

Lower Thames Crossing

Preliminary environmental information summary

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1 Introduction

Background

The Lower Thames Crossing (the 'Project') is a proposed new motorway connecting Kent, Thurrock and Essex through a tunnel beneath the river Thames. The Project will provide over 90% additional road capacity across the River Thames east of London.

The Project is classified as a Nationally Significant Infrastructure Project (NSIP), as defined by the Planning Act 2008 and was identified by HM Treasury as one of the top 40 priority investments in its National Infrastructure Plan 2013.

The Lower Thames Crossing Project is being developed as part of the Government's £15 billion Road Investment Strategy over the period 2015-2020.

Plate 1.1 Indicative aerial view of Lower Thames Crossing tunnel portal



Purpose of the Preliminary Environmental Information Summary

As part of the statutory consultation and planning process, a *Preliminary Environmental Information Report (PEIR)* has been commissioned. The purpose of the *PEIR* is to provide members of the public, statutory consultees and other stakeholders with preliminary information about the Project's likely significant environmental effects and the measures that are being considered to avoid and minimise them. This information will help readers to develop an informed view of the Project. The *PEIR* is required for the Project to comply with Environmental Impact Assessment (EIA) Regulations.

The *PEIR* presents an overview of the preliminary environmental information available at this stage. Further assessment and the development of detailed measures to reduce environmental effects are ongoing and will be reported in the Environmental Statement (ES). The ES will include a detailed and comprehensive EIA and will be submitted as part of the Development Consent Order (DCO) application.

This document summarises the *PEIR* and is written using non-technical language.

Feedback received from this consultation will help to shape the Project, including aspects relating to the environment, before the DCO application is submitted.

2 The Lower Thames Crossing project

Key objectives of the Project

Together with Department for Transport (DfT) we have established seven scheme objectives to ensure the delivery of economic, environmental, community and transport benefits. These have been developed and refined for the Project and are set out below.

- To support sustainable local development and regional economic growth in the medium to long term
- To be affordable to government and users
- To achieve value for money
- To minimise adverse impacts on health and the environment
- To relieve the congested Dartford Crossing and approach roads, and improve their performance by providing free-flowing north-south capacity
- To improve resilience of the Thames crossings and the major road network
- To improve safety

History of the Project

The need for a new crossing of the River Thames east of London due to growing congestion at the Dartford Crossing was identified by DfT as a top 40 priority project in its *National Infrastructure Plan* in 2011. Together with Government, we have explored many options, and considered feedback from the public before reaching our current design. The Secretary of State for Transport announced the preferred route in 2017.

Since the announcement of the preferred route, new information has been gathered, including the results of environmental surveys and information from stakeholder consultation. The information gathered has been used to further develop the Project route, making changes to junctions, link roads and carriageway alignments, leading to the current design set out in the *PEIR*.

