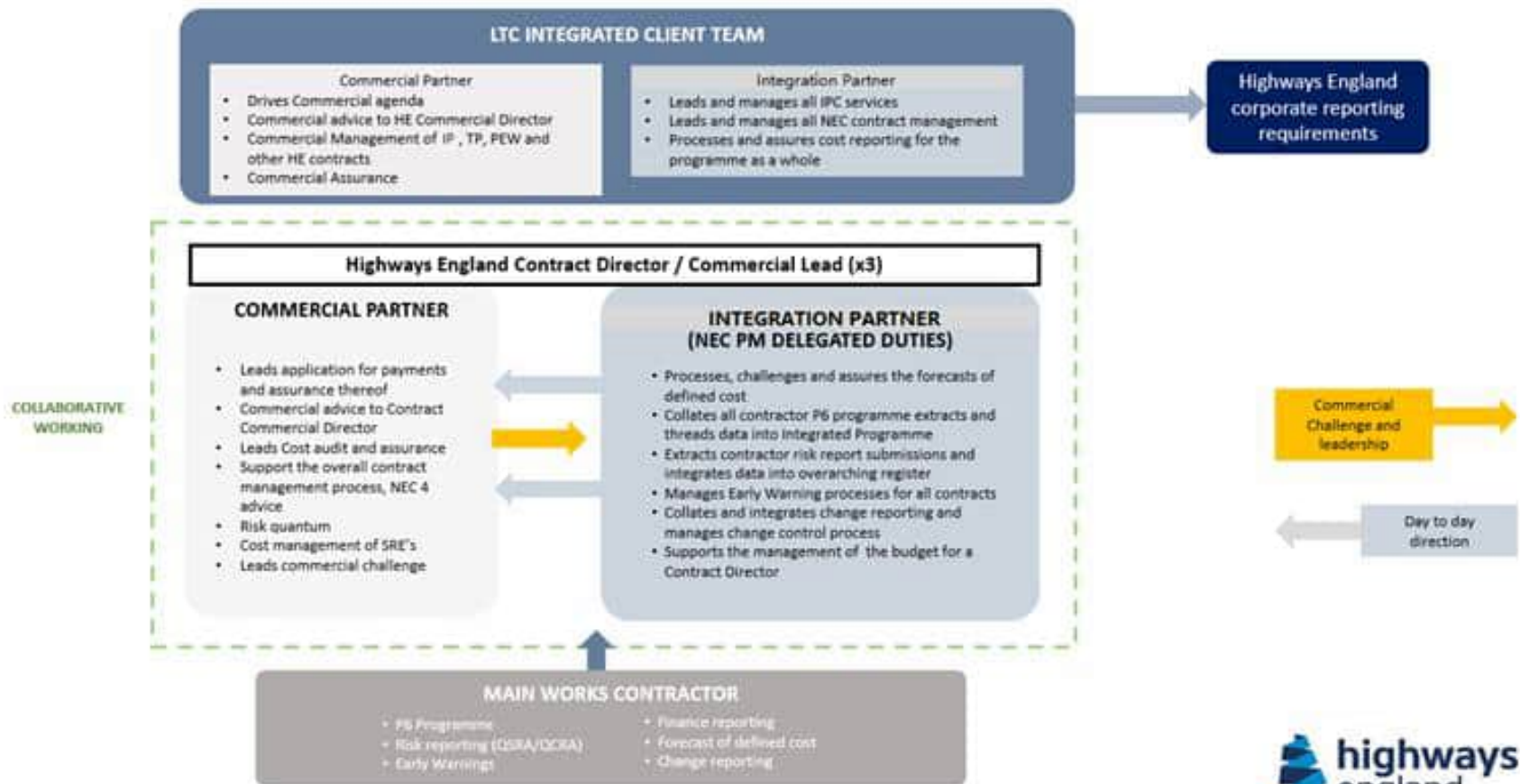
3.2.10 The Commercial Partner role is currently being fulfilled on an interim basis by Mott McDonald through a SPaTS (Specialist Professional and Technical Services) framework.

3.2.11 An Integration Partner, responsible for integrating the various components of this project during delivery, will be incorporated into Integrated Client Team. The Integration Partner and the Commercial Partner roles have been kept as separate organisations so that:

- a. the Commercial Partner can provide an independent and consistent cost assurance service to Highways England across all our LTC contracts, including the main works contracts, the Integration Partner contract and the Technical Partner contract
- b. the Commercial Partner will be able to directly challenge the Integration Partner (if necessary) and can provide assurance of the Integration Partner's work
- c. there will create a direct relationship between our Project and Contract Highways England Commercial Directors and our Commercial Partner (building a long-term partnership)
- d. the Integration Partner does not have to bring an additional sub-contractor supplier to provide the support that will be provided by the Commercial Partner
- e. Highways England has the flexibility and resilience to scale-down or remove Integration Partner services should its performance fail to meet expectations
- f. Highways England can drive the commercial agenda in line with best practice and lessons learned from previous projects, avoiding the risk of the Integration Partner taking control of the commercial agenda.

3.2.12 We recognise it will be important to maintain a high degree of clarity in terms of the relationship between the Integration and Commercial partners. This has already been analysed in detail and a diagram summarising out the division of roles between the Integration Partner and the Commercial Partner is set out in Figure 3.5 below:

Figure 3.5 Division of roles between Commercial Partner and Integration Partner

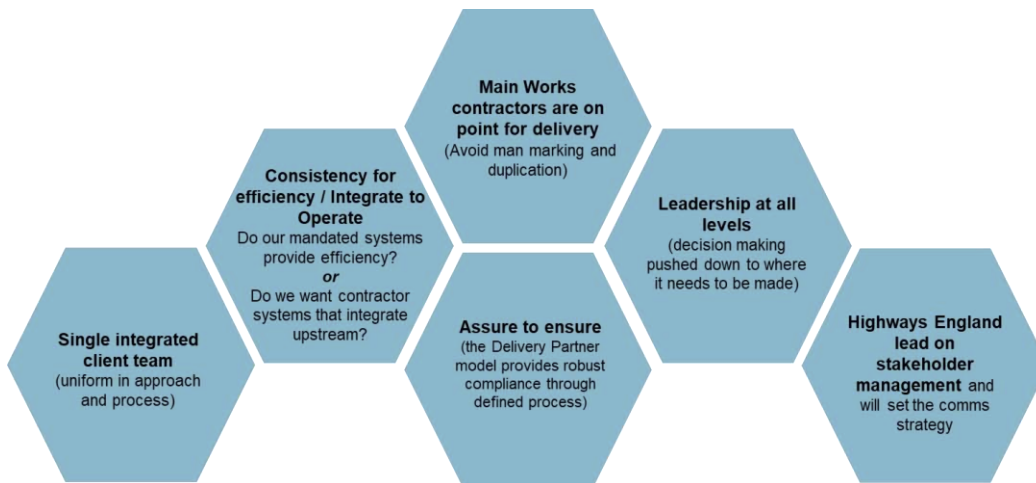


Note: Commercial lead can be Commercial Director or Head of Commercial as actual roles



- 3.2.13 The leadership and management functions that the Technical Partner has supported us with during the development phase will transition to the Integration Partner for the delivery phase. The Technical Partner will be retained to focus on its role in the Design Authority, supporting us with technical expertise in tunnelling in particular. The Integration Partner is scheduled to be appointed by late 2020 to allow sufficient time for the transition of responsibility from Technical Partner to Integration Partner before the delivery phase starts following the DCO award.
- 3.2.14 Our Integrated Client Team will operate to the principles set out in Figure 3.6 below:

Figure 3.6 Key Management Principles



- 3.2.15 The commercial aspects of the appointment of the Integration Partner are addressed in the Commercial Case in Section 9.3.
- 3.2.16 There will be an LTC Business Review Group for issue resolution and coordination. The terms of reference have been agreed. It is not part of the formal governance arrangements for HE projects but aims to support effective project delivery by providing a regular forum for discussion on key issues.

3.3 Shift to Site and Handover to Operations

- 3.3.1 The Shift to Site model will be designed to ensure the transition to site-based activity does not detract from the focus on managing the Main Works contracts and managing the interfaces described. At the same time the model will also have to provide an appropriate platform for the development of the commissioning and handover plans needed to close out the project.
- 3.3.2 Before the project is closed out an operational model will be developed to ensure a smooth handover into operations and a focus on the need to operate the LTC as part of the SRN.

4 Governance and assurance

4.1 Overview

- 4.1.1 Due to the size and complexity of LTC, it has been defined as a Tier 1 project. A clear governance and assurance pathway provides the required distinction between co-ordination/issue resolution, decision making and assurance. This is structured to include project, Highways England, DfT and broader government processes. Within the new Governance arrangements is a proposal for LTC to have a dedicated Investment Decision Committee. There will be no change in the project's interaction with DfT, HMT, IPA or other Government departments. The revised flow chart is illustrated in Figure 4.1 below.
- 4.1.2 The multi-organisation membership of the various decision making, co-ordination, issue resolution and assurance groups provides for regular interaction and collaboration between the Highways England, DfT, HMT and IPA attendees. This is described in more detail in the section below.

4.2 The organisation of governance and assurance

- 4.2.1 We have worked with the IPA to develop governance and assurance arrangements for all Tier 1 projects. These arrangements ensure:
- clear separation between decision-making approval and coordination
 - the input into decision-making is given and received by the right people at each level.
- 4.2.2 The Project Committee which is chaired by the SRO and held bi-monthly, is responsible for periodic monitoring of progress, resources, risks, and project finances. Responsibility for routine management, issue resolution and coordination of day-to-day activities on LTC is delegated to the Project Executive Group (PEG) which meets at least monthly.
- 4.2.3 The SRO, who has clear delegated authority, is the ultimate decision maker but is supported in the decision-making by the other Project Committee members and, where appropriate, technical experts. Under his letter of appointment⁶ the SRO is authorised to:
- approve expenditure in line with the Highways England delegated schedule
 - agree project rescheduling within the Highways England Delivery Plan of agreed milestones (but rescheduling beyond that must be agreed with DfT)
 - recommend to DfT via the Highways England Board that LTC should be either paused or terminated where necessary.
- 4.2.4 Any decisions that go beyond these boundaries are escalated upwards to the relevant Highways England Committee. Where appropriate, the Project Committee escalates programme related matters to the CIP Programme Committee.
- 4.2.5 As a Tier 1 project the ultimate authority to invest is granted by the DfT's Secretary of State and the Chief Secretary to the Treasury. Before submission to these Ministers a

⁶ The letter of appointment is published on line at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/592422/Lower-Thames-Crossing-SRO-appointment-letter-addendum.pdf

well-established process of approvals must be followed. After approval by the SRO (level 1), the approval process for investment takes place in the following order:

- a. Highways England's Investment Decision Committee (level 2)
- b. Highway England's Investment Committee (a sub-committee of the Highways England Board) or the Highways England Board
- c. DfT's Infrastructure Panel and Decision Committee (IPDC)
- d. Final approval is received from the DfT and Treasury Ministers

- 4.2.6 The governance arrangements for the delivery of LTC have been considered, having regard to its complexity and the approach to procurement. The DfT and the IPA are represented in several governance meetings, including the Project Committee and the PSG.
- 4.2.7 The sponsorship team regularly meet with DfT, as well as HM Treasury and the IPA, to update them on LTC progress and provide detail as needed. This provides transparency and shared understanding on an ongoing basis and supports progressive assurance which, in turn, benefits the programme being followed. IPA provides an additional level of assurance and critique for Tier 1 projects.
- 4.2.8 We consider the need to revise the governance approach to be applied at regular intervals. The next significant change proposed is described below.

4.3 Proposed Changes to Governance and Assurance

- 4.3.1 Following a review undertaken by IPA and co-sponsored by Highways England and DfT a new governance model has been developed in conversations with the Executive, the LTC Business Review Group (interim governance arrangements), Investment Committee and the Board. It will be implemented in Autumn 2020.
- 4.3.2 The key features of this model are:
- a. the LTC project team will operate as a separate directorate of Highways England
 - b. it will be led by a dedicated LTC Executive Director, ie, a member of the Highways England executive reporting directly to the CEO
 - c. the Executive Director will provide a quarterly update on the progress of the project to the Board. Given the complexity of the project, time will need to be set aside by the Board to discuss LTC papers and submissions to provide sufficient time for close oversight of the project
 - d. the Executive Director will be the SRO for the project and will chair Project Committee meetings
 - e. the role of the Project Committee will be to advise the Executive Director on how to drive delivery of the project and on the development of proposals to the Highways England Board where required
 - f. proposals to the Board will be subject to Highways England Executive scrutiny as under the current arrangements for all Executive Directors

- g. two Highways England Non-Executive Directors will attend the Project Committee to provide direct input, support and advice to the Executive Director
 - h. Independent project advisors and DfT representatives may also sit on the Project Committee.
- 4.3.3 The LTC Executive Director and LTC project senior leadership team will determine the project operating model to deliver the project, drawing on Highways England and external best practice.
- 4.3.4 The project organisation will comply with existing Board governance and Highways England policies unless explicitly agreed otherwise at an appropriate level of delegation.
- 4.3.5 The functional leads within the project will report directly to the Executive Director and be dedicated full time to the project as appropriate.
- 4.3.6 The LTC directorate will comply with existing Board governance and Highways England policies in all areas including in relation to delegated authority. The authority retained by the Executive and the authority delegated to LTC Executive Director is summarised in Table 4.1 below.

Table 4.1 The LTC Executive Director’s Delegated Authority

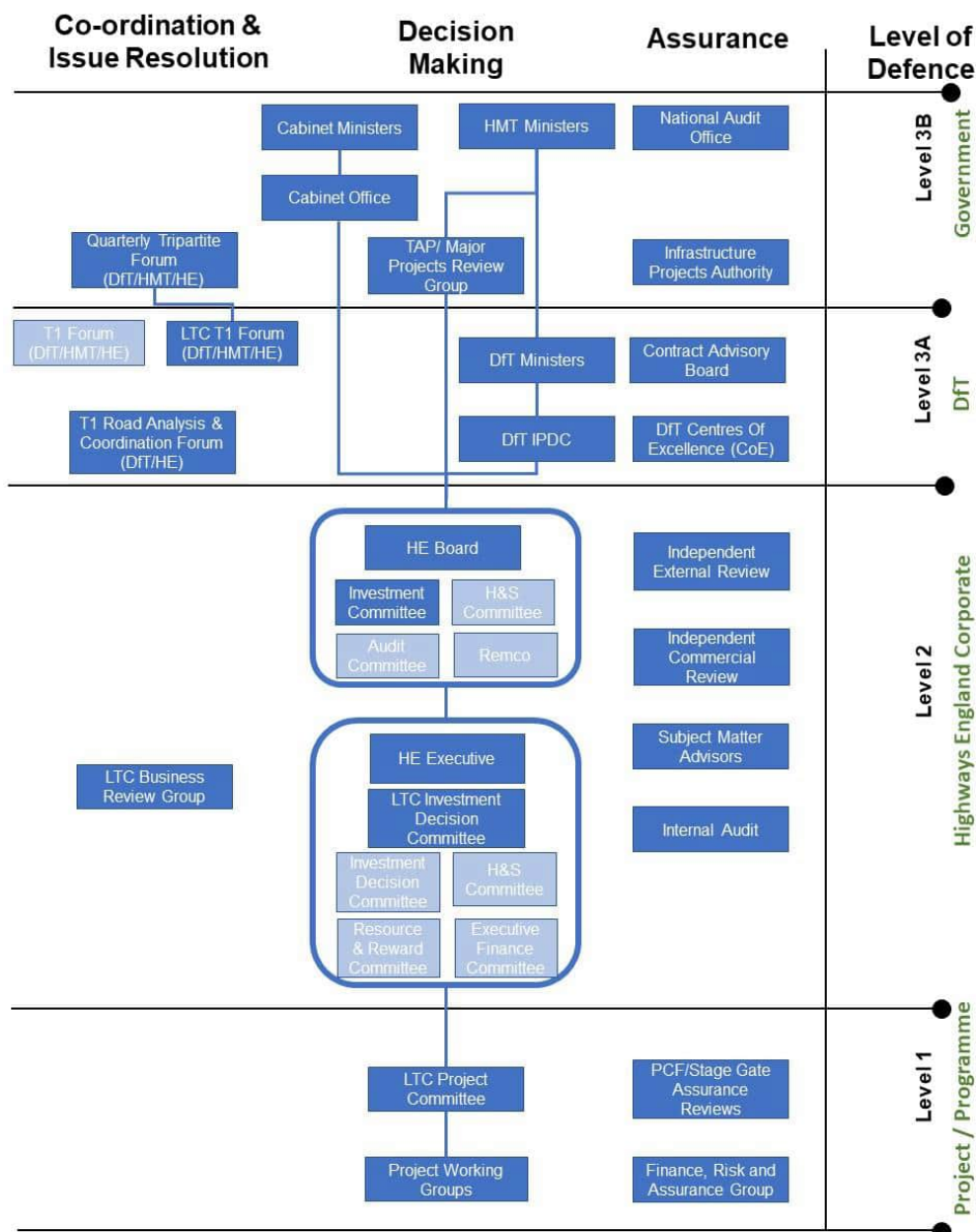
Function	Executive Authority	Authority Delegated to LTC Executive Director
Finance	Accountable for overall financial performance, as now Accountable for annual budget setting and in year flex, as now Sets internal assurance activity on LTC in discussion with the Executive Director Owns shareholder relationship	Accountable for performance within financial delegations and for financial reporting in line with current approach Responsible for flagging financial risks early and transparently. Specific responsibility for provision of information (transparency) on shareholder relationship on LTC
Commercial and Procurement	Accountable for signing off key Procurement activity and discharging Highways England procurement delegated authority	Accountable for LTC commercial strategy and execution, in agreement with the Board
Safety, Engineering and Standards	Accountable for technical assurance and audit to demonstrate compliance Accountable for safety policy and audit to evidence compliance	Accountable for meeting technical standards, gaining approval to departures from SES, and providing assurance to evidence this Accountable for safety performance and providing assurance to evidence this
General Counsel	Accountable for providing legal advice to the Board including on LTC. Retains authority to commence legal action	Accountable to work within advice from General Counsel

Function	Executive Authority	Authority Delegated to LTC Executive Director
Human Resources	Approval of LTC WFP in line with current practice. Retains authority on all specialist and Senior pay matters	Accountable for operating within approved Work Force Plan. Pay changes can be approved within bands and WFP affordability
Information Technology	Accountable for IT architecture and service model	Accountable for delivery and progressive assurance that LTC systems comply with corporate policy and approach
Comms	Accountability for our reputation and brand and ultimate call on decisions where DfT comms are involved	Responsible for enhancing our reputation through LTC. Full control of digital offering Leads stakeholder relationships and customer agenda within LTC
Strategy & Planning	Continues to own relationships with DfT client, ORR and Transport Focus, recognising size, scale and impact of LTC on these core relationships	Responsible to ensure information clearly communicated and risks opportunities understood
Operations	In addition to current position accountable to engage and support LTC by defining requirements and expectations for handover	Responsible to ensure handover to operations is effective, timely and with known whole life costs
Major Projects	Owens the Project Controls Framework (PCF). Head of profession for project management	Accountable for evidencing compliance to PCF
CPM	Unchanged from current position	Unchanged from current position

Proposed New Governance and Assurance Model

- 4.3.7 When the proposal to establish LTC as a directorate within Highways Engagement is implemented in Autumn 2020 the governance and assurance model applied to the project will be as illustrated in Figure 4.1 below.

Figure 4.1 LTC Proposed Governance and Assurance Model



- 4.3.8 The Investment Committee (or Board as appropriate) will continue to consider all investment decisions in relation to LTC as part of the Tier 1 process.
- 4.3.9 It is proposed that a dedicated Investment Decision Committee is set up to support LTC investment decisions. This will ensure sufficient time is allocated for through consideration of all relevant material and effective discussion of any areas of concern. It is anticipated that a level of project contingency will be held at this IDC level. Therefore, the remit of the committee will include considerations of applications for contingency draw-down. It will also review applications to Government to draw-down on the contingency above the most likely cost estimate.
- 4.3.10 The current roles and membership of the governance and assurance meetings for the four levels of defence are described in Table 4.2, Table 4.3 and Table 4.4.

Table 4.2 Level 1 – membership and purpose of governance meetings

Meeting/ Group	Membership	Purpose	Meeting type
Project Committee (PC) - Current	<ul style="list-style-type: none"> • SRO (Chair) • Ministry of Housing, Communities and Local Government Representative • DfT RISC Dep Director • Highways England CIP Sponsorship Director • SES Executive Director • Major Project Executive Director • LTC Project Director (PD), Project Manager, Highways England Regional Operations Director • Highways England General Council representative • Highways England Corporate Finance Director, Highways England CIP Commercial and Procurement Director • Communications and Engagement Representative • JV Board representatives 	<ul style="list-style-type: none"> • Held bi-monthly • The PC takes a forward-looking perspective on LTC and advises the SRO on the overall strategic direction, notably in the development of stakeholder support and the case for LTC. • The PC also provides advice and support to the PD and monitors LTC to ensure that it has comprehensive and robust plans in place, has adequately assessed and secured the resources and funding required, identified and assessed risk and taken appropriate mitigating actions. 	Decision making

- 4.3.11 Under the revised governance arrangements, the Project Committee will be chaired by the LTC Executive Director/SRO. Like all project committees it will operate in line with Major Projects Instruction 59 (Project Governance). The LTC Executive Director will act within their delegated authority and the various baselines (scope, cost, schedule) confirmed through investment approvals.
- 4.3.12 The Committee is there to both support and challenge, and to help successful delivery of the project. It is also there to aid the development of proposals to present to this Board where required.
- 4.3.13 Committee members representing business functions (eg, finance, legal, C&P) can “flag” issues where they do not agree with the decisions made and these will be escalated to the relevant Executive Director and the LTC Executive Director. If the two Executive Directors do not agree, escalation is to the LTC IDC/CEO.
- 4.3.14 The exact composition of the Project Committee is not finalised at this point (July 2020) but will include the attendance of one or more Independent Project Advisor(s).
- 4.3.15 The DfT sponsor and an HMT representative will be invited to attend the Project Committee (although it is likely HMT will ask IPA to represent them).

Table 4.3 Level 2 – membership and purpose of governance meetings

Meeting/ Group	Membership	Purpose	Meeting type
Proposed LTC Investment Decision Committee (LTC IDC)	<ul style="list-style-type: none"> • Chief Executive Officer (Chair), • Chief Financial Officer, • Chief Highways Engineer/SES Director • Commercial and Procurement Director, • General Counsel • Strategy and Planning Director • Executive Director Operations • Executive Director Major Projects • Chief Analyst and Head of CPM as advisors • LTC Exec Director in attendance 	<ul style="list-style-type: none"> • Held bi-monthly • Attendance and reporting by representatives of LTC required at least 6-monthly • Responsible for recommending requests for funding or procurement approval to the Investment Committee • It also approves all changes to the approved baseline expenditure to ensure Highways England portfolio remains within budget and within its level of authority 	Decision making
Investment Committee (IC)	<ul style="list-style-type: none"> • Highways England: • Non-Executive Directors • Chief Executive Officer • Chief Financial Officer 	<ul style="list-style-type: none"> • Held bi-monthly • Attendance and reporting by representatives of LTC required at least 6-monthly • This is a sub-committee of the Highways England Board. The committee is attended by senior level Highways England staff who review projects before making investment decisions • All Tier 1 projects are passed through the IC, who can recommend the investment for approval, before IPDC. The IC can also approve investment within its level of authority 	Decision making

Meeting/ Group	Membership	Purpose	Meeting type
Highways England Board	<ul style="list-style-type: none"> • Highways England: • Highways England Chairman (Chair), Chief Executive • Chief Finance Officer • Non-Exec members • Chief Engineer • Company Secretary • General Counsel 	<ul style="list-style-type: none"> • Held monthly • The committee is attended by senior level Highways England staff who review projects before making investment decisions • It is Highways England's forum to recommend investment for approval, before IPDC. Depending on timing, investment decisions can be approved via either the Board or IC (a Board sub-committee) 	Decision making
Internal Audit	<ul style="list-style-type: none"> • As required 	<ul style="list-style-type: none"> • In accordance with Highways England's corporate governance, audits are arranged periodically through the lifecycle of LTC 	Assurance
Subject Matter Advisers (SMA)	<ul style="list-style-type: none"> • Legal (General Counsel) • Health & Safety (National Health and Safety team) • Strategic (Strategic Planning) • Capital Portfolio Management (Capital Planning) • Economic including Value for Money statement (Chief Analyst's Division) • Financial (Strategic Finance team/Finance Business Partner) • Commercial (Commercial and Procurement) • Management • Information and Technology (ICT) 	<ul style="list-style-type: none"> • To provide an assurance review of the authority paper and supporting documents that will be presented to the IDC, IC or Highways England Board • Each SMA will provide a list of comments following their review for inclusion as an annex in the authority paper. These comments will include a priority rating for the Committee/Board viewing and consideration 	Assurance

Table 4.4 Level 3 – membership and purpose of governance meetings

Meeting/ Group	Membership	Purpose	Meeting type
Tier 1 Road Analysis and Coordination Forum (TRAC)	<p>Highways England:</p> <ul style="list-style-type: none"> • Programme Sponsorship Director • Highways England Chief Analyst, Relevant strategy and planning sponsor, Tier 1 Scheme Economic Business Partner, Relevant Project Director and Project Manager • DfT: • Roads Economics and Modelling (REM) Deputy Director – Chair of Analysis Meetings • Road Investment Strategy-Client (RIS-C) Deputy Director – Chair of Policy meetings • REM Economic Advisor • REM Transport Modeller • RIS-C Delivery Manager • RIS-C Tier 1 Project Sponsor (as required) • Other Centre of Excellence representatives 	<ul style="list-style-type: none"> • This group undertakes the following ahead of IPDC or at other key approval points: • Shapes, agrees and supports a successful policy and analytical approach to Tier 1 Strategic Roads decisions • Identifies key policy and analytical issues in advance of formal decisions and agrees an appropriate plan • Obtains agreement between the DfT and Highways England on what relevant, robust and trusted analysis is to be carried out 	Co-ordination and issue resolution
T1 Forum (DfT/HM Treasury/Highways England)	<p>Standing Attendees</p> <ul style="list-style-type: none"> • DfT RIS Client/Sponsor (Chair) • DfT Road Economics Deputy Director, HMT Transport Spending 	<ul style="list-style-type: none"> • Held monthly • Considers, plans and coordinates for successful decision making and approval of Tier 1 projects through the DfT and HMT Governance 	Co-ordination and issue resolution

Meeting/ Group	Membership	Purpose	Meeting type
	<p>Team representatives</p> <ul style="list-style-type: none"> • Highways England Strategy and Planning Sponsorship Director • Highways England Programme Sponsorship Director • Highways England Programme SRO • Other senior directors as required • DfT Project Sponsors and Highways England Project Sponsors • Optional • IPA, SRO/Sponsor for other T1 projects, Project Representatives, Highways England Chief Analyst 	<ul style="list-style-type: none"> • Commissions Highways England to undertake T1 project activity • Resolves escalated issues from TRAC • Considers emerging potential strategic risks to determine appropriate plans 	
h	<ul style="list-style-type: none"> • IPDC is chaired by the DfT's Permanent Secretary, held every 2 weeks. Membership consists of the following DfT staff: • Directors General • Directors for Corporate Finance, Project Sponsor, Group Finance, Analysis & Strategy, Group Commercial Services and Group Assurance • Commercial Advisor • Director of Legal 	<ul style="list-style-type: none"> • Attendance by representatives of LTC required at least annually. IPDC endorses business cases, funding and procurement and other investment-related requests on large scale projects. IPDC endorsement is required for projects of over £200 million 	Decision making

Meeting/ Group	Membership	Purpose	Meeting type
	<ul style="list-style-type: none"> Lead Non-Executive Board Member Other Non-Executive Board Members attend by invitation 		
DfT Ministers	<ul style="list-style-type: none"> Secretary of State for Transport (SoS) Roads Minister 	<ul style="list-style-type: none"> Following the IPDC meeting a submission is made by the DfT to the SoS and the Roads Minister, seeking approval of IPDC recommendations. In parallel the DfT write to HM Treasury (HMT) seeking funding approval 	Decision making
Quarterly Tripartite Forum (DfT/HMT/HE)	<ul style="list-style-type: none"> HMT Transport Spending Team Divisional Director (Chair) DfT Director Strategic Roads Highways England Director Strategy and Planning Others by invitation only 	<ul style="list-style-type: none"> Held quarterly To maintain alignment and co-ordination across organisations on key issues for Tier 1 projects including: <ul style="list-style-type: none"> overall integrated plan progress significant announcements handling decisions and approvals emerging risks, issues and proposed mitigation/resolution progress updates on key issues 	Co-ordination and issue resolution

4.3.16 We will consider the need to revise the governance approach to be applied beyond the development phase and reflect our position in the FBC.

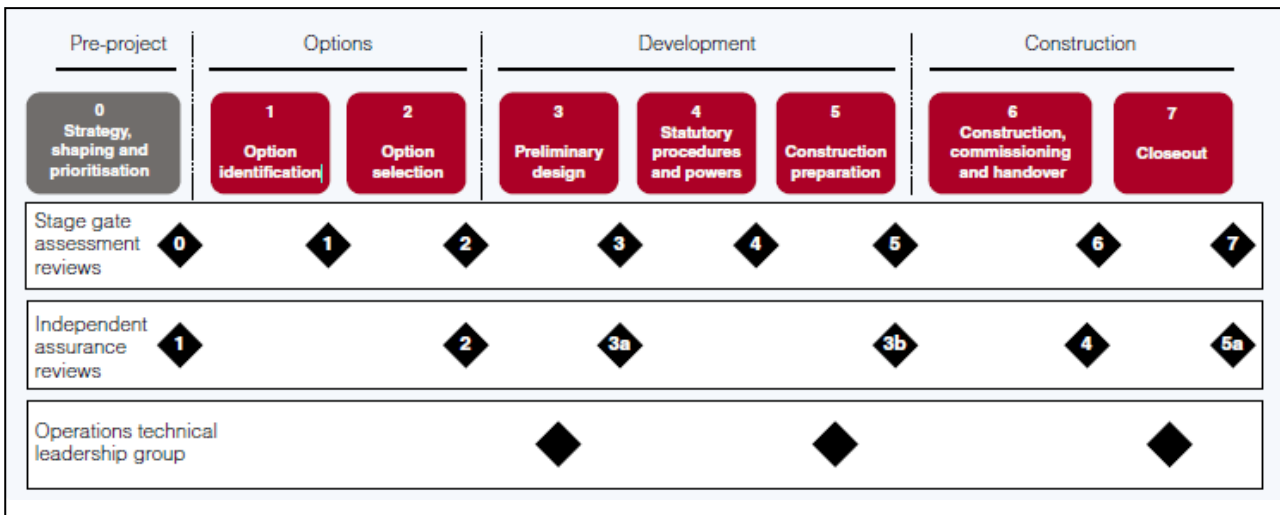
4.4 Project Control Framework and project assurance

4.4.1 LTC follows the Major Projects PCF process which sets out how we manage and deliver projects of over £10 million capital value. The PCF is designed to ensure that we deliver road schemes which meet customers' aspirations in a consistent, cost efficient and timely manner. It defines responsibilities and deadlines, setting expectations in respect of outputs. These are assured through a series of gateways across the life of a project. The PCF process was launched and developed jointly by

the Highways Agency (superseded by Highways England) and the DfT in 2008 and has proven effective in aiding the successful delivery of projects.

- 4.4.2 The PCF process sets out a clear structure for the project life cycle. Three phases (options, development and construction) are broken down into seven key stages as shown in Figure 4.2, which also shows the timing of the Stage Gate Assessment Reviews (SGARs) and independent assurance reviews.

Figure 4.2 Timing of Stage Gate Assessment Reviews, independent assurance reviews and Operations Technical Leadership Group



Source: Highways England Project Control Framework⁷

Stage Gate Assessment Reviews

- 4.4.3 At the end of each stage the SGARs provide basic assurance that:
- the stage is complete and is within its tolerance
 - the PCF has been followed
 - LTC is ready to proceed to the next stage
- 4.4.4 SGARs are evidence-based reviews that draw on documentation that demonstrate that LTC is equipped to accomplish its objective.
- 4.4.5 The project team took LTC through a Stage 1 Gateway Review in November 2015, a Stage 2 Gateway Review in June 2017 and an interim Stage 3 Gateway Review in July 2018.

Operations Technical Leadership Group

- 4.4.6 The PCF process requires all projects to present their operational solution to the Operations Technical Leadership Group (Ops TLG) at Stage Gates 3, 5 and 7. The review by Ops TLG places focus on operational, safety and maintenance issues, helps LTC develop consistent approaches and ensures knowledge is shared across project teams.

⁷ <https://s3.eu-west-2.amazonaws.com/assets.highwaysengland.co.uk/roads/road-projects/A12+Chelmsford+to+A120/The+Project+Control+Framework+Quick+Reference+Guide+v1+February+2017.pdf>

Assurance Reviews

4.4.7 LTC undergoes both internal and independent assurance and commercial reviews, run by specialist external reviewers (including the IPA) at key points in the delivery lifecycle. These reviews are generally timed to support requests for funding and business case approval and therefore normally occur shortly before a IPDC authority request.

4.4.8 The main assurance review processes are shown in Table 4.5.

Table 4.5 Assurance Reviews

Meeting/Group	Membership	Purpose
PCF/Stage Gate Assurance Reviews	Highways England: <ul style="list-style-type: none"> SRO Programme Sponsorship Director Project Director PCF Assurance Team 	<ul style="list-style-type: none"> At the end of each of LTC's PCF stages there are Stage Gate Assessment Reviews (SGARs). The reviews ensure that the PCF stage process has been followed and the PCF stage products have been delivered to the required quality to allow LTC to progress to the next stage.
DfT Centres of Excellence (CoE)	<p>Strategic:</p> <ul style="list-style-type: none"> Policy Unit Strategy Unit <p>Economic:</p> <ul style="list-style-type: none"> Transport Appraisal and Strategic Modelling <p>Finance:</p> <ul style="list-style-type: none"> Strategic Finance and Planning <p>Commercial:</p> <ul style="list-style-type: none"> Group Procurement Corporate Finance Management: Programme and Project Management 	<ul style="list-style-type: none"> To provide an assurance review of the authority paper and supporting documents that will be presented to IPDC. Each CoE will provide a list of comments following their review for inclusion as an annex in the authority paper. These comments will include a priority rating for the Committee's viewing and consideration.

Meeting/Group	Membership	Purpose
Procurement Advisory Board (PAB)	DfT: <ul style="list-style-type: none"> Deputy Director Assurance and Supplier Relationship Management Commercial Delivery Advisor for RIS Client Team CoE representatives 	<ul style="list-style-type: none"> Provides advice to IPDC on procurement matters.
Independent Reviews <ul style="list-style-type: none"> Commercial Schedule Cost 	<ul style="list-style-type: none"> As required 	<ul style="list-style-type: none"> An independent panel of experts brought together by Highways England, as required, to provide third party challenge. It provides a critical friend review of procurement documents.
Infrastructure and Projects Authority organised review	<ul style="list-style-type: none"> As required 	<ul style="list-style-type: none"> The assurance review is to inform the Major Projects Review Group (MPRG)/Treasury Approval Point (TAP) and provide a list of recommendations for LTC to address. It gives a delivery confidence assessment.
TAP/Major Projects Review Group	TAP <ul style="list-style-type: none"> HMT officials IPA Attended by DfT and Highways England MPRG <ul style="list-style-type: none"> Cabinet Office Permanent Secretary Senior HMT officials 	<ul style="list-style-type: none"> The groups meet to consider investment decisions, with more complex projects being reviewed by MPRG.
National Audit Office	<ul style="list-style-type: none"> As required 	<ul style="list-style-type: none"> The NAO undertakes audits on matters of specific interest to Parliament.

4.4.9 Each review results in a series of recommendations. Actions to address recommendations are planned and tracked, aimed at increasing the level of delivery confidence in LTC. A record of these recommendations and associated actions and responses forms part of the Integrated Assurance and Approval Plan (IAAP) and is included in all authority requests to IPDC as part of GMPP governance.

Procurement governance and assurance process

- 4.4.10 The proposed procurement processes for each package are set out in the Commercial Case. Some processes will involve CD or negotiations. The associated governance and approvals required for this type of procurement have been split up into six stages:
- a. OBC approval and Commercial and Procurement Strategy (CPS) (see Appendix C)
 - b. permission to publish the OJEU notice and Select Questionnaire
 - c. invitation to participate in dialogue (ITPD) or invitation to tender (ITT) for the Main Works contracts
 - d. FBC approval
 - e. contract award
 - f. Notice to Proceed (NTP), ie, the notice issued when the contractor is ready for the start of the construction of permanent works
- 4.4.11 In line with the Tier 1 governance process, DfT and HMT Ministers will approve the OBC and FBC and provide investment approval to support the issue of the OJEU and contract award.
- 4.4.12 Under our procurement delegations, Highways England would approve all other steps in the process:
- a. post OBC, approval of the main works procurement documentation and recommendations to down select bidders following the evaluation of Selection Questionnaire (SQ) and invite them to participate in dialogue
 - b. post FBC, approval of the main works contracts award
- provided the parameters agreed with DfT are not exceeded.
- 4.4.13 These approvals will be carried out by a dedicated Tender Panel. This will be chaired by the Executive Director of Major Projects, or his/her authorised delegated representative, and include senior representatives from the Finance, Commercial and Procurement, and Legal teams.
- 4.4.14 The key functions of the Tender Panel will be to:
- a. act as the delegated decision-making forum for the delivery of the procurement transaction
 - b. make decisions on behalf of the Highways England Board based on recommendations from CD leads
 - c. approve all core procurement documentation before OJEU and before the ITPD
 - d. ensure consistency in the resolution of issues raised by bidders during the procurement process.
- 4.4.15 This procurement process is proposed as the right balance of effective and thorough governance whilst enabling LTC to proceed at pace and maintain the OfT date. As

shown in Table 4.6 assurance points are built into the process to ensure that any issues are identified and fed into the approvals process at the appropriate stage.

- 4.4.16 The process also recognises the need for ongoing engagement with the DfT, HMT and IPA and the need to ensure all public announcements are effectively managed through the standard Ministerial grid and DfT/HMT Press Office processes and other government clearances.