Project description

The route

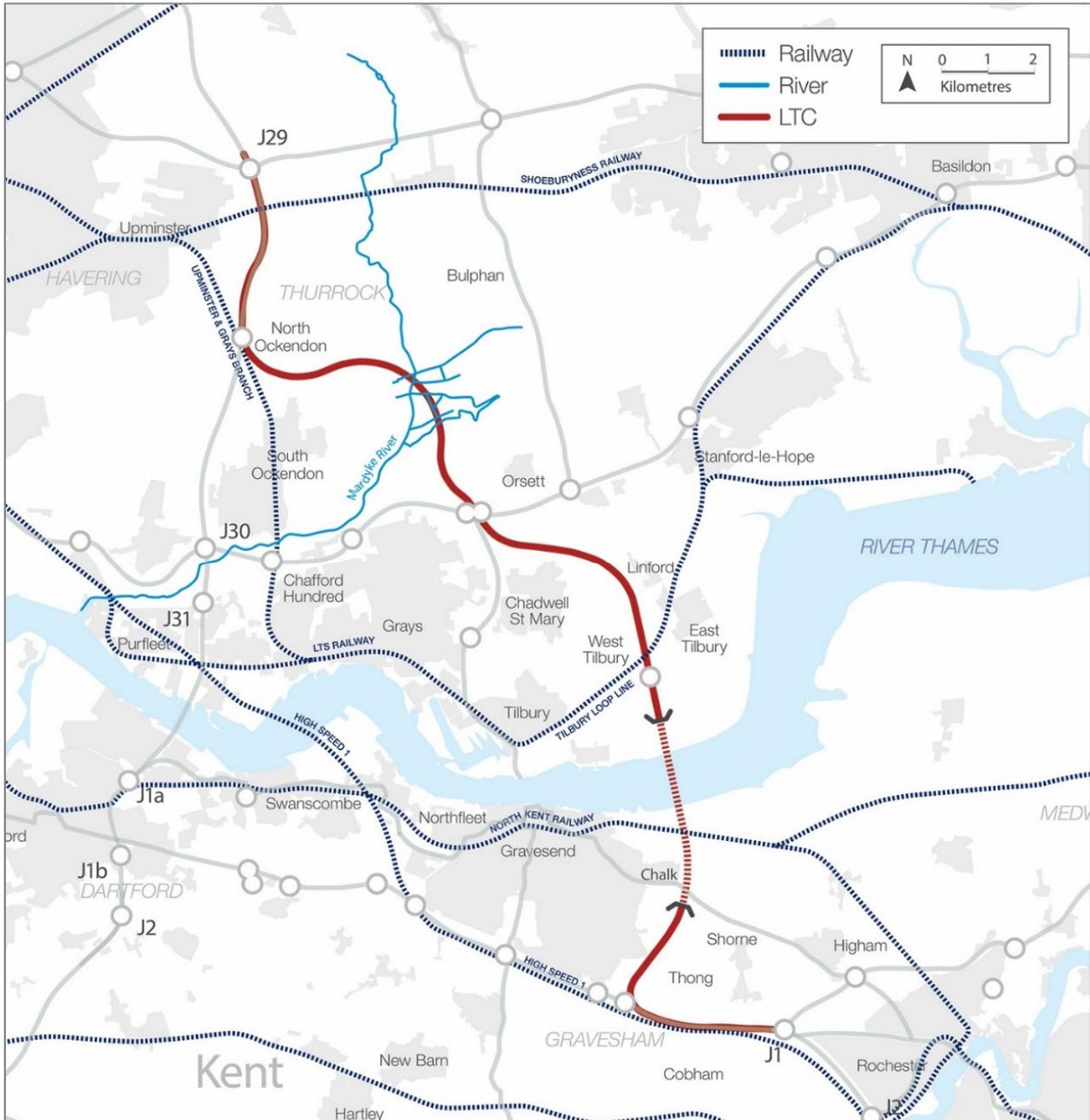
On the south side of the Thames, the new road will link the tunnel to the A2 and M2 in Kent. On the north side, it will link to the A13 and junction 29 of the M25 in the London Borough of Havering.

The Lower Thames Crossing will comprise:

- approximately 14.5 miles (23km) of new motorway connecting to the existing road network from the A2/M2 to the M25
- two 2.5-mile (4km) tunnels, one southbound and one northbound
- three lanes in both directions with a maximum speed limit of 70mph
- improvements to the M25, A2 and A13, where the Lower Thames Crossing connects to the road network

- 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
- a free-flow charging system, where drivers don't need to stop but pay remotely, similar to that at the Dartford Crossing

Plate 2.1 Map showing Project's route at statutory consultation



Junctions are proposed at the following locations:

- a new junction with the A2 to the east of Gravesend
- a new junction east of Tilbury
- a modified junction with the A13/A1089 in Thurrock
- a new junction with north-facing slip roads on the M25 between junctions 29 and 30

The main road between the A2 and the M25 would be 3 lanes in both directions, using technology for lane control and variable speed limits. There would be no hard shoulders but there would be hard strips, motorway vehicle restrictions, emergency refuge areas and a rest and service area. Modern safety measures and construction standards will be used with technology to manage traffic and provide better information to drivers:

- variable message signs on gantries to display travel information, hazard warnings and both advisory and mandatory signage to drivers
- CCTV cameras to manage and investigate incidents, monitor onsite activities, protect assets, gauge network usage and prevent and detect crime
- above ground traffic detectors to control automatic traffic management systems (like variable speed limits) and to collect data on traffic flows

Existing side roads affected by the route will be reconnected to ensure that existing communities and public rights of way remain connected. In most locations, the affected side roads would go over the new route.

Plate 2.2 Example of modern motorway with variable message signs



Pedestrians, cyclists and horse riders

The Lower Thames Crossing will be a motorway and have the same restrictions, which means pedestrians, cyclists and horse riders will not be allowed to use the tunnels or the roads.

In some areas along the route, footpaths, bridleways and cycle paths may be affected by the Lower Thames Crossing. Wherever this happens, routes will be reinstated or a nearby alternative provided. Throughout the design process we will continue to consider how the Project will affect these routes.

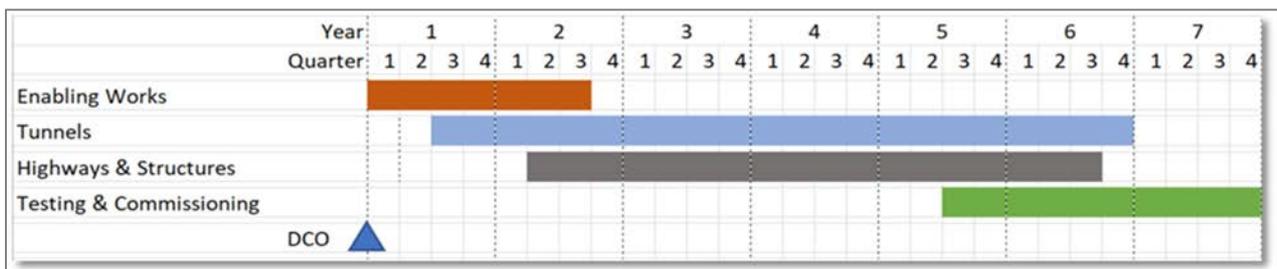
Plate 2.3 Example of footpath/cycle path



How would the Project be constructed?

The new road and tunnel will be built in phases. The suggested plan, alongside indicative timings are below in Plate 2.4:

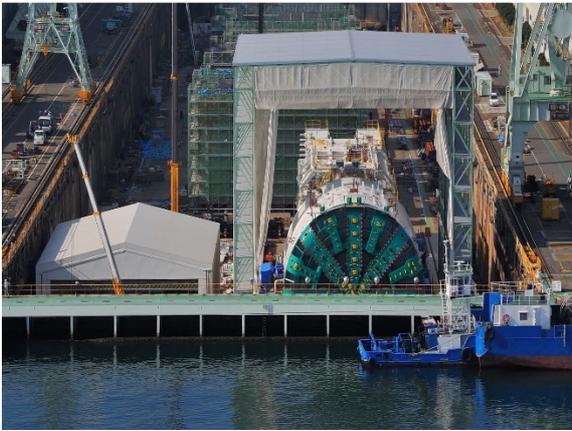
Plate 2.4 Project’s indicative construction timeline



Enabling works will be started before the main construction work begins. This will include diverting public rights of way and utilities, carrying out environmental mitigation such as relocating protected species and undertaking archaeological investigations, building access roads and preparing individual sites for construction.

The tunnel will be bored using tunnel boring machines (TBMs), and it is likely to take around 6 years to complete the crossing under the River Thames.

Plate 2.5 Tunnel boring machine (left) and bored tunnel (right)



The new road, junctions, bridges and underpasses will be built at the same time as the tunnelling work. Construction compounds containing temporary buildings and storage areas will be needed. Four main compounds are currently being considered, one north of the Project, one south of the Project and one at each tunnel portal either side of the river. Smaller satellite compounds will be placed along the route to support the main compounds.

Construction traffic routes will be carefully planned. Road closures will be kept to a minimum, but where unavoidable these will be agreed with the local authority. Road users will be given plenty of notice, so they can consider alternative routes.

To reduce construction traffic using the existing road network, river transport is being considered to move materials and waste to and from work sites where possible.

The use of the river to deliver the TBMs is also being explored, to seek the most efficient and least disruptive ways to construct the tunnel. If the river is used, the TBMs will be delivered to a suitable location in sections and assembled on site.

The Lower Thames Crossing Code of Construction Practice (CoCP) will form part of the DCO application. It will describe how disruption to local communities and impacts on the environment will be minimised during construction, including how noise and vibration will be limited.

Services and utility diversions

The Project would need diversion or alteration of overhead high voltage electricity transmission and distribution lines mainly north of the River Thames. Large high-pressure gas feeder mains would also need to be diverted.

Demolition and land take

We have set out a Development Boundary which outlines the extent of the land we may need. Within this boundary, some of the land will only be needed temporarily during construction. When work is complete, we will restore it to its original state, or better. Other areas of land will be needed permanently, including for new roads, junctions, maintenance areas, landscaping and to make existing floodplains bigger in areas where the existing ones will be impacted by the Project.