Table 4.6 Procurement governance and assurance process

Key Decision Point	OJEU Contract Notice	Invitation to Participate in Dialogue	Contract Award	Notice to Proceed
Substantive Decision	Commence Procurement	Shortlist bidders	Make legally binding commitment	Commence construction on Site
Highest approval level	Tender Panel	Tender Panel	Tender Panel	Tender Panel
Pre-condition form HMG	OBC approved		FBC Approved	

5 Management of key activities

5.1 Introduction

5.1.1 LTC’s key management challenges will change over time. This section sets out how the key activities are to be managed throughout the development phase up to the start of construction, using the following headings:

- a. management of existing contracts
- b. management of design development
- c. management of land acquisition
- d. management of the Early Works
- e. management of the DCO process
- f. management of Third Party Agreements and utilities
- g. management of procurement
- h. management of the Integration Partner

5.2 Management of existing contracts

5.2.1 The current and planned contracts for LTC are illustrated Figure 5.1 below:

Figure 5.1 Lower Thames Crossing contracts



5.2.2 The number and nature of the contracts being managed at any time will change during the lifetime of LTC. This section focusses on the contracts already signed and being managed. Each of these contracts will have a Contract Management Plan (CMP) which sets out contractual roles and performance management arrangements.

Technical Partner

5.2.3 The contract with the Technical Partner, Cascade, is a New Engineering Contract 3 (NEC3) Professional Services Contract (Option G). The One Team approach agreed in 2018 has led to a revised contract model being devised to address changes to the contractual relationship.

5.2.4 Highways England’s Collaborative Performance Framework (CPF) is being used to measure Cascade’s performance on each of the Task Orders against key performance indicators (KPIs). Cascade submits a quarterly performance report, with appropriate

supporting documentation, for the Highways England supplier performance team to review. Their average CPF score is linked to future work opportunities and financial incentivisation and penalty calculations within Cascade's contract.

- 5.2.5 Cascade is incentivised to perform through a two-part incentive fund. This currently comprises:
- a. An annual incentive of 5% of revenue in the year which is assessed via a performance scorecard which identifies 4 defined deliverables for each of 10 performance indicators. The performance is assessed every quarter and payment is made at the end of the fourth quarter for the year's performance. The residual funds remaining from the full 5% available are rolled over to the following year, to incentivise improved performance.
 - b. A one-off incentive of up to 5% of revenue (from 31 March 2017 until the date the DCO is approved) for submission of the DCO.
- 5.2.6 As LTC progresses through the development phase, it is recognised that the scorecards will need to reflect the future performance imperatives. The headline success factors and metrics are currently being revised to align with the key delivery items needed to assure the milestones needed in the next two years.

Planning lawyers

- 5.2.7 BDB Pitman's have been appointed as the planning lawyers and their contract continues until DCO Consent. The Highways England legal lead for LTC is responsible for managing requests for legal advice and managing BDB's performance and costs.
- 5.2.8 Advice is commissioned based on the DCO Legal Services Standard Scope of activities and deliverables developed by Highways England. Performance is formally assessed on a quarterly basis against a set of KPIs developed by Highways England's General Counsel's Office.

Procurement lawyers

- 5.2.9 The procurement legal advisers are DLA Piper who have been appointed until 2022. Their role is to provide:
- a. specialist legal knowledge of contract law and practice
 - b. the overall assurance of the Design and Build contract
 - c. full assurance of the procurement process
 - d. specialist advice on the different procurement procedures to enhance the capability of the team.
- 5.2.10 DLA Piper are managed in accordance with the Contract Management Plan. Their performance is managed by the Highways England Contract Development and Assurance team.

5.3 Management of design development

- 5.3.1 A Preliminary Design has already been developed by the Technical Directorate which provides enough detail for the DCO process. To guide the further development of the

design, a Design Management Strategy⁸ (DMS) has been developed which sets out how:

- a. the Technical Partner will produce the Developed Design for inclusion in the tender packs used for procurement
- b. the main works contractors will develop a Detailed Design that is fit for construction.

5.3.2 Formal decision making on the design is made by the Development Steering Group. As the design is developed, the process will be coordinated and managed through the change management process and design/scheme releases subject to formal governance.

5.3.3 In the construction phase a Design Authority will be established by LTC to review and assure contractor designs in line with the contract, mitigating client risk. The Design Authority will also be responsible for the overall integration of the various designs prepared by Main Works contractors.

5.4 Management of land acquisition

5.4.1 LTC will permanently occupy land for the highway and associated operational facilities as well as for the permanent relocation of utilities, provision for flood compensation, ecological and environmental mitigation and the replacement of open space.

5.4.2 It will also require temporary access to some land to:

- a. undertake the surveys required to inform the DCO application (eg, ecological, noise and air quality surveys, ground investigations and archaeological trial trenches)
- b. locate facilities which support construction (eg, compounds, haul routes and power supplies).

5.4.3 In addition, the compensatory regime allows for the purchase of properties under the blight and discretionary purchase principles. For LTC this generally relates to residential properties.

5.4.4 The current land take requirements for LTC are detailed within the Development Boundary published for the statutory consultation in October 2018. This defines the outer limits of the area within which we need to undertake works or secure land. The Development Boundary will be updated before the submission of the DCO application.

5.4.5 Government guidance on the use of compulsory powers requires major projects needing to assemble land, to develop a strategy or plan for securing site, taking account of specific factors around that project. The aim is to have a consistent approach that:

- a. helps deliver the Road Investment Strategy (RIS) effectively
- b. enables projects to obtain the land they need
- c. respects the requirements of Managing Public Money
- d. fulfils our statutory duties

⁸ HE540039-CJV-GEN-GEN-STRPRO-00030

e. follows the principles of the Compensation Code.

5.4.6 The best route to acquiring a site will depend upon on timing. If the agreement is to be entered into pre-DCO it will have to be agreed through negotiation. After the DCO Highways England can either negotiate or use the powers granted within the consent.

Pre DCO site assembly

5.4.7 Before DCO award we will attempt to purchase priority sites by negotiation. However, in case this is not possible we will twin-track the option of using compulsory acquisition powers as prescribed within the DCO, which itself requires evidence of prior negotiations.

5.4.8 Ideally negotiations will lead to an agreement in principle with the landowner on the terms of the purchase, possibly including a minimum level of compensation that will be paid, and an agreed time of acquisition or an agreement that the purchase should be affected through us using our compulsory powers.

5.4.9 During the examination of the draft DCO we expect the examining authority to follow standard practice and request updates on the status of our negotiations with each land interest. The LTC project team maintains a complete and accurate record, via the Project Customer Relationship Management System, of every attempt at contact with each land interest, so to evidence our attempts at acquisition by agreement.

5.4.10 The drivers to acquire land before the DCO consent fall under the three headings below:

- a. Landowner Requirements – the LTC project team has engaged with all the major landowners impacted by the scheme. Some have indicated they would prefer to dispose of land or enter into agreements to provide for the use of land for LTC in advance of the proposed DCO. From their perspective this has the advantage that they can potentially:
 - i. negotiate a more flexible agreement than would be available through the compulsory acquisition route
 - ii. attain certainty at an earlier date.
- b. Programme Requirements – securing land earlier will enable the LTC project team to accelerate activities required in advance of the main construction works which are on the critical path (eg, the creation of areas required for ecology and environmental mitigation, site clearance/demolition and preparation for any utility diversions). Whilst some of these activities cannot start before DCO consent, early acquisition does mean that once the DCO is granted, works can start without the need for the long lead-in times for noticing under the DCO or to negotiate access. The priority sites have been identified and discussions are ongoing with the owners.
- c. Main Works Procurement – experience from other projects has shown that pre-DCO land assembly provides a better context for the tender process.

Proposed agreement framework

5.4.11 There are four mechanisms available to secure land by agreement before the DCO consent:

- a. Agreements in principle/Option – an agreement with an option to exercise/draw down the land in the future on a trigger event, eg, the DCO being granted.
- b. Agreements for Temporary Land use – based upon the requirements of LTC, including areas for construction compounds, access and power supplies.
- c. Favourable Opportunity – to consider the purchase of land pre-DCO where there is a clear financial gain (such as avoiding a landowner developing land and significantly increasing its value, and therefore increasing compensation to be paid later).
- d. Special Payment in terms of Managing Public Money/Incentives – there is a need to consider value for money and balance against certainty of programme or risk reduction in the future.

5.4.12 Wherever possible pre DCO acquisitions will be option agreements which allow us to pay most of the consideration only if we exercise an option after the DCO is granted.

Post DCO site assembly

5.4.13 For priority sites Highways England will negotiate to secure land before the DCO. All parcels of land within the development boundary will be included within the DCO application and powers for temporary use or compulsory acquisition powers will be sought.

5.4.14 The DCO will give Highways England the necessary powers to enter land to survey, use land temporarily or compel acquisitions. We will work with the Main Works contractors to exercise our powers in line with the construction programme to ensure an immediate handover of the sites to the contractor. This negates the need for Highways England to hold and manage sites before the contractor taking over responsibility. This process will be detailed within the Main Works contracts.

Blight and Discretionary Purchase

5.4.15 Statutory Blight was triggered following the preferred route announcement (PRA)⁹ in April 2017. This allows property owners, residential and small businesses, within the Development Boundary to request that Highways England purchase their properties. To date, a few residential properties have been purchased by Highways England

5.4.16 Discretionary Purchase relates to residential property owners outside the Development Boundary. Should an owner be able to demonstrate that they have a pressing need to sell and are unable to do so except at a significant loss due to LTC, they can apply to Highways England for the purchase of the property. To date Highways England have purchased a small number of such properties.

5.4.17 Once purchased the properties are managed and where possible let out on the open market for rental and at an appropriate time post construction the properties will be disposed of on the open market.

Access to sites for surveys

5.4.18 Since the PRA we have undertaken a range of surveys on land both within and outside of the Development Boundary. Where possible access has been secured by agreement with the landowner with the payment of compensation as appropriate.

⁹ <https://www.gov.uk/government/news/new-lower-thames-crossings-to-cut-congestion-and-create-thousands-of-jobs>

Statutory Powers under Section 172 of Housing and Planning Act 2016¹⁰ are available should access not be granted.

- 5.4.19 Post DCO all access will be as per the powers confirmed within the DCO and again any appropriate compensation payable.

5.5 Management of the early works

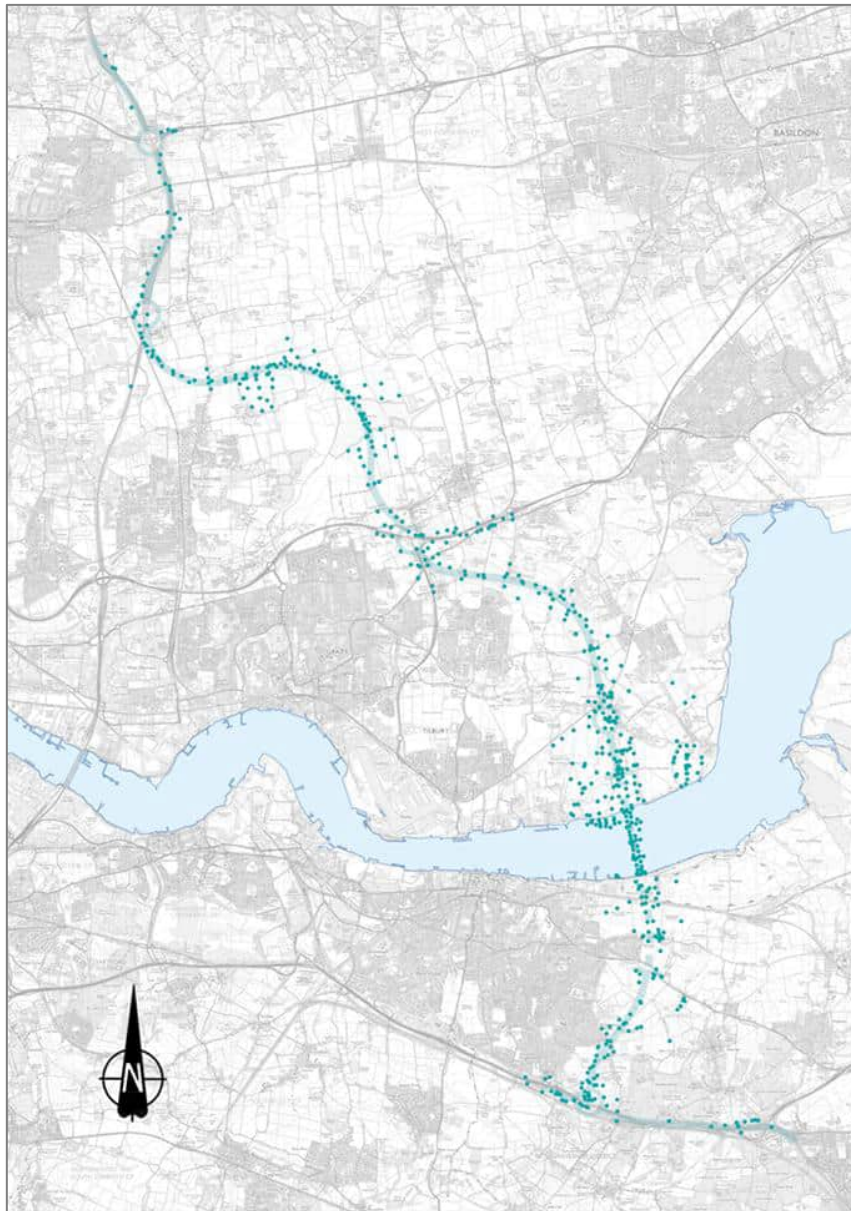
- 5.5.1 The Early Works include site surveys, site investigations, design services and construction of ecological habitats for the translocation of protected species. These activities are being delivered within a multi-package approach based on specialisms and/or geographical locations. These are being managed with support from our Technical Partner.

Ground Investigations (GI)

- 5.5.2 The GI team is led by the Head of Ground Investigation Delivery and supported by a team of commercial and technical experts. On 1 July 2019 we launched a comprehensive programme of ground investigations and surveys in Kent, Essex and Thurrock to provide us with a clear picture of the type of soils, rock and groundwater along the proposed route. This will help us design the structures required for the road including bridges and viaducts, embankments and cuttings, conduct environmental assessments as part of our DCO application, and help us plan the construction of the tunnel.
- 5.5.3 Tests will be carried out at over 700 locations, including over 400 boreholes, ground water sampling and monitoring, shallow trial pits and a wide range of unobtrusive geophysical surveys. See Figure 5.2 below.

¹⁰ <http://www.legislation.gov.uk/ukpga/2016/22/section/172/enacted>

Figure 5.2 Location of ground investigation tests



- 5.5.4 The contractors are being managed by a contract management team within the project team. The size of this team will flex dependent upon the number of GI suppliers engaged at any point in time.

5.6 Management of the DCO process

- 5.6.1 The DCO submission and examination are the responsibility of the Development Director. The Consents team, of approximately 70, brings together project managers and technical staff with widespread experience of the DCO process and a range of specialisms including:
- a. planning
 - b. information management
 - c. environmental consenting
 - d. stakeholder engagement

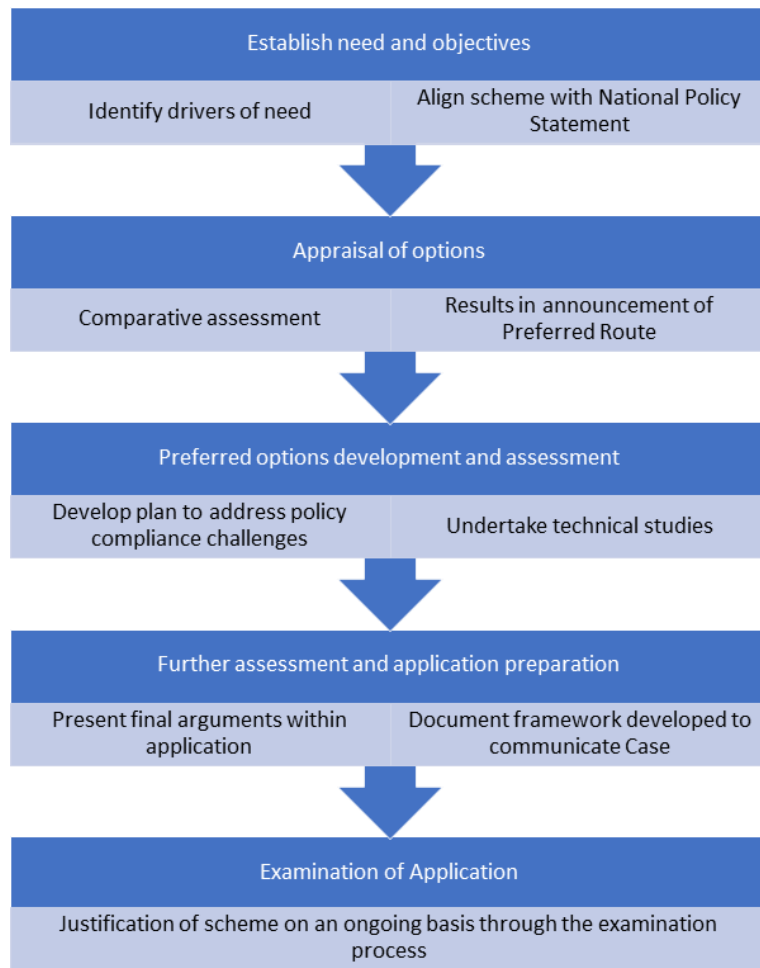
- e. legal
- f. communications

5.6.2 We have implemented a structured approach to deliver a successful DCO application. At the outset, alignment of documentation is achieved through a storyboard process. As documents mature, alignment will be maintained through an integration review process. Finally, an approval process will ensure that the review and sign-off process is managed efficiently and aligns with formal project governance.

Making the case for the Lower Thames Crossing

5.6.3 A Case Making workstream has been set up to ensure that assessments are completed in line with the requirements of the National Policy Statement and to support a response to any challenges. The process for case making is shown in Figure 5.3.

Figure 5.3 Process for case making



5.6.4 Working groups have been set up to explore each area of concern. These are led by a topic specialist supported by technical experts and counterparts from the planning lawyers BDB Pitmans. These groups ensure technical work is carried out as appropriate, policy issues are ironed out and an evidence base is documented.

5.6.5 The working groups are arranged as follows:

- a. Environment (HRA – Ramsar/HRA – SAC (Yew Tree)/Ancient Woodland/Mitigation proposals/Air quality/Noise)

- b. Sustainable Local Development and Regional Economic Growth (OBC/Economic Case/Sustainability/Benefits)
- c. A2/M2/AONB
- d. User Charging
- e. Land – Residential (Landowners/Travellers)
- f. Land – Special Category (Common/open space/Greenbelt)
- g. Carbon and Energy Management
- h. Historic Options (Route selection/Alternatives to a tunnel)
- i. Community and Environment (Social impacts/Community (Env)/Health impacts)
- j. Transport (SRN/LRN/Transport Assessment)
- k. Construction

Preparing the draft DCO

- 5.6.6 The DCO granted will be fundamental to the successful delivery of LTC. To ensure it gives the required powers for delivery of LTC, the draft DCO will be challenged through a series of inter-disciplinary workshops. These workshops will include the design team, the environment team, the network operations team, the construction team and the commercial and procurement team. The aim is to ensure that the powers sought through the draft order are:
- a. capable of being consented
 - b. flexible enough to ensure the delivery of value during the procurement and for the commercial model for the Main Works contractors to operate as intended.

- 5.6.7 This is a process that has been successfully used by the team on other similarly complex DCO applications.

Stakeholder Engagement to support DCO

- 5.6.8 Statements of Common Ground (SOCG) will be prepared with all key stakeholders to set out what is agreed, what is not agreed and what is under discussion. These will assist the Examining Authority in focusing attention on key issues. Each SOCG has a named relationship manager, author and reviewer and all will be subject to project level assurance and approval before finalisation.

Examination planning

- 5.6.9 The Examination Management Plan will set out the framework for managing the responses through triage, response preparation and governance. Before DCO submission LTC's governance requirements will be reviewed to ensure that decision making supports the challenging requirements and timescales of the DCO examination process. Embedded through this process will be input from the commercial and procurement team to ensure all challenges that could impact the commercial deliverability of LTC are understood and agreed.

- 5.6.10 Lessons learned sessions will be held with other projects including the A14 and A303 leading to an assessment of the governance procedures and their ability to meet examination timelines.

5.7 Management of Third-Party Agreements and Utilities

- 5.7.1 We intend to sign over a thousand Third Party Agreements (TPAs) with a significant proportion of our agreements being in place before DCO submission.
- 5.7.2 TPAs are legally binding agreements between Highways England and third parties which protect the third party's interests by indemnifying them against loss or damage and providing for reimbursement of their costs in defined scenarios. They also provide a dispute resolution procedure and define termination arrangements and benefits to those named within the agreement.
- 5.7.3 By entering these TPAs we will mitigate the risk of objections to LTC, maximise commercial opportunities, protect Highway England's interests and promote activities beneficial to the business more broadly.
- 5.7.4 Within the total of over one thousand TPAs we are prioritising concluding agreements with about 40 landowners and statutory undertakers including:
- a. the local authorities affected by LTC who also act as Highway and Planning authorities
 - b. the statutory environmental bodies such as the Environment Agency and Natural England who have a regulatory function as well as owning assets
 - c. the land and business owners whose land or business operations will be affected by LTC
 - d. utility providers who own assets that need to be protected or diverted during construction and operation.
- 5.7.5 The issues addressed in individual TPAs vary but may include:
- a. protective provisions (defining how the powers of statutory undertakers will be dealt with through the DCO)
 - b. asset protection agreements (describing how the assets of third parties will be protected during construction)
 - c. service agreements (framing the services we will draw upon from third parties)
 - d. land agreements (including temporary/permanent land take and compensatory measures).
- 5.7.6 We will put the TPAs into place through a series of engagement and negotiations between now and DCO submission. A team have been set up on LTC to manage the securing and management of agreements across the topic areas described. Each team consists of a lead negotiator, supported by technical and commercial representatives. Legal, financial and relationship management workstreams underpin all aspects of the team's work. A working group and steering group have been set up to govern the activities of the workstream: approving negotiation strategies, overseeing negotiations and signing off agreements. All activities feed into the LTC monthly reporting cycle via an integrated Power BI dashboard.

- 5.7.7 The obligations Highways England will take on under these agreements will mainly be delivered through our early and main works contractors under our oversight.

5.8 Management of procurement

- 5.8.1 Procurement is the responsibility of the Commercial and Procurement Director. The team has approximately 20 FTE to deliver the Early Works (already in progress – see Section 5.5 above) and the Main Works packages (Roads North, the A2/M2 Connections, and the Tunnels and Approaches packages).
- 5.8.2 There will also be a separate small piece of work to connect the various technology systems delivered by the Main Works contractors including CCTV and roadside technology to the existing SRN systems. The best method of securing this works will be decided post CD.
- 5.8.3 The team is also responsible for preparing a statement of needs for the user charge service to be procured by Highways England Corporate Finance. The service is being procured jointly for the Dartford Crossing and LTC so responsibility for the procurement itself necessarily sits outside the LTC project team.
- 5.8.4 The Commercial Case sets out the procurement routes to be used. This case sets out:
- how each requirement is managed
 - the project team in place to take procurement forward, including their capacity and capability
 - the methods of management to be used.

Management of Early Works procurement

- 5.8.5 The Early Works will be delivered under call off arrangements from existing frameworks or in the case of the non-contestable utilities works delivered by statutory undertakers and their contractors. These processes will be managed through the existing team organisation described in this Management Case.

Management of Main Works procurement

- 5.8.6 The Tunnel and Approaches package will be tendered under the CD procedure.
- 5.8.7 The Roads North and the A2/M2 Connection package will be delivered through a two stage Early Contractor Involvement (ECI) contract.

Management of Competitive Dialogue Process.

- 5.8.8 A dedicated team will oversee the production of the procurement documentation and direct the process including the CD phase. The team will comprise the Procurement Transaction Lead, the commercial lead for the package, the Head of Commercial and Procurement for LTC and the CIP Commercial and Procurement Director.
- 5.8.9 Delivery expertise, including tunnelling has been brought into LTC at senior level through our Technical Partner. This technical and commercial expertise will:
- inform the development of the tender documentation
 - shape the approach to contract management plans, mitigating key risks and embedding lessons from other major projects.
- 5.8.10 The Procurement Transaction Lead will manage the end-to-end procurement process. This is a new senior role within the project team, requiring significant experience of CD.

- 5.8.11 The Head of Commercial and Procurement will manage the development of the contract, including the appropriate performance and incentive mechanisms. They will work with the commercial leads and the Procurement Transaction Lead to ensure the completion of all procurement and contract documents and the coordination of the overall assurance.
- 5.8.12 The CIP Commercial and Procurement Programme Director will provide overall guidance to the leadership team.
- 5.8.13 Throughout the procurement process we will prioritise consistency of people and capability; the team is intrinsically involved in defining the output specification and setting the minimum (and high) quality standards for the technical, commercial and legal evaluation teams. Consistency and capability of team members is ensured using experienced Highways England staff and named staff within the Technical Partner.
- 5.8.14 There are three distinct phases of the procurement process, namely, the Supplier Qualification, CD and final tender evaluation. The roles of our evaluators, the Senior Dialogue Lead, the Dialogue Teams for each bidder, the moderation panels and the Tender Panel in each phase are described below.

Supplier qualification

- 5.8.15 Technical, financial, commercial and legal specialists will evaluate responses received from applicants. Training will be provided to all evaluators to ensure they fully understand how to score all responses. It is key that evaluators understand the minimum quality standards and the key areas of added quality that will differentiate bidders.
- 5.8.16 Evaluators will assess each area individually and impartially before going to moderation. A small team of financial assessors will be engaged, following the approach we adopted on the recent procurement of the Regional Development Programme, to manage the evaluation of the final prices in line with defined process set out in the Commercial Case.
- 5.8.17 A moderation panel will be used to moderate the initial evaluation at the Supplier Qualification stage.

Competitive Dialogue

- 5.8.18 There will be a dedicated Dialogue Team for the duration of the CD process. The Commercial and Procurement Strategy (see Commercial Case Section 6.5) details the structure of this team. Staffing levels will be set as part of the business planning of the procurement workstream. Subject matter experts will be present throughout the process and attend all dialogue meetings.
- 5.8.19 The negotiation strategy for the CD phase will be signed off by the SRO and the CIP Commercial and Procurement Director before the start of the process. It will be informed by the CPS and define our Most Desirable Outcome (MDO) and the Least Acceptable Solution (LAS) for each issue. The objective of the dialogue will be to achieve the MDO for a high proportion of the overall solution (greater than 70%). The Dialogue Team will only be able to accept positions worse than the LAS with the approval of the Tender Panel.
- 5.8.20 A Senior Dialogue Lead (SDL) will be appointed to manage the CD process and be the face of LTC to internal and external stakeholders engaged in the process. The SDL will work under the direction of the Project Director with strong guidance from the CIP Commercial and Procurement Programme Director.
- 5.8.21 The SDL will be accountable for:
- a. producing the tender documentation used throughout the transaction

- b. ensuring the technical documentation and specification are accurately reflected in the tender documentation
 - c. updating the negotiation strategy as required during the dialogue progresses.
- 5.8.22 The dedicated Dialogue Team will consist of a dialogue manager whose key responsibilities are to manage the sessions and to ensure detailed and accurate minutes are taken that reflect the agreements, observations and challenges that are made throughout the process.
- 5.8.23 The dialogue manager will be supported by a procurement team to ensure all logistics and administrative matters are handled effectively. The Dialogue Team will include technical, commercial and legal personnel who will lead the dialogue on each area respectively. These are senior people from each of the functions, drawn from the existing project team. Capability assessments and necessary training will be completed for all people who participate in CD. We will train people on what CD is and how it works, the negotiation strategy and behaviour. This will ensure that the team is fit for purpose, having regard to their need to hold the conversation with senior industry people within bidding teams with deep experience of such processes. The same team will be used for all bidders.
- 5.8.24 During the CD process the dialogue team will start each day with a discussion of activities for the day ahead and finish the day with a review of the dialogue held to ensure coordination across dialogue workstreams. To ensure the team can work at pace, the whole team will be located in the project office throughout the process.
- 5.8.25 The Senior Procurement Manager will provide a weekly update to the Tender Panel.

Tender evaluation

- 5.8.26 We do not intend to down-select tenderers during the CD process (see Commercial Case Section 6.6) so there will be no formal, evaluated interim submissions.
- 5.8.27 As far as possible the same individuals who evaluated the Supplier Qualification submissions will also evaluate the final bids received from the suppliers.
- 5.8.28 A moderation panel formed of technical, commercial and legal experts will moderate the evaluation of the bidder's responses. This will comprise experts from within Highways England but outside the project team including experts from within our Safety Environment and Standards (SES) Directorate and CIP, to ensure impartiality while retaining enough technical understanding.
- 5.8.29 A Tender Panel will be formed to give the Dialogue Team rapid access to executive decision making throughout the procurement process. This will be chaired by either the Procurement Transaction Lead or the Senior Dialogue Lead. We anticipate the Tender Panel will consist of the Project SRO, Project Director, the CIP Commercial and Procurement Director, our Director of Procurement and General Counsel.

Managing the Two Stage Processes

- 5.8.30 During Stage One the Contractor will deliver pre-construction activities, developing the construction methodology, logistics and detailed design. The contractors will also have the opportunity to input into the critical utilities developments and other stakeholder interfaces that are central to successful phasing and delivery of the project.
- 5.8.31 A strong management structure and process for Stage One will be critical for controlling delivery. Stage One will be structured into a series of Gateways, through which the Contractor can demonstrate the development of their proposal to progressively assure the final proposals for Stage Two.

- 5.8.32 At each Stage One Gateway the contractors will be required to present evidence of sufficient progress against a set list of requirements. An important aspect of this development will be the production of a Target Budget within the Affordability Envelope and will this need to be supported by confidence in the planned approach for Stage Two, in order for the project to proceed to that stage.
- 5.8.33 The structured approach will ensure that these cost and associated schedule requirements are developed alongside the methodology and design elements, in order that they reflect the planned approach and provide the required confidence to proceed.

Procuring the Technology

- 5.8.34 As set out in the Commercial Case Section 9.6, LTC will not independently procure a technology package or provider(s) as technology will be delivered within the scope of the Main Works packages or through variations to existing (and successor) contracts that serve the whole of Highways England's strategic network for these areas of specialist scope.
- 5.8.35 The NRTS2 contract will expire and need to be renewed by a successor vehicle (at this juncture termed NRTS3) during early stages of the LTC delivery period. Highways England has experience of NRTS transition whilst supporting major projects work, from the original transition from NRTS to NRTS2 whilst supporting the Smart Motorways Programme.
- 5.8.36 A fully project managed transition programme, with overlapping ramp up and ramp down phase is anticipated, as well as transitioning across of key resources including TUPE of key personnel. A Lessons Learned exercise was conducted by the NRTS team, and the LTC project team has been given access to and is familiar with the output

5.9 Management of the Integration Partner

- 5.9.1 The Collaborative Performance Framework (CPF) and the Quality Management Systems (QMS) will be used to manage the Integration Partner's performance.
- 5.9.2 The CPF will be used to measure the Integration Partner's performance of the contract. The Integration Partner will record its performance against the metrics in the CPF and will be obliged to propose relevant improvements. If the Integration Partner fails to meet the applicable performance level it will be treated as a substantial failure to comply with its obligations under the contract. A CPF score of six or over will trigger payment of additional profit, with the maximum additional 100% being payable for a CPF score of ten. This will then feed into the quality Phase Key Performance Indicator.
- 5.9.3 The Integration Partner contract will be managed through a specific Contract Management Plan (CMP) which will set out all our bespoke contractual obligations as well as the generic NEC4 contract management processes from Early Warning Notices through to Final Account Payments. The CMP will also include the delegation's matrices for the NEC Project Manager and NEC Supervisor roles on the main works contracts as well as the Service Manager roles on the Technical Partner and Commercial Partner contracts.
- 5.9.4 Within the ICT, the Integration Partner and the Commercial Partner will be separate organisations. The Integration Partner will provide most of the services required within the ICT to deliver LTC. However, it is advantageous to have a specialist cost-assurance function in the form of a Commercial Partner that is distinct from the Integration Partner scope as:
- independent cost assurance – the Commercial Partner can provide an independent and consistent cost assurance service to Highways England across

all LTC contracts, including the main works contracts, the Integration Partner contract and the Technical Partner contract.

- b. the Commercial Partner will be able to directly challenge the Integration Partner (if necessary) and can provide assurance of the Integration Partner's work.
- c. it will create a direct relationship between our Project and Contract Highways England Commercial Directors and our Commercial Partner (building a long-term partnership).
- d. the Integration Partner will be required to provide a broad spectrum of services and would likely need to bring in an additional supplier to provide the support that will be provided by the Commercial Partner.
- e. the use of an independent Commercial Partner provides Highways England with the flexibility and resilience to scale-down or remove Integration Partner services should its performance fail to meet expectations
- f. this approach allows Highways England to drive the commercial agenda in line with best practice and lessons learned from previous projects and avoids the risk of the Integration Partner taking control of the commercial agenda.

5.9.5 At a high level, the Commercial Partner will drive the commercial agenda on the Project which will include:

- a. the provision of commercial advice to the Highways England Commercial Director
- b. the provision of commercial management of the Integration Partner, the Technical Partner, PEW and other Highways England contracts in connection with the Project
- c. the provision of commercial assurance.

6 Benefits realisation management

6.1 Introduction

- 6.1.1 As set out in the Economics Case at Sections 4, 5 and 6, LTC will directly deliver, or indirectly promote, a range of economic benefits to customers, local communities and to Highways England.
- 6.1.2 Whilst some of these benefits are realised during the lifetime of the LTC project many will only be realised when Highways England operates the crossing after the LTC project has been completed. Equally whilst some benefits are realised solely by the operation of the LTC for others this will not be enough on its own to ensure the potential benefit is realised. For these additional actions will be required to realise the potential benefit and in some cases responsibility for these actions will lie outside Highways England's remit.
- 6.1.3 In this section we explain how our benefits realisation management strategy will address the twin challenges of:
- a. maintaining a focus on benefit realisation over a period longer than the life of the LTC project itself
 - b. identification and agreement of roles and responsibility for the realisation of benefits where some or all key responsibilities lie outside Highways England's remit.
- 6.1.4 Our strategy has been reviewed by an expert panel drawn from Transport for London (TfL), the DfT and the IPA to ensure that it aligns with best practice. The key features are described in detail in this section which sets out how the overall approach is based on IPA guidance¹¹, the status of the work on defining metrics for measuring benefit realisation, the plans for managing benefits beyond the close out of the project and the arrangements for working with other bodies which will need to play a role if benefits are to be realised to the full.

6.2 Overall approach

- 6.2.1 Highways England is committed to ensuring the LTC project delivers the outcomes required to promote the scheme objectives, as defined in the CSR, as well as additional, sustainable outcomes which will benefit the environment, local economy and communities.
- 6.2.2 Many of these additional outcomes, and the resulting benefits, will be delivered directly through the completion of the project outputs in the right way. However, some will require complementary activity realised through either:
- a. partnerships between Highways England and relevant stakeholders
 - b. initiatives managed independently of Highways England
- 6.2.3 LTC's Legacy and Benefits Strategy¹² (LBS) has been developed on this basis. The LBS is aligned with the IPA's 'Guide to Effective Benefits Management in Major Projects'. Key elements of the strategy include:

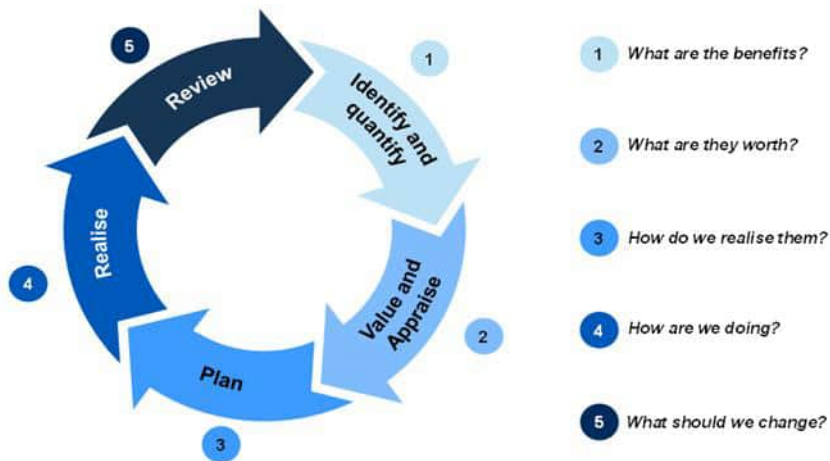
¹¹ <https://www.gov.uk/government/collections/infrastructure-and-projects-authority-assurance-review-toolkit>

¹² CASCADE-CJV-XXX-XXX-REP-BEN-50011

- a. industry-leading appraisals to understand the impacts of LTC and needs of local communities, and how these translate into benefits
- b. strong stakeholder partnerships to deliver additional initiatives that extend outcomes beyond the Development Boundary
- c. working with government departments and local authorities to identify and articulate the potential wider benefits of this investment and activities critical to their realisation.

6.2.4 Our approach to benefits realisation management (BRM) has been designed to implement the LBS. It follows the five-stage lifecycle for benefits management set out in Highways England's Benefits Management Handbook (October 2018) and reproduced in Figure 6.1.

Figure 6.1 Five-Stage Benefits Management Lifecycle



6.3 Stage 1 – Identifying and quantifying the benefits

- 6.3.1 An initial assessment of Highways England's strategies, national policies and the CSR (the drivers) (see Strategic Case Section 3.2), and elements of the project design as it has developed (the enablers)
- 6.3.2 Internal engagement informed a long list across 21 areas and further assessment of the environmental and community impacts of LTC. Stakeholder engagement and an analysis of consultation responses informed the development of the project's benefits wheel (see Figure 6.1)
- 6.3.3 The wheel demonstrates a clear line of sight from the CSR and Highways England's strategic objectives, through to the project outcomes. The strategic objectives that align with the Highways England Delivery Plan are:
 - a. Improving safety for all
 - b. Improving the customer experience
 - c. Delivering value for money
 - d. Supporting economic growth
 - e. Enhancing the environment

f. Improving quality of life for communities

6.3.4 The benefits wheel shown at Figure 6.2 sets out the areas of focus that have been prioritised by LTC as offering greatest opportunity to make maximum impact based on an assessment of project impact, local needs and aspirations.

Figure 6.2 LTC Benefits Wheel



6.3.5 In July 2019, following a baseline review of the scope, a logic mapping exercise provided further validation of the benefits previously identified. This resulted in the benefits list being updated.

6.4 Stage 2 – Valuing and appraising the benefits

6.4.1 A series of appraisals have been undertaken to date to provide a robust assessment of the economic benefits of the scheme in accordance with DfT guidance. These are presented in the Appraisal Summary Table and detailed in the Economic Case at Section 8.

6.4.2 As the FBC is developed, LTC will consider opportunities to further appraise the wider benefits and impacts identified.

6.5 Stage 3 – Planning to realise benefits

6.5.1 Technical engagement continues to ensure the project design considers local needs and aspirations and provides the best balance of benefits and impacts for local communities, the environment and the economy. Specialist engagement with key stakeholders will also shape the approach to skills, local employment, STEM and support for the local supply chain.

6.5.2 Internally a Project Benefits Group is responsible for ensuring benefit dependencies are not compromised, risks to delivery are managed and opportunities identified to optimise outcomes within project scope or the change control process.

- 6.5.3 We are aiming to deliver the best balance between meeting the scheme objectives while creating additional, sustainable outcomes for the environment, economy and local communities. This will be achieved by working with stakeholders to deliver a programme of activity that extends beyond the Development Boundary.
- 6.5.4 Opportunities will be identified based on local needs and aspirations and shared objectives between LTC and Highways England more widely, and stakeholders. These will be progressed as appropriate either by establishing specialist stakeholder working groups, on a one-to-one basis or by representatives from the LTC joining pre-existing partnerships.

6.6 Benefits and the procurement process

- 6.6.1 An outcome-focused procurement approach will require potential delivery partners to demonstrate how they would maximise the benefits of LTC through its delivery (see Commercial Case Section 5 and 6).
- 6.6.2 Identified outputs that contribute to outcomes will be contained within the scheme requirements. Further contributing contractor commitments will be included in final tender submissions and contractualised as appropriate.
- 6.6.3 Additional, non-standard questions in the Selection Questionnaire will reflect the LTC's critical success factors and ask applicants to demonstrate how they have previously delivered projects that have had a positive impact in these areas.
- 6.6.4 The benefits team will be involved in evaluating tenders to provide assessment of additional contractor commitments that maximise opportunities around the benefits wheel. Appropriate targets will be agreed, and measures put in place to monitor delivery.
- 6.6.5 To support this, detailed profiles are being developed for each benefit that underpins LTC's business case as well as other key areas of focus for LTC.
- 6.6.6 The profiles demonstrate:
- alignment between the CSR, project strategic goals and the outcomes identified
 - the contributing outputs to be delivered within scope or in partnership with stakeholders, including owners and timelines for delivery
 - appraisal undertaken to date, forecast of benefit realisation per annum and alignment to GMPP benefit categories
 - risks to realisation and mitigation measures identified
 - monitoring and evaluation approach; including alignment to Highways England KPIs, baselines and appropriate targets.
- 6.6.7 This information supports the production of the Benefits Realisation and Evaluation Plan at the end of Stage 5.

6.7 Benefits realised outside delivery of the core project

- 6.7.1 The sponsorship team will be responsible for working with stakeholders to develop a programme of activity that contributes towards LTC outcomes but extends beyond the Development Boundary and/or outside LTC's scope and remit. We have learnt from other schemes, including A14 Cambridge to Huntingdon, that in the next phase of the project this may involve setting up, for example, working groups specialising in skills and employment or the environment.

- 6.7.2 Potential funding streams include Highways England Designated Funds. This funding is designed to provide additional enhancement to the environment and communities impacted by the SRN and contribute to wider Highways England objectives outside delivery of the core project.
- 6.7.3 To date this funding has been secured by LTC to identify options to create a new community green space outside the Development Boundary in partnership with the Forestry Commission, and work with local authorities and other relevant organisations to develop an enhanced regional NMU (non-motorised user) network.
- 6.7.4 As a wider programme of activities are developed, they will be added to the benefit profiles detailed above.

6.8 Wider benefits

- 6.8.1 It is widely recognised that the transformational potential of LTC for the South East is dependent on engagement and delivery from other key stakeholders including local government, central government and the Thames Estuary Board. A Wider Benefits Steering Group has therefore been established that brings together central government stakeholders. Its role is to ensure that such benefits are identified and appraised, and that a plan is produced to ensure that they are realised and evaluated.
- 6.8.2 The group is co-chaired by the LTC Sponsorship Director and DfT RIS Client Sponsor who both represent the group at Project Committee, to ensure that the opportunities for realising wider benefits are considered during the decision-making process.
- 6.8.3 The group will be responsible for assigning ownership for each wider benefit to the organisation best placed to deliver or facilitate delivery. It will then provide a mechanism for DfT to continue to monitor the ongoing realisation of these wider benefits of the scheme post-delivery by Highways England.

6.9 Stage 4 – Realising the benefits

- 6.9.1 Contractualised outputs will be monitored throughout the construction period as part of LTC's monthly reporting cycle and subject to scrutiny by the SRO at meetings of the Project Committee.
- 6.9.2 A robust change control process will be in place to ensure that dependencies are considered and that the anticipated outcomes are not compromised through changes in scope.
- 6.9.3 Additional activities developed to further enhance outcomes for the environment and community outside the core project will continue to be led by the LTC Sponsorship Team, in partnership with stakeholders.
- 6.9.4 Risks to realisation will continue to be identified and managed through LTC's established risk management system.

6.10 Stage 5 – Reviewing the realisation of the benefits

- 6.10.1 The Highways England post-opening evaluation (POPE) process will be extended to assess LTC's performance against the benefits appraised in the Appraisal Summary Table as well as the other areas of focus across the benefits wheel.
- 6.10.2 Full details will be contained within the Benefits Realisation and Evaluation Plan (BREP) that will be produced at the end of Stage 5. Informed by the benefit register and detailed profiles, this will establish how delivery outcomes will be evaluated as the scheme is handed over into operation. It will also include how lessons learnt can be shared across the wider industry.

6.11 Assurance of the approach

- 6.11.1 LTC's BRM will be reviewed as part of the IPA assurance programme throughout the project lifecycle. This will assure:
- a. LTC's approach to identifying, appraising, planning, realising and reviewing benefits
 - b. that benefits have been appropriately valued in the business case
 - c. there is a clear understanding of roles and responsibilities to ensure benefits realisation post-opening
 - d. the effectiveness of the governance structure in place.
- 6.11.2 Two BRM products are also subject to internal assurance as part of Highways England's PCF process: a Benefits Register and a BREP. A Benefits Register is refined at each stage and a BREP will also be produced by the end of PCF Stage 5 to demonstrate how the realisation of the anticipated benefits will be managed, monitored and evaluated.

7 Communications and stakeholder management

7.1 Introduction

7.1.1 Support from key stakeholders is critical to LTC's timely and successful passage through the design, DCO and procurement processes within the development phase. This section summarises how we manage stakeholder engagement and communications to support the successful delivery of the project and further engagement plans.

7.2 Stakeholder Engagement and Communications Strategy

7.2.1 We have produced a Stakeholder Engagement and Communications Strategy for LTC, which provides direction and an overarching framework for all engagement and communication with stakeholders and customers through a staged approach up to the submission of the DCO. It is updated at regular milestones to ensure a balance between long and shorter-term delivery objectives.

7.2.2 We are delivering the strategy via a series of specific stakeholder engagement and campaign plans to take LTC through its defined stages.

7.2.3 In the strategy we have set ourselves six objectives for communications and engagement that will apply throughout the lifecycle of LTC (see Figure 7.1).

Figure 7.1 Communications and engagement objectives



7.2.4 Stakeholders are categorised in to nine cohorts as shown in Figure 7.2. Each cohort has a specific engagement plan that is developed and delivered by a dedicated relationship manager.

Figure 7.2 Stakeholder cohorts



- 7.2.5 Within each cohort, we have identified key stakeholders based on their influence on LTC and how they are impacted by LTC. These stakeholders are deemed critical to the success of LTC and each has an organisation specific engagement plan. The list of key stakeholders evolves with LTC and is regularly updated.
- 7.2.6 While there are relatively high levels of support in principle for LTC¹³, there are also challenges, particularly in areas close to the proposed route. The strategy and delivery plans reflect this by ensuring an appropriate balance between engaging meaningfully with those who oppose LTC and enabling them to influence LTC, and maximising and building a good understanding of the need for LTC with the (often silent) wider audience.
- 7.2.7 To communicate and promote LTC objectives and benefits, we run campaigns as part of the strategy. Currently there are seven campaigns as shown in Figure 7.3. Each campaign is managed by one of the External Affairs team and has a bespoke delivery plan.

Figure 7.3 Current campaigns (March 2019)



- 7.2.8 The campaigns form part of the engagement delivered through the stakeholder engagement plans, but they also have a wider remit; for example: the ground investigation and surveys campaign informs the stakeholder engagement plan for those stakeholders impacted by the surveys to ensure they are aware of the impacts. However, it also includes a wider outreach element which raises awareness of ground engineering and surveying.
- 7.2.9 The current campaigns are described in more detail in Section 7.4.

¹³ During the 2018 Statutory Consultation, 80% of respondents strongly agreed or agreed with the need for the Lower Thames Crossing and 75% strongly supported or supported the proposed route alignment.

7.3 Stakeholder engagement

- 7.3.1 As described above we have put in place a stakeholder cohort structure to engage with and involve stakeholders in the development of LTC.
- 7.3.2 Each cohort has a relationship manager from the External Affairs team. The relationship manager develops the cohort engagement plan and the organisation specific engagement plans. They are responsible for maintaining the relationship with the stakeholders in their cohort and ensuring the needs of the stakeholders are addressed by LTC. All engagement with external parties is managed by the relationship managers.
- 7.3.3 Further details of the nine cohorts is provided in Table 7.1.

Table 7.1 Stakeholder cohorts

Cohort	Details	Key stakeholders
Local government	<p>The impact of the scheme on local authorities is arguably greater than any other group of stakeholders, and the need to meaningfully engage is paramount.</p> <p>The authorities greatest affected by the proposed project (Thurrock and Gravesham in particular) oppose the preferred route, whilst others are typically more supporting.</p> <p>The range of issues that a project of this scale needs to engage on with local authorities is extensive, ranging from their Local Plan, to Health Impact Assessments, to the effect on the local road network, to the opportunities for long-term benefits that LTC can be a catalyst, or facilitator, for. Our engagement plans reflect this and involve significant amounts of engagement at all levels of the affected local authorities from councillors to officers.</p> <p>We meet at least weekly with officers from those local authorities most impacted by LTC to discuss technical issues and ensure they are aware of current progress and activities. There are also regular briefings and meeting with councillors, and when requested we attend council meetings. We meet other authorities less frequently, but still regularly.</p> <p>Other engagement activities with local authorities include:</p> <ul style="list-style-type: none"> • Design development workshops (where specific technical issues are discussed with the aim of informing the development of the design) • CEO meetings • Correspondence • Briefing notes 	<ul style="list-style-type: none"> • Thurrock Council • Gravesham Council • London Borough of Havering • Dartford Council • Brentwood Council • Medway Council • Essex County Council • Kent County Council

Cohort	Details	Key stakeholders
Environment	<p>LTC clearly has the potential to cause a significant environmental impact and therefore we need to work closely with environmental regulators.</p> <p>The aim of our engagement with the Statutory Environmental Bodies (SEBs) is to facilitate regular, consistent communication and provide project updates in relation to, but not limited to: ongoing design development; the proceedings of the DCO; ongoing environmental assessments and emerging findings; environmental benefit opportunities; and the requirements of the next stages of LTC, chiefly the early works and main works. Further, our engagement aims to provide opportunities to discuss and seek consensus on cross-topic environmental issues, such as drainage & flood management and heritage & landscape.</p> <p>We have regular (at least quarterly) senior, director level meetings with the SEBs to review progress, resolve more complex issues and provide direction to the ongoing engagement. This supports the weekly meetings and teleconferences that are held between our technical staff and officers within the SEBs. SEBs participate in the design development workshops that local authorities take part in.</p> <p>Our environmental engagement also involves liaising with non-statutory bodies to identify opportunities to mitigate the environmental impact of LTC.</p> <p>These bodies are provided with regular updates on progress, and are engaged more directly on specific issues as required.</p>	<ul style="list-style-type: none"> • Environment Agency • Historic England • Natural England • Marine Management Organisation • Royal Society for Protection of Birds • Kent Area of Outstanding Natural Beauty • Non-statutory environmental bodies.
Community	<p>LTC will have a significant impact (positive and negative) on the local population. We therefore need to keep the local community engaged on project progress, the impact it is/will have on them, and what opportunities LTC could provide them.</p> <p>Our approach on community engagement typically involves engaging with a relatively small number of people/organisations who can then pass our message on to many others (eg, parish councils). This allows us to engage with the greatest number of people with a limited resource pool.</p> <p>As ground investigation and surveys start, and then enabling works, our community engagement will also need to address the impact this work has on the local population.</p>	<ul style="list-style-type: none"> • Parish Councils • Campaign groups • Resident associations • Local Authority Community Engagement Officers • Traveller communities • Hard-to-reach groups

Cohort	Details	Key stakeholders
	<p>The campaigns we run (see para 7.4.1) interact greatest with our community engagement cohort.</p>	
<p>Political</p>	<p>Although there is widespread support for LTC, there is vocal opposition locally. MPs with constituencies affected by LTC need to be kept abreast of current developments and are often a channel for people who oppose LTC or are directly impacted by it (eg, landowners).</p> <p>Our engagement therefore focuses on how we can assist the local MPs and keep them informed, as well as engage with more regional MPs to encourage vocal support and advocacy. This is achieved through regular one-to-one meetings, working with MPs on their project-related casework, as well as bi-annual MP Forums.</p>	<ul style="list-style-type: none"> • MPs with constituencies affecting by the proposed route • Regional MPs
<p>Third party infrastructure</p>	<p>A project of the scale of the Lower Thames Crossing interacts with a range of existing infrastructure. It is therefore necessary for us to engage with the owners/operators of this infrastructure to identify how any conflicts can be managed (eg, realignment of electricity pylons that cross the proposed route).</p> <p>Our engagement with third party infrastructure organisations tends to be very focused on what is required, technically and from a consenting perspective, to facilitate the construction of LTC.</p>	<ul style="list-style-type: none"> • National Grid • Network Rail • High Speed 1 (HS1) • UK Power Networks • RWE • Health and Safety Executive
<p>Business</p>	<p>There are two elements to our Business engagement plan: firstly, engagement with businesses directly affected by LTC to keep them informed of progress and how LTC impacts them.</p> <p>The second element focuses on the large amount of support that many local and regional businesses have for LTC and the opportunities it could provide them. We use a channel of a small number of organisations who provide the greatest reach in terms of reaching local business (eg, the chambers of commerce).</p>	<ul style="list-style-type: none"> • South-east Local Enterprise Partnership • Essex Chamber of Commerce • Kent Chamber of Commerce • Freight Transport Association • Port of Tilbury • Port of London Authority • Ebbsfleet Development Corporation • Other businesses affected by the route

Cohort	Details	Key stakeholders
Land and property	<p>The project team has a dedicated Land and Property team who advise affected landowners on their rights relating to LTC, and then negotiate any land purchase, blight claims, etc.</p> <p>The cohort ranges from single residential property owners to large landowners.</p>	<p>Landowners within, or close to, the Development Boundary</p>
Customer	<p>The approach to customer engagement is aligned with our customer service strategy which will guide the whole lifecycle of LTC through design, construction and operation.</p> <p>LTC is being designed with the customer experience in mind, including during its construction.</p> <p>The design also aims to reduce driver stress associated with travelling through a tunnel and its approach roads. We have commissioned research into how to make the tunnel a less stressful place for road users. The findings will be incorporated into the project design.</p>	<p>All the groups covered by our definition of customer including road users, stakeholders and communities.</p>
Highways England and Government	<p>LTC is currently part of our CIP and is both an opportunity and a risk for our corporate reputation. Close relationships between the project team and the wider Highways England organisation are therefore critical and will ensure that post-construction LTC delivers what is required.</p> <p>In addition to maintaining closeness with Highways England, ongoing and regular stakeholder communication also takes place with the DfT, HMT and the IPA through the issue resolution boards and forums as well as at IPDC, PSG and Project Advisory Board meetings. The Lower Thames Crossing Project Committee is also attended by the DfT's Project Sponsor and the Ministry of Housing, Communities and Local Government representatives. Such regular engagement provides the opportunity to share information, resolve issues and create constructive working relationships across all parties and is crucial to ongoing successful project delivery.</p>	<ul style="list-style-type: none"> • Highways England corporate departments • Department for Transport • HM Treasury • Ministry for Housing, Communities and Local Government • Infrastructure and Projects Authority (IPA) • Board Investment and Commercial Committee (IPDC) • Procurement Steering Group (PSG) • Project Committee

7.4 Communication campaigns

7.4.1 We are currently running seven campaigns alongside our stakeholder engagement plans. These are described in Table 7.2.

Table 7.2 Current (July 2019) communications campaigns

Campaign	Details
Consultation	<p>This campaign is reviewing the outcomes from the 2018 Statutory Consultation (see Section 7.5) and considering how to communicate these outcomes with stakeholders and the wider public, as well as ensuring that the feedback from the consultation is fed into the project development.</p> <p>In July 2019 we ran a public awareness campaign¹⁴ to provide an overview of the results from statutory consultation following engagement with our key stakeholders.</p>
DCO	<p>At the point of DCO application, stakeholders and the wider public will need to understand what LTC is, the need for LTC and what we are applying for. Therefore, we are developing a campaign to ensure there is enough information both in the application pack, and supporting it, and appropriate engagement around the submission of the application is carried out.</p> <p>The campaign also has a governance role working with LTC's Consents team to ensure the presentation and messaging within the application is consistent and appropriate.</p> <p>The campaign team is currently planning the activities and resources required to deliver what is required.</p>
Ground Investigations and Surveys	<p>The ground investigation and surveys that are required to inform the project development are the first physical presence LTC has had in the local area. It is therefore important that:</p> <ul style="list-style-type: none"> • the community impact of the investigations is considered and mitigated • stakeholders and the wider public understand what is being done and how they are impacted. <p>There is also an opportunity to generate interest in LTC based on the surveys themselves as well as the results from the surveys.</p> <p>Before ground investigation works started, the campaign team produced a communications plan for the early stages of the investigations. This plan focuses on ensuring key stakeholders, and members of the public affected by the works are made aware of our plans, and the impact on them. The channels to be used include letter-drops, bilateral meetings with key stakeholders, and meetings/teleconferences with local councillors and the leaders of the opposition action groups.</p> <p>As part of the wider campaign, a delivery plan is also being developed for a potential schools STEM programme 'What's Below Your Feet?' raising awareness of ground engineering and surveying.</p>

¹⁴ <https://highwaysengland.citizenspace.com/ltc/consultation/>

Campaign	Details
Community Routes and Spaces	<p>We have an opportunity to leave a legacy in terms of public space and amenity, and access for non-motorised users. During the period before statutory consultation the project focus was on mitigating the effect of LTC on these issues; there is now an opportunity to investigate opportunities to do more than this (for example, investigating if we can join remote footpaths and bridleways to create a new network and greater connectivity). This campaign is investigating what opportunities may exist (using stakeholder knowledge), how that can then be fed into the development of LTC and then how success is communicated.</p> <p>The campaign team is currently working closely with the Value and Legacy and Communities Engagement teams to plan what tangible actions can be carried out, both before and after award of the DCO.</p>
Skills, Training and Employment	<p>There is an aspiration, both within the project and from stakeholders, that LTC delivers a skills, training and employment legacy, as well as the physical infrastructure.</p> <p>The project team has been engaging with businesses and academic institutions on this for some time and in early 2019 developed this into a bespoke campaign. The campaign focuses on how to identify the skills, training and employment opportunities that stakeholders are keen to see (and will be required to deliver LTC), and then how to deliver these throughout the life cycle of LTC. This will be delivered through engagement with regional colleges, universities and education establishments to understand the local aspirations and opportunities; and then combining this with the project needs for delivery to establish areas to focus on.</p> <p>The campaign is also planning to deliver a school's educational programme to support the national STEM initiative. To date we have engaged with some local schools to confirm the need. We are now speaking with some specialist third party suppliers to understand how best to deliver this.</p>
Market Engagement	<p>Engaging the right type of contractors will be key to attracting both the right number and quality of bidders, to ensure we realise value for money for LTC. We have developed a market engagement strategy which is now being delivered to ensure that LTC engages with a wide range of suppliers and excites them to work on LTC, demonstrates the scale and complexity of the works and establishes LTC and Highways England as a 'client of choice'.</p> <p>The Commercial Case provides further details on market engagement.</p>
Design Development	<p>The statutory consultation that ended in December 2018 (see Section 7.5) provided rich information on stakeholder views on the proposed project. In the period between statutory consultation and the granting of the DCO, we will provide a meaningful opportunity for stakeholders to influence the design of LTC, beyond the ongoing technical engagement that already occurs. Using best practice from other similar projects and in consultation with key stakeholders we are planning a series of stakeholder design development workshops that will be attended by local authorities and statutory environmental bodies (see Table 7.1). This will be the first phase of this campaign.</p>

7.5 Statutory consultation

7.5.1 We held a statutory consultation, as required by the Planning Act 2008¹⁵, between 10 October and 20 December 2018. The consultation took place in accordance with the

¹⁵ <http://www.legislation.gov.uk/ukpga/2008/29/contents>

Statement of Community Consultation, which was subject to a targeted consultation with the eight host local authorities and the 34 additional authorities most likely to have an interest in LTC. The consultation provided statutory consultees (including people with an interest in land affected by LTC) as well as non-statutory consultees (including local communities and the wider public) an opportunity to comment on LTC proposals.

- 7.5.2 The following engagement activities took place during statutory consultation and were open to the public and stakeholders:
- a. 25 public information events – large events show all elements of LTC, with experts from specialist disciplines available to provide information and answer questions.
 - b. 9 awareness raising events – smaller events providing an overview of LTC, with staff available to provide further information and answer questions.
 - c. 30 mobile information centre visits – we used a vehicle the size of a small mobile library to make information available to the public at 30 locations. Staff were available to provide further information and answer questions, with the vehicle visiting areas where larger events were less feasible. This allowed information to be made available to harder-to-reach groups, including the traveller community.
 - d. 35 information points – paper information about the consultation materials was made available at libraries, council offices and community hubs, so the public could view information about the proposals or take it away.
- 7.5.3 The engagement activities were mostly local to LTC, taking place in locations designed to be as accessible as possible to the public and stakeholders. A smaller number of activities took place in areas more distant from LTC (such as Chelmsford, Dover, Folkstone and Southend-on-Sea) in recognition of the wider geographical benefits of LTC.
- 7.5.4 Nearly 29,000 responses were submitted to the consultation, making it the largest consultation of its type. Overall, most consultees supported LTC, (as described in paragraph 7.2.6) but there were also a significant number of critical comments and suggestions as to how LTC could be improved. Feedback from the consultation is being fed into the design process and the Stakeholder Engagement Plans. The details of the issues raised and, where appropriate, the way in which these have been addressed within LTC will be set out within the Consultation Report which forms part of the DCO application.
- 7.5.5 Building on the 10-week statutory consultation held in October 2018, we held an eight-week non-statutory supplementary consultation in January 2020 with the updated design that had evolved from the engineering reviews and feedback from the Statutory Consultation.
- 7.5.6 We have further refined the design proposed as a result of ongoing feedback received and ongoing stakeholder engagement, as well as final design development. As a result, we commenced a final 30 day design refinement consultation commencing 14 July 2020 to give the project sufficient time to receive, review and respond to feedback ahead of the submission of the application for a DCO at the end of October 2020.
- 7.5.7 We are not consulting on any changes to the core scheme which haven't already been discussed in the previous supplementary consultation. There are no changes to the road layout itself.

7.6 Ongoing engagement and consultation

- 7.6.1 The support of key stakeholders is critical to LTC to secure DCO approval, to enable a construction programme which mitigates (as far as is practicable) impacts on the public, and to maximise the benefits of LTC in the long-term.
- 7.6.2 We will maintain the strong relationships we have built to date throughout the lifetime of LTC and will continually update and develop our Communications and Engagement Strategy.

8 Project management

8.1 Introduction

- 8.1.1 The Lower Thames Crossing Project Management Plan¹⁶(PMP) sets out the approach to managing LTC as part of a suite of documents that together define LTC and its delivery. The current version has been prepared for the development phase of LTC.
- 8.1.2 As LTC moves through each phase, the PMP will be updated and processes will be developed and implemented to deliver each phase. It will be substantially revised before the construction phases.
- 8.1.3 There is a comprehensive set of systems and controls in place on LTC reflecting good industry practice. They build on in-house experience of managing programmes and the combined experience of Cascade's Joint Venture members in providing project controls to recent major infrastructure projects including Crossrail, Thames Tideway and HS2. These are summarised below.

8.2 Integrated Management System

- 8.2.1 To maximise efficiency and continuity, a project-wide Integrated Management System (IMS) has been developed and is managed by the Project Services team. The IMS comprises all the policies, plans, procedures and processes for the Quality, Environmental and HSSW management systems. It provides a consistent, standardised approach to support LTC and is compliant with the appropriate international standards ISO9001, ISO14001 and ISO45001¹⁷.
- 8.2.2 Individual documents are developed in line with our relevant strategy documents and with industry best practice. Where applicable, the IMS draws from our JV partner's management systems which are certified by accredited bodies.

8.3 Project baseline

- 8.3.1 The project baseline is managed by the Project Services team. It defines LTC in a controlled and aligned data set for scope, schedule, cost, risk/opportunities and assumptions, providing a basis for:
- establishing deliverability/likelihood of delivering within given targets or constraints
 - managing change to LTC
 - measuring progress in delivering LTC.
- 8.3.2 The scope of LTC is an element of the project baseline developed by the project team in response to the Project Requirements set by Highways England. These in turn reflect the DfT's higher level CSR.
- 8.3.3 The project team uses a structured approach to develop the baseline, building the schedule based on the scope of work required. Costs and resources, including a forecast of risk exposure, calculated from the Project Risk and Opportunity Register, are loaded into the schedule to aid performance management. The most recent review and update of the project baseline (known on LTC as the Silver Review) was undertaken in July 2019. The baseline comprises over 2,000 line-items in the cost

¹⁶ HE540039-LTC-GEN-GEN-PEP-PMG-00001

¹⁷ <https://www.iso.org/iso-9001-quality-management.html>

estimate, approximately 1,000 activities in the P6 schedule and over 500 risks in Xactium.

8.4 Schedule management

- 8.4.1 A detailed schedule for delivery of LTC has been developed using Oracle's Primavera P6 Professional. This records a series of logic-linked activities which will deliver the project scope in line with our commitment to open the road in 2027. The software also allows the team to develop and illustrate the critical path for delivery.
- 8.4.2 The schedule is one of the key tools used to manage the delivery of LTC. It allows co-ordination of the directorates and ensures that the interfaces and interactions between different areas of work are controlled.
- 8.4.3 The schedule is reviewed regularly to monitor progress across the whole project and inform progress reports to the Project Committee as part of the governance process. The objective is to provide transparency and consistency at all levels of LTC and traceability of activities from the detailed to summary levels. It describes the mechanisms for agreeing and changing the baseline that progress is monitored and reported against.
- 8.4.4 The schedule is summarised in Appendix Q – Level 0 Programme which sets out the key milestones, decision and approval points for LTC. This in turn is supported by an integrated plan which includes DCO and procurement milestones and the approval points for the OBC and the FBC. For each approval point the programme sets out the authorising bodies (Highways England, DfT, HMT, Cabinet Office, etc). The integrated plan has been developed in conjunction with the DfT and HMT.
- 8.4.5 The two key activities in the current development phase are:
- d. DCO process – the DCO process includes all environmental, traffic analysis, design development, land and property negotiation, consultation and statutory processes necessary to define the solution and gain the planning powers to deliver LTC up to approval of the DCO.
 - e. Procurement – procuring the necessary contracts for construction includes putting in place the processes to successfully deliver LTC, ensuring resource capability and capacity, while also arranging contracts to successfully deliver the construction works and put LTC into service. It also includes the specification, procurement and delivery of Early Works before the Main Works start.
- 8.4.6 Major milestones defining LTC through to completion are set out in Table 8.1.

Table 8.1 Level 1 DCO and procurement milestones

Milestone activity	Milestone dates
Commence procurement for Integration Partner (OJEU)	July 2020
Commence procurement for Tunnels and Approaches packages	September 2020
Commence procurement for A2/M2 Connections and Road North Packages	October 2020
DCO submission	October 2020
Award Contract for Integration Partner	December 2020
Main Contract Award for A2/M2 and Roads North	July 2021

Milestone activity	Milestone dates
DCO Close of Examination	September 2021
DCO Grant	March 2022
Contracts Award for Tunnels and Approaches package	April 2022
Notice to Proceed for A2/M2 Connections and Roads North	October 2022
Roads North and Tunnels and Approaches packages ready for Construction	December 2022

- 8.4.7 The procurement of the Tunnels & Approach packages is planned to start within a few weeks of the DCO being submitted. The dialogue for this package will be held open until the close of the DCO Examination. This means that bidders will understand any concessions that we may have made through the DCO Examination process before finalising and submitting their tenders.
- 8.4.8 This is a lower risk strategy than proposed at OBC in November 2019 and recommended because the programme advantage of closing dialogue before examination has been shown to be more limited (c. 1 month) for the updated project programme, than was the case for the OBC programme. It also means that contracts are planned for award after the DCO is granted.
- 8.4.9 There are residual risks with running the procurements in parallel to the DCO process:
- Resource intensity required to simultaneously support a competitive dialogue, and two 2-stage ECI process and the consenting process is significant.
 - Risk of procurement challenge or cost escalation due to changes introduced between the close of DCO Examination and DCO grant.
 - Delays to the DCO process will impact procurement.
- 8.4.10 The project plan sets out the key governance and assurance points and the activities and contributions required from DfT, IPA and HMT. This is to ensure timely decision making and approvals, so avoiding unnecessary delay to LTC.
- 8.4.11 The project plan is reviewed weekly at a schedule review meeting, monthly by work package for progress reporting and monthly by PEG to ensure each directorate has the required level of detail in the plan, to monitor progress and review the need for corrective actions. This is a continual cycle where detail may be added or amended at the working level without any impact to the strategic milestones. If an impact on strategic milestones is anticipated, then this is escalated to the Project Committee.
- 8.4.12 The delivery team leads monitor progress against key strategic major infrastructure projects milestones, eg, the submission of the DCO (see the Level 0 Programme (Appendix Q)). The Level 1 milestones are also monitored by the delivery team leads and owned by the SRO. These include many of the governance and procurement milestones.
- 8.4.13 The schedule also identifies detailed milestones leading up to delivery of high-level milestones. Work packages review progress against these operational (level 2) milestones which are identified on a rolling basis, eg, completion of the Environmental Statement to support the DCO.

Weekly integrated planning meeting

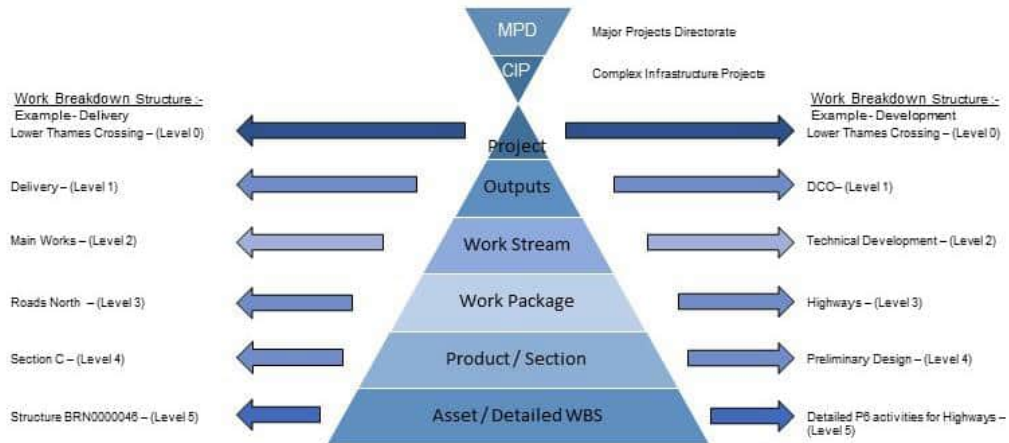
- 8.4.14 Each directorate has its own plan. These are integrated at the weekly meeting.

Work breakdown structure

8.4.15 The work breakdown structure (WBS) is used to allocate detailed codes to each element of the work (scope). A standard WBS is used which allows consistent reporting across projects through Power BI software.

8.4.16 The higher-level features of the WBS hierarchy are illustrated in Figure 8.1.

Figure 8.1 Illustration of work breakdown structure



8.5 Change control

8.5.1 Changes to the baseline (cost, schedule, scope and quality or benefits) are controlled by the Change Process.

8.5.2 Any member of the project team can identify a change and submit a change form after ratification by the relevant steering group. This form allows the Project Controls team to assess the impact on cost, schedule and risk, in addition to reviews of the quality and HSW impacts.

8.5.3 Changes are then reviewed and approved by the Change Board. Changes are escalated to the Project Committee and further where required by governance.

8.6 Cost management

8.6.1 A monthly Finance Steering Group (FSG) is responsible for ensuring LTC out-turn cost is within the agreed affordability constraint detailed in the Financial Case. The FSG is chaired by the project team's finance lead and comprises members of the Estimating team, the Risk team, and Contract managers, the Commercial and Procurement Director, the CIP finance team and the Sponsor.

8.6.2 The FSG reviews:

- a quarterly reforecast of total LTC cost identifying cost pressures and opportunities in-year and across the whole life of the project
- all movements of between different cost elements within the total cost estimate
- all calls on contingent funding and makes recommendations to PEG and Project Committee
- all contracts to ensure the financial consequences are adequately assessed

- e. arrangements for ensuring compliance with regulatory and other oversight requirements.

8.6.3 It also defines LTC's position on key financial issues including the approach to risk/contingency, efficiency, forecasting, funding levels, inflation forecasting and business planning.

8.6.4 The cost breakdown structure provides the framework for organising cost estimates, collection of actual costs and forecasts. It is aligned to the WBS at work package level. Cost estimates are developed in accordance with the Cost Estimation Manual and are controlled through the cost planning process.

8.7 Risk and opportunity management

8.7.1 We have a Risk and Opportunity Management Plan (RMP) which sets out our approach to the management of risks and opportunities at the strategic, delivery and delivery levels. The primary objectives of the RMP are to:

- a. ensure that LTC has enough capability and capacity to identify and manage risk and opportunity at all stages of the project
- b. establish clear ownership and accountability across directorates; detailing specific roles, responsibilities and reporting requirements
- c. ensure directorates apply a consistent methodology for the identification, assessment and management of risks and opportunities in a timely manner
- d. provide timely information to support risk-based decision-making
- e. create an open, transparent and communicative culture for the pro-active management of risk and opportunity
- f. develop quantitative risk assessments (QRAs)
- g. ensure there are suitable fora for discussions regarding risk and opportunity management
- h. escalate risks and opportunities as required to programme level to seek guidance and assistance in relation to mitigating the risk or realising the opportunity.

8.7.2 The RMP addresses our approach to identifying/registering risks and opportunities, quantification, developing mitigation plans, reviewing the status of risks and opportunities and assurance. The key features of our approach are set out below.

Identifying and registering risks/opportunities

8.7.3 Risks and opportunities can be identified and proposed for registration by anyone on LTC. However, initial registration of a new risk/opportunity requires the approval of both the operational directorate leads and the risk manager

8.7.4 Once risks/opportunities are approved for registration, they are input directly into the risk management database Xactium which we mandate for all our major projects. An extract from Xactium is contained in Appendix M.

Quantification of risk and opportunities

- 8.7.5 In the Xactium database we record an estimate of the impact and probability and those numbers are used to generate the Quantified Schedule Risk Assessment and Quantified Cost Risk Assessment, which are incorporated into the schedule and cost estimate elements of the integrated baseline (see the Financial Case for further details).
- 8.7.6 Palisade’s Monte Carlo @Risk Standard Edition 105 and Primavera Risk Analysis are being used to undertake these assessments. The tool uses the probability of a range of risks occurring together to produce a quantified assessment of risk in the form of a probability of exceedance bell curve.

Mitigating risks/opportunities

- 8.7.7 Once registered all risks/opportunities are allocated to owners who are well placed to develop and implement plans to mitigate the risk or exploit the opportunity. In general, operational workstream leads own all the risk within their area of accountability. However individual elements of the mitigation plan for each risk are assigned to individuals appropriately placed to execute them, with their knowledge and agreement. The individuals can be from any workstream.
- 8.7.8 The execution of the mitigation plan for each risk is jointly reviewed by a designated specialist risk manager (from the PMO) and the owner at an agreed frequency. This might be monthly or quarterly as appropriate for the risk/opportunity.
- 8.7.9 Under this collaborative approach the PMO retains overall accountability for risk and the risk management process but the operational workstream leads are responsible for articulating and demonstrating that they are aware of significant risks and opportunities and have plans in place to mitigate risks and develop opportunities.

Review of risk/opportunities

- 8.7.10 Regular risk management reviews take place to ensure risks are being managed in line with the RMP. Risk review meetings are held at workstream and project level as indicated below in Table 8.2.

Table 8.2 Risk management meetings

Risk management meetings	Attendees	Frequency	Objectives	Outputs
Directorate Risk Review	Chair: Operational Directorate Lead Facilitator: Risk Manager Directorate Project Manager Other directorate specific attendees	One meeting a month for each directorate on a continuous cycle through the month	Review of any new risks or opportunities Consideration of new risk mitigations Review of the directorate’s risks to ensure the register is up to date	Items for escalation to Project Risk Review Group Risk Register updates Action and decisions log

Risk management meetings	Attendees	Frequency	Objectives	Outputs
Project Risk Review	Chair: Lead Risk Manager Deputy Project Director Highways England PM Cascade contract director Operational directorate leads	Monthly	Review key project risk(s) from a project wide perspective to reach agreement on: <ul style="list-style-type: none"> risk descriptions risk impacts risk mitigations consideration of knock-on risks Agree risk mitigation plans	Items for escalation to Project Committee Action and decisions log

8.7.11 Once a month the Project Controls team submits a consolidated project report to PEG, the Project Committee and the Cascade JV Board. This includes a list of the top five risks for the period.