Procedures for assessing appropriate levels of compensation will follow the Compensation Code. Consultation with relevant landowners, occupiers and agents will continue, to manage and reduce impact on property owners as far as is practicably possible.

Development timeline

The journey from this consultation to a development consent decision could take several years. The timeline below shows an estimate of when each stage will begin.

Table 2.1 Indicative Development Consent Order stages and opening date

Oct 2019	2019	2019	2020	2020	2021	2027
Pre-application	Submission and acceptance of DCO application	Pre-examination of DCO application	Examination	Recommendation	Decision and start of construction	Opening

3 Environmental Impact Assessment

Scope of the Environmental Impact Assessment

The EIA is the process of assessing the likely significant effects of a proposed development. It is designed to feed into the development of the Project and provide decision makers and statutory consultees with the environmental information they need to decide whether the Project should go ahead.

The scoping process of an EIA determines the content and extent of the topics that should be covered. A Scoping Report for the Lower Thames Crossing was submitted to the Planning Inspectorate in November 2017. The Planning Inspectorate reviewed the Report and issued their view on it in December 2017. This is called a Scoping Opinion and sets out the environmental issues which must be assessed. The Scoping Opinion has been used to inform the structure of the *PEIR* and confirm the environmental topics relevant to the Project.

The Lower Thames Crossing Scoping Report and Scoping Opinion can be found on the Planning Inspectorate website:

<https://infrastructure.planninginspectorate.gov.uk/projects/south-east/lower-thames-crossing/?ipcsection=docs>

Environmental Impact Assessment work completed to date

The EIA work completed to date is included in the *PEIR*. Site surveys, desk-based studies and consultation with key organisations have been carried out to understand the existing environmental conditions in the Lower Thames Crossing area. Potential effects of the Project have been identified and mitigation measures are being developed.

Approach to mitigation

Measures to avoid or minimise environmental impacts are being incorporated into the design of the route where possible. Examples of these measures can be found in the 'Environmental effects' section of this document. Mitigation will continue to be developed throughout the design process and through regular consultation with affected parties.

Consultation

Consultation with local authorities, statutory environmental bodies and environmental organisations has been carried out and will continue throughout the development of the Project and the preparation of the ES.

Consultation has focused on the design, approach to environmental surveys and assessments, modelling, mitigation, consents and ongoing engagement. Non-statutory public consultations were held in 2013, 2014, and 2016 on the route options.

Further work to be undertaken

Surveys, desk-based studies and additional noise and air quality modelling will be carried out. Environmental effects will be assessed in more detail and mitigation will be developed further as part of the EIA process. This work will be documented in the ES, which will be submitted as part of the DCO application.

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4 Environmental effects

This section summarises the findings of the preliminary environmental assessment so far. The topics covered are air quality, cultural heritage, landscape, terrestrial biodiversity, marine biodiversity, geology and soils, materials, noise and vibration, people and communities, road drainage and the water environment and climate. For further information on these topics and the potential environmental effects of the Project, please refer to Chapters 6 to 16 of the *PEIR*.

Air quality

Existing conditions

The Lower Thames Crossing will pass close to populated areas both north and south of the River Thames. There are several Air Quality Management Areas designated by Gravesham, Thurrock and Havering Councils. There is also an Air Quality Management Area at the existing Dartford Crossing. These are areas that currently do not exceed UK Air Quality Strategy thresholds.

Designated ecological sites could also be affected by changes in air quality due to the Project.

The key pollutants in relation to road assessments are nitrogen dioxide (NO₂) and particles (PM₁₀). These pollutants have the greatest impact on human health.

Air quality monitoring data has been gathered from local authorities and Highways England, and a Project-specific monitoring survey has also been carried out. The survey included locations along the route that were agreed with local authorities, and ecological sites such as Darenth Wood Site of Special Scientific Interest (SSSI) and Wouldham to Detling Escarpment SSSI, in consultation with Natural England. This baseline information indicates that air quality is currently exceeding UK and EU limits across the study area.