8.7.12 The Project Committee monitors the risk profile to ensure it stays within levels acceptable to Highways England. The review also considers the overall effectiveness and suitability of the RMP.

Risk assurance

8.7.13 In addition to the review process outlined above, our approach to risk management is further assured as follows:

- a. the Project Committee can escalate individual risks within Highways England if necessary
- b. the Finance Risk Assurance Group (see Table 4.2) provides additional assurance to LTC's SRO about the overall risk profile of LTC and that the key project risks are being managed in line with agreed plans.

8.8 Issue management

8.8.1 Our issue management approach is broadly aligned with our risk management processes. An issue can be raised at any point, whether it was previously identified as a risk or not. Once identified, issues are listed on LTC's Issues Register which articulates the nature of the issue, the potential effect on cost, time or scope as well as any proposed further mitigating actions. The issue is assigned an owner and an action plan is implemented. Issues are managed as a priority within LTC with the action plan designed to contain, mitigate, or minimise their potential impact.

8.8.2 The operational directorate leads review the Issues Register weekly. Key issues are reviewed in detail by relevant operational directorate leads, allowing issues to be escalated upwards to the PEG and Project Committee.

8.8.3 Above Project Committee there are separate meetings for issue resolution including the executive level CIP business review meeting, Tier 1, and tripartite meetings with

the DfT and HMT. The level of authority held by Highways England has been clearly set out; should the issue result in the need for additional funding or affect schedule or scope then LTC must seek this additional authority from the DfT.

- 8.8.4 Project issues and assumptions are captured, recorded and managed through the issues register following the process established in the Issue Management Plan. These essentially follow the same principles as risk management.
- 8.8.5 Issues and assumptions can be identified by any member of LTC with the Issues Manager. Issues are raised by the delivery teams through the Monthly Dashboard reporting process and discussed as part of the performance review cycle.

8.9 Project monitoring and reporting

- 8.9.1 LTC's reporting framework is based on our corporate standard cycle of monthly progress reporting, as mandated by the Major Project Programme Hub. This drives the structure of weekly and monthly outputs.
- 8.9.2 Each functional lead reports progress against the baseline plan and specific milestones as part of the monthly performance cycle. They are supported by the Project Controls team which provides them with a summary of their cost, risk and schedule performance over the past month.
- 8.9.3 These reports are then combined into the monthly dashboard which is reviewed by the Project Manager to create a cumulative performance report which is reviewed by the Project Director.
- 8.9.4 Reporting arrangements are owned by the PMO and managed by the Project Controls function.
- 8.9.5 Overall project performance is monitored and reported monthly by means of a dashboard report at Performance Review Meetings which then feed through the Project Committee to the CIP Performance Committee. In addition, the performance of LTC is assured through the ongoing quarterly FRAG reviews.
- 8.9.6 As LTC is part of the GMPP, quarterly reports are returned to the DfT along with the latest Integrated Assurance & Approvals Plan (IAAP).

9 Post Full Business Case issues

9.1 Introduction

9.1.1 This Management Case focuses on the detailed arrangements we have in place to respond to the management challenges we face up to the award of the Main Works contracts and securing the DCO. However, in this section we outline our current thinking on some of the challenges which will arise once the Main Works contracts are awarded and we are managing those contracts.

9.1.2 The key issues addressed are:

- a. securing a solution in relation to user charging for LTC
- b. contract management for the Main Works contracts
- c. interface management during construction
- d. planning for project close out.

9.2 User charging

9.2.1 Like the Dartford Crossing, the LTC will have a road charging system, where drivers pay user charges remotely and therefore do not stop to pay on the crossing. The project team has been working closely with experts in Highways England to develop the charging scheme, subject to guidance and approvals from the Project Committee.

9.2.2 The legal basis for the road user charges at LTC will be obtained via the DCO. This differs from the Dartford Crossing where the legal basis for the charging is the Transport Act 2000 and subsequent regulations. However, it is intended that the LTC road charging operations will mirror the Dartford Crossing with the same level of charges, the same charging authority (the Secretary of State), the same contractor and the same payment arrangements. This minimises operational complexity for Highways England and promotes the objective of making the user experience in relation to charging the same for both crossings.

9.2.3 Future customers will make decisions on journey timing and route based on a number of factors, which may include the relative charges at the LTC and the Dartford Crossing. These decisions will affect the environmental impact, network performance and the benefits of the new crossing. A user charging strategy has therefore been developed alongside network performance criteria to fully inform proposals for the DCO and this business case. Both the performance criteria and the charging strategy are managed by the Networks Operations team as the level of user charging could directly impact traffic flows and therefore network performance.

9.2.4 LTC has reviewed several alternative charging scenarios, commencing with a desk-top assessment of long-list options and progressing onto sensitivity testing of a short list of alternatives to fully inform DCO proposals. The most recent modelling shows that equal charges between the LTC and Dartford Crossing meets the network performance and value for money objectives, and that differential charges would not give material benefits. Equal charges will therefore be used for the DCO. Sensitivity testing to be completed before DCO examination will be based on this one option only.

9.2.5 This approach is considered to minimise DCO risk with regards to charging as it reduces operational complexity for any charging and enforcement contractor(s) and for users of the existing and new crossing.

- 9.2.6 The current Dart Charge contract expires in November 2021 but can be extended for up to three years. Given the high level of interfaces between the Dart Charge and the LTC road user charging, close working has been established between the Highways England teams, including project representation on the Highways England free flow charging project board and on management groups to ensure future alignment between the two charges.
- 9.2.7 As the scope of the road user charging service to be procured includes the Dartford Crossing and is therefore wider than the LTC project, the procurement will be undertaken by Highways England's Corporate Finance team rather than the LTC project team.
- 9.2.8 However, the capital expenditure and the ongoing operational costs required for the service are included within the LTC project cost estimates.

9.3 Contract management

- 9.3.1 The Performance Management Framework (PMF) will include:
- a. a suite of Contract Management Plans together with a Contract Management Coordination Plan
 - b. a Performance Measurement System that defines the system for measuring contractor performance against the Balanced Score Card.
 - c. a Performance Points Regime (PPR) which provides an additional tool for the Project Manager to ensure delivery of the obligations under the contract. The PPR will be linked to a mechanism to withhold the contractor's fee if poor performance exceeds a defined threshold.

Contract Management Plans

- 9.3.2 Each contract will be supported by a Contract Management Plan, setting out how it is to be managed from award and mobilisation to completion. They will be developed during the preparation of tender documentation and will address:
- d. Planning and governance
 - e. People
 - f. Administration
 - g. Managing relationships
 - h. Managing performance
 - i. Payment and incentives
 - j. Contract development and change
 - k. Supplier development – improving supplier performance
 - l. Supplier relationship management
 - m. Market management

- 9.3.3 Our approach to contract management will focus on contract compliance and delivery performance in support of LTC's defined outcomes.
- 9.3.4 The Contract Management team will be established during procurement, to prepare for the operation of the PMF once contracts are awarded. This team will be established in time to allow for systems and processes to be established and tested. Lessons learned on contract management from the IPA Operational Efficiency Programme will be considered.
- 9.3.5 We recognise that NEC4 contracts require active management and our preparation includes:
- a. the creation of a strong, client-led cost estimating capability to develop the estimates, benchmarked across other contracts and projects, that will form the basis of the Target Budget
 - b. planning tender documents that will require tenderers to provide a Schedule of Cost Components and Activity Schedules in their tenders and contractually oblige the winning tenderer to report against those schedules post contract award
 - c. planning the resourcing of the contract management and administration of the NEC4 contracts
 - d. initial consideration of the software packages required to ensure a 'no surprises' one data approach in forecasting defined cost to completion
 - e. drafting contracts to address the contractor's performance in managing interfaces with the other main contractors and third parties (as described in interface matrices)
 - f. designing procurement processes that generate programmes submitted by the winning bidder that is capable of acceptance by the Project Manager on day 1 of the contract.

Performance Measurement System

- 9.3.6 Contractor performance will be monitored against the Balanced Scorecard. The performance indicators will be specific, measurable, achievable, relevant and time-bound (SMART). The KPIs will be developed for each contract with a clear and direct link from LTC's Balanced Scorecard.
- 9.3.7 The use of KPIs aligned to our critical success factors is intended to support a broad perspective on the value being delivered through the contract. It will help us work with our contractors to drive the outcomes that we seek for LTC and assess day-to-day delivery performance in that context.
- 9.3.8 We will use Earned Value Management techniques (EVM) to monitor production. We will provide the WBS and Cost Breakdown Structure to provide consistency across our contracts. Contractors will formally report monthly; however, we will establish a shared, live data environment. The commercial model will require the employer and the contractor to jointly populate data which relates to the identification and management of risk to allow mitigation to be jointly developed.

Performance points regime

- 9.3.9 In addition to the standard provisions within NEC4 of Early Warnings and Corrective Actions for addressing poor performance, we will use a PPR.

- 9.3.10 This will provide a graduated scale of interventions, that are likely to include:
- a. additional audit/substantiation data collection
 - b. additional reporting requirements
 - c. rectification plans
 - d. reductions against interim applications for payment
- 9.3.11 For severe or repeated performance failures, quantified via a performance points regime the option to terminate the relevant contract will exist.
- 9.3.12 The rationale for delivery performance issues in the administration and management of the contract does not necessarily impact the long-term value of LTC but will cause disruption to the delivery of LTC and to our reputation. This additional provision will incentivise the contractor to perform rather than risk a reduction in cashflow from withholding of fee.

Potential areas to be reinforced by the PPR

- 9.3.13 Table 9.1 below identifies areas where the existing provisions of the contract could be supported by the PPR.

Table 9.1 Existing remedies for performance areas covered by the PPR

Performance area	Existing remedy
<p>General contractual obligations eg, submission of a monthly progress report by the contractor</p>	<ul style="list-style-type: none"> • Non-compliance is a technical breach • Project manager (PM) powers are limited • Potential to disallow costs if terms and conditions give that power for the default • Output of contract not materially affected
<p>Specific contractual obligations/deliverables eg, progress towards a KPI on an activity, eg, recruitment of apprentices</p>	<ul style="list-style-type: none"> • Non-compliance is a technical breach, • PM powers in specific areas are enhanced by terms and conditions • Non-compliance behaviour remedied by imposing sanction, eg, temporarily withholding of fee • Physical output of the contracted scope not materially affected

Performance area	Existing remedy
<p>Specific contractual obligations/deliverables eg, defective work</p>	<ul style="list-style-type: none"> • Defective work is a breach • Standard PM powers exist in terms and conditions • Contractor is obliged to remedy defect and is paid but not relieved from achieving completion • PM can bring in others to remedy defects if the contractor does not mobilise. Employer may contra charge costs of others to the contractor • Physical output of the contracted scope not materially affected
<p>Completion of specific work activity by specified key date eg, finish works to allow access for others</p>	<ul style="list-style-type: none"> • Terms and conditions allow flow through of loss if key date is not met. • Loss of potential bonus payment for harmonised project delivery date
<p>Completion of the works by the completion date</p>	<ul style="list-style-type: none"> • Delay damages inserted into the Contract Data • Terms and conditions allow employer to levy delay damages if contractor does not achieve completion by the due date
<p>Completion of the work over budget eg, Defined Cost spend exceeds the Target Budget (including any fundamental changes)</p>	<ul style="list-style-type: none"> • Contractor loses opportunity for profit from gain share on underspend against tendered total • Contractor loses opportunity for share of residual Target Budget amounts of the risk quota • Contractor liable for pain, eg, amount of fee refunded or percentage of defined cost spend not paid. Pain likely to be capped

9.4 Interface management

9.4.1 See Section 8.4 of Commercial Case.

9.5 Project close out

9.5.1 One year after the OfT date, LTC will formally be closed out in accordance with our standard approach to project delivery. At this point LTC project specific arrangements will generally be wound up (unless there is a case for an exception) and responsibility for ongoing management issues will be reallocated. This section sets out at a high level the approach we propose to take in relation to:

- a. operating the LTC as part of the SRN
- b. ongoing delivery of the long-term benefits arising from LTC which are not a direct consequence of bringing the crossing into operations
- c. capturing and sharing lessons learned from the delivery of the LTC

- d. ongoing communication and stakeholder management.

Operating the Lower Thames Crossing as part of the strategic road network

- 9.5.2 Consideration of the future operation and maintenance of LTC and the impact on our customers is central to the current activities of the project team. This must continue to be the case following the dissolution of the project team after the OfT date. The team's success will ultimately be measured on the improvement to the customer experience when LTC is integrated into the SRN.
- 9.5.3 To maintain this focus on ultimate long-term outcomes and ensure the interests of customers and Highways England's Operations Directorate are always considered, a Network Operations team has been established within the LTC project team. This team brings together Highways England's and Cascade's operation and maintenance specialists. The role of the team is to ensure the following key objectives for operating the SRN are considered by every directorate at every stage of the project:
- a. **A safe network** – The network that we create must be safe for the customers and the workforce. In support of our 2041 safety target of zero killed or seriously injured on the SRN, we have set targets to challenging our designs to provide a safe user and worker environment. We will strive to ensure we create a road where journeys are completed without incident or reason for concern.
 - b. **An available network** – Lane availability is our key metric for measuring the customer experience as a road with minimal lane unavailability is likely to deliver high levels of customer satisfaction. Within the Project Requirements we have set for the project team we have set lane availability targets that exceed our normal KPI for the SRN.
- 9.5.4 A strong emphasis on asset management and whole-life costing is key to delivering a network that sustainably meets the needs of its customers over time.

Integration into the wider network

- 9.5.5 To assess whether LTC ultimately meets the CSR (see Strategic Case Section 3.2) of improved resilience and reduced congestion at Dartford Crossing, the impact of LTC must be considered across the regional SRN not just the LTC.
- 9.5.6 We are therefore taking a holistic view of the area affected impacted by the LTC and working with Highways England Operations Directorate and Strategy and Planning to develop strategies and plans for integration into wider strategic and local road networks.

Procurement

- 9.5.7 Our vision for LTC as an operational asset will only be fully realised if each of the Main Works contractors is aware of that vision and committed to designing and building their section of the works in accordance with the vision. We are therefore working to ensure the procurement processes result in agreed contractual specifications focused on delivering operational outcomes through the Design and Build contracts.
- 9.5.8 Consideration of the operations and maintenance issues is essential for assessment of whole life cost. Clear sight of the whole life strategy is a key development phase objective, by creating a model that further evolves through construction and into an operational whole life plan.

Handover

- 9.5.9 This transition is a key focus, to ensure the asset and organisation is ready for opening. The handover period is being planned in detail to ensure that sufficient time and resource is focused on system integration and building the competency of the on-going operators and maintainers.

Benefits and legacy realisation

- 9.5.10 Our Post Opening Project Evaluation (POPE) process will be used to assess whether the core benefits identified in the business case have been achieved (see Table 9.2 below).

Table 9.2 Analysis of core economic benefits

Evaluation output	Description
Pre-Opening Baseline Data	Observed data collected before construction which acts as a benchmark for comparison once a project has opened.
Project Evaluation Plan	Summarises the planned approach to evaluation, highlighting key issues to be taken into consideration. The plan is structured to mirror the Appraisal Summary Table.
POPE – one year after study	Compares the forecasted and actual impact against each of the DfT objectives (and sub-objectives) one year after opening. The study is supplemented by a summary report outlining the main findings.
POPE – five years after study	Compares the forecast and actual impact against each of the DfT objectives (and sub-objectives) five years after opening. The study is supplemented by a summary report outlining the main findings.

- 9.5.11 The POPE process is well established within Highways England and is used to demonstrate our level of performance to stakeholders to whom we are accountable.
- 9.5.12 The evaluation of the core economic benefits through the lifecycle of LTC is part of our usual business. We are intending to widen the process to include evaluation of performance against environmental objectives.
- 9.5.13 The management of the other benefits will be undertaken using the IPA model¹⁸ and will involve ongoing monitoring of performance against the agreed performance indicators agreed.

Ongoing communication and stakeholder management

- 9.5.14 LTC currently works closely with Highways England’s corporate Communications, Engagement and Public Affairs teams, and this will continue throughout the construction stages.
- 9.5.15 Following an appropriate transition period, responsibility for ongoing communications and stakeholder management relating to the operation of the new infrastructure will pass to these corporate teams. Highways England will then manage communications and stakeholder issues in line with their other SRN activities.

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/671452/Guide_for_Effective_Benefits_Management_in_Major_Projects.pdf

Lower Thames Crossing

Outline Business Case

Appendices

Appendices

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Appendix A: Policy review

A.1 European and national policy

A.1.1 The following European policy framework applies to the Lower Thames Crossing project (LTC) setting out both the strategic vision (Policy 2.1) and what needs to be done (Policy 3.3) to achieve a single European transport area as part of a Europe 2020 strategy.

Table A.1 European policy requirements

Ref	Policy guidance
2.1	Growing transport and supporting mobility while reaching the 60% emission reduction target
3.3	Modern infrastructure, smart pricing and funding

Source: Roadmap to a single European transport area – towards a competitive and resource-efficient transport system (2011)

A.1.2 Highways England is responsible for operating, maintaining and improving England’s motorways and major A-roads: the strategic road network (SRN), which is part of the European transport system. The Dartford Crossing is a Trans-European Network core route, while the M2-A2 corridor from Dover to the M25 is part of the comprehensive Trans-European Network.

A.1.3 At a national level, the following Government strategies highlight the importance of LTC, as a key strategic highways project, in meeting the identified need for reducing congestion on the existing highways network and to accommodate forecast traffic growth.

Table A.2 Transport Investment Strategy

Department for Transport, <i>Transport Investment Strategy (TIS), 2017</i>
Policy guidance
<p>In July 2017, the government published a TIS that sets out the national strategic priorities for future investment in transport infrastructure. The TIS provides four main objectives for investment decisions:</p> <ul style="list-style-type: none"> • create a more reliable, less congested, and better-connected transport network that works for the users who rely on it • build a stronger, more balanced economy by enhancing productivity and responding to local growth priorities • enhance our global competitiveness by making Britain a more attractive place to trade and invest • support the creation of new housing

A.1.4 As the TIS is the key Department for Transport document we have set out in more detail how the proposed project supports each of the four main objectives from the TIS based on supplementary questions from TAG in a series of tables below.

Table A.3 LTC response to TIS objective 1

Objective 1. Create a transport network that works for users, wherever they live.	
Overall response: LTC will reduce congestion at the Dartford Crossing and on local approach roads, leading to more reliable journeys for all users with fewer incidents and availability of alternative routes when needed.	
<ul style="list-style-type: none"> • What groups are affected by LTC? 	Assessment undertaken for the Distributional Impact Appraisal shows that a wide range of groups, both in terms of their spatial and income distribution will be affected by LTC.
<ul style="list-style-type: none"> – Which groups/communities/users will benefit and in what ways? 	Those groups/communities/users that either live/work or use the existing Dartford Crossing, will benefit, either as a result of improved journey time/quality or through reduced noise. Those who will use the new Lower Thames Crossing will also benefit as a result of improved journey times between Kent and Essex.
<ul style="list-style-type: none"> – What are the risks/downsides and for which groups/communities/users and are there ways of mitigating these? 	There will be downsides for those who live or work near the proposed alignment of LTC as a result of worsening noise, particularly for those in the most deprived and least deprived quintiles and some limited local severance issues.
<ul style="list-style-type: none"> • What is being done to minimise disruption during construction? 	<p>A Code of Construction Practice (COCP) will be submitted with the DCO application and will set out how disruption to local communities and the environment will be kept to a minimum.</p> <p>We will limit the hours of construction, reduce HGV movements by either re-using materials or transporting material by river if practical.</p> <p>Noise and vibration will be kept to acceptable levels, with construction hours limited, especially at weekends.</p> <p>Engagement will be held with local authorities, so we best meet the needs of local communities.</p>

Objective 1. Create a transport network that works for users, wherever they live.	
<ul style="list-style-type: none"> How does LTC deliver for people? 	<p>Refer to the Economic Case in para 1.2.5 and a summary of the report is included in Section 6.5.</p>
<ul style="list-style-type: none"> – This could be through making the network more reliable or safer, making journeys easier, faster, less congested or more comfortable/better quality 	<p>LTC will reduce congestion at the existing crossing and surrounding network, which will improve both reliability and resilience. Less congestion with fewer incidents will enable easier, faster and more comfortable journeys for road users. Journey times will also be improved across the network due to new route options and additional capacity.</p>
<ul style="list-style-type: none"> – How does LTC seek to help people access employment centres and vital services? 	<p>LTC will improve availability and connectivity on the network and provides 92% additional capacity across the Thames several miles east of the existing crossing. Our economic appraisal shows that LTC provides significant wider economic benefits (see Economic Case, Section 5), largely due to reduced travel times between people and jobs.</p> <p>LTC intends to protect all local linkages, diverting and reinstating where necessary.</p>
<ul style="list-style-type: none"> How does it help facilitate the flow of skills, services and products locally, regionally or across the country and its international gateways? This can include facilitating access to leisure activities too, eg, retail, tourism and hospitality 	<p>LTC will provide new connectivity across the Thames with a new link from the M25 to and from the ports of Tilbury, London Gateway, Dover and the Channel Tunnel. It will also reduce congestion at the existing crossing, resulting in improved local accessibility for all road users including business, leisure and commuting trips. The significant productivity benefits of LTC are presented in the Economic (see Section 6.6 of the Economic Case),</p>
<ul style="list-style-type: none"> How have users and affected groups been consulted? What are the key issues that have been raised and how has LTC been adapted to reflect these? 	<p>Users and affected groups were invited to the public consultation events and to respond to the non-statutory public consultation that was held in 2016. This enabled the re-assessment of LTC following the consultation and make changes before the preferred route announcement.</p> <p>A summary of stakeholder views is presented in Section 2.7.</p>

Table A.4 LTC response to TIS objective 2

Objective 2. Improve productivity and rebalance growth across the UK.	
Overall response: LTC will enhance productivity by providing significantly increased cross-river highway capacity for long distance traffic, including freight. The increased capacity will provide relief to the SRN in the south-east <i>and</i> increase local cross-river economic activity by improving reliability for business journeys across the Thames.	
<ul style="list-style-type: none"> In what ways does LTC seek to improve productivity. For example, producing more for the same cost or per employee 	LTC will improve the availability and resilience of the existing network, reducing journey times for both business and commuting trips that rely on the existing crossing. See Section 5.5 of the Economic Case includes more details.
<ul style="list-style-type: none"> What are the wider economic benefits of LTC? Is the discussion of GDP and employment consistent with the analysis in the Economic Case? 	Overall, LTC provides wider economic benefits, including productivity impacts through agglomeration benefits and labour supply impacts on GDP. Section 3.6 of the Economic Case includes more details.
<ul style="list-style-type: none"> What is being done to develop the skills base in the UK through the construction and operation of LTC? 	As a Tier 1 project, the Lower Thames Crossing, as part of a change programme coordinated by Highways England's Major Projects Programme Hub (MPPH), is developing a change programme; one theme of which is to increase investment in people to provide more training and clearly defined career paths. This will also help LTC prepare for the staff and skills needed for the future
<ul style="list-style-type: none"> How does LTC contribute to spreading growth across the country? 	LTC provides a new strategic highway link across the Thames, which will reduce congestion and provide increased reliability and resilience for long distance business trips to, from and through the South East. Links for long distance business trips with origins or destinations in continental Europe will also benefit in the same manner.

Table A.5 LTC response to TIS objective 3

Objective 3. Enhance our global competitiveness by making Britain a more attractive place to invest.	
Overall response: LTC will improve access to international gateways and support key industries in the region that rely on road transport	
<ul style="list-style-type: none"> How does LTC improve trade flows? For example, through more efficient handling, greater connectivity (including domestic connectivity) and reliability of our ports and airports 	LTC is located in a region with strong distribution and transport industries, and several major international ports. LTC will help to improve trade flows through: <ul style="list-style-type: none"> the provision of a new strategic highway links several miles to the east of the existing crossing

Objective 3. Enhance our global competitiveness by making Britain a more attractive place to invest.	
	<ul style="list-style-type: none"> greater strategic highway capacity near the international ports of Tilbury, London Gateway, Dover and the Channel Tunnel improved network availability, reliability and resilience near the existing Dartford Crossing <p>The wider economic impacts of the current problems at Dartford Crossing are discussed in Section 3.4 of the Economic Case</p>
<ul style="list-style-type: none"> How will LTC help the UK attract greater foreign direct investment or tourism? 	<p>Improving the flow of transport in the SRN in the South East, including to the Channel Crossings, will facilitate tourism. Section 6.6 of the Economic Case refers to increased inward investment, which includes foreign investment</p>
<ul style="list-style-type: none"> How will LTC help the UK's transport and infrastructure sector increase exports? 	<p>LTC will help increase exports by providing improved access to the ports of Tilbury, London Gateway, Dover and the Channel Tunnel. In addition, journey quality will be improved at the existing crossing because of improved availability, reliability and greater resilience, which will benefit business travel in the region.</p> <p>We recognise that the “capacity and reliability of the strategic road network is critical to the performance and competitiveness of businesses across the logistics sector. Unreliable roads subject to delays constrain growth and economic success”¹</p>

Table A.6 Scheme response to TIS objective 4

Objective 4. Support the creation of new housing.	
<p>Overall response: LTC will increase road capacity and resilience in a region with ambitious targets for new housing.</p>	
<ul style="list-style-type: none"> What does LTC do to address constraints on housing? 	<p>LTC is not directly dependent on new housing development, nor does it directly support housing development.</p> <p>LTC does, however, provide additional strategic highway capacity across the Thames and improves the reliability and resilience of the SRN by reducing congestion and incident-related delay at the Dartford Crossing.</p>

¹ *International Gateways and the SRN*, Highways England, November 2016

	In addition, the assessment work being undertaken to support the new crossing is being developed in co-ordination with and cognisant of the impact of local plans being brought forward by local authorities. These are detailed further in this Appendix A.
<ul style="list-style-type: none"> Are any new housing developments dependent on LTC? For example, does it open up access to new pieces of land? 	There are no specific housing developments that are dependent on the project. LTC does, however, improve access and connectivity to areas on both sides of the Thames and will support the access to/from a number of planned major developments in the area as shown in Figure 2.9 in the Strategic Case.
<ul style="list-style-type: none"> In what other ways will LTC help to unlock housing development, for example, by connecting housing or land to employment centres and services or accommodating demand? 	LTC will help to accommodate existing and forecast future demand. Total morning peak traffic flows across the Dartford Crossing are forecast to increase by 17% between 2016 and 2026, and these flows are already constrained by network capacity. Section 2.3 of the Strategic Case details the current demand at the crossing and Section 2.6 of the Strategic Case provides forecast growth in demand without LTC.
<ul style="list-style-type: none"> What evidence of commitment is there from developers to the new housing? For example, have developers provided funding for LTC? 	Not applicable. LTC is not dependent on new housing development.
<ul style="list-style-type: none"> How does LTC align with housing plans? Does it contribute to 'place making'? 	A review of regional and local planning and transport policy related to LTC is included in Sections 2.5 of the Strategic Case.
<ul style="list-style-type: none"> What engagement has taken place with the relevant planning authorities? 	Local authorities have been engaged for several years, and together with other stakeholders were invited to the non-statutory public consultation which took place in 2016. A summary of stakeholder views is presented in Section 2.7 of the Strategic Case.

Table A.7 National policy requirements

HM Treasury National Infrastructure Delivery Plan 2016–2021	
Para	Policy guidance
3.12	The Government is committed to increasing capacity on the SRN and throughout the course of this Parliament will start work to add 1,300 extra lane miles and improve over 60 problem junctions, to address existing bottlenecks, and transform regional connectivity across the UK.
3.15	Lower Thames Crossing – a new crossing to reduce congestion at the Dartford Crossing and support economic growth. After careful assessment, Highways England has proposed connecting junction 1 of the M2 to the M25 between junctions 29 and 30. These crosses under the Thames just east of Gravesend and Tilbury.

Action for Roads: A network for the 21st century Department for Transport. July 2013	
Para	Policy guidance
1.6	Well-connected road infrastructure with sufficient capacity for our needs is a vital component of economic success. However, our roads must overcome significant challenges if they are to keep supporting our economy and driving growth into the future.
1.22	Our latest estimates show that even in the worst economic circumstances and assuming low population growth, traffic levels on strategic roads will be 24% higher in 2040 than they are today. In our central case traffic will rise by 46% above today's levels.
1.23	Even under our lowest growth forecasts we would expect traffic growth to cause major increases in congestion, greater delays and more unpredictable journeys. Without action, growing demand will place unsustainable pressure on our roads, constraining the economy, limiting our personal mobility and forcing us to spend more time stuck in traffic. This will mean more pollution and more frustration for motorists.
1.25	Without investment, conditions on the most important routes are expected to worsen by 2040. By then, around 15% of the entire strategic road network may experience regular peak-time congestion and often suffer poor conditions at other times of the day.
Department for Transport. Road Investment Strategy for the 2015/16 – 2019/20 Road Period	
Page	Policy guidance
13	Capacity has become a major issue in recent years, with parts of the network becoming increasingly congested. It is important that we continue to address this to ensure that the network drives, instead of constrains, growth.
19	In certain places, our strategic roads have already reached or exceeded capacity, resulting in areas of significant congestion, particularly around larger cities. Relative congestion levels across Europe highlight the challenges we face, even accounting for differences in respective networks. For instance, traffic density on UK motorways is 113 million vehicle miles per mile of road compared to 47 million in Germany and 39 million in France.
46	Schemes developed for the next Road Period (including): Lower Thames Crossing – the Government continues to consult on the different route options for a new Lower Thames Crossing. A decision on a preferred option will be reached during this Road Period, and design work is likely to begin.
HM Treasury Investing in Britain's future. June 2013	
Ref	Policy guidance
Para. 2.11	The Government will build all available Highways Agency road projects, tackling the most congested parts of the network, subject to the usual tests of value for money and deliverability.
Para. 2.13	Government will tackle some of the most notorious and long-standing road hot spots in the country. Roads which are widely recognised as needing a solution to alleviate congestion and tackle enduring problems that have been avoided by successive governments.
Fig. 1.A	Long-term capital investment includes Lower Thames Crossing.

A.1.5 Through their policy framework, the Government has clearly stated its support for LTC in both policy and funding terms as part of a long-term commitment to support investment in the SRN.

A.2 National Policy Statements

A.2.1 The National Policy Statement for National Networks (NPSNN) is the principal policy framework against which applications for major road and rail infrastructure at a strategic level will be assessed by the Secretary of State. In the NPSNN Section 2 'Summary of need', the following vision and strategic objectives are set out:

Table A.8 National Policy Statement for National Networks, DfT, Jan 2015

Ref	Policy guidance
Page 9	<p>Government's vision and strategic objectives for the national networks.</p> <p>The Government will deliver national networks that meet the country's long-term needs; supporting a prosperous and competitive economy and improving overall quality of life, as part of a wider transport system. This means:</p> <ul style="list-style-type: none"> • Networks with the capacity and connectivity and resilience to support national and local economic activity and facilitate growth and create jobs. • Networks which support and improve journey quality, reliability and safety. • Networks which support the delivery of environmental goals and the move to a low carbon economy. • Networks which join up our communities and link effectively to each other.
Para 2.20	<p>The Government has therefore concluded that at a strategic level there is a compelling need for development of the national networks – both as individual networks and as an integrated system. The Examining Authority and the Secretary of State should therefore start their assessment of applications for infrastructure covered by this NPS on that basis.</p>

A.2.2 The need for the development of the national road network is established by Government policy, as set out within the NPSNN. This recognises that without improvements to the SRN, it will be difficult to support further economic development, employment and housing across the UK. The Lower Thames Crossing will provide improved network capacity, connectivity and resilience, along with reduced journey times, both in meeting the scheme objectives (see Strategic Case) and in line with the NPSNN.

A.3 Local planning policy

A.3.1 A summary of key transport objectives within the Local Plans of the local planning authorities are listed below, noting the references to local growth set out in paragraphs.

Table A.9 Local planning policy

Gravesham Local Plan: Core Strategy Adopted 2014	
Page	Strategic objectives
61	S017 – Increase accessibility, reduce the need to travel, minimise congestion and improve air quality through improved provision of local public transport and the provision of local jobs and services.
Thurrock Core Strategy and Policies for Management of Development (as amended) Adopted 2015	
Page	Strategic spatial objectives
25	SS07 – Plan for provision of transport and utility infrastructure that will support and underpin a sustainable level of development in new and existing communities and address current deficits to include key interchanges at Grays and Lakeside.
Adopted Kent and Medway Structure Plan (2006)	
Page	Core principles
11	Promoting and investing in efficient transport that will serve future needs, tackle congestion, avoid unacceptable damage to the environment and make best use of the existing road and rail infrastructure

- A.3.2 In addition, for certain Plan policies issues of overriding need may have to be demonstrated for LTC to comply with the policy requirements.
- A.3.3 This applies particularly in the case of Green Belt land, where a justification of the ‘very special circumstances’ will be needed to support an exception to the policy restriction on highway development. Issues of overriding need may also apply in relation to the proposed route alignment within the Kent Downs AONB, and within areas of ancient woodland, and considering the potential impacts on heritage sites, recreation land and open space, Sites of Specific Scientific Interest, and the Ramsar site and SPAs.
- A.3.4 Where the proposed development is shown to be contrary to planning policy presumptions, a substantive justification for LTC being sited in a particular location may be regarded as a significant material planning consideration in meeting wider strategic highway needs.
- A.3.5 We are confident that the strength of the case for LTC, as outlined above, will ensure that those policy tests requiring overriding need to be established will be met.

A.4 Local transport policy

- A.4.1 This section identifies the strategic transport policies contained within the respective local transport plans of the affected highway authorities.

Table A.10 Highway authority transport plans, local policies

Kent County Council. Local Transport Plan 4: Delivering Growth without Gridlock 2016–2031	
Page	Policy guidance
13	<p>The existing Dartford Crossing is the shortest freight route between Kent and the major distribution centres in the Midlands and the North. However, the capacity is overloaded for large periods of the day and it is extremely vulnerable to incidents – over 300 times a year the Crossing is fully or partially closed. Due to congestion and delays, it affects productivity and constrains economic growth.</p> <p>We are clear that a new Lower Thames Crossing, to the east of Gravesend, is required to unlock growth, improve journey time reliability, improve network resilience, and enable opportunities for regeneration.</p>
Essex County Council Essex Transport Strategy: The Local Transport Plan for Essex	
Para	Policy guidance
4.2.4	Strategic links to ‘Greater Essex’, London, Kent, Cambridgeshire, Suffolk and Hertfordshire Cross-Thames movements, linking Kent and Essex are also currently constrained by limited capacity at Dartford Crossing... Significant growth is planned adjacent to Essex which is likely to add further pressure to strategic transport networks.
4.2.5	<p>Summary of key issues</p> <p>Key issues to emerge from the Plan’s preceding analysis of the three challenges which need to be met if the Council are to provide reliable connectivity within Essex, include the, ‘limited capacity at Dartford Crossing, potentially compromising economic growth in the Thames Gateway.’</p>
4.3	The Council’s approach to meeting the three challenges is to seek the following outcome: ‘Provide reliable connectivity for international gateways and Essex communities to support sustainable economic growth and regeneration.’
Greater London Authority: Mayor’s Transport Strategy, March 2018	
Ref	Policy guidance
201	<p>Wider South East</p> <p>Economic growth and the provision of new housing in London and the Wider South East – the economic powerhouse of the country – depend on improvements to the connectivity and capacity of the strategic transport network... Figure 35 shows the initial strategic infrastructure priorities the Wider South East partners have broadly agreed for further investment.</p>
Fig 35	Includes reference to Lower Thames Crossing
Thurrock Borough Council: Thurrock Transport Strategy 2013–2026	
Ref	Policy guidance
-	<p>The Challenge</p> <p>High numbers of HGVs and high traffic flows on strategic roads are adversely impacting on local air quality, CO₂ emissions, and congestion. Growth could well make this worse. Worsening air quality will increase respiratory problems whilst increasing congestion could harm job creation and economic performance, particularly with regard to international gateways, such as London Gateway.</p>

-	<p>Tackling Congestion</p> <p>Promoting capacity improvements on the Strategic Road Network, with priority for freight routes to key strategic economic hubs and interurban bus routes, where modal shift and network management are insufficient. Improvements have been identified on M25, A13 and A1014.</p>
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Table A.11 Status of local authority plans

Local authority	Local Plan	Local Transport Plan
Essex County Council	Local Planning Policy is covered by the Borough and District Councils.	Essex's Local Transport Plan was adopted in 2011.
Kent County Council	Local Planning Policy is covered by the Borough and District Councils.	Kent's LTP4 (2016-31) was adopted in August 2018.
Medway Council	The Local Plan was adopted in 2003. A new Local Plan, Future Medway is currently under development, with adoption expected in 2020.	The Medway Local Transport Plan was adopted in 2011 and runs until 2026.
Thurrock Council	The Core Strategy was adopted in December 2011 and revised in January 2015. A new Local Plan is being developed, with adoption expected in late 2020.	The Thurrock Transport Strategy covers the period 2013-26.
Brentwood Borough Council	The Brentwood Replacement Local Plan was adopted in August 2005. A new Local Development Plan is being developed with adoption expected in mid 2019.	Transport policy is covered by Essex County Council.
Dartford Borough Council	The Core Strategy Local Plan was adopted in 2011 and is supplemented by the Development Policies Local Plan 2017. A new local plan is being prepared, with consultation expected to start in 2018.	Transport policy is covered by Kent County Council.
Gravesham Borough Council	The Local Plan Core Strategy was adopted in September 2014 and covers the period 2011-2028. A local plan review is currently underway covering site allocations and	Transport policy is covered by Kent County Council.

Local authority	Local Plan	Local Transport Plan
	development management policy.	
London Borough of Havering	<p>The Core Strategy was adopted in 2008 and covers the period to 2020</p> <p>Local plan (2016-31) currently being consulted on and went through Examination in Public in March 2018.</p>	Transport policy is covered by the GLA.
Greater London Authority	<p>Adopted London Plan from 2016 under previous administration.</p> <p>Draft New London plan is currently being revised following public consultation earlier in 2018.</p>	The Mayor's Transport Strategy was published on 13 March 2018.

Appendix B: Thames Crossing options considered

Table B.1 Thames crossing options considered

Location	Key dates	Assessment
<p>A – Additional capacity at the existing Dartford Crossing</p>	<ul style="list-style-type: none"> • 2009 – Identified in the study carried out on behalf of the DfT <i>Dartford River Crossing Study Final Report, 2009</i>, DfT • 2013 – Appraised and presented for public consultation by the DfT • <i>Options for a New Lower Thames Crossing, 2013</i>, DfT • 2016 - Appraised in further detail and considered not to meet scheme objectives • <i>Scheme Assessment Report, 2016</i>, Highways England • <i>Lower Thames Crossing Route Consultation 2016</i> • 2017 – Re-appraised and not selected as the preferred route • <i>Post Consultation Scheme Assessment Report, 2017</i>, Highways England 	<p>Location A was identified as a potential option in public consultation undertaken in 2013. It was then considered in further detail but was considered not to meet the scheme objectives. Public consultation in 2016 invited feedback on the Highways England proposal to locate the crossing at location C. Further appraisal of location A took place following conclusion of that consultation.</p> <p>Location A could not be developed into a solution that met the scheme objectives. The identified solutions were not viable because they failed to relieve the congestion on the approaches to the Dartford Crossing as they did not provide a suitable alternative route for traffic travelling along the A2 and A13. Solutions that relied on the connection at junction 2 and junction 30 of the M25 failed to relieve congestion at or on the approaches to these key junctions, while solutions that did not include these connections failed to provide the necessary relief to the Dartford Crossing itself.</p>
<p>B – Swanscombe Peninsula Link to the A1089</p>	<ul style="list-style-type: none"> • 2009 – Identified in the study carried out on behalf of the DfT <i>Dartford River Crossing Study Final Report, 2009</i>, DfT • 2013 – Appraised and taken to public consultation by the DfT • <i>Options for a New Lower Thames Crossing, 2013</i>, DfT • 2013 – The decision was made not to carry out further work on this location • <i>Options for a New Lower Thames Crossing – Consultation Response Summary, 2013</i>, DfT 	<p>Location B was presented at public consultation in 2013. Following the consultation, this location was not taken forward for further assessment. The identified solutions conflict with the local development plans, particularly including Ebbsfleet Garden City and the Swanscombe Peninsula. As a result, no viable solutions could be developed at this location.</p>

Location	Key dates	Assessment
<p>C – East of Gravesend and Link to the M20</p>	<ul style="list-style-type: none"> • 2009 – Identified in the study carried out on behalf of the DfT <i>Dartford River Crossing Study Final Report, 2009, DfT</i> • 2013 – Appraised and taken to public consultation by the DfT • <i>Options for a New Lower Thames Crossing, 2013, DfT</i> • 2016 – Multiple options were developed, and three different options were taken forward to public consultation • <i>Scheme Assessment Report, 2016, Highways England</i> • <i>Lower Thames Crossing Route Consultation 2016</i> • 2017 – Re-appraised following consultation and the preferred route was identified at location C <i>Post Consultation Scheme Assessment Report, 2017, Highways England</i> 	<p>Following early studies and the public consultation in 2013, location C was developed into a series of potential solutions which were appraised in detail in the 2016 assessment. Three routes to the north of the Thames, identified as routes 2, 3 and 4, and two routes to the south identified as Eastern Southern Link and Western Southern Link, were identified as being capable of meeting the scheme objectives. Each of these potential routes would be connected across the Thames by a tunnel to minimise impacts on the local environmentally sensitive areas. These routes were presented at public consultation in 2016. Information gathered during and following the consultation was then used to re-appraise each of the routes. Following this appraisal, it was identified that route 3, with the Western Southern Link would have the lowest impact on several environmentally sensitive areas, particularly on the Thames Estuary and Marshes SPA and Ramsar site, the ancient woodland and the Kent Downs AONB, as well as on the communities close to the route.</p> <p>On 12 April 2017 the Secretary of State for Transport confirmed the preferred route as follows:</p> <ul style="list-style-type: none"> • a tunnel crossing under the Thames east of Gravesend and Tilbury (location C) • a new road north of the Thames which will join the M25 between junctions 29 and 30 (route 3) • a new road south of the river which will join the A2 east of Gravesend (the Western Southern Link)
<p>D1 – M2 Link to A130 via Cliffe/Pitsea</p>	<ul style="list-style-type: none"> • 2009 – Identified in the study carried out on behalf of the DfT. The decision was made not to carry out further work on these locations <i>Dartford River Crossing Study Final Report, 2009, DfT</i> 	<p>The two alternative location D options were not taken forward following the first stage of location identification and appraisal. The location D options were found to be located too far to the east and modelling showed that they failed to provide the necessary relief to the congested Dartford Crossing as they did not support the key traffic movements across the Thames.</p> <p>As a result, no viable solutions could be developed at this location that would meet the scheme objectives.</p>
<p>D2 – M2 to A130 via Canvey Island</p>		

Location	Key dates	Assessment
<p>E – Isle of Grain Link to East of Southend</p>	<ul style="list-style-type: none"> 2009 – Identified in the study carried out on behalf of the DfT. The decision was made not to carry out further work on these locations <i>Dartford River Crossing Study Final Report, 2009, DfT</i> 	<p>As with the two alternative location D options, location E was not taken forward following the first stage of location identification and appraisal. Similar to the D options, location E was located too far to the east and did not provide the necessary relief to the congested Dartford Crossing as it did not provide for the key traffic movements across the Thames. As a result, no viable solutions could be developed at this location that would meet the scheme objectives.</p>

Appendix C: Commercial and Procurement Strategy

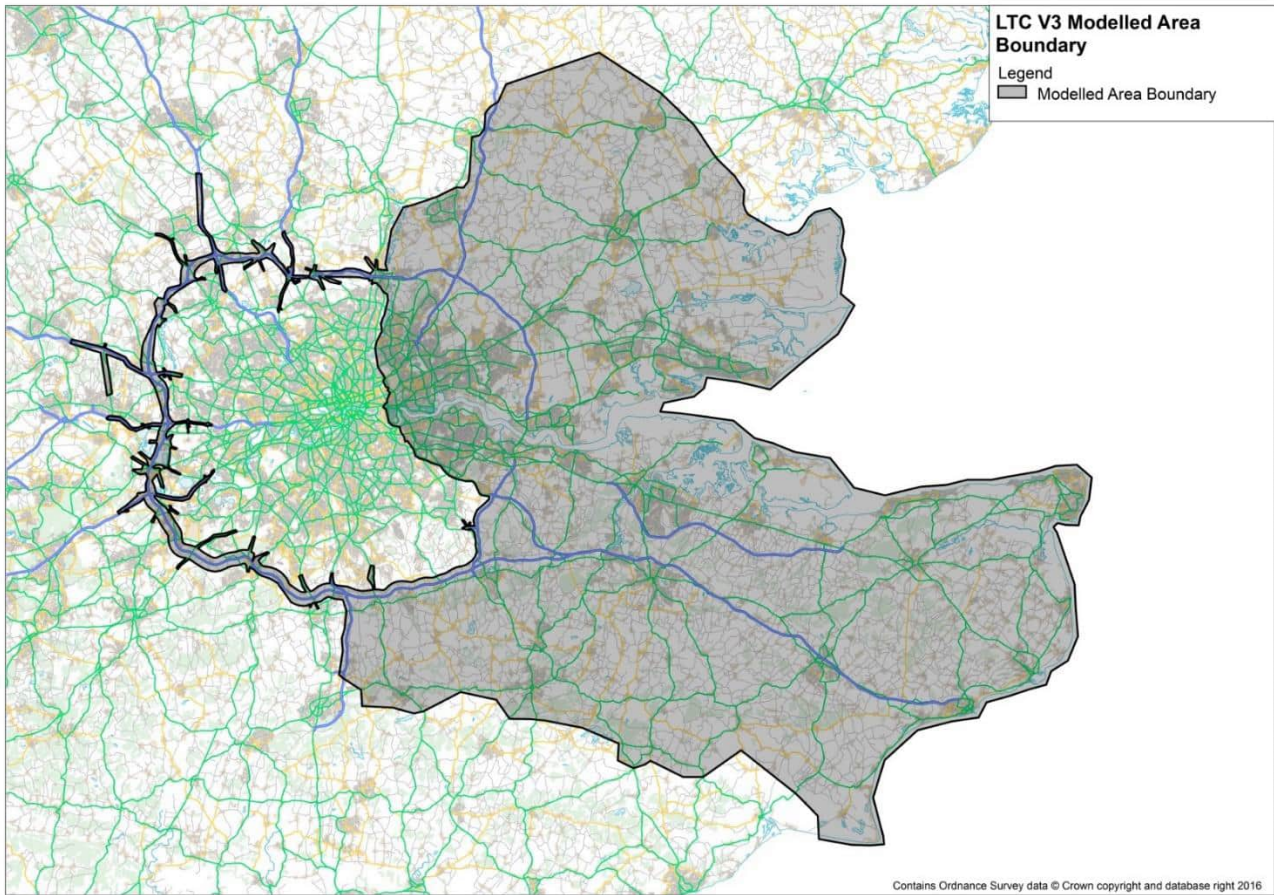
BC Link : <https://collaborate.ms/bc/bc.cgi/d64828761/HE540039-CJV-GEN-GEN-STR-PRO-00022.pdf>

Lower Thames Crossing, Commercial and Procurement Strategy,
Revision 5.3 – Approved 07 July 2020

Document Ref : HE540039-CJV-GEN-GEN-STR-PRO-00022

Appendix D: Traffic Model fully modelled area

Figure D.1 Lower Thames Area Model fully modelled area



Appendix E: Costs

E.1 Introduction

- E.1.1 This Appendix provides more details about the approaches used to estimate the CAPEX costs and OMR costs.
- E.1.2 It also presents CAPEX and OMR annual cost profiles.

E.2 CAPEX costs elements

- E.2.1 The CAPEX costs are split into Base Costs and Additional Costs

Base costs

- E.2.2 The base costs are divided into the following cost categories:
 - a. **Options:** This refers to the actual historic costs incurred in developing and appraising options for LTC, as recorded in LTC's financial system. These costs are now sunk and therefore they are excluded from the PVC for LTC.
 - b. **Development Stage:** These costs relate to PCF Stages 3, 4 and part of 5 and include work to (for more information on PCF refer to the Management Case at Section 4.3):
 - i. define the scope of LTC
 - ii. develop the key delivery contracts
 - iii. obtain development consent
 - iv. develop the Full Business Case and successfully achieve Stage Gate Assessment Review 5 (SGAR5)
 - c. The costs are calculated based on the historic and forecast monthly resource profile required to deliver the above outputs. The staff rates are based on those agreed with LTC's technical partner Cascade. The costs exclude Highways England staffing costs, which are not allocated to LTC.
 - d. **Lands:** This includes costs for:
 - i. Blight
 - ii. Land acquisition
 - iii. Part 1 claims
 - iv. Other costs

- e. The Land Cost Estimate is produced in consultation with the Property and Compensation team to determine the correct development boundary using the latest district valuer estimate (March 2019) and full schedule of affected property and land areas.

Blight

- a. Blighted land is a reflection of the reduction in marketability and/or value of property and land within the published Development Boundary due to the decision to proceed with LTC. Property and land are purchased in advance of the Start of Works at the Full Market Value.
- b. LTC has identified properties potentially affected by the project and have provided them to the Valuation Office Agency.
- c. The Valuation Office Agency has analysed the properties and have provided market values for the properties including fees and Stamp Duty Land Tax.

Land acquisition

- a. Land acquisition covers the 'red line' boundary of the land requirements (both surface and sub-surface) in order to construct the project scope as designed.
- b. LTC has identified the revised 'red line' boundary of land required for the route. The Valuation Office Agency has analysed and provided market values per acre for agricultural land and the project team have applied this to the required areas (taken from GIS).

Part 1 Claims

- a. Part 1 claims arise for property owners/occupiers outside the development boundary whose property value has been reduced by the physical effects of LTC in use rather than the construction of LTC. Any compensation reflects the difference in value post-scheme from the value pre-scheme.
- b. The estimate for Part 1 Claims has been submitted by the Valuation Office Agency.

Other costs

- a. Other costs include Inflation, Statutory Interest and a Risk allowance which is automatically calculated by Highways England's Land Database in line with HM Treasury guidance.
- b. The cost of advisors to the land and/or property transactions are included in Blight, Land Acquisition and Part 1 claims.

- c. At this stage a percentage allowance has been made, based upon 2% of land costs (not including Part 1 claims).
- d. No allowance has been made for potential non-statutory mitigation (ie, temporary relocation, double glazing etc).
- e. **Pre-delivery phase management costs:** These are management costs for advance works before Highways England issues the Notice to Proceed (NtP) for LTC. The costs include:
 - i. Technical and commercial assurance in PCF Stage 5: The costs are based on an estimate of staffing levels required to provide assurance of the ECI Contractor. The costs reflect utilised average hourly or day rates for the different work streams and a monthly forecast of the number of FTEs estimated for each work stream
 - ii. Delivery Integrated Partner PCF Stage 5: The costs are based on an estimate of staffing levels required for a contractor during a period prior to NtP. The costs reflect utilised average hourly or day rates and a monthly forecast of the number of FTEs required
 - iii. Project overheads and associated fee for the Enabling Works contract: This is an estimate of costs associated with the establishment of site compounds. The scope and quantity of compounds has been provided by Cascade's Construction Team. The rates have been taken from Highways England's rate database. A percentage contractor fee has been applied to the estimate
- f. **Preliminary costs:** These are costs incurred after the NtP is issued. In calculating these costs, they were split by individual Enabling Works compounds and aligned to Highways England CSD work-breakdown structure.
- g. Specific assessments of preliminary costs have been undertaken for Roads North, Roads South and the Tunnel contract packages. The costs have been built up from existing Highways England assured rates and prices derived from previous projects and publicly available data.
- h. The cost estimate is produced from first principles using a bespoke LTC Preliminaries cost model.

- i. Preliminary cost estimates were built for each main and satellite works package by the geographical location of each preliminary works compound and these costs were subsequently allocated to the contract packages as follows:
 - i. Roads North (three main works packages, eight satellite works packages)
 - ii. Roads South (one main, one satellite)
 - iii. Tunnels and Approaches (two main, one satellite)
- j. The costs of an Enterprise Office were split across the contract packages.
- k. The costs include the following:
 - i. General Labour – this is based on a forecast of the full-time equivalent staff (FTEs) associated with each preliminary works compound.
 - ii. General Plant – this is based on an assessment of the number of vehicles based at each compound.
 - iii. Temporary Works – this is based on an assessment of the temporary works needed to support construction activities, eg, construction of haul roads and the running costs of each compound.
 - iv. Traffic Management – this is based on an assessment of likely traffic management requirements. Items include traffic management, vehicle recovery, CCTV, speed enforcement cameras and temporary barriers.
 - v. Offices – this includes the costs associated with the construction of site offices including hard standings, car parking and buildings.
 - vi. Construction Management – this includes contractor staff for each compound broken down by discipline (eg, project management, engineering, commercial, etc.) and an assessment of the Full Time Employee (FTEs) required.
 - vii. Design Management – this includes a percentage allowance for the costs of the contractor's detailed design produced during PCF Stage 6. It excludes site supervision costs.
 - viii. Ancillary Overheads – these are the costs associated with site transport, security, order licences and fees, survey and communication equipment, safety related items and equipment, small tools and the testing of materials.
 - ix. Client Overseeing Ancillary Costs – this includes the costs of a Portfolio Office based upon m2/person.

- I. **Cost of Works:** This includes the costs of Enabling Works and the direct costs of the construction of LTC. The latter is split into two Highways contract packages (Roads North and Roads South) and a Tunnels and Approaches contract package, in line with the planned procurement strategy.
- m. There are around 1,900 components for the roads assets and 200 for the tunnel. Components are costed using a mixture of bottom up resource plans for labour, known rates for plant and materials, and using unit rates (£/m² £/km etc.) for the less defined items. The full cost breakdown includes 10,000 cost lines.

Enabling Works

- a. The Enabling Works costs primarily include:
 - i. Third Party Infrastructure (TPI) costs for the protection, monitoring and diversion of other infrastructure assets to enable LTC and ensure continuous service provision to end users
 - ii. Mitigation works costs for activities undertaken before the main crossing and road works, including environmental mitigation, archaeology, habitat relocation and flood compensation
- b. Ancillary and auxiliary costs include the costs associated with third party assets and infrastructure, both current and planned. They also include provision for consultation, consenting, monitoring and diversion/protection works as required. The scope of third parties contained in the cost estimate includes the following:
 - i. Ground Investigations
 - ii. Trial Trenches (utility identification and archaeology)
 - iii. Instrumentation and Monitoring
 - iv. Ecological Habitat Creation
 - v. Civil Works
 - vi. Archaeology
 - vii. Ecological Translocations
 - viii. Non-contestable works
 - ix. Contestable works
 - x. Statutory Undertakers (SU) Design – this covers payments to utility companies to undertake design for diversion of their assets

- xi. Third Party Infrastructure
- xii. Enabling Works Delivery Manager Contractor
- xiii. Prelims for compounds
- xiv. Prelims for compounds – advance costs

Highways

- a. The highways estimate is based on the assured baseline (August 2019) delivery schedule referenced in the Basis of Estimate Report.²
- b. It is assumed that the highways will be delivered through two main works packages:
 - i. Roads North
 - ii. Roads South
- c. There was a separate Quantity take-off (QTO) for each segment of works (including earthworks) at 100 metre intervals for each link road from provided plans and profile drawings. Standards and assumptions not on the drawings were confirmed with LTC's Highways design team (eg, drainage network, road restraint systems). The costs include an outline earthworks' mass haul. Works productivity rates were tailored to on-line constraints and off-line site characteristics.
- d. The work has been priced using existing Highways England assured rate libraries in 2016 Q1 prices in three-point estimating format, derived from previous projects and publicly available data. The totals for each sub-section are deterministic totals that are then run through a simulation. The simulation acts in the same way as a Monte Carlo risk model to derive the range estimate. Priced bills were produced for each segment.
- e. The highways cost of works are based on Highways England standard cost estimating structure, which include expenditure on:
 - i. site clearance
 - ii. fencing
 - iii. road restraint systems
 - iv. drainage and ducts
 - v. earthworks

² Highways England (2019): Lower Thames Crossing Basis of Estimate

- vi. pavement
 - vii. kerbs, footways and paved areas
 - viii. traffic signs and road markings
 - ix. road lighting columns, brackets and CCTV masts
 - x. electrical work for lighting and signs
 - xi. motorway communication and technology
 - xii. landscape and ecology
 - xiii. structures
 - xiv. retaining walls
 - xv. tunnels
 - xvi. accommodation works
- f. The costs include the capital costs for the road user charging system.

Tunnels

- a. These costs were based on an assumed construction methodology and sequencing and they were priced from first-principles. Specific assessments of the plausible minimum, most-likely and plausible maximum estimate were developed for each item to generate a three-point estimate.
- b. The costs are split into:
 - i. Portals and approach ramps
 - The portals and approach ramps have been estimated using a blend of existing Highways England assured rate libraries in 2016 Q1 prices and external contemporary data from rail sector tunnel projects in the UK.
 - Parallel estimating was undertaken to provide confidence in the derived estimates and peer reviews were undertaken to check the outputs and mitigate uncertainty.
 - ii. Crossing
 - QTO was undertaken on detailed design drawings and confirmed temporary works methodology with project technical specialists. Parallel estimates were undertaken.

- c. **Contractors fee (on Cost of Works):** A contractor's fee of 9% has been applied to all construction costs for Highways contracts and a fee of 10% has been applied to the Tunnels and Approaches contracts.
- d. **Delivery phase management costs:** These cover technical and commercial assurance during PCF Stage 6 and 7 activities. These are calculated based on a resource profile developed to deliver the required outputs. The basis of rates is that utilised by the technical and commercial assurance supplier.

E.3 Additional costs

Project risks

- E.3.1 Forms the basis of the project risk assessment included in the cost estimate. Risks were quantified to provide an allowance for the cost of mitigation, and it is anticipated that funding for mitigation will be drawn down from the agreed contingency.
- E.3.2 Project risk relates to all CAPEX costs and includes both Highways England and contractor owned risks. Risk is apportioned in accordance with Work Breakdown Structure (WBS) headings. This allocation and ownership of risks is based on the contract lead's considerations and is included within the Risk and Opportunity Register.
- E.3.3 The Risk and Opportunity Register also contains a large number of potential cost savings and the highest priority savings are included in an Opportunity Tracker.
- E.3.4 Project risks have been assessed as the uncertainties (threats or opportunities) related to events, actions, and other conditions that are specific to the scope of a project. (eg, weather, soil conditions). The historically inconsistent project specific nature of the risk-to-impact relationship favours the use of more deterministic methods of quantification such as expected value calculations.
- E.3.5 Individual risks have been identified based upon the effect to the project, its probability of occurrence and severity of impact. The impact has been expressed as a probability distribution.
- E.3.6 The Management Case provides more information on project risks.

Uncertainty

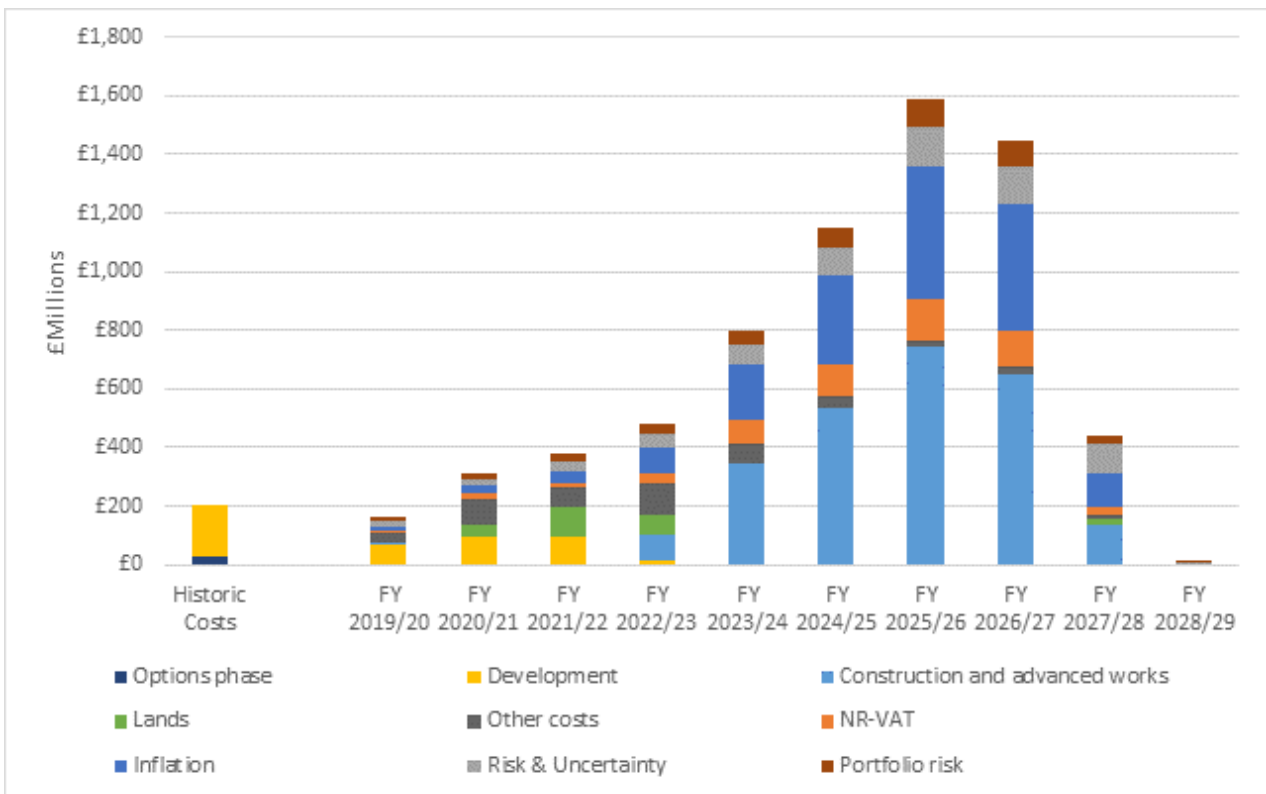
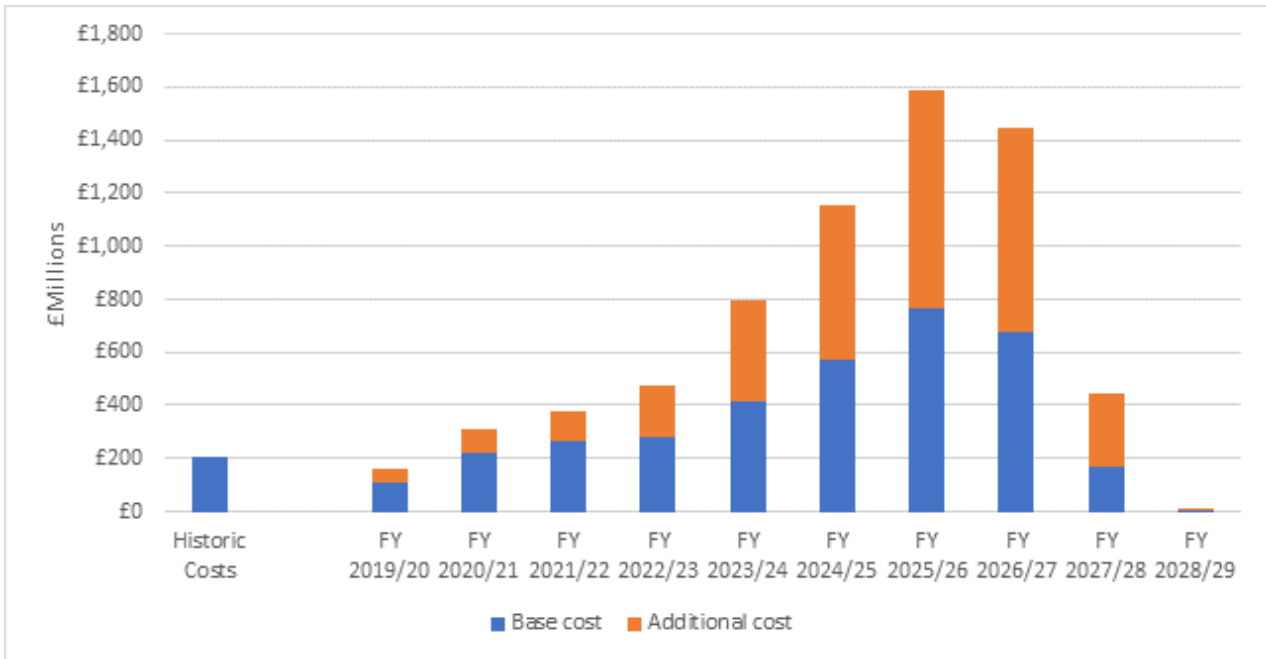
- E.3.7 Where risks are difficult to quantify with any precision, project specific adjustments are included within an uncertainty cost element. These are allocated against the WBS items and accompanied with explanatory notes to record the basis for these allowances.

Non-Recoverable VAT

- E.3.8 Non-Recoverable VAT (NR VAT) for LTC is incurred on expenditure outside of the existing highway boundary. Allowances for NR VAT were based upon an assessment of the percentage of expenditure outside of the existing highway boundary to the nearest 5%. An individual assessment was undertaken for each package of works i.e. Enabling Works, Roads North, Roads South, Tunnels and Highways England.
- E.3.9 These assessments take account of the recent determination by HMRC that NR VAT is to be calculated on all bridges.
- E.3.10 For each contract package, an assessment was carried out of the percentage of work that is located outside of LTC's red line boundary and to which NR VAT should be applied. These percentages are listed below:
- a. Highways England 92%
 - b. Enabling Works 92%
 - c. North Roads 90%
 - d. South Roads 85%
 - e. Tunnel 100%
- E.3.11 Portfolio risk and inflation: Once the distribution of base costs, project risk and uncertainty was completed, the costs were reviewed and amounts for portfolio risk and inflation were generated using Highways England's Range Estimating Template (RET) tool.
- E.3.12 Inflation allowances for LTC have been calculated following development of a monthly expenditure profile for LTC aligned with the delivery schedule.
- E.3.13 Highways England's standard inflation forecast for major projects has been applied to the assured CAPEX base costs and additional costs. Actual inflation values, sourced from the Building Cost Information Service (BCIS) for the period Q1, 2016 to Q1, 2019 have been applied.
- E.3.14 Inflation rates based on the emerging Roads Period 2 (RP2) inflation profile with a 25 basis points adjustment have been applied to the unassured CAPEX costs and additional costs.
- E.3.15 Portfolio risks reflect an assessment of risks of LTC at a portfolio level (or are more appropriately managed at that level) based on a Portfolio Risk Register. These risks are allocated across schemes and an allowance is included in LTC's cost estimate.

CAPEX cost profiles

Figure E.1 CAPEX costs (outturn, assured, Most Likely, £m)

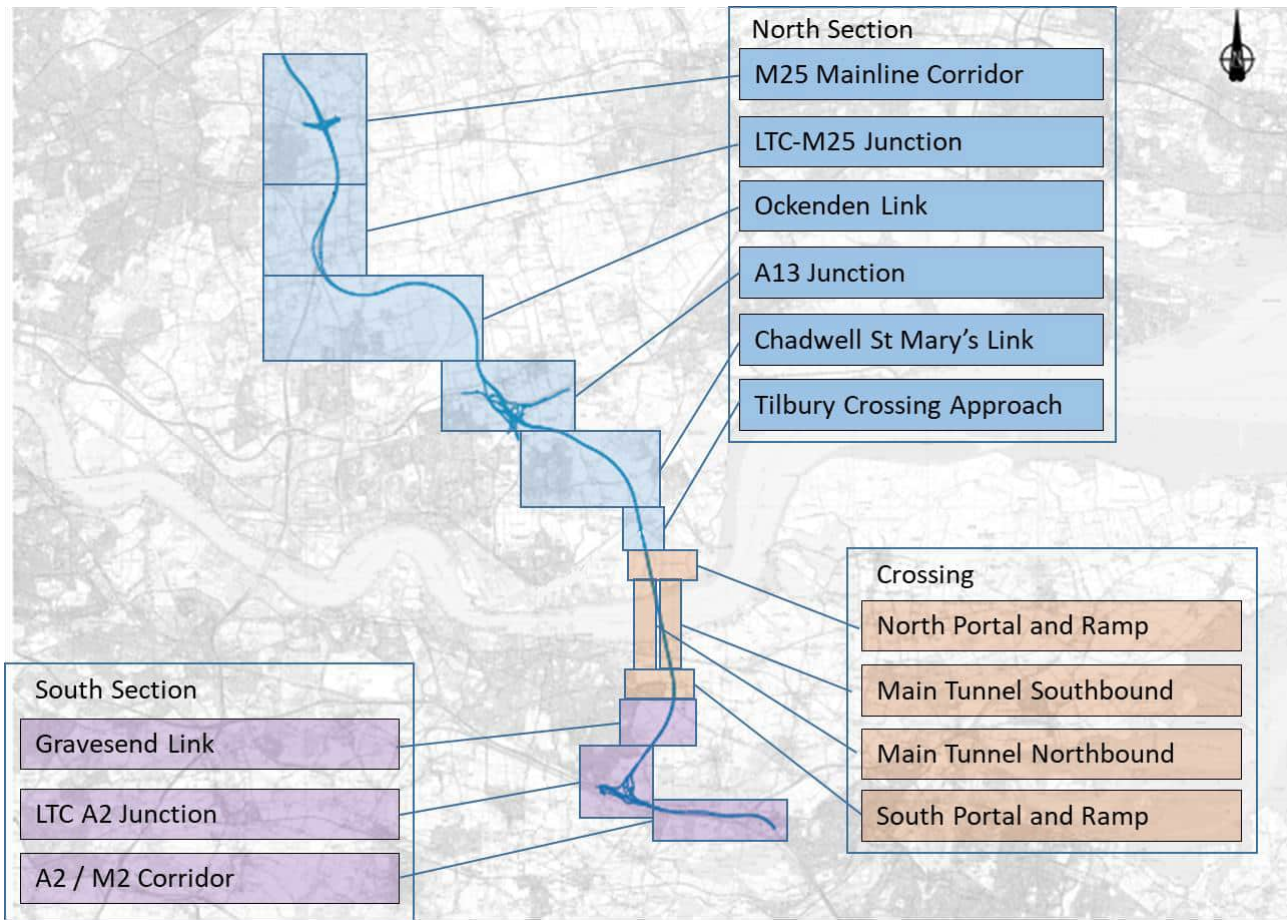


E.4 Operations, maintenance and renewal estimation approaches

Highways

- E.4.1 The operations, maintenance and renewal (OMR) costs comprise highways, tunnel and road user charging costs
- E.4.2 The highways and tunnels costs were estimated using a lifecycle costing approach. The road user charging costs are based on those included in Highways England's Dart Charge 1 Extension business case.
- E.4.3 The principal quantities (eg, structures, pavement area) have been adjusted to be consistent with the CAPEX estimate and to reflect the assured baseline (August 2019) project design.
- E.4.4 Highways England's Chief Economist has reviewed OMR inflation rates across its portfolio of highway schemes and has identified appropriate OMR inflation rates. These have been used to convert the highways and tunnel OMR costs expressed in 2016 prices to outturn costs. The road user charging costs have been inflated to outturn using CPI inflation rates because these are used in the existing and future Dart Charge contracts.
- E.4.5 In estimating the tunnels and highways OMR costs, LTC was divided, or segmented, into three broad sections – North, Crossing and South – that encompass newly constructed roads and existing roads that are impacted by LTC. Each of these sections was further divided into sub sections, as shown in Figure E.2.
- E.4.6 In agreement with DfT, the road user charging costs included in the Economic Case are based on first time compliance and exclude enforcement costs. This ensures that the road user charging costs and revenues are on a comparable basis. Enforcements costs are included within the Financial Case.

Figure E.2 Segmentation of the LTC scheme for estimating OMR costs



Highways

E.4.7 The Highways OMR costs cover routine operation and maintenance and renewals expenditure on:

- a. highways assets
- b. structures
- c. technology assets
- d. non-operational costs

Highways assets

E.4.8 This covers the costs of routine operation and maintenance of highways assets and includes:

- a. cyclical and reactive maintenance
- b. incident response activities
- c. severe weather incidents

- E.4.9 Costs have been estimated based on contract conditions in Highways England's Asset Delivery procurement model. Rates have been taken from Highways England's CSD prices for Asset Delivery tenders and reflect central values within the range of tenders and not the successful tenderers' Highways rates.
- E.4.10 Incident related costs have been based on assumed incident frequencies. The costs of gritting in severe weather are based on an average per lane-km cost derived from Asset Delivery tender documents, ie, in line with costs on other parts of the SRN that are operated using the Asset Delivery model.
- E.4.11 The costs of renewing highway assets such as road resurfacing are based on estimated quantities and CSD's standard renewal frequencies for motorways that have similarly high HGV volumes. Other costs elements are based on asset types and standard renewal rates from current standards and are not directly dependant on traffic numbers.
- E.4.12 The costs have been adjusted to reflect the lack of a hard shoulder over the length of the project.
- E.4.13 The costs include some expenditure on highways assets in adjacent maintenance areas (Area 4, Area East 6 and Area 5).

Structures

- E.4.14 The costs of maintaining structures, such as bridges and retaining walls, are based on the sum of the average annualised cost for each structure. This annual cost is calculated as a percentage of the capital cost of the structure.
- E.4.15 The structures costs include an assessment for betterment for existing aged assets that are replaced or renewed in situ during the construction of LTC.

Technology assets

- E.4.16 The costs include routine operation and maintenance of technology assets, such as Variable Message Signs (VMS) that are managed under Regional Technology Maintenance Contracts. The renewal of technology assets is based on estimated quantities and CSD standard renewal frequencies.
- E.4.17 Highways energy costs are not included. These costs are relatively small and will be covered for LTC centrally by Highways England.

Non-operational costs

- E.4.18 These costs include the overheads of running the operations and maintenance area (eg, general management structure, asset planning, IT systems).

Tunnels costs

- E.4.19 Tunnel OMR costs include routine tunnel operation, maintenance and periodic renewals activities for the following tunnel asset categories:
- a. pavements
 - b. fabric and finishes
 - c. air monitoring system
 - d. heating, ventilation and air conditioning (HVAC) systems
 - e. hydraulic treatment, stormwater and drainage
 - f. high voltage electrical distribution and control
 - g. low voltage electrical distribution and control
 - h. uninterruptable power supply
 - i. lighting
 - j. electronic signage systems
 - k. fire detection and suppression system
 - l. roadside furniture and fencing
 - m. monitoring and control system
 - n. surveillance and detection
 - o. telephone, communication and public address
- E.4.20 The cost model used to estimate costs for these asset categories includes base rates from the WestConnex road tunnel in Sydney. These rates are applied to LTC asset quantities (eg, area of carriageway, no. of jet fans). The asset categories, sub-elements, quantities and renewal frequencies have been reviewed to be consistent with the tunnel design at the current stage of development.
- E.4.21 It is assumed that operation and maintenance activities of these assets will be undertaken by a full-time, standalone, tunnel operation and maintenance organisation.
- E.4.22 A design definition for the mechanical, electrical, instrumentation, control and automation systems (MEICA) has not yet been developed for LTC. Therefore, the operating and maintenance costs for the tunnels' mechanical, electrical and controls systems are based on asset quantities and rates derived from

cost build-ups for existing and planned WestConnex Dual-3 lane all-purpose urban tunnels in Sydney.

E.4.23 The costs also include operational expenditure on staff, overheads, premises and energy.

E.4.24 Staffing costs are based on an assumed organogram for the tunnel organisation and an average salary of £45k.

E.4.25 Energy costs have been included for the tunnels.

E.5 Opportunities and risks

E.5.1 Three main opportunities for highways and tunnels OMR cost reductions have been identified:

- a. the level of service within the cost estimate is above the Asset Delivery “low” level for most years of the assessment period and is conservative for largely new assets
- b. the incremental costs of the LTC network are absorbed into wider network costs when maintenance Areas 4, 5, 6 are tendered in future
- c. efficiency of tunnel and highways

E.5.2 Risks for operation and maintenance will be managed locally and therefore cost allowances are not included in the annual OMR cost estimates.