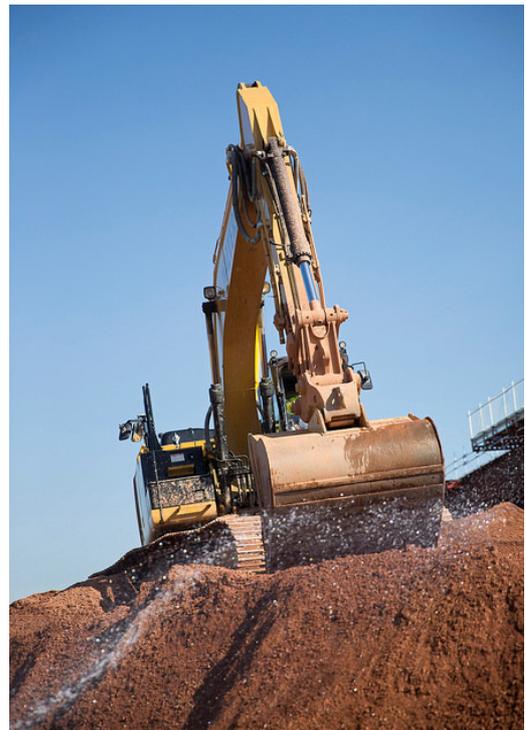
Construction

Key potential impacts

Residential properties, schools, hospitals, ecological designated sites and other sensitive locations within 200m of the roads affected by the Project could be affected by dust generated from construction activities and by emissions from construction traffic and machinery travelling to, from and within the construction sites.

Key potential mitigation

Dust impacts will be minimised by implementing best practice measures such as washing the wheels of construction vehicles before they leave site, damping down surfaces during dusty activities, covering stockpiles and moving dust-generating activities as far away as possible from sensitive receptors. Dust-minimising measures will be



included in the CoCP, which will be submitted as part of the DCO application.

Measures to reduce emissions from construction traffic and machinery will include switching off engines when not in use and making sure that all on-road vehicles comply with the London Low Emission Zone and London Non-Road Mobile Machinery emissions standards. Opportunities to transport construction materials and waste by river are being investigated to reduce the number of construction vehicles using the road network and reduce impacts on local communities.

Operation

Key potential impacts

A preliminary assessment of the operational air quality impacts has been carried out, using a model that has been calibrated against the baseline air quality monitoring data. Air quality has been modelled to represent existing conditions, and future conditions with and without the Project.



The preliminary modelling suggests that the Lower Thames Crossing would improve local air quality in some areas and worsen it in others. Most of the improvements in air quality would be in the Dartford Air Quality Management Area, around the approach to the Dartford Crossing. This would be due to a reduction in traffic and congestion in this area.

Some locations may experience a slight worsening in air quality due to the Project. However, this is:

- unlikely to cause air quality to exceed UK Air Quality Strategy thresholds in areas that wouldn't exceed them without the Project
- unlikely to result in a perceptible negative change in air quality in areas that already exceed the thresholds.

The Project is also unlikely to affect compliance with the EU Ambient Air Quality Directive.

Key potential mitigation

The preliminary air quality assessment suggests that the Project is unlikely to require mitigation for air quality for the operational phase, as there is a low risk of the Project leading to significant adverse air quality effects and exceeding EU limits. However, once the full air quality assessment has been carried out, if significant negative effects are predicted, appropriate mitigation measures will be agreed with the relevant authorities to manage traffic in affected areas.

Further assessment

Further monitoring of existing air quality in the area around the proposed route will be carried out to understand the current conditions. A full, detailed modelling assessment will be undertaken to predict what the air quality would be like in the future both with and without the Project at sensitive locations along the proposed route and along existing roads affected by the Project. The significance of effects on air quality will be assessed and the need for mitigation or monitoring during the operational phase of the Project will be identified. An assessment of construction dust and construction traffic emissions will also be carried out.

Cultural heritage

This topic comprises all aspects of the historic environment: archaeological remains, built heritage and historic landscapes.

Existing conditions

The study area for this assessment considers the area within the Development Boundary, plus a 1km zone extending outwards from it. A limited number of heritage assets outside the 1km area are considered because of potential changes in the setting of these features.

Desk-based studies and site surveys are being carried out across the study area to build a picture of the existing archaeology and cultural heritage in the Lower Thames Crossing area. The following designated assets have been identified within the study area:

- 18 scheduled monuments
- 217 listed buildings
- 11 conservation areas
- 3 registered parks and gardens

Six of these designated assets are within the Development Boundary: the scheduled cropmark complex at Orsett (scheduled monument), four grade II listed buildings and one grade II* registered park and garden at Cobham Hall.