Road user charging costs

E.5.3 The OMR costs include the costs associated with operating, maintaining and renewing a road user charging system for LTC.

E.5.4 A key assumption underpinning these costs is that they are estimated by identifying the costs incurred for Dartford. For the variable costs, a cost per vehicle is identified and multiplied by the incremental traffic flow created by the existence of LTC. For the fixed costs and renewal costs, the cost to LTC is applied in accordance with LTC’s percentage of traffic flow across the river in the Lower Thames area. A combination of fixed and variable costs is considered to reflect the scalability benefits of combining with the operation at Dartford. Table E.2 shows the main variable and fixed cost elements. Renewals costs have also been included.

E.5.5 The road user charge (RUC) costs are based on actual costs (November 2014 to March 2019) and forecasts costs (April 2019 to October 2021) for the Dart Charge 1 scheme. The forecasts costs are split into fixed costs, traffic-based variable costs and renewals costs. However, for this appraisal the variable costs have been adjusted to reflect forecast traffic volumes using LTC and

they have been extrapolated to cover the 60-year period from scheme opening in 2027.

Table E.1 Fixed and variable road user charging OMR cost elements

Variable costs	Fixed costs
Service provider payments / calls	Service provider electricity
Service provider account management	Service provider accommodation
HE marketing	Service provider Key staff
HE staff ongoing	Roadside technology

Variable costs

- E.5.6 The variable costs have been estimated by applying a cost rate of 32 pence per trip to the forecast change in traffic volumes at LTC and the Dartford Crossing produced by the LTAM traffic model.
- E.5.7 The cost rate was based on information from the Dart Charge 1 contract and was calculated by:
- dividing the sum of Dart Charge actual costs (for the period 2014 to 2018) and forecast costs (for the period 2019 to 2021) by the total number of trips across the Dartford Crossing over the period 2014 to 2021
 - removing the costs of road user charging enforcement activities based on a 65%/35% split between road user charging collection costs and enforcement costs.

Fixed costs

- E.5.8 The incremental fixed costs of the road user charging system associated with the LTC scheme are based on actual and approved forecast cost information taken from the Dart Charge 1 contract. The costs have been calculated by applying the ratio of incremental LTC traffic to total traffic volumes (LTC and Dartford) to the average annual Dart Charge 1 collection fixed cost.
- E.5.9 The fixed costs are not sensitive to traffic volume increases, but they will increase if the additional LTC traffic as a percentage of total traffic increases from the current range of 21% to 29% over the 60-year period.
- E.5.10 Enforcement costs were excluded from the estimate based on a 65%/35% split of road user charging collection costs and enforcement costs in the Dart Charge 1 contract.
- E.5.11 The fixed costs include implementation costs, which include the costs of equipment such as cameras. These are based on actual costs from Dart Charge 1, but they have been reduced by a gainshare payment received due to savings made. The percentage of fixed costs split between LTC and

Dartford Crossing is based on the percentage split of traffic between the two crossings.

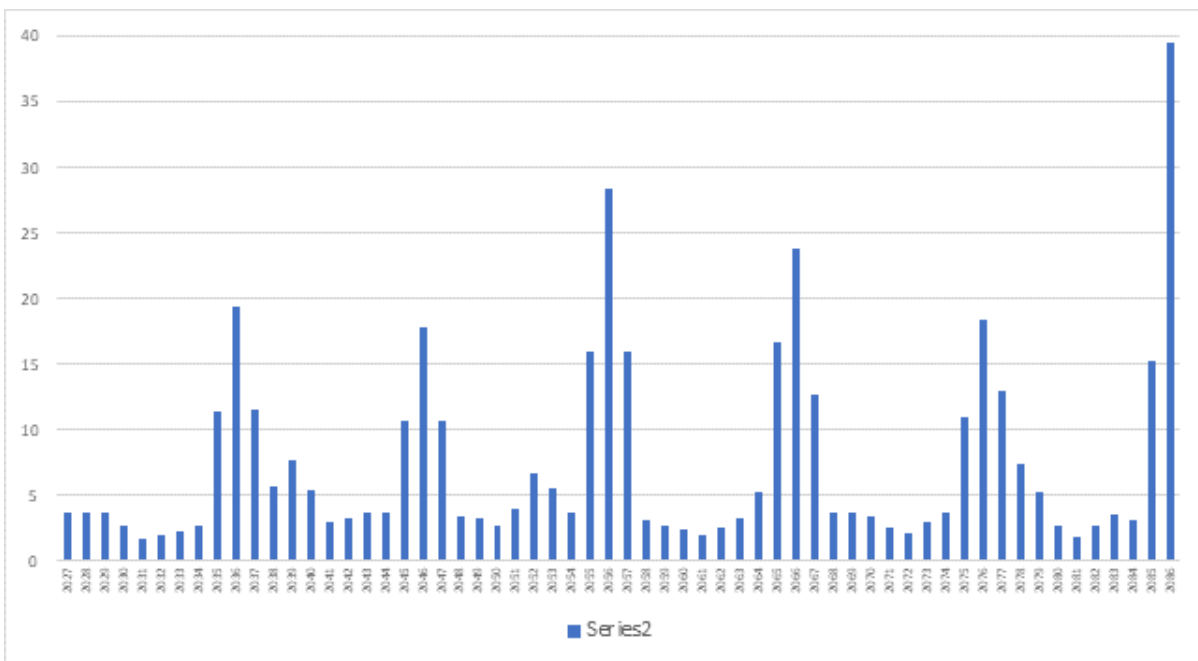
E.5.12 Consultancy or procurements costs have not been included within the fixed costs.

Renewals

E.5.13 A renewals cost for the charging system has been included every 10 years from 2027.

OMR cost profiles

**Figure E.3 Highways OMR costs over all segments
(2016 Q1 prices, Most Likely, £m)**



**Figure E.4 Tunnels OMR costs
(2016 Q1 prices, Most Likely, £m)**

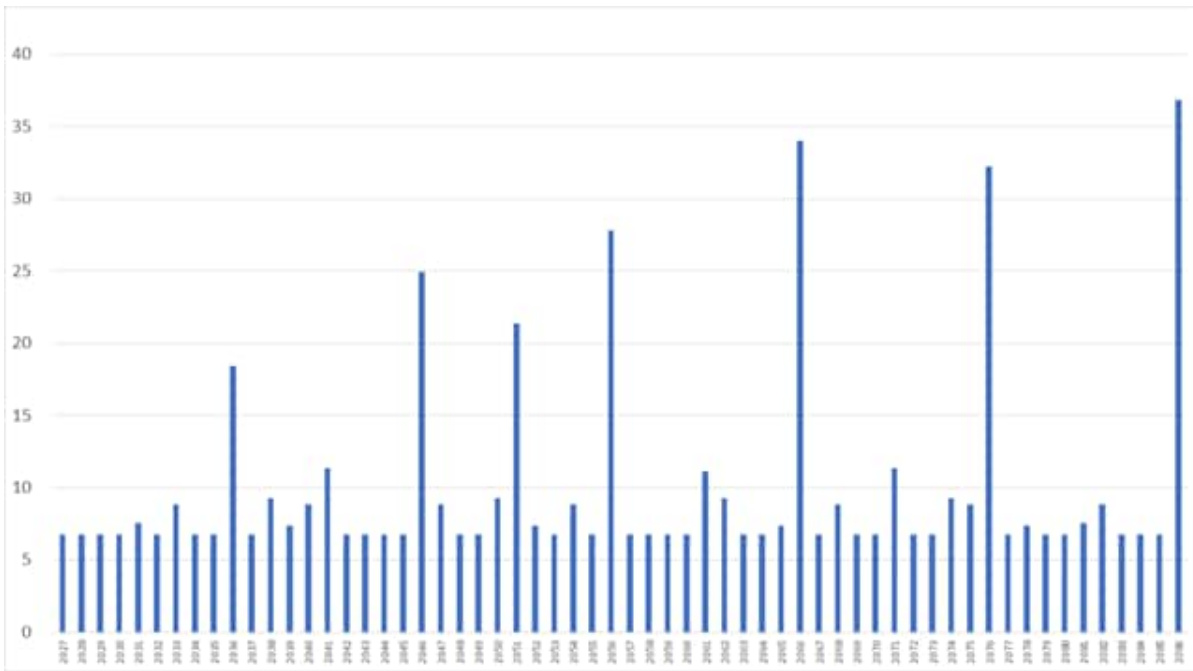
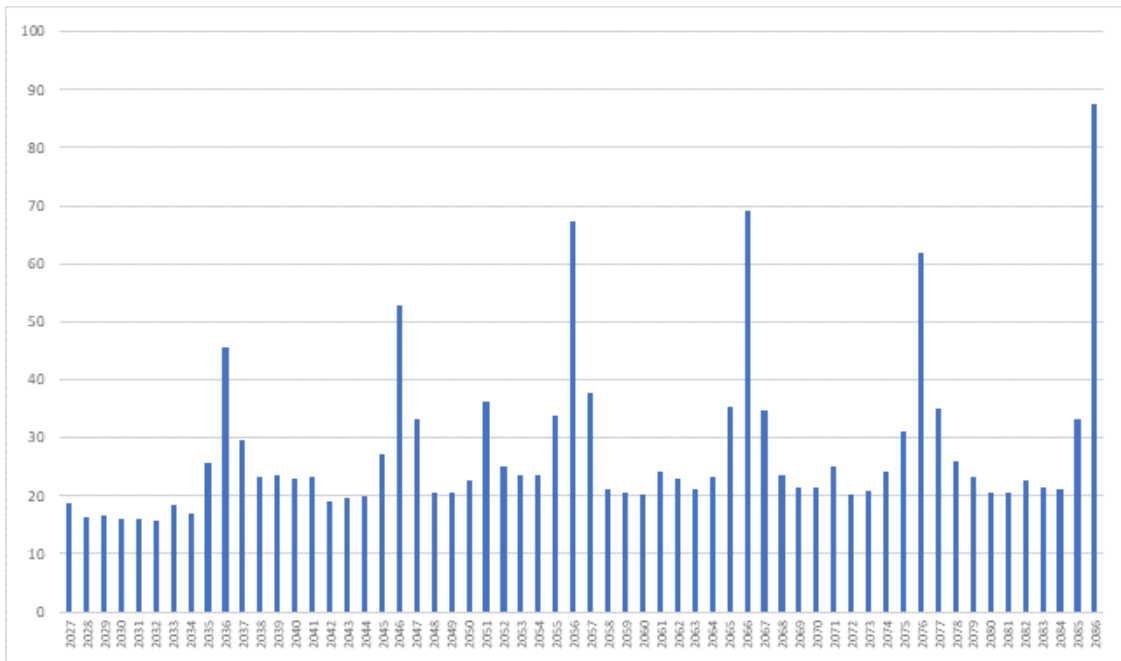
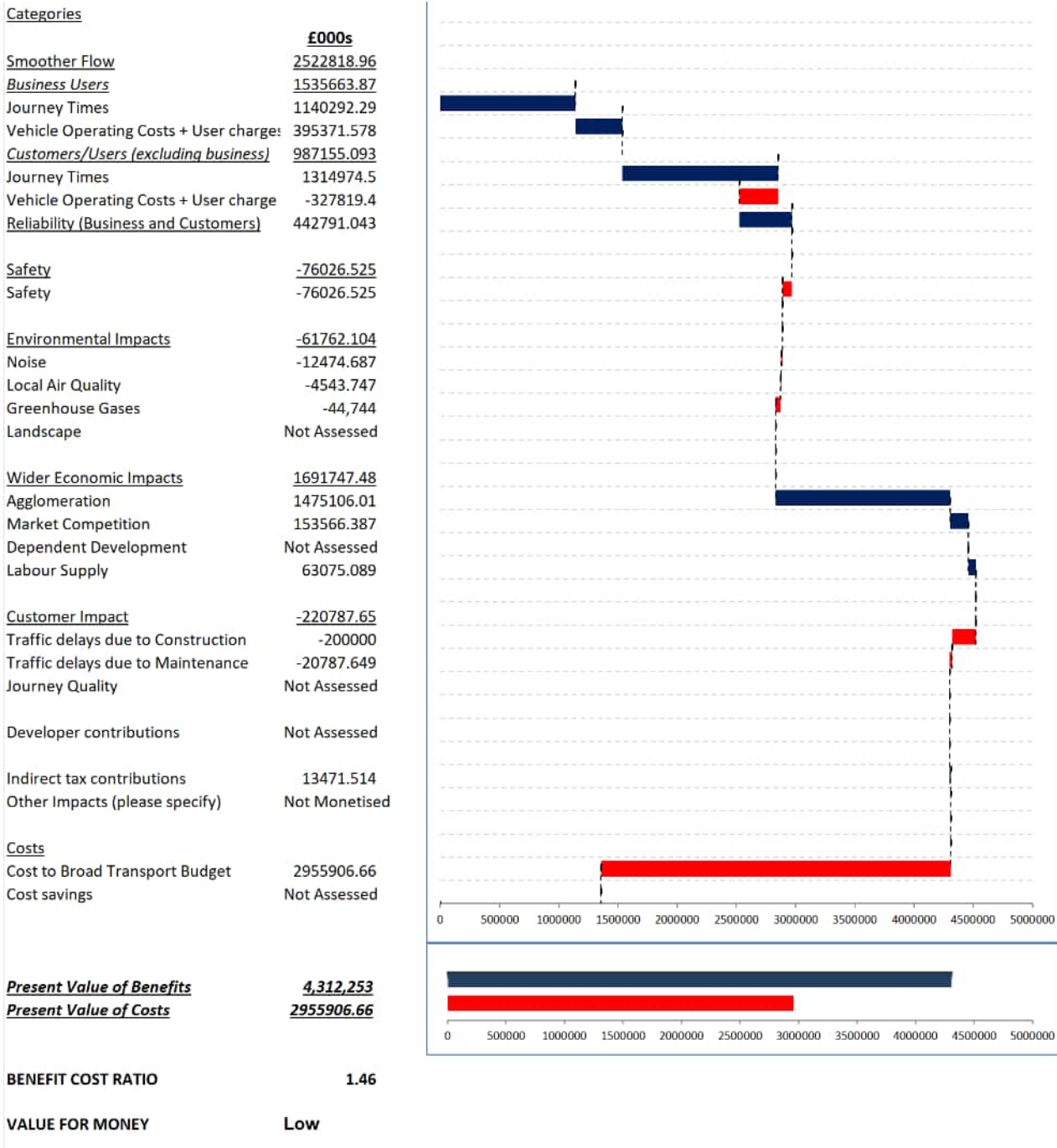


Figure E.6 Total OMR costs (2016 Q1 prices, Most Likely, £m)



Appendix F: Waterfall charts

Figure F.1 Impact waterfall chart, Most Likely assured CAPEX (£000s, 2010 prices and values, core traffic growth)





Appendix G: Sensitivity test results

Table G.1 PVCs for traffic growth and costs sensitivity tests, assured CAPEX (£m, 2010 prices and values)



	Low growth	Core growth								High growth
		P2.5	P10	P30	ML (P43)	P50	P70	P90	P97.5	
CAPEX	3,167	2,187	2,454	2,911	3,167	3,293	3,699	4,051	4,676	3,167
OMR	434	434	434	434	434	434	434	434	434	434
Revenues	-627	-645	-645	-645	-645	-645	-645	-645	-645	-665
PVC	2,974	1,976	2,242	2,700	2,956	3,082	3,488	3,840	4,465	2,936

Table G.2 Sensitivity of BCRs to different costs and traffic growth, assured CAPEX

Impact of traffic growth scenarios

	Lower benefits	Comparable costs and benefits	Higher benefits
Indicator		Central Core	
	Low		High
PVB	3,396	4,312	5,200
PVC	2,974	2,956	2,936
Adjusted BCR	1.14	1.46	1.77
Based on Most Likely CAPEX. The PVC Changes because the revenues vary with traffic growth			

Impact of variations in CAPEX

	Lower benefits	Comparable costs and benefits	Higher benefits
Indicator			
	Minimum P2.5	Most Likely P43	Maximum P97.5
PVC	1,976	2,956	4,465
Adjusted BCR	2.18	1.48	0.97
Based on the Core growth estimate of PVB of £4,312m			

Appendix H: Landscape monetisation

H.1 Introduction

H.1.1 This Appendix provides more details about the monetisation of the landscape impacts. This was based on the baseline (July 2018) version of the project design and DfT's supplementary guidance of landscape valuation which involves a seven-step process:

H.2 Approach

H.2.1 Identification of landscape features – this was informed by the qualitative landscape appraisal worksheet presented in the AST Report and additional information about environmental constraints;

H.2.2 Segment LTC – the project has been subdivided into 4 sections based on the anticipated potential level of intervention that LTC has on the land:

- a. where LTC connects with M25
- b. where LTC connects with A13
- c. where LTC connects with A2 and M2
- d. the LTC scheme

H.2.3 Determine land type – most of LTC is in areas of Urban Fringe and the Green Belt. Land is either used for intensive agriculture or forested amenity land (eg, Thames Chase Community Forest), with some nature conservation designations including pockets of ancient woodland.

H.2.4 North of the Thames land is mainly Urban Fringe (Green Belt) with smaller areas of Urban Fringe (Forested Land) and nature conservation areas (Natural semi-natural land).

H.2.5 South of the Thames some land falls within the Kent Downs AONB. Elsewhere it is urban fringe and falls within the Green Belt.

H.2.6 Land within the AONB has various designations including Ancient Woodland and SSSI, Country Park and Historic Park and Gardens. The predominant land type is either Natural semi-natural land or Urban Fringe (Forested Land).

H.2.7 Land outside the AONB but within its setting is mostly used for intensive agriculture. However, towards the A2/M2 there are large areas of ancient woodland. The land type is Urban Fringe (Green Belt) with some Natural semi-natural land.

- H.2.8 Determine landscape footprint – LTC will have a footprint of 50 hectares per kilometre. This represents an area that extends for 250 metres on each side from the centre line of the road.
- H.2.9 Mitigation – the valuation takes account of the marginal impact of the M25, A13 and A2/M2 on the land based on the blacktop width of each road including the hard shoulder and central reserve. No account has been taken of the impact of HS1 or of other mitigation measures because these have not yet been fully developed.
- H.2.10 Valuation – the valuation involves multiplying the project length by the appropriate landscape value for each land type (shown in Table H.1) and the area of the land type which is impacted upon. The valuation equation is:
- $$\text{Valuation} = \text{Length} \times \text{Land type value} \times \text{Land type Area}$$
- H.2.11 Sensitivity tests – no further sensitivity tests of the valuation were undertaken.

Table H.1 Landscape values for different landscapes

Land Type	Value per hectare per year (3)	Present value per hectare (3£)	Comments
Urban core	75,153	15,031,000	Central urban area, examples include public spaces and city park
Urban fringe (greenbelt)	1,237	247,000	Area of transition where area meet countryside
Urban fringe (forested land)	3,758	752,00	Forested land on urban fringes, more valuable than typical urban areas
Rural forested land (amenity)	9,222	1,844,000	This value represents the range of forests in the UK, including both commercial and amenity forests
Agricultural land (extensive)	4,384	877,000	Area of rough grassland where extensive agricultural; practice such as sheep farming dominate. May include farm buildings
Agricultural land (intensive)	143	29,000	This type of land is usually farmland under intensive agriculture (usually land under food production). May include farm buildings forming a part of the agricultural holdings
Natural and semi-natural land	9,208	1,842,000	This includes uncultivated areas, wetland and areas with nature conservation designation

H.2.12 Figure H.1 and Figure H.2 show the area north and south of the Thames included in the monetary estimate of landscape impact.

Figure H.1 Landscape valuation study area north of the Thames

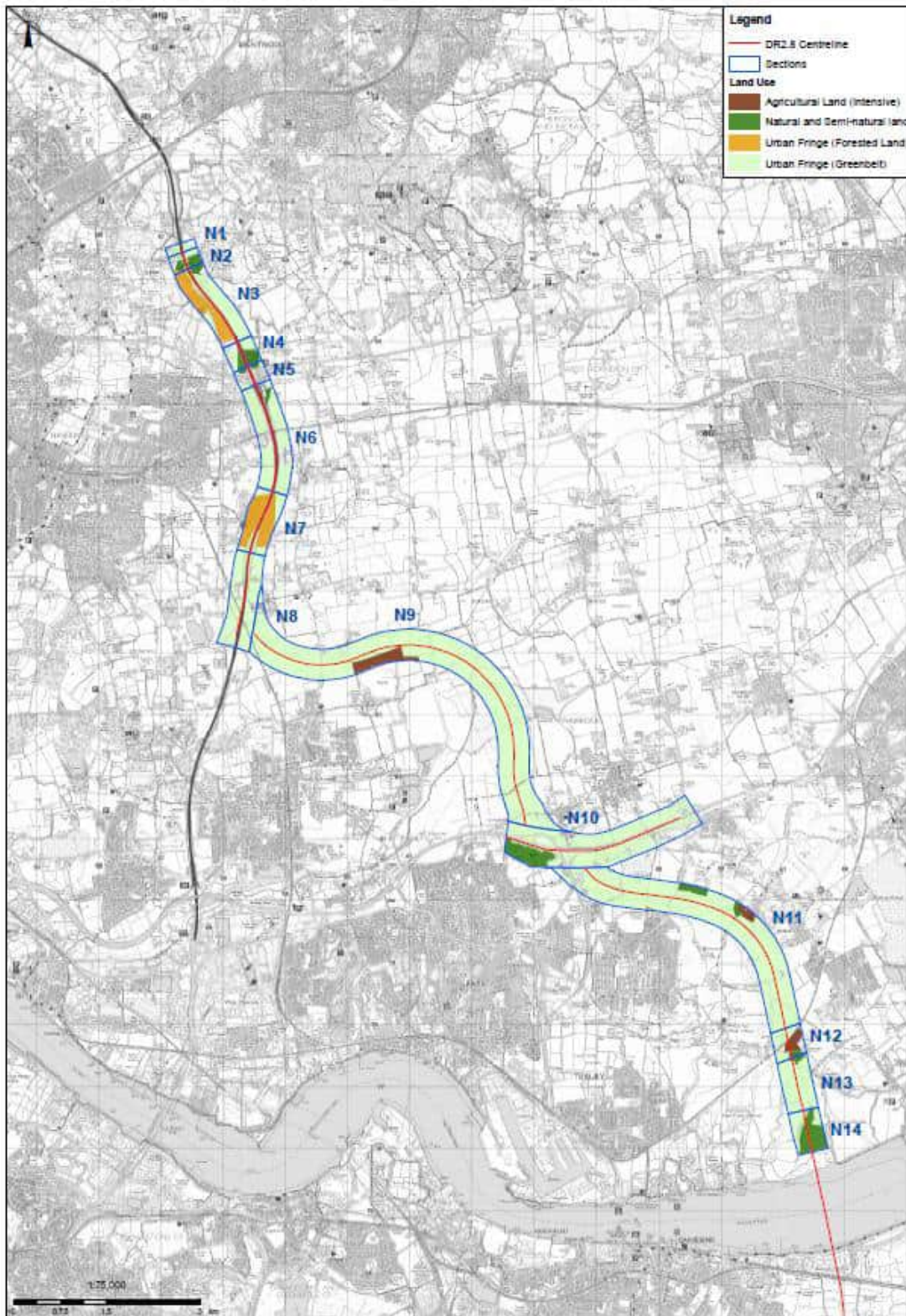
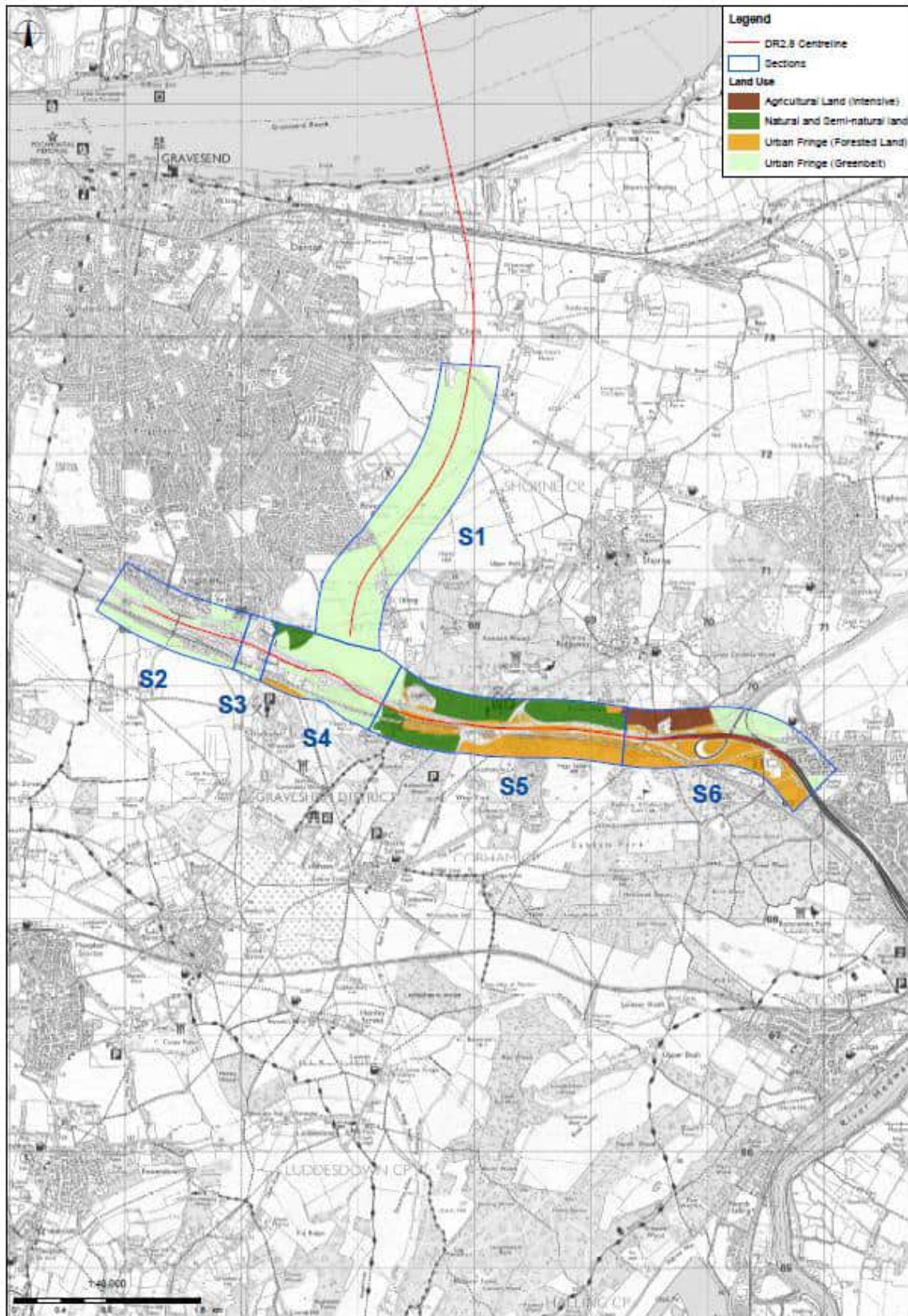


Figure H.2 Landscape valuation study area south of the Thames



H.3 Valuations

- H.3.1 Table H.2 presents the valuation calculations and shows that the valuation of the landscape impacted by LTC, taking account of the marginal impact of existing infrastructure, is a disbenefit of £694m.

Table H.2 Landscape valuation calculations
£m, 2010 prices discounted to 2010

Land Type	Valuation £m	Length (km)	Value (£m/ha)	Area impacted (ha) assumes 50ha/km	Area of existing infrastructure to be discounted (ha)
Urban core	£0	0.0	£15,031	0.00	0.00
Urban fringe (greenbelt)	£298	24.7	£0.274	1236.03	30.47
Urban fringe (forested land)	£165	4.7	£0.752	235.42	15.93
Rural forested land (amenity)	£0	0.0	£1.844	0.00	0.00
Agricultural land (extensive)	£0	0.0	£0.877	0.00	0.00
Agricultural land (intensive)	£0	0.0	£0.029	0.00	0.00
Natural and semi- natural land	£231	2.8	£1.842	140.71	15.29
Total	£694				

H.3.2 This estimate is likely to represent a significant over-estimate of the underlying impact LTC could have on the landscape for two key reasons:

- a. DfT has revised downwards their assessment of landscape values. The landscape values applied in the analysis reflect those currently set out in published DfT guidance. A review has been undertaken by DfT of these values that has identified four significant issues with the data. Whilst these issues are addressed within the forthcoming Landscape appraisal guidance that DfT expect to issue in 2019, the DfT has concluded that landscape values should be reduced by 76% (see Table H.3 below). Applying this within our analysis would reduce the landscape valuation to a disbenefit of £166m.
- b. Any significant landscape mitigation measures have yet to be designed. Once mitigation measures have been designed, we would expect the residual landscape disbenefit to reduce further. Highways England Subject Matter Advisors have reported that on some (unrelated) schemes, updated landscape valuations that incorporate mitigation measures can be up to 50% lower than their original valuation.

Table H.3 Current and new DfT proposed landscape values

	Current VfM guidance values (£ per ha)	New proposed values (£ per ha)
Urban core (city park)	£15,031,000	£3,601,344
Urban fringe (greenbelt)	£247,000	£59,289
Urban fringe (forest)	£752,000	£180,067
Rural (forest)	£1,844,000	£441,898
Agricultural (extensive)	£877,000	£210,078
Agricultural (intensive)	£29,000	£6,869
Natural and semi-natural (wetlands)	£1,842,000	£441,231

H.3.3 Given the uncertainties associated with the current landscape valuation calculated on the basis of the published DfT method and landscape values, it is proposed to communicate the landscape valuation result as a qualitative impact.

H.3.4 However, given the potential significant disbenefit observed from the existing analysis, it is prudent to assign the landscape impact as Large Adverse. This is consistent with the precautionary qualitative assessment that has been conducted into landscape as one of five natural environment impacts.

- H.3.5 Whilst it may still be appropriate to report the landscape valuation above as a secondary indicator to substantiate the main qualitative assessment, references should also be made to the updated landscape valuation that has been completed using DfT's recently advised landscape values.

Appendix I: Roads North and South – cost of works

Table I.1 Roads North (£m) cost of works 2016 prices

Description	M25 J29	LTC M25 Jnct	Ockenden Link	A13 Junction	Chadwell St Marys	Tilbury Junction	Subtotal :direct works	UIA	Total
Site Clearance	£11	£8	£8	£14	£2	£2	£45	£1	£46
Fencing	£2	£2	£3	£3	£3	£0	£14	£0	£15
Road Restraints	£5	£3	£7	£5	£5	£4	£29	£1	£30
Drainage	£26	£35	£32	£86	£23	£18	£220	£5	£225
Earthworks	£65	£170	£242	£110	£75	£159	£820	£18	£839
Pavements	£132	£63	£77	£150	£76	£34	£532	£12	£544
Kerbs, footways & paving	£5	£3	£2	£13	£2	£3	£29	£1	£30
Traffic signs & markings	£3	£3	£2	£7	£1	£1	£17	£0	£18
Road lighting	£3	£3	£0	£7	£0	£0	£14	£0	£14
Elec for signs/lighting	£21	£17	£7	£19	£5	£1	£70	£2	£71
Motorway comms/tech	£48	£24	£27	£64	£27	£20	£211	£5	£216
Landscape/ecology	£23	£11	£51	£84	£28	£51	£249	£427	£676
Special Structures	£190	£227	£463	£1,097	£111	£607	£2,696	-£360	£2,336
Piling/retaining walls	£36	£173	£2	£78	£	£	£290	£7	£297
Accommodation	N/A	N/A	N/A	N/A	N/A	N/A	£194	£4	£199
Other value engineering	N/A	N/A	N/A	N/A	N/A	N/A	-£86	£-	-£86
TOTAL	£571	£742	£925	£1,737	£359	£900	£5,344	£122	£5,466

Table I.2 Roads South (£m) cost of works 2016 prices

Description	Gravesend Link	LTC A2 Jnct	A2/M2	Subtotal: direct works	UIA	Total
Site Clearance	£2	£13	£6	£21	£0	£22
Fencing	£2	£1	£0	£3	£0	£3
Road Restraints	£2	£6	£6	£14	£0	£14
Drainage	£20	£47	£20	£87	£2	£89
Earthworks	£111	£445	£48	£605	£14	£618
Pavements	£35	£179	£121	£335	£8	£343
Kerbs, footways & paving	£2	£8	£3	£13	£0	£13
Traffic signs & markings	£1	£5	£4	£9	£0	£9
Road lighting	£0	£8	£3	£11	£0	£12
Elec for signs/lighting	£3	£23	£24	£49	£1	£51
Motorway comms/tech	£11	£41	£38	£90	£2	£92
Landscape/ecology	£33	£50	£2	£85	£2	£87
Special Structures	£26	£858	£83	£968	£22	£990
Piling/retaining walls	£ -	£91	£9	£100	£2	£103
Accommodation Works	N/A	N/A	N/A	£33	£1	£33
Other value engineering	N/A	N/A	N/A	-£6	£ -	-£6
TOTAL	£247	£1,776	£368	£2,418	£55	£2,473

Appendix J: Preliminaries

- J.1.1 These are included within each of the contract packages – Enabling Works, Highways and Tunnel packages.
- J.1.2 The preliminaries include overheads and method related costs and have been produced from first principles using a bespoke Preliminaries model. The estimate has been built for each main package of works by geographical location and subsequently split into contract packages. The main packages of works are
- a. Northern Highways Preliminaries estimate (three main, eight satellite offices)
 - b. Southern Highways Preliminaries estimate (one main, one satellite); and
 - c. Crossing Preliminaries estimate (two main, one satellite).
 - d. Enterprise Office (one main – cost split across packages)
- J.1.3 Table J.1 below provides a summary of the preliminaries by key cost components and contract packages. It also includes a brief description of cost.

Table J.1 Preliminary cost summary Preliminaries £ in m

Cost description		Enabling Works	North Highways	South Highways	Tunnel	Total
Project overheads						
Cost of Offices	Costs associated with construction of site offices including hard standings, car parking, buildings etc	£191	£174	£45	£124	£535
Construction Management	Contractor staff for each compound broken down by discipline (project management, engineering, commercial etc) and an assessment of FTEs against each role	£194	£1,073	£238	£961	£2,466
Design Management	Allowance, %, for contractor detailed design during PCF Stage 6.	£37	£224	£102	£297	£660
Insurance		£-	£-	£-	£-	£-
Ancillary Overhead Costs	Costs associated with site transport, security, order licences & fees, survey and communication equipment. Also, safety related items/equipment, small tools and testing of materials	£-	£511	£157	£333	£1,002
General Labour	An estimate of FTEs associated with each compound	£-	£200	£52	£104	£356
Method Related Cost						
General Plant	Assessment of no. of vehicles for inclusion in each compound	£-	£76	£25	£50	£150
Temporary Works	Assessment of Temporary works to support construction activities, eg, Haul Roads and running costs for each compound	£12	£219	£55	£49	£335
Traffic Management	Includes traffic management Vehicle Recovery, CCTV, Speed Enforcement Cameras and Temporary Barrier. Built up from existing HE assured rates and prices, derived from previous projects, and publicly available	£-	£251	£114	£-	£365
Total		£433	£2,729	£789	£1,918	£5,869

Appendix K: Tunnel benchmarking

K.1.1 The following aspects tunnelling cost have been benchmarked at a granular level:

- a. Tunnel production rate
- b. Tunnel Boring Machine (TBM) cost
- c. Tunnel excavation and lining cost
- d. Precast concrete segments

K.2 Tunnel production rates

K.2.1 This is a key cost driver that affects the direct and indirect tunnelling cost but also has a significant impact on the overall programme and cost.

K.2.2 Our current assumption of 240 metres per month or 56 metres per week is well below the benchmarked rates of other slurry machines and is considered prudent. A summary of recent slurry TBM production rates is provided in Table K.1 below.

Table K.1 Summary of recent slurry TBM production figures – chalk drives

Project	Length	Rings	Int diameter	Ext Diameter	Ring Length	Start	Finish	Metres /7d wk.	Comments
HS2 Proposal	15,900	8,833	8.80	9.60	1.70	Yet to be constructed		103 - 109	
Lee tunnel	6,890	4,053	7.80	8.50	1.70	Apr-12	Jan-14	75m	The first 1500m was slow at 74 m/wk. The remainder of the drive long average was 150 m/wk.
CTRL 320	5,000	3,333.3	7.15	7.80	1.50	Jun-02	Dec-03	112m	89-135 m/Wk.
Crossrail 310			6.20	6.80	1.60			105m	Drivers were in two lengths with Woolwich box split
Tideway Proposal	5,500	3,056	7.80	8.50	1.80	Yet to be constructed			

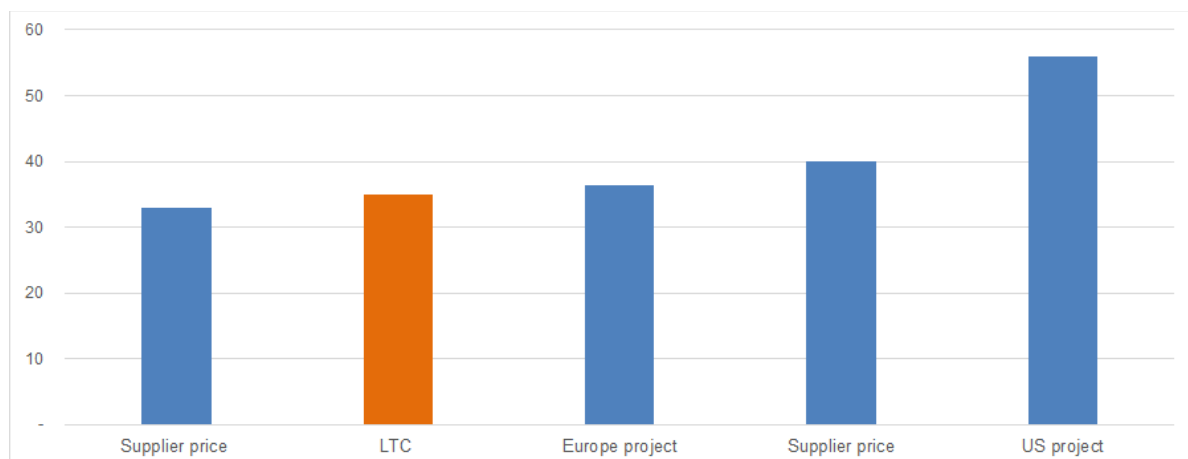
Note: All above long averages include all the issues, interventions, stoppages but exclude machine builds and install launches

- K.2.3 The benchmark data shows that all the previous drives with slurry machines in chalk in SE UK in recent years have had long averages much higher than 240 metres per month. Also, the planned rates for similar future drives are significantly higher than our current assumption.
- K.2.4 The major difference between LTC and the other benchmark cases is the diameter, with LTC being larger. The overall drive rate is largely made up of shove rate + ring build time + intervention time.
- K.2.5 The large diameter is not expected to significantly affect shove rate (how fast the machine moves forward) as all the supporting systems are scaled to support this. The ring build time is likely to be similar or slightly longer on LTC as there will probably be more segments to place in a ring. However, the number of ring build cycles per unit length of tunnel will be less on LTC because the rings are longer. Intervention times may be similar. On balance these considerations, the diameter differences do not indicate a significantly slower drive rate.
- K.2.6 We have however used rates below the benchmark as this is prudent, given the lack of direct experience of machines as large as LTC in similar ground conditions. Market engagement is planned to be used to seek further assurance on this.

K.3 Tunnel boring machines (TBM) procurement

- K.3.1 The TBM at £35m each total up to £70m and approximate 9% of the direct Tunnelling costs of £757m.
- K.3.2 Our estimate of £35m per TBM is comparable to prices seen on other schemes and is close to the average cost across the benchmarked data. Figure K.1 below shows the benchmarked data for comparable Slurry TBM delivered to site.

Figure K.1 Tunnelling costs (in £ m)

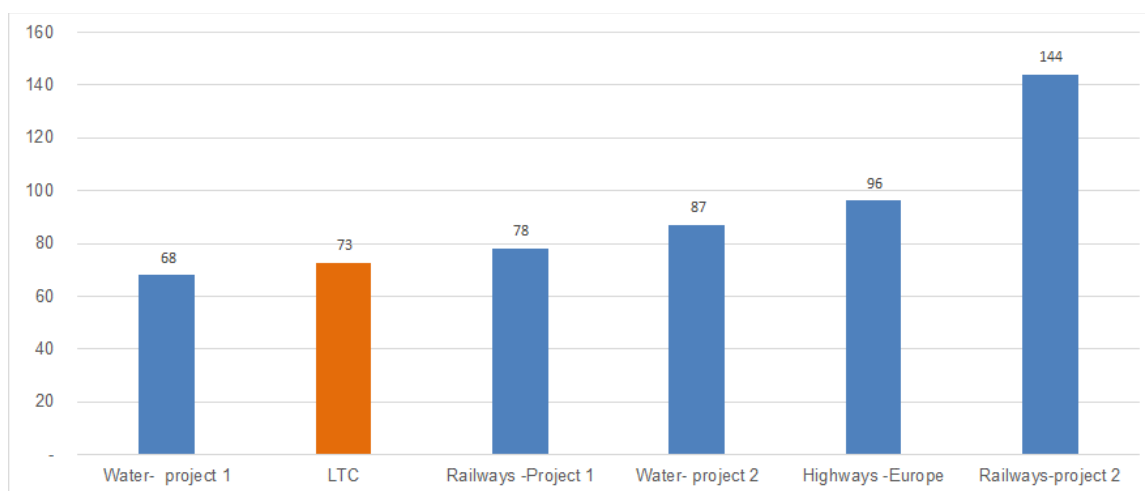


K.4 Tunnel excavation and lining cost

K.4.1 Our estimated rate for tunnel excavation and lining is c.£72.7/m³ and approximates to £109m, which is c.14s/b% of the direct tunnelling cost. The rate has been derived from detailed cost build up.

K.4.2 The benchmark data from comparable infrastructure projects shows a wide range from £68/m³ to £144/m³ for tunnel excavation and place segmental lining. This is expected as no two tunnelling projects are similar, and rates vary depending on many factors including the ground conditions and size of the tunnel. This is shown in the Figure K.2 below.

Figure K.2 TBM Excavation and Lining £/m³



K.4.3 The benchmark data shows that our rate of £72/m³ for tunnel excavation and place segmental lining is broadly comparable to rates achieved and or expected on other schemes. It is however on the lower end of the range.

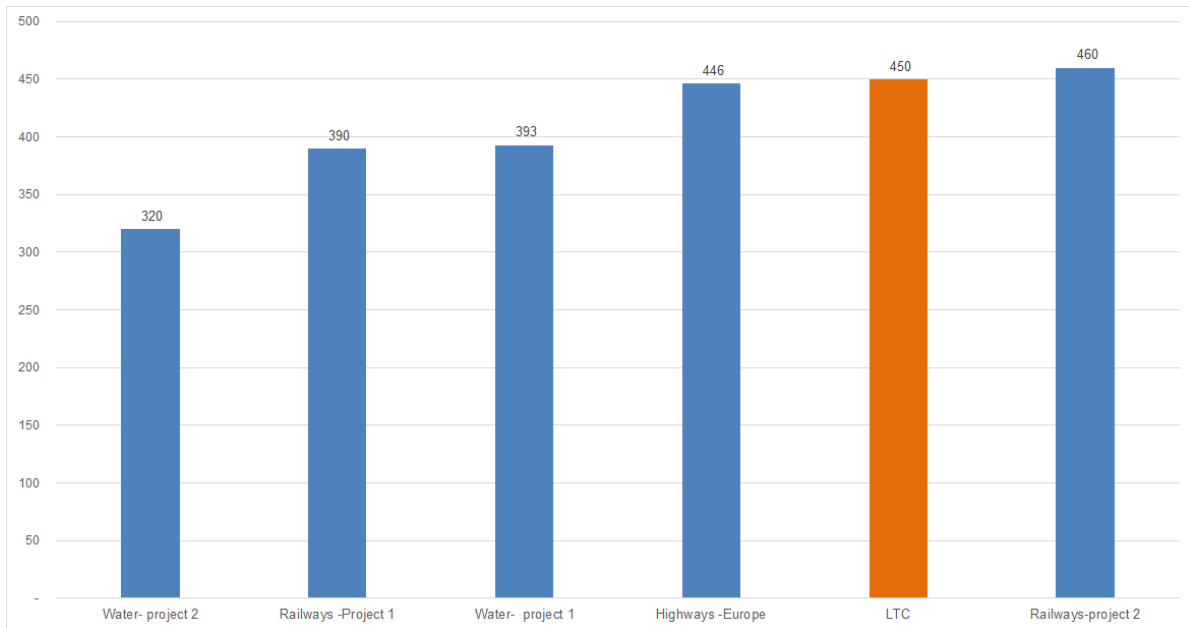
K.4.4 When considered together with c.£54 m provision for tunnel excavation risk, our overall provision for tunnel Excavation and Lining is c. £163m, which translates into c.£108/m³ equivalent rate. This brings it close to the top end of the benchmarked data and therefore considered overall reasonable.

K.5 Precast Concrete Segments

K.5.1 Our segment supply rate is £450/m³ and is based on market rates for the precast concrete segments supply. This equates to £120m, which is c.15s/b% of the direct tunnelling cost.

K.5.2 As can be seen in the Figure K.3 below, our segment supply rate is within the benchmark range and is considered reasonable

Figure K.3 Benchmarked data for precast concrete segments supply



Appendix L: Opportunities

Table L.1 Opportunities

Cost categories	Opportunities	Comments
North Roads	102	<ul style="list-style-type: none"> Challenge to the design and programme and cost to reflect actual constructability. Key ones include Simplification of the A13 ,Chadwell St Mary's, Ockendon Link and M25 structures Used of a Top down construction method for the two A13 jack Box Structures Structures removed as a result of A13 amendment of Vertical braiding Reduction in the length and height of Retaining Wall Solutions Optimisation of the earthworks strategy retaining surplus material, optimising the design in areas of soft ground Moving the OHV loops location Reduction is the Markdyke delivery programme
Tunnel	103	<ul style="list-style-type: none"> Challenge to the design and programme and cost to reflect actual constructability. Key ones include Increase in TBM production rates from 240m/mth to 280m/mth Redesign of the North Portal to a Caterpillar Design North Portal - combining temporary and permanent structure Cross Passages (mechanisation of construction) South Portal Bore Separation Ventilation (reduction in design fire to on basis of FFFS provision as at A3030 and STT) Madrid Method (simplified modular road deck)
A2/M2	43	<ul style="list-style-type: none"> Challenge to the design and programme and cost to reflect actual constructability. Key ones include Simplification of the A2 /M2 structures Revised Retaining Wall Solutions Optimisation of the earthworks strategy - retaining surplus material and optimising the design in areas of soft ground
Lands	32	<ul style="list-style-type: none"> Reduced land take through detailed assessment and detailed review of risk allowances allowed within the district valuers estimate.
Others	23	<ul style="list-style-type: none"> Integration Partner and enabling works
Total : Opportunities	302	

Appendix M: Top 10 risk

Table M.1 LTC top 10 risks

Risk Title	Cause	Actions	2016 EMV
LTC - Development	<p>Extinguishment compensation exceeds forecast</p> <p>High compensation claims or possible business extinguishment that exceed the compensation forecast due to a lack of understanding of the impact of land take on businesses e.g. loss of income, staff numbers, loss of future contract (Waitrose, M&S, etc)</p>	<ul style="list-style-type: none"> Change is being progressed, value of extinguishment to be refined. Allow an additional £20m for potential impact on new business within the Red Line Boundary (RLB) 	71.1
1LTC - Tunnels & Approaches	<p>Poor ground conditions at N Portal - presence of a thick alluvium strata</p> <p>GI surveys show subsoil conditions inconsistent with the design assumptions for the N Portal. GI surveys show presence of a thick alluvium strata and challenging subsoil conditions.</p>	<ul style="list-style-type: none"> Further ground investigation to enhance the information available for contractor's design and support procurement dialogue. Continued engagement with the stakeholders around Port of Tilbury to enable the earliest practicable construction access to provide additional time to mitigate risk. Plan market engagement and competitive dialogue to ensure an early focus from tenderers on achieving early and successful TBM launch. Consider potential engineering mitigation measures to cater for a range of potential outcomes (e.g. base grouting and treatment of the alluvium). This may include grouting of peat layers prior to TBM arrival. Review TBM type (i.e. dual/variable mode), to ensure no slurry loss. Further ground investigation information can influence specification requirements of TBM. 	44.6
LTC - Tunnels & Approaches	<p>Unknown chalk conditions along the tunnel route impacting the TBM</p> <p>Desk studies indicate that the chalk layer in the ground in the bored tunnel area may contain flint and other discontinuities.</p> <p>TBM works may be delayed or stopped. Possible unplanned interventions, or more frequent planned interventions to repair cutter head.</p>	<ul style="list-style-type: none"> Develop a detailed intervention strategy to ensure optimised production in conjunction with good control of damage risk of TBM. This will include consideration of higher frequency interventions and different intervention methods. Sizing and type of slurry treatment plant to suit envisaged ground conditions. 	27.4

Risk Title	Cause	Actions	2016 EMV
LTC - Roads South	Roads South - Significant service strikes A significant service strike may occur during construction works due to lack of service information.	<ul style="list-style-type: none"> Undertake significant trial holes to identify service locations and update services drawings accordingly. 	16
LTC - Development	Discretionary payments Risk that additional discretionary payments are required as property owners that have been unable to sell their property due to the LTC scheme and suffering financial hardship can claim discretionary payments for their properties.	<ul style="list-style-type: none"> Monitor number of enquiries and applications and appropriate forecasting 	15.5
LTC - Development	Southern Valley Golf Course may require replacement The Open Space study may identify that the Southern Valley golf course is not necessarily surplus in recreational terms. However, the project has made the decision to replace only the open space elements of the golf club and not the golf facility itself. There is a risk that the golf club may be required to be re-established.	<ul style="list-style-type: none"> Establish basis of the open space argument to determine the requirement for the golf facilities to be replaced. Working with the Lawyers /QC to rehearse the arguments for not replacing the Golf Facility based on wider public need. Southern Valley Golf Club needs to be acquired under the DCO however we are seeking to buy the land in a pre DCO agreement to negotiate land value. The option to buy now minimises the risk of Special Parliamentary Procedures being invoked which is a risk to the DOC confirmation and start on site. Establish basis of the open space argument to determine the requirement for the golf facilities to be replaced. 	15.5
LTC - Development	Unforeseen increase in land costs	<ul style="list-style-type: none"> Engagements with both landowners and valuers to regularly review land forecast 	13
LTC - Roads North	Ground improvement due to soft Alluvium - M25 Junction 29. Desk study information indicates possible presence of soft Alluvium. Additional delays and cost of redesign and additional ground improvement measures with programme implications.	<ul style="list-style-type: none"> GI surveys delivery and analysis to establish extent of the potential problem and to allow more detailed pricing of any potential improvement measures 	9.4

Risk Title	Cause	Actions	2016 EMV
LTC - Roads North	<p>Ground improvement due to soft Alluvium - Tilbury.</p> <p>Phase 2 GI indicates that soft Alluvium of significant thickness is present in the Tilbury area.</p> <p>Additional ground improvement could be needed including piling. Also possible EA consenting for construction works in the Chalk aquifer.</p>	<ul style="list-style-type: none"> GI surveys delivery and analysis to establish extent of the potential problem and to allow more detailed pricing of any potential improvement measures 	9.3
LTC - Roads North	<p>Ground and groundwater conditions at Chadwell St Mary Link.</p> <p>Desk study information and Phase 2 GI indicate that soft Alluvium is present. Lack of groundwater monitoring information.</p> <p>Additional ground improvement which could include piling, dewatering or other groundwater control measures during construction. Possible EA consenting / engagement.</p>	<ul style="list-style-type: none"> GI surveys delivery and analysis to establish extent of the potential problem and to allow more detailed pricing of any potential improvement measures 	9.3
Sub total			229.6
Other risk			213
Total risk			442.6

Appendix N: Uncertainty provision

Description	£ in m
As per CRF179, This is a decrease to base cost for stage 4 & 5 SU Design Works	-3
Roads North - Allowance for Contractor Detailed Design Staff During the Period between Post Contract Award and Pre Noticed to Proceed	12
Roads South - Allowance for Contractor Detailed Design Staff During the Period between Post Contract Award and Pre Noticed to Proceed	5
Tunnels - Allowance for Contractor Detailed Design Staff During the Period between Post Contract Award and Pre Noticed to Proceed	16
Roads North - Structures Cost Increase (Bottom up Quantification and Pricing Exercise carried out by LTC Estimating team)	15
Roads South - Structures Cost Increase (Bottom up Quantification and Pricing Exercise carried out by LTC Estimating team)	10
Total	55

Appendix O: Lessons Learned from other major projects

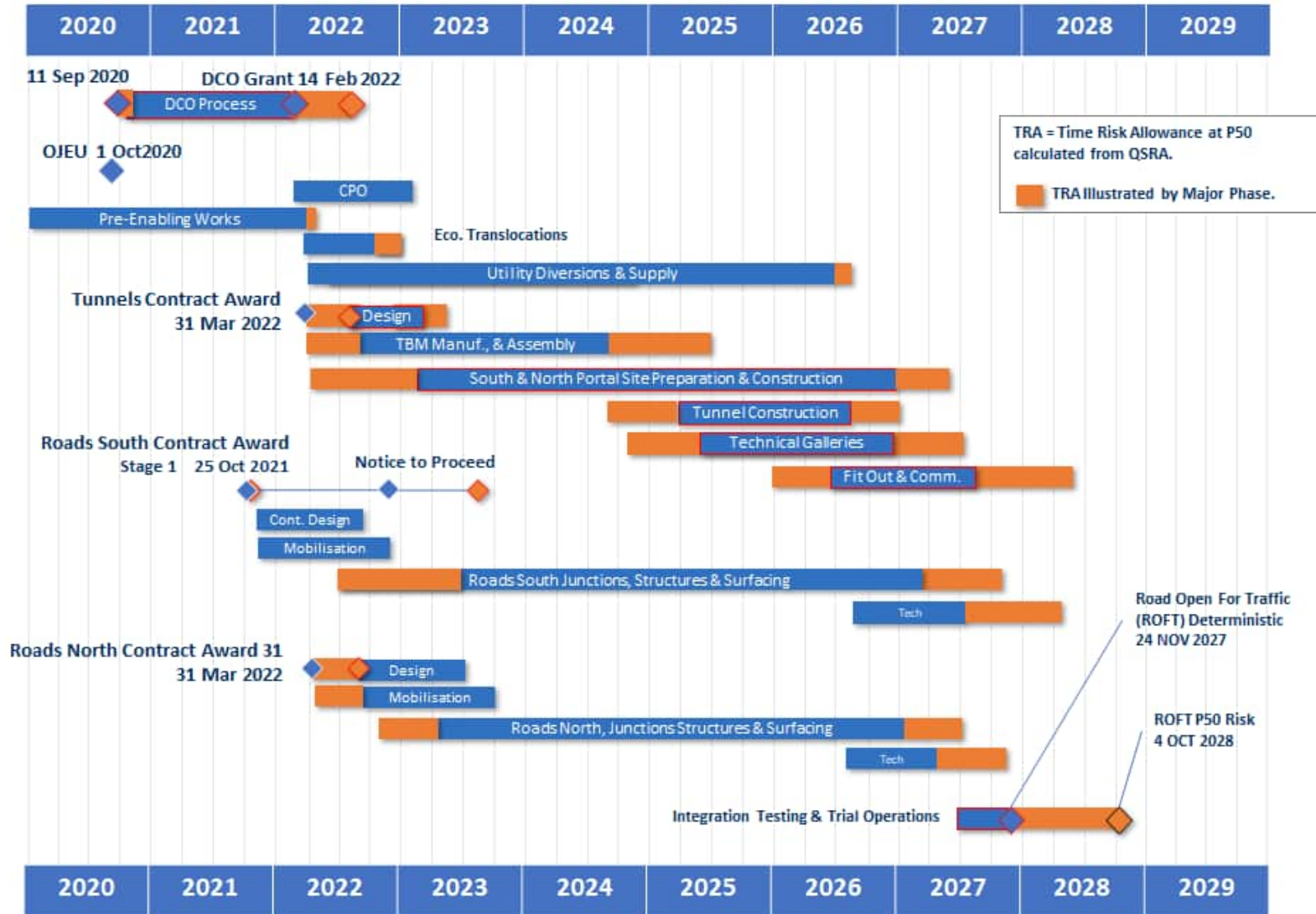
Project name	DCO	Road element	Tunnel element	NEC contract	Value (£bn)	Lesson learned
Silvertown	✓	✓	✓		1	Recent DCO process learnings including evolving approach to stakeholder consultation on detailed design, byelaws and powers around the tunnel and fit with procurement process. Uncertainties in traffic forecasting leading to more onerous requirements and a need for wider consultation in discharging requirements.
Crossrail	✓		✓	✓	15	Latest tunnel construction methods and best practice. Recent programme difficulties have highlighted issues on cost management and governance. Innovation in tunnel construction methods, particularly the use of Sprayed Concrete Lining for underground stations and caverns, in complex urban environments. TBM tunnelling in Chalk on Contract C310 (Woolwich-Plumstead).
Thames Tideway Tunnel	✓		✓	✓	4	Lessons from the DCO process when used with a large and controversial project with numerous objectors, plus highlighted need for strong management of sensitive environmental issues. Management of stakeholder data in a comprehensive system. Time and project management required to discharge consents for local authorities for complex infrastructure, including advance environmental monitoring and structural assessments for third party assets (bridges & river walls). Design and construction in chalk for the eastern section C415, with the provision of the secondary lining subject to review.
Lee Tunnel			✓		0.65	Innovation in shaft sinking and construction. Practical issues associated with secondary lining construction.
High Speed 2	✓		✓	✓	50	Use of Balanced Scorecard with supply chain.
Waterview Tunnel, Auckland, NZ		✓	✓		0.8	Use of bespoke tunnel boring machine design.
M25 DBFO		✓			6	The need for sound contract wording and commercial levers regarding items such as compensation mechanisms. To apply updated change control processes.

Project name	DCO	Road element	Tunnel element	NEC contract	Value (£bn)	Lesson learned
Norwich Northern Distributor Road	✓	✓		✓	0.2	Lessons from the DCO process
Tuen Mun Chep Lap Kok, HK		✓	✓		40	To allow time during the procurement phase to work through risk-sharing mechanisms ahead of contract award. Innovation in design and construction with a sub-sea crossing including cross-passage construction using Mini-TBMs.
E4 Stockholm Bypass, Sweden		✓	✓		2.5	Rock tunnel design and construction for the largest tunnel network in the world, with an emphasis on collaborative working practices developed for a multi-national multi-disciplinary team. The use of BIM in the development of 3-D models for design and subsequent tender.
Elb Tunnel, Hamburg, GER		✓	✓		0.86	European tunnel design and construction methodology approaches.
A14 Cambridge to Huntingdon	✓	✓		✓	1.5	Approach to flexibility in DCO to allow value engineering and stakeholder engagement in detailed design. For archaeology, the need to invest sufficient time in engagement and pre-works
Hinkley Point C Nuclear New Build	✓				20	Management of stakeholders and the DCO process, community engagement. Use of Planning Performance Agreement with host authority. SCL and TBM tunnel construction.

Appendix P: Lessons learned workshops

Name of Decision	Decision description	Owner	Facilitator	Status	Date started	Date of workshop(s)
Environmental Scoping Report – review process	Lessons learned to make the process more efficient	██████████	██████████	6. Completed		13/12/2017
GI relationship workshop	Building a trustful relationship	██████████	██████████	6. Completed		18/01/2017
COMMs team		██████████	██████████	7. Not being progressed		XX 2018
GI lesson learned phase 1	Collaborative lessons learned to overcome the challenges from phase 1.	██████████	██████████	6. Completed		13/03/2018
Stat Con process		██████████	██████████	1. Screening & scoping	01/10/2018	Postponed to Jan
Design gab	A14 faced challenges because the design was fit for DCO but did not live up to the contractors' expectations of a design basis for detailed design. This workshop is aiming at learning from this	██████████	██████████	6. Completed	05/10/2018	
Working hours	Currently people have been asked to work long hours over weekends. This workshop is aiming at identifying the root causes to hopefully avoid this in the future	██████████	██████████	6. Completed	05/10/2018	

Appendix Q: Level 0 Programme



Appendix R: Named project roles

Role	Name
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
Senior Users:	
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
Client Team Roles	
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
Technical Partner Roles	
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]

Appendix S: Our learning activities

S.1 Introduction

S.1.1 Many of our activities are opportunities for learning. Learning is drawn in and exchanged with other major projects; and is captured within LTC by reflecting on what we have done. Table S.1 identifies these activities and examples of each.

Table S.1 Activities for capturing lessons learned

Internal lessons	External lessons
Workshops to review key events, eg, lessons from preparing for Statutory Consultation	Desktop research , eg, National Audit Office lessons reports influencing our procurement strategy
Developing new processes, standards and guidance , eg, for staff leaving LTC	Site visits , eg, understanding the operation of Mersey, Dartford and Hindhead tunnels
Learning sessions , eg, toolbox talks, learn at lunch talk on mental health awareness, inductions	Learning sessions , eg, learn at lunch talk on key findings of the 7 th annual conference on Nationally Significant Infrastructure Projects
Quality Audits to assure compliance to policy, eg, compliance of management system documentation to ISO9001	Guest speakers , eg, A303 experience of Development Consent Order
Root cause analysis to review quality issues, eg, Document Assurance Process	Interviews , eg, senior management from Silvertown and Tyne Tunnel projects on procurement lessons
Staff surveys , eg, engagement surveys before and after reorganisation to capture the differences	Networking , to discuss experiences and challenges eg, Complex Infrastructure Lean knowledge sharing network
Deep Dive Reviews to receive advice, direction and support to enable issues to be resolved effectively to the SRO's satisfaction, eg, review of project baseline prior to approval	External Assurance Reviews at various levels, eg, Operations Technical Leadership Group, Design Panel, Independent Commercial Review, Infrastructure Project Authority, Major Projects Review Group
Collaborative Performance Framework submissions , eg, best practice in stakeholder engagement communications methods that is being shared with other programmes.	Programme knowledge , drawing lessons captured by Major Projects Hub and Complex Infrastructure Programme from across Highways England

S.2 Our way of working

S.2.1 Outputs from these activities are captured through notes and actions that are discussed with the relevant directorates. We are developing a process to improve our consistency at sharing and recording the lessons, which has three key steps as illustrated. A centrally maintained lessons learned log is being developed as a key output.

Figure S.1 Illustrates the key events for the current Stage to DCO submission

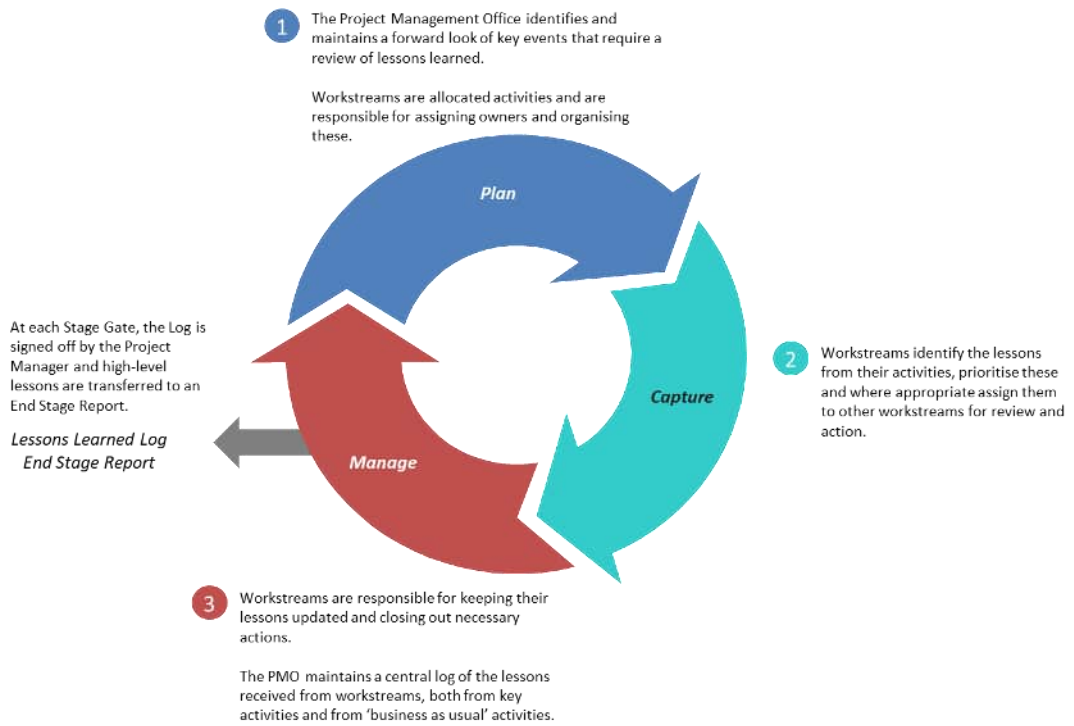
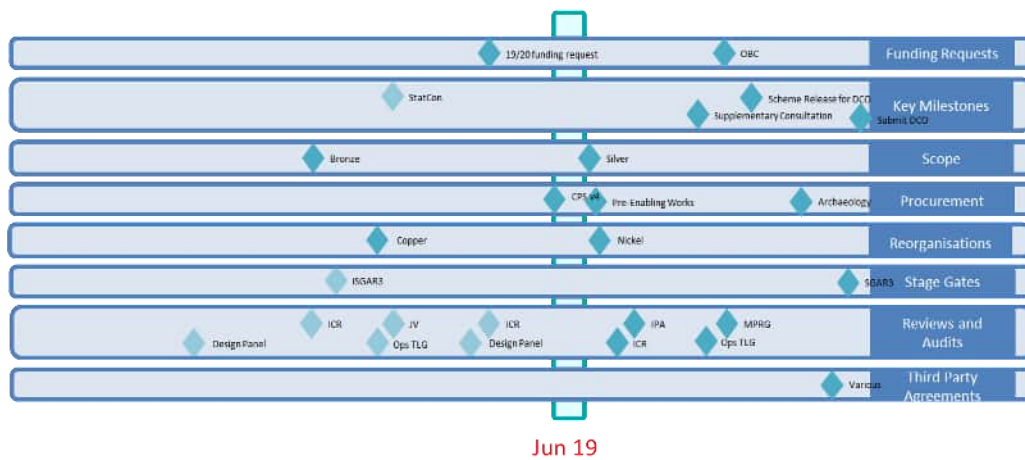


Figure S.2 Key Events for Learning during current Stage of work



S.2.2

The PMO exchanges best practice with the Highways England Complex Infrastructure Programme and Major Projects Knowledge Team. The Knowledge Team was created in April 2019 and is developing initiatives including:

- a. A Knowledge Management Strategy
- b. A system to capture, share and use lessons learnt from all projects and programmes
- c. A Community of Practice to oversee and contribute to the development and implementation of the Strategy

- d. A programme of events to share lessons

S.3 Lessons identified from our programme

S.3.1 Whilst the Knowledge Team builds its capability, we have reviewed the lessons information that they hold to summarise our view of the high-level lessons that are most relevant to our project at this point in the lifecycle (see Table S.2). Like most lessons learnt, they mainly reflect the key imperatives of *doing the basics well* and *optimising processes*. The Knowledge Team also recommends the checklist of questions in the ‘Common Causes of Programme/Project Failure’ (Cabinet Office, 2012) as a health-check on whether key lessons are being applied to a project.

Table S.2 High-level lessons captured from other Highways England Major Projects most relevant to Lower Thames Crossing at current stage of the project

Topic	Key lesson	Activities in response
Specification Requirements and Design	Importance of survey information. The project submitted to DCO becomes fixed which causes problems later when survey results come in during detailed design.	Accelerated funding and delivery of surveys during preliminary design
Communications, SES Approvals	Consultation is a vital component, not an afterthought. Consultees should be identified at an early stage and told when and why their input will be required.	Consultees identified at an early stage and told when and why their input will be required.
Project Management	One team culture is needed to align Highways England and suppliers, but can be undermined through commercial pressures, culture, lack of capability or behaviour.	Procurement that aligns client and supplier objectives. Avoiding man marking suppliers. Leadership role modelling behaviours.
Procurement	Lower tier specialists needed during development to encourage and develop innovation and standardised products.	Procurement that engages specialists during preliminary design
SES Approvals, Standards and Specifications	The solution that is developed needs to be accepted by the end user at handover.	Operating personnel inputting into the preliminary design
Project Management	Plan the coming stage properly focussing on what outcomes need to be delivered. A lot of upfront effort is needed before each Stage starts.	Planning for Delivery early in the development phase
Procurement	Continuity of design team. Re-tendering for detailed design drives more insular behaviour, prolongs the programme and churns staff.	Procurement that retains continuity of key design staff
Project Management	Clear and appropriate roles and responsibilities	Clarifying and improving delegations of authority and decision-making process
Scope	Scope of works needs to be clearly defined with attention to detail, including for third parties	Clarifying project baselines linking the requirements, scope and work packages
Procurement	Problems working with Statutory Undertakers.	Improving the processes for working with third parties

Appendix T: Proposed allocation of risks

Risk	HE	Contractor	Approach
Archaeology	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Highways England is carrying out archaeological investigations including trial trenching before commencement of works, the information obtained will be included in tender packs. A watching brief will be established during the works – the risk of discovering archaeological objects of interest in the delivery phase will be a shared risk via the risk quota
Ground Conditions	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Ground condition risk will be a shared risk. The Target Budget will contain a ground condition baseline created by LTC that is used to create the project estimate, risk amounts for unexpected ground conditions will exist within the risk quota.
Inclement Weather	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Weather is a shared risk, covered by the risk quota. Extreme impact of inordinate weather events, defined as a weather event with a probability of in excess of a 1/10 year occurrence, are considered to be High Impact Low Probability events and are excluded from the scheme to DfT / HMT ownership.
Utilities Diversion Direct Costs	<input checked="" type="checkbox"/>		Highways England are directly procuring the non-contestable utilities works, power, water, comms and the like, including high voltage pylon relocation and provision of services to support TBM power requirements.
Utilities Diversion Interfaces	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Contractors (Delivery Manager and Main Works) will contract the contestable works and coordinate with ongoing non-contestable works. Contractors will not be responsible for the direct cost of non-contestable works but will share programme/interface/schedule risk via the risk quota.
Protestor Action	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Given the sensitivity of environmental and community impacts, this risk is best managed jointly. The contractor will be responsible for normal site security and will use their teams/CCTV to enforce this, and this would be both contractor risk if it does not fulfil his contractual obligations (potentially via disallowed costs lever), and impact of site intrusion and protestor action not directly due to his fault would be a shared risk. Highways England must be involved and lead if incidents happen on approaches, or external to the site, as we have the power to engage with local authorities and the police and have the land access rights. As such, Highways England is best positioned to work with the contractor to manage such risks.
Construction work fails to meet specification or required outputs		<input checked="" type="checkbox"/>	The contractor is required to meet the specifications/outputs. Non-compliance would be classed as a defect which will need to be remedied by the contractor who carries the risk if such is undertaken post “Handover Date”. Classed as a contractor risk as the cost of remedying notified defects after handover being considered as disallowable This is linked to achieving a high availability asset.

Appendix U: Glossary

Term	Acronym or Abbreviation	Explanation
-	Bravo	an eTendering portal used in procurements to provide data/communications in electronic only format with an auditable trail to enable fair treatment for all bidders.
-	Opex	An operating expense or operating expenditure or operational expense or operational expenditure: an ongoing cost for running a product, business or system.
-	Px	costs for which there is a x% chance that they will not be exceeded
-	VISUM	Traffic modelling software
-	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.
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.
A303 Amesbury to Berwick Down (Stonehenge)	-	A303 Stonehenge is one of nine schemes Highways England plans along the A303, A358 and A30 to create a world-class Expressway to link the south west and south east of England
Above ordnance datum	AOD	Vertical datum used by an ordnance survey as the basis for delivering altitudes on maps.
Advanced construction phase works	-	Early construction activities on LTC that may be undertaken by Highways England.
Advanced Motorway Indicator	AMI	Advanced Motorway Indicator, with optical feedback for enforcement.
AECOM	-	AECOM Technology Corporation
Affected Road Network	ARN	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).
Air Quality Management Area	AQMA	an area, declared by a local authority, where air quality monitoring does not meet Defra's national air quality objectives.

Term	Acronym or Abbreviation	Explanation
Air Quality Strategy Objective	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.
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.
All-purpose trunk road	APTR	
Annual Average Daily Traffic	-	The number of vehicles travelling on a particular stretch of road on an average day.
Annual Population Survey	APS	The Annual Population Survey (APS) is a combined statistical survey of households in Great Britain which is conducted quarterly by the Office for National Statistics (ONS). It combines results from the Labour Force Survey (LFS) and the English, Welsh and Scottish Labour Force Survey boosts which are funded by the Department for Education and Skills (DfES), the Department for Work and Pensions (DWP), the National Assembly for Wales and the Scottish Executive
Appraisal Summary Table	AST	A table that appraises the performance of each option against economic, environmental, social and distributional sub-impacts and is used to directly inform the VfM assessment for the economic case.
Area of Outstanding Natural Beauty	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
Asset Support Contract(or)	ASC	-
At grade	-	On the same level, for example, an at grade junction is two or more roads meeting or crossing on the same level.
Automated Number Plate Recognition	ANPR	A technology for automatically reading vehicle number plates.
Automatic Rural and Urban Network	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.
Average Annual Daily Traffic	AADT	An estimate of the average daily traffic along a defined segment of roadway. This value is calculated from short term counts taken along the same section which are then factored to produce the estimate of AADT. Because of this process, the most recent AADT for any given roadway will always be for the previous year.

Term	Acronym or Abbreviation	Explanation
Award Criteria	-	The criteria used by a contracting authority to assess tenders and which collectively determine the most economically advantageous tender (MEAT)
Award Letter	-	Communication sent (typically by email, fax or through an electronic procurement system) which denotes the end of Standstill period and confirms Award to the successful bidder.
Balanced Scorecard	BSC	A strategic planning and management system used to monitor alignment of a business's activities with the vision statement.
Batter slope	BS	In construction is a receding slope of a wall, structure, or earthwork. The term is used with buildings and non-building structures to identify when a wall is intentionally built with an inward slope.
Benefit Cost Ratio	BCR	The ratio of the present value of benefits (PVB) to the present value of costs (PVC).
Benefits Realisation Management	BRM	The processes and activities required to identify, define, plan, track and realise business benefits
Biodiversity Action Plan	BAP	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.
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.
Board Investment and Commercial Committee	BICC	the Department for Transport's Board Investment and Commercial Committee
Bored Tunnel	BT	A circular tunnel at depth, without removing the ground above, created using a tunnel boring machine.
Bridge	BR	-
British Geological Survey	BGS	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.
British Safety Council	BSC	An organisation providing courses and advice to help other bodies achieve Health and Safety standards required by law.
British Trust for Ornithology	BTO	An organisation founded in 1932 for the study of birds in the British Isles.
Budgetary Classification	-	Balance sheet classification of the DBFM contract by reference to ESA10.
Building Cost Information Service	BCIS	It is a provider of cost and price information for the UK construction industry and is part of RICS

Term	Acronym or Abbreviation	Explanation
Building Information Modelling	BIM	The process of designing, constructing, operating and maintaining a building or infrastructure asset using digital information to reduce waste and enable more informed, timely decisions.
Business As Usual	BAU	Business As Usual
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.
Capex	-	Capital expenditure, the cost of developing or providing non-consumable parts of the product or system.
Carbon dioxide equivalent	CO2e	A standard unit for measuring carbon footprints that describes, for a given amount of Greenhouse Gas emissions, the amount of CO2 that would have the same Global Warming Potential (GWP), when measured over a timescale of 100 years
Cascade	-	The Joint Venture organisation (including Cowi, Jacobs (incorporating CH2) and Arcadis (incorporating EC Harris)) which is currently delivering a Technical Partner service to Highways England for LTC.
Catchment Flood Management Plan	CFMP.	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.
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
Centre of Excellence	CoE	A team in the Department for Transport which is described in the Management Case
Chart Datum	-	The level of water from which charted depths displayed on a nautical chart are measured.
Civil Engineering Environmental Quality Assessment and Award Scheme	CEEQUAL	An evidence-based sustainability assessment, rating and awards scheme for infrastructure and celebrates the achievement of high environmental and social performance.
Clarification Question	CQ	-
Client	-	The organisation responsible for translating the requirements from the Sponsor and managing the delivery of outcomes including selecting the most appropriate supplier(s) to meet project objectives.

Term	Acronym or Abbreviation	Explanation
Client Scheme Requirements	CSR	The formal means by which the DfT instruct Highways England to develop a scheme and define the scope of a project.
Closed-circuit television	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.
COBALT	-	DfT's software tool for estimating accident benefits.
Collaborative Delivery Framework	CDF	-
Collaborative Performance Framework	CPF	The incentives framework developed by Highways England's Commercial Intelligence team to measure supplier performance.
Combined kerb drain(s)	CKD	-
Commercial and Procurement Strategy	CPS	-
Commercial Services Division	CSD	-
Common Highways Agency Rijkswaterstaat Model	CHARMS	-
Community Infrastructure Levy	CIL	A way of capturing contributions to wealth creation at a local level, established by local planning authorities.
Compensation Event	CE	Contractual mechanism in the NEC form of contract that allows changes to be administered and allow for time or cost impacts to be defined for events or occurrences identified within the contract
Competitive Dialogue	CD	The legal procurement procedure that allows a contracting authority to discuss different options with bidders with a view to identifying the best solution(s) to meet its needs, on which it then invites final tenders. The competitive dialogue procedure is used when the open and restricted procedures are not suitable for the procurement and if the conditions set out at Regulation 26(4) of the Public Contracts Regulations 2015 are met.
Competitive Procedure with Negotiation	CPN	A process allowing contracting authorities to negotiate with more than one supplier to select a preferred bidder and to award a contract. Bidders must submit an initial tender which is then the basis for any subsequent negotiation.
Complex Infrastructure Programme	CIP	A Programme Division under the Major Projects Directorate of Highways England
Conflicts of Interest	CoI	
Connect+	M25 DBFO	Operates and maintains the M25 motorway network, including all adjoining trunk and slip roads on behalf of Highways England.

Term	Acronym or Abbreviation	Explanation
Conservation Area	-	An area of special environmental or historic interest or importance, of which the character or appearance is protected by law against undesirable changes (Section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990).
Construction Design Management	CDM	Construction Design Management used in the context of the Construction (Design and Management) Regulations 2015
Consumer Price Index	CPI	It is a measure that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food, and medical care. It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them.
Contingency	-	A defined risk reserve of cost and/or time to manage the impacts of identified risks.
Contract Award	-	Final award of the DBFM contract following any standstill period.
Contract Event Management and Reporting Tool	CEMAR	An online, web-based system for NEC3, NEC4 and FIDIC contract management.
Contracting Authority	CA	The public sector counterpart to a procurement
Contracts Finder	-	HM Government's online procurement service designed for businesses especially SMEs. It allows Government buyers to publish contract notices online.
Cost Analysis Simulation Tool	CAST	
Cost Breakdown Structure	CBS	A Cost Breakdown Structure is a cost allocation to the lowest level of the Work Breakdown Structure (WBS)
Cost Reimbursable	-	A cost reimbursable contract (sometimes called a cost-plus contract) is one in which the contractor is reimbursed the defined costs they incur in carrying out the works, plus an additional fee. NEC4 Option E is an example of a cost reimbursable contract.
Critical Drainage Area(s)	CDA	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".
Critical Success Factor	CSF	-
Customer relationship management	CRM	-
Dangerous goods vehicle	DGV	A vehicle which is transporting goods classified as dangerous by the relevant authorities.
Dart Charge	-	The Dartford Crossing free-flow electronic number plate recognition charging system (operates between 0600 and 2200).

Term	Acronym or Abbreviation	Explanation
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.
Dartford Crossing Control Centre	DCC	The building adjacent to the crossing, from which the operations of the crossing are controlled.
Dartford River Crossing Control Centre	DRCC	-
Deadweight tonnage	DWT	A measure of how much weight a ship is carrying or can safely carry.
decibel	dB	Between the quietest audible sound and the loudest tolerable sound, there is a million to one ratio in sound pressure (measured in pascals, Pa). Because of this wide range, a noise level scale based on logarithms is used in noise measurement called the decibel (dB) scale. The (a) weighting takes account of the relative loudness of sounds in air as perceived by the human ear as its sensitivity to some frequencies is greater than to others.
Delivery Model	-	The organisational entity that will be appointed to deliver LTC (eg, establishment of a special purpose vehicle. This is a key consideration in determining governance arrangements.
Delivery Strategy	-	Strategy which sets out how the delivery of LTC will be co-ordinated and managed.
Deneholes	-	An underground structure consisting of a number of small chalk caves entered by a vertical shaft.
Department for Environment, Food and Rural Affairs	DEFRA	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
Department for Transport	DfT	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.
Department for Transport Value for Money Framework	-	Outlines the DfT's approach to Value for Money assessments and provides guidance on how the outputs of these assessments should be communicated to decision-makers.

Term	Acronym or Abbreviation	Explanation
Design Manual for Roads and Bridges	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.
Development Consent Order	DCO	Means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIP) which is being pursued for LTC
Disbenefit	-	A disadvantage or loss.
Distributional Impact	DI	Distributional impacts (DIs) consider the variance of transport intervention impacts across different social groups. The analysis of DIs is mandatory in the appraisal process and is a constituent of the Appraisal Summary Table (AST).
Distributional Impact Appraisal	DIA	Distributional Impact Appraisal
District Valuer	DV	District Valuer Services (DVS) is the specialist property arm of the Valuation Office Agency (VOA). They provide independent, impartial, valuation and professional property advice across the entire public sector, and where public money or public functions are involved.
District Valuer Services	DVS	Property Specialists, the specialist property arm of the Valuation Office Agency (VOA).
Down Select	-	Reduction in the number of bidders, in accordance with the criteria established usually in the ITPD documents.
DP World Dubai Ports World	-	World Dubai Ports World, London Gateway Port
Dual 3 lane all purpose road	D3AP	A road that has 6 lanes with traffic going one way on 3 lanes and in the opposite direction on the other 3 lanes. An all-purpose road is available for all types of traffic.
Dual two-lane all-purpose road	D2AP	A road that has 4 lanes with traffic going one way on 2 lanes and in the opposite direction on the other 2 lanes. An all-purpose road is available for all types of traffic.
Dynamic integrated assignment and demand modelling software	DIADDEM	Software developed on behalf of DfT to provide a user-friendly method for setting up a multi-stage transport demand model and then finding equilibrium between demand and supply, using an external assignment package as the supply model.

Term	Acronym or Abbreviation	Explanation
Early Assessment and Sifting Tool	-	Department for Transport tool that can be used at an early stage to present available information and compare options.
East London Highway Assignment Model	ELHAM	TfL's East London Highway Assignment Model
Eastern Southern Link	ESL	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.
Emergency Refuge Area	ERA	On roads for use in emergency or breakdown only, located approximately every 800 metres and separated from the main carriageway
Enabling Works	-	The works required to enable the Main Works packages to proceed on schedule as described in the Commercial Case.
Enabling Works Delivery Manager	EWDM	-
Engineering and Construction Short Contracts	ESCS	-
Engineering Construction Contract	ECC	-
Enterprise Culture	-	An organisation with an Enterprise Culture is one where people are imaginative and creative rather than being reluctant to take risks. This contrasts with the culture often found in large organisations where the structure of the organisation can discourage enterprise.
Environment Agency	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.
Environmental Assessment Report	EAR	A report that informs the design process and aids the development of mitigation measures to reduce the severity of the environmental impact
Environmental Impact Assessment	EIA	A report prepared a consenting authority, when deciding whether to grant consent for a project which is likely to have significant effects on the environment, does so in the full knowledge of the likely significant effects, and takes this into account in the decision making process.

Term	Acronym or Abbreviation	Explanation
Equilibre Multimodal, Multimodal Equilibrium	EMME	A complete travel demand modelling system for urban, regional and national transportation forecasting.
European System of Accounts	ESA	An internationally compatible accounting framework for the European Union.
European System of National and Regional Accounts (ESA10)	-	Set of rules, issued by Eurostat (the statistical analysis body of the EU), for determining whether assets or entities (and any associated debt) should be classified as being public sector assets or entities.
Evaluation Criteria	-	Another term for Contract Award Criteria. May sometimes also be used to refer to selection criteria.
Evaluation Methodology	-	The methodology used by the contracting authority to evaluate suppliers' responses either at selection stage or tender/award stage and which encompasses the criteria to be used, relative the methodology used by to evaluate suppliers' responses either at selection stage or tender.
Expected Monetary Value	EMV	This looks at how much money can be expected to make from certain decisions.
Fastrack	-	A bus rapid transit scheme operating in the Thames Gateway area of Kent, operated by Arriva Southern Counties.
Fatalities and Weighted Injuries	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'.
Finance Steering Group	FSG	-
Flood Storage Area	FSA	A natural or man-made area basin that temporarily fills with water during periods of high river levels.
Full Business Case	FBC	The business case defines reasoning which justifies LTC together with the anticipated benefits and costs involved. The LTC full business case will be developed in Stage 3 ahead of the investment decision.
Geographic information system	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.
Government Major Project Portfolio	GMPP	The Government Major Projects Portfolio (GMPP)

Term	Acronym or Abbreviation	Explanation
Green Book	-	HM Treasury's guidance on how publicly funded bodies should prepare and analyse proposed policies, programmes and projects to obtain the best public value and manage risks. It covers the evaluation of policies, programmes and projects after implementation to find out how well they have achieved their original objectives and how well they have delivered within their original budgets and planned timescales.
Gross Domestic Product	GDP	A monetary measure of the market value of all final goods and services produced in a period. Nominal GDP estimates are commonly used to determine the economic performance of a whole country or region, and to make international comparisons.
Gross Value Added	GVA	The measure of the value of goods and services produced in an area, industry or sector of an economy.
Ground Investigation	GI	-
Habitats Regulations Assessment:	HRA	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.
Health and Safety Executive	HSE	The government body responsible for health and safety regulation in Great Britain
Health, Safety, Security and Welfare	HSSW	A cross delivery team within the LTC project team responsible for health, safety, security and welfare issues.
Heavy Goods Vehicle	HGV	A large, heavy motor vehicle used for transporting cargo.
Hectares	Ha	The hectare is an SI accepted metric system unit of area primarily used in the measurement of land as a metric replacement for the imperial acre. An acre is about 0.405 hectare and one hectare contains about 2.47 acres.
HEIDI software	HEIDI software	HEIDI is a bespoke DIADEM interface developed for RTMs.
Her Majesty's Government	HMG	-
Her Majesty's Treasury	HMT	A ministerial department, supported by 12 agencies and public bodies providing the government's economic and finance ministry, maintaining control over public spending, setting the direction of the UK's economic policy.
High Impact Low Probability	HILP	A type of risk considered when analysing the risks of LTC, it is a risk that cannot be quantified.

Term	Acronym or Abbreviation	Explanation
High Speed 2	HS2	High Speed 2 rail line (planned high-speed railway between London Euston and the North West)
Highway Assignment Model	HAM	TfL's Highway Assignment Model
Highways Agency Traffic Officer	HATO	
Highways England	HE	A UK government-owned company with responsibility for managing the motorways and major roads in England.
Highways England Geotechnical Data Management System	HAGDMS	
HS1 High Speed 1 rail line	HS1	High Speed 1 is a 109-kilometre high-speed railway between London and the United Kingdom end of the Channel Tunnel. The line carries international passenger traffic between the United Kingdom and Continental Europe; it also carries domestic passenger traffic to and from stations in Kent and east London, as well as Berne gauge freight traffic.
IDC	-	Investment Decision Committee
Information Management System	IMS	Information Management System
Information Technology	IT	
Infrastructure & Projects Authority	IPA	HMG's Infrastructure and Projects Authority
Institution of Civil Engineers	ICE	
Integrated Assurance and Approvals Plan	IAAP	A mandatory requirement for all central government major projects from April 2011. The Plan sets out the planning, coordination and provision of assurance activities and approval points throughout the 'policy to delivery' lifecycle of a project.
Interface Control Specification	ICS	
Interim Advice Notice	IAN	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
Inter-peak	IP	-
Investment Decision Committee	IDC	-
Invitation to participate in dialogue	ITPD	A document inviting bidders in the competitive dialogue procedure to participate in a dialogue process and setting out the terms applicable to that process
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.
Joint Venture	JV	-

Term	Acronym or Abbreviation	Explanation
Judicial Review	-	A process under which executive or legislative actions, such as the decision of the Secretary of State on the DCO for LTC, may be subject to review by the courts.
Kent and Medway Economic Partnership	KMEP	An economic partnership for Kent and Medway which aims to drive forward economic growth and prosperity throughout the region.
Key Performance Indicator	KPI	Measurable value that demonstrates how effectively a company is achieving key business objectives
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.
Lane Control Signs	LCS	are used to permit or prohibit the use of specific lanes of a street or highway
Lean, Value Management and Innovation	LVMI	-
Legacy and Benefits Strategy	LBS	-
Lessons Learned	-	Lessons learned by Highways England from the experience of Highways England and other procurers on the procurement of other major infrastructure projects.
Light Goods Vehicle	LGV	Vehicles meeting the Department for Transport VWEH04 criteria.
Local Enterprise Partnership	LEP	A voluntary partnership set up between local authorities and businesses to drive local economic growth and job creation activities. There are 39 LEPs across England.
Local Road Network	LRN	-
Local Wildlife Site	LWS	Locally designated nature site protected through the planning system. Seen also LNR
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 options at Locations C and A with additional widening of the A229 between the M2 and the M20.
London Area Transport Surveys	LATS	-

Term	Acronym or Abbreviation	Explanation
London Distribution Park	LDP	An area, 70 acres (28Ha), of land for industrial and logistics development 6.5 miles from the M25, adjacent to Port of Tilbury, London.
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.
London Tilbury Southend railway	LTS	-
Lower Thames Area Model	LTAM	Transport model designed to forecast impacts of providing additional road based capacity across the Thames at locations at or east of the existing Dartford Crossing
Lower Thames Area Network	LTAN	Lower Thames Area Network
Lower Thames Crossing	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.
M25	M25	Orbital motorway that encircles most of Greater London.
Major Projects	-	A division in Highways England which support and manage planned major road schemes.
Management Consultancies Associations	MCA	Representative body for management consultancy firms in the UK which publishes annual awards for projects
Managing Agent Contractor	MAC	-
Marine Management Organisation	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.
Market Engagement	-	Market engagement by Highways England.
Mechanical Electrical Instrument Control and Automation	MEICA	Mechanical Electrical Instrument Control and Automation
Medway Traffic Model	MTM	-
Ministry of Housing, Communities & Local Government	MHCLG	Ministry of Housing, Communities & Local Government
Most Desirable Outcomes	MDO	-

Term	Acronym or Abbreviation	Explanation
Most Economically Advantageous Tender	MEAT	Most Economically Advantageous Tender, being the optimum combination of whole life costs and benefits assessed (scored) against predetermined evaluation award criteria (award criteria) which will normally be detailed in the Invitation to Tender (ITT) or equivalent documentation. MEAT is One of two systems which are allowed for tender selection (the other being lowest price). MEAT enables tender evaluation on the basis of the quality of the tender offer as well as the price.
Motorway Incident Detection and Automatic Signalling	MIDAS	Motorway Incident Detection and Automatic Signalling
Motorway Reliability Incidents and Delays	MyRIAD	Motorway Reliability Incidents and Delays software
National Audit Office	NAO	National Audit Office – which audits the financial statements of all government departments and agencies, and many other public bodies. They report on how well the expenditure of public money achieves value for money (VFM) and improvements in the delivery of public services.
National Cycle Route	NCR	National Cycle Route: a cycle route part of the National Cycle Network created by Sustrans to encourage cycling throughout Britain.
National Infrastructure Delivery Plan	-	Document published by the UK Government, setting out its strategy for meeting the infrastructure needs of the UK economy.
National Infrastructure Programme	NIP	-
National Nature Reserve	NNR	Reserves established to protect some of the most important habitats, species and geology in the United Kingdom, and to provide 'outdoor laboratories' for research. There are currently 224 NNRs in England with a total area of over 94,400 hectares - approximately 0.7% of the country's land surface. Natural England manages about two thirds of England's NNRs. The remaining reserves are managed by organisations approved by Natural England, for example, the National Trust, Forestry Commission, RSPB, Wildlife Trusts and local authorities.
National Planning Policy Framework	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.

Term	Acronym or Abbreviation	Explanation
National Policy Statement	NPSNN	National Policy Statement for National Networks: The NPSNN sets out the need for, and Government's policies to deliver, development of nationally significant infrastructure projects on the national road and rail networks in England. It provides planning guidance for promoters of nationally significant infrastructure projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.
National Policy Statement for National Networks	-	This sets out the national roads policy framework, as presented to Parliament in December 2014.
National Roads Telecommunications Services	NRTS	Connects Highways England's seven regional control centres, the national traffic operations centre and the 30,000 roadside technology assets including message signs, CCTV cameras and emergency roadside telephones.
National Strategic Infrastructure Project	NSIP	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.
National Technology Control Centre	NTCC	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.
National Trip End Model	NTEM	A model forecasts the growth in trip origin-destinations (or productions-attractions) up to 2051 for use in transport modelling. The forecasts consider national projections of population, employment, housing, car ownership and trip rates.
National Trust	-	Charity that cares for historic houses, gardens, ancient monuments, countryside and other sites across England, Wales and Northern Ireland, including the Stonehenge landscape.
Net Present Value	NPV	A measure of the total impact of a scheme upon society, in monetary terms, expressed in 2010 prices.
Network Delivery and Development Directorate	NDD	Highways England Directorate responsible for the development and management of Highways England's maintenance renewals and local Network Management Schemes
Network Operations Strategy	NOS	-
Neue Emme Bank	EMMEBANK	Neue Emme Bank Vorm.Amtersparniskasse Burgdorf
New Engineering Contract	NEC	A system of contracts created by the Institution of Civil Engineers and used as the form of contract to engage both designers and contractors

Term	Acronym or Abbreviation	Explanation
Nitrogen dioxide	NO2	A reactive gas, introduced into the environment by natural causes, including entry from the stratosphere, bacterial respiration, volcanos, and lightning. It is also introduced by the emissions of internal combustion engines burning fossil fuels.
Noise-important area	NIA	Areas 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.
Nomenclature of Territorial Units for Statistics	-	A classification of spatial units used for statistical purposes across the European Union. There are five subcategories: NUTS1, 2 and 3, and Local Area Units 1 and 2.
Non-recoverable VAT	NR VAT	NEW F/Case requested 18 March 2019
Non-motorised user(s)	NMU	User of non-motorised vehicles (e.g. cyclists, horse-riders) and pedestrians
Not Environmentally Worse Than	NEWT	Not Environmentally Worse Than, meaning comparative assessments critical to LTC to ensure that deviations from, as outlined in the Environmental Statement, do not degrade the environment and jeopardise project approval and completion
Operating, maintenance and renewal costs	OMR	Operating, maintenance and renewal costs
Office for National Statistics	ONS	Office for National Statistics: the executive office of the UK Statistics Authority, a non-ministerial department which reports directly to the UK Parliament.
Office of Rail and Road	ORR	It is a non-ministerial government department responsible for the economic and safety regulation of Britain's railways, and the economic monitoring of Highways England
Official Journal of the European Union	OJEU	Official Journal of the European Union (Tender and Public Procurement process) which is published every working day in all official languages of the European Union. It consists of two related series (L for legislation and C for information and notices) and a supplement (S for public procurement). This supplement is where OJEU notices and award notices are published
OJEU Notice	OJEU Notice	The contract notice published in the Official Journal of the European Union to launch the procurement process for a contract under the Public Contracts Regulations.
On Time Reliability Measure	-	The percentage of journeys on the Strategic Road Network that are on time.
Open for Traffic	OfT	LTC being commissioned such that it is open to traffic.

Term	Acronym or Abbreviation	Explanation
Optimised Contract Involvement	OCI	A period, starting at Contract Award, and anticipated to last about 9 months, for discussions with contractors designed to optimise contractors delivery plans and mobilise resources.
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.
Origin-Destination	-	The points between which people travel.
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.
Outline Business Case	OBC	Developed in Stage 2 ahead of procurement
Output Based Specification	-	Describes the output requirements for the proposed development in terms of the type and standard of road to be delivered.
Outstanding Universal Value	-	To be included on the UNESCO World Heritage List, sites must be deemed to be of 'outstanding universal value'.
Overhead and Profit	OH&P	-
Oxides of Nitrogen	NOx	Nitrogen oxides are produced in combustion processes, partly from nitrogen compounds in the fuel, but mostly by direct combination of atmospheric oxygen and nitrogen in flames. Nitrogen oxides are produced naturally by lightning, and also, to a small extent, by microbial processes in soils.
PA metrics	-	Production and attraction metrics
PAB Procurement Advisory Board	PAB	-
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.
Parliamentary Advisory Council for Transport Safety	FACTS	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.

Term	Acronym or Abbreviation	Explanation
Passenger Car Unit(s)	PCU	This is a metric to allow different vehicle types within traffic flows in a traffic model to be assessed in a consistent manner. Typical pcu factors are: 1 for a car or light goods vehicle; 2 for a bus of heavy goods vehicle; 0.4 for a motorcycle; and 0.2 for a pedal cycle.
Payment Mechanism	-	Contractual provisions relating to the calculation and timing of the payments from the client to the supplier in relation to the services provided under the contract.
Peak Hour	-	The busiest hours, as during traffic, etc; rush hour.
Peel Ports	-	Britain's second largest group of ports, part of the Peel Group.
Penalty Charge Notice	PCN	A Charge for not paying the charge for the London congestion zone, low emission zone or Dartford Crossing (Dart Charge) on time
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.
Perfect Circle	-	a JV formed by Pick Everard, Gleeds and AECOM, which delivers services in the built environment.
Performance Incentive Framework	PIF	-
Performance Indicator	PI	-
Performance Management Framework	PMF	An approach to the performance management of contractors proposed in the Commercial & Procurement Strategy that comprises the Contract Management Plans (how each contract will be managed), the Performance Measurement System and the Performance Points Regime.
Performance Measurement System	PMS	A system for measuring contractor performance against the Balanced Score Card.
Performance Points Regime	PPR	A graduated scale of interventions, in addition to standard provisions within the NEC4 contract, to ensure delivery of the obligations under the contract and to address poor performance.
Performance, Reliability, Availability, Maintainability, Safety	PRAMS	Performance, Reliability, Availability, Maintainability, Safety
Permit to Use	PTU	A certificate issued when all, or the specified part, of the new road is considered by the authority to be suitable and safe for use by members of the public without traffic management restrictions.
Personal Injury(ies) Accident(s)	PIA	An accident that involves personal injury occurring on the public highway (including footways) in which at least one road vehicle or a vehicle in collision with a pedestrian is involved and which becomes known to the police within 30 days of its occurrence.

Term	Acronym or Abbreviation	Explanation
Planning Inspectorate	PINS	An executive agency sponsored by the Department for Communities and Local Government and the Welsh Government. The Planning Inspectorate deals with planning appeals, national infrastructure planning applications, examinations of local plans and other planning-related and specialist casework in England and Wales.
Pollution Climate Mapping	PCM	Defra's Pollution Climate Mapping model
Port of London Authority	PLA	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.
Post Opening Project Evaluation	POPE	Checks whether investments in Major Projects are delivering the outcomes documented in the Appraisal Summary Table published prior to scheme approval. Highways England produces the reports '1 year after' and '5 years after' road opening.
Potential Special Protection Area	PSPA	Sites which are approved by Government that are in the process of being classified as Special Protection Areas.
Preferred Route Announcement	PRA	Preferred Route Announcement by government of the preferred route for a new road or crossing
Preliminary Environmental Information Report	PEIR	An initial output of the EIA process
Preliminary Sources Study Report	PSSR	Used to provide geotechnical assessments for LTC.
Present Value of Benefits	PVB	The monetised benefits accruing to users (in terms of travel time, vehicle operating cost, and tolls to be paid), monetised impacts upon the environment, the monetised value of accidents, and monetised wider economic impacts. PVBs less PVCs provide estimates of Net Present Values (NPVs) and the ratio of the PVB to the PVC constitutes the BCR.
Present value of costs	PVC	A measure of the monetary cost of a scheme, less revenues, discounted to and expressed in prices prevailing at a defined base date. For LTC that date is 2010.
Private Finance Initiative	PFI	It is a way of financing public sector projects through the private sector. PFIs alleviate the Government and taxpayers of the immediate burden of coming up with the capital for these projects.
Procurement Implementation Plan	PIP	-
Procurement Steering Group	PSG	-

Term	Acronym or Abbreviation	Explanation
Professional and Technical Services Division	PTSD	-
Professional Services Contract.	PSC	-
Programmatic Assessment	-	Used to enable the appraiser to understand the contribution to each scheme within a programme of investment.
Project Controls Framework	PCF	Highways England Project Control Framework process. Setting out how Highways England, together with DfT, manage and deliver major improvement projects
Project Execution Plan	PEP	-
Project Executive Group	PEG	A group of executives who are responsible for the day to day operation of LTC CASCADE
Project Information Note	PIN	Issued to market to initiate the procurement process (before SQ)
Project Management Office	PMO	Provides support to a project and improves efficiency via a consistent approach and a single set of systems.
Project Management Plan	PMP	How the Highways England project team will execute and manage LTC in line with the company's three imperatives; Safety, Delivery and Customers. To provide a succinct articulation of the "what", "why", "how" and "who" on a project
Public Contracts Regulations	PCR	The Regulations 2015 in force for all procurements commenced on or after 26 February 2015. These regulations provide rules for the award of contracts by public authorities and utilities for works and/or services above certain financial thresholds.
Public Right of Way	PRoW	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.
QEII	-	Bridge Queen Elizabeth II Bridge, part of the Dartford-Thurrock crossing.
Quantified Schedule Risk Analysis	QSRA	Any factors that may impact on project costs have been identified and quantified to produce a risk-adjusted cost estimate.
Quantitative Risk Assessment	QRA	A formal and systematic risk analysis approach to quantifying the risks associated with the operation of an engineering process.

Term	Acronym or Abbreviation	Explanation
Queues and Delays at Roadworks	QUADRO	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.
Radio-frequency identification	RFID	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.
Ramsar	-	A wetland of international importance, designated under the Ramsar convention.
Range Estimation Tool	RET	
Rat-running	-	The practice by motorists of using residential side streets or any unintended short cut instead of the intended main road.
Recommended Marine Conservation Zone	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.
Reference Design	-	Design proposals that the DCO application will refer to.
Regional Control Centre	RCC	Highways England Regional Control Centre(s)
Regional Delivery Partner	RDP	Highways England's Regional Delivery Partner Framework
Regional Technology Maintenance Contract(or)	RTMC	
Responsible, Accountable, Informed, Consulted	RACI	Means of defining the scope of individual roles
Retail Price Index	RPI	It is a measure of inflation published monthly by the Office for National Statistics. It measures the change in the cost of a representative sample of retail goods and services.
RIS 2 Period	-	The financial years 2020/21 to 2024/25
RIS 3 Period	-	The financial years 2025/26 to 2029/30
Risk Quota	Risk Quota	The Risk Quota is the difference between the Target Budget and the contractor's Total of the Prices.

Term	Acronym or Abbreviation	Explanation
Road Investment Strategy	RIS	The Government's long-term strategy to improve England's motorways and major A roads. The first RIS (known as RIS1) was published in 2014 and covers the period 2015-2020. A second RIS (RIS2) was published in 2015 and covers the post-2020 period.
Roadside facility	RSF	
Road traffic collision	RTC	
Road User Charging	RUC	Charging road users for the use of the tunnel.
Royal Society for the Protection of Birds	RSPB	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.
SANEF	-	Société des Autoroutes du Nord et de l'Est de la France, a motorway operator company.
SCAPE/Perfect Circle	-	a joint venture formed by Pick Everard, Gleeds and AECOM, which delivers services in the built environment.
Scheduled monument	-	A 'nationally important' archaeological site or historic building, given protection against unauthorised change and included in the Schedule of Monuments kept by the Secretary of State for Culture, Media and Sport. The protection given to scheduled monuments is given under the Ancient Monuments and Archaeological Areas Act 1979.
Scheme Assessment Report	SAR	HHJV's Pre-Consultation Scheme Assessment Report of the Lower Thames Crossing.
Science, Technology, Engineering and Mathematics	STEM	
Secretary of State.	SoS	The Secretary of State has overall responsibility for the policies of the Department for Transport.
Selection Questionnaire	SQ	A questionnaire used to gather the information used to assess which respondents will be invited to participate in the Competitive Dialogue process.
Senior Dialogue Lead	SDL	
Senior Responsible Owner	SRO	The individual with overall accountability for the delivery of LTC ensuring the project remains focused on achieving its objectives. The SRO has the authority to make decisions concerning the delivery of LTC within a certain delegation.
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.'

Term	Acronym or Abbreviation	Explanation
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.
Simulation and Assignment of Traffic to Urban Road Networks	SATURN	A suite of computer programs developed at the Institute for Transportation Studies, University of Leeds, with four basic functions: (1) a combined traffic simulation and assignment model for the analysis of traffic management plans; (2) a conventional assignment model for the analysis of large networks; (3) a simulation model of individual intersections; (4) a network database and analysis system.
Site of Special Scientific Interest	-	A conservation designation denoting to a protected area in the United Kingdom. The Sites are protected by law to conserve their wildlife or geology.
Site of Special Scientific Interest	SSSI	A conservation designation denoting an area of particular ecological or geological importance.
Skills Level 4	-	Equates to a Certificate of Higher Education, Key Skills Level 4, NVQ Level 4, BTEC Professional award, certificate and diploma Level 4, and HNC.
Small and Medium Sized Enterprise	SME	As defined by the European Commission
Smart motorway	-	Term for a range of types of actively controlled motorway, using technology to optimise use of the carriageway including the hard shoulder.

Term	Acronym or Abbreviation	Explanation
Social Impact Appraisal	SIA	Social impacts cover the human experience of the transport system and its impact on social factors, not considered as part of economic or environmental impacts. Each social impact is required to be assessed as part of the appraisal and an assessment entered into the Appraisal Summary Table which includes: Accidents, Physical Activity, Security, Severance, Journey Quality, Option and Non-Use Values, Accessibility and Personal Affordability.
Source protection zone	SPZ	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.
South East Local Enterprise Partnership	SELEP	The business-led, public/private body established to drive economic growth across East Sussex, Essex, Kent, Medway, Southend and Thurrock.
South West Regional Traffic Model	-	A Highways England regional transport model of the South West of England. The model simulates traffic movements within the strategic road network of the South West.
Spatial Compatible Computable General Equilibrium	S-CGE	A method of economic modelling.
Spatial Computable General Equilibrium	EnvIS	A methodology that can be used in the appraisal of the wider economic impacts of a transport intervention.
Special Area of Conservation	SAC	Special Area of Conservation: defined in the European Union's Habitats Directive (92/43/EEC), also known as the Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora. SACs are to protect the 220 habitats and approximately 1000 species listed in annex I and II of the directive which are considered to be of European interest following criteria given in the directive.
Special Protection Area	SPA	A designation under the European Union Directive on the Conservation of Wild Birds.
Special Purpose Vehicle	SPV	A newly incorporated limited company with no prior trading history and without any actual or contingent liabilities.
Specific Measurable Achievable Relevant and Time-Bound	SMART	-
Speed Enforcement Camera System	SPECS	Average Speed Enforcement Camera System

Term	Acronym or Abbreviation	Explanation
Sponsor	-	The sponsor organisation that secures the funding, owns the business case and is responsible for specifying the requirements to the client. The Sponsor ensures that the project remains strategically aligned and viable, and that benefits are on track to be realised. In some contexts, such as this, the Sponsor and Client are from the same organisation.
Stage Gate Assessment Review	SGAR	part of Highways England Project Control Framework (PCF) process.
Stakeholder Advisory Panel	SAP	LTC Stakeholder Advisory Panel: comprises key local authority stakeholders to share local knowledge, their needs, priorities and opinions with respect to LTC. SAP meetings have been held at key stages of the LTC scheme; bi-lateral meetings with SAP members have also been held.
Standstill Letter	-	Communication sent (typically by email, fax or through an electronic procurement system) which commences the Standstill period. Often referred to as an Alcatel Letter.
Standstill Period	-	A period of at least ten days after the notification of an award before the contract is concluded with the successful supplier(s). It is designed to enable unsuccessful bidders to challenge the award decision before the contract is concluded. It is named after a pair of linked European Court cases which are jointly known as the Alcatel case. The formal name used in the Procurement Regulations is the standstill period. Often referred to as an Alcatel Period.
Statement of Common Ground	SOCG	A written statement containing factual information about the proposal which is the subject of the appeal that the appellant reasonably considers will not be disputed by the local planning authority.
STATS19	STATS19	A database collection of all road traffic accidents that resulted in a personal injury and were reported to the police within 30 days of the accident. The variables and fields of data collected are defined by the Department for Transport.
Statutory Environmental Body(ies)	SEBs	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 LTC.

Term	Acronym or Abbreviation	Explanation
Statutory Utilities	SU	They are generally considered to include electricity, gas, water and sewage and communications services
Strategic Economic Plan	-	A document produced by a Local Enterprise Partnership setting out its plans for the future and the funding that will be required to deliver these plans.
Strategic Road Network	SRN	The core road network in England managed by Highways England
Subject Matter Adviser	SMA	Highways England team members who work with partners to review business cases.
Surface Water Management Plan	SWMP	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.
Sustainable drainage system	SuDS	A drainage system designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges.
Target Budget	-	The Target Budget is the funding that we have allocated for delivery of the contract, inclusive of both client and contractor risk.
Target Cost	-	a price is agreed between the parties which includes the Contractor's estimate of what are called "Defined Costs" in the NEC4 form plus a fee which is meant to cover the Contractor's costs, overheads and profit.
Technical Appraisal Report.	TAR	HHJV's Technical Appraisal Report of the Lower Thames Crossing.
Technical Partner	-	The consultant performing the role as set out in the Management Case
TEE Table	-	Table used to present the results, as part of a business case, of Economic Efficiency of the Transport System.
Thames Estuary 2100	TE2100	An Environment Agency's 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.
Thames Tideway Tunnel	-	A 25 km sewage tunnel running underneath central London, which is currently under construction. The project has been procured under a regulatory model and will be regulated by OFWAT. Further information can be found at www.tideway.london
Third Party Agreements	TPAs	A contract between two parties that later adds an outside party. In general, the third party provides goods or services to help one of the parties fulfil its contractual obligations. E.g. Utilities

Term	Acronym or Abbreviation	Explanation
Tier 1 Roads Analysis and Coordination	TRAC	-
TM	-	Highways England's Traffic Management (directorate)
Traffic Flow Data System	TRADS	holds information on traffic flows at sites on the network
Traffic Management Cell	TMC	These include traffic light signals, barriers and variable message signs to stop and redirect errant vehicles from the carriageway. The TMCs are also utilised to regulate the traffic prior to entering the tunnels during incidents and periods of congestion or Dangerous Goods Vehicle convoy crossings.
Transfer of Undertakings (Protection of Employment) Regulations 1981	TUPE	Govern the transfer of an undertaking (that's a business or part of one) to a new employer.
Transport Analysis Guidance	TAG	National guidance document produced by the Department for Transport.
Transport and Road Research Laboratory	TRRL	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.
Transport Appraisal and Strategic Modelling	TASM	Division within DfT
Transport Economic Efficiency	TEE	The economic efficiency of the transport system
Transport for London	TfL	The integrated body responsible for London's transport system
Transport Users Benefit Appraisal	TUBA	Transport Users Benefit Appraisal (DfT economic appraisal software tool) UPS Uninterruptible power supply
Travel time variability	TTV	-
Tunnel Boring Machine	TBM	Machine used to excavate tunnels with a circular cross section.
Tunnel Design and Safety Consultation Group:	TDSCG	A formal group of stakeholders including emergency services, police, the tunnel promoter, the highway authorities, the tunnel and highway operator and maintainer and the tunnel designer. It meets regularly through the planning and detailed engineering design phases to consider and agree matters of safety provision in the proposed tunnels.
Unitary Charge	-	An annual sum payable to the DBFM Co under the DBFM contract, as adjusted under the Payment Mechanism.
United Nations Educational, Scientific and Cultural Organisation	UNESCO	The United Nations agency which promotes international collaboration through education, science and culture.

Term	Acronym or Abbreviation	Explanation
Urban All Purpose	-	A road in an urban area designed for all types of traffic in accordance to the relevant DMRB Standards.
Value for Money	VfM	Value for Money, being the optimum combination of whole-life costs and quality to meet the user requirement
Variable Mandatory Speed Limits	VMSL	One of the key features of smart motorways is variable mandatory speed limits. These speed limits are displayed on the motorway and come into operation when traffic volumes increase, and the sensors activate lower speeds. Reducing speed during peak demand decreases stop-start conditions and allows traffic to move smoothly.
Variable Message Sign	VMS	Variable Message Sign, typically mounted on a portal gantry.
Vehicle Operating Cost	VOC	Costs that vary with vehicle usage, including fuel, tires, maintenance, repairs, and mileage-dependent depreciation costs.
Vehicles per day	vpd	-
Vision and Strategic Goals	VSG	-
Volume over Capacity	V/C	-
Vopak	-	Royal Vopak N.V. is a Dutch company that stores and handles various oil and natural gas related products.
Vortex separator	-	A device for effective removal of sediment, litter and oil from surface water runoff.
Water Framework Directive	WFD	A European Community Directive (2000/60/EC) of the European Parliament and council designed to integrate the way water bodies are managed across Europe.
westbound	WB	-
Western	WSL	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.
Whole Life Costing	-	An approach to design and construction that considers the operating and maintenance costs in a way that seeks to reduce the overall cost of the asset, rather than just focusing on the costs of design and construction.
WHS Partnership Panel	-	A group representing both parts of the WHS made up of the three key partners (English Heritage, the National Trust and Wiltshire Council). Its role is to coordinate actions affecting both parts of the WHS and to oversee the work of the Coordination Unit.

Term	Acronym or Abbreviation	Explanation
Wider economic benefits	WEBS	
Work Breakdown Structure	WBS	A work breakdown structure is a key project deliverable that organizes the team's work into manageable sections.
World Heritage Site	-	A site listed by UNESCO because of its special natural or cultural value.