Non-designated assets within the study area comprise:

- 1,673 non-designated heritage assets (historic buildings that are not listed but are still important, and buried archaeological remains)
- 698 Historic Landscape Character units, representing 53 different character types that describe the history and development of the area

Plate 4.1 Tilbury fort



Construction

Key potential impacts

Key potential impacts on cultural heritage features include:

- Physical damage to buried archaeological remains during enabling works and construction. Removal of buried geological deposits, compaction or change in groundwater levels could result in partial or complete removal of the asset or deterioration of its condition. The Orsett Crop Mark Complex scheduled monument will be mostly removed.
- Demolition of two listed buildings and some activity within part of a registered park and garden.
- Impacts on the setting of heritage assets including conservation areas, listed buildings and registered parks and gardens due to removal of vegetation screens, introduction of new structures and movement of construction vehicles in the landscape. Tilbury Fort and Coalhouse Fort could also experience impacts on their setting, but this is unlikely to be significant due to their distance from the Project and limited visibility between their locations and the proposed route.
- Potential removal of deeply buried Palaeolithic remains in the Tunnel Boring Machine launch and receiving shafts.
- Potential removal and compaction of some palaeoenvironmental remains.

Key potential mitigation

Archaeological investigations will take place before construction starts, to check the baseline information compiled during the desk-based studies. Trenches will be dug in areas of known archaeology to determine the extent and significance of the features present.

Geophysical surveys and palaeoenvironmental investigations will also be employed in parts of the Project. The results of these investigations will be used to develop a robust programme of mitigation for all forms of archaeology. For known archaeological remains which will be removed by the Project, preservation by record will be employed. This involves hand excavating and recording (written, surveyed, located, drawn and photographic) on all those areas where impacts cannot be avoided. This will mitigate the removal of archaeological remains through the creation of an archive.

Preservation of the archaeological resource may also be possible in some areas within the Development Boundary. This might be achieved through Early Works design and the positioning of temporary works areas away from areas of known archaeological sensitivity.

The CoCP will include measures to minimise impacts relating to construction activity, including temporary screening, where appropriate.

Operation

Key potential impacts

Impacts on the setting of heritage assets would continue into the operation phase of the Project, due to the presence of the new road, other structures and vehicle movements within the landscape.

Key potential mitigation

Mitigation could include screening of the road through landscape planting and construction of embankments and cuttings, use of appropriate materials for building cladding and sympathetic architecture. This is being developed as part of the landscape mitigation.

Further assessment

Site surveys and various desk-based studies will continue, and findings will inform a cultural heritage desk-based assessment and the ES. Methodologies for all surveys and assessments will be presented in technical specification documents and provided to heritage stakeholders for agreement prior to implementation. Specialist sub-consultants for key areas of the historic environment will be employed to provide advice and technical support, where appropriate.

Landscape

This topic assesses the potential impacts of the Project on the landscape and on visual amenity. This is the visual experience of residents and visitors in the area.

Existing conditions

The study area for landscape extends to 2km on either side of the Project's route on the south side of the River Thames, and 5km either side of the route on the north side of the Thames. The study area is larger on the north side due to the more open, flat nature of the landscape and proposed elevated sections of the Lower Thames Crossing route.

The Lower Thames Crossing will pass through the Kent Downs Area of Outstanding Natural Beauty, green belt land, four National Character Areas and through or near to 23 local authority local character areas. The route also passes close to public rights of way, the Timeball and Telegraph Trail long distance path, National Cycle Route 177, areas used for recreation including Southern Valley Golf Club, Orsett Golf Club and Stubbers Adventure Centre, and areas designated for biodiversity and heritage value. Sensitive visual receptors include viewpoints from public rights of way, recreational areas and residential properties within the study area.

Landscape, townscape, noise and visual surveys are being carried out, as well as baseline photography during winter and summer and at night-time to capture seasonal changes in views. Desk-based research is also being undertaken.

Construction

Key potential impacts

Construction activities are likely to have an adverse impact on landscape character along the whole route, but most notably in the Kent Downs Area of Outstanding Natural Beauty and along the A2 corridor. This area would also experience impacts on tranquillity. North of the River Thames, the landscape is low-lying and flat and areas such as Tilbury Marshes and Orsett Fen are likely to experience adverse impacts. Visual amenity would be impacted for residential properties, visitors to heritage assets, and users of public rights of way, long distance paths, the national cycle route network and other recreational land.

Key potential mitigation

During construction, mitigation will be included in the CoCP and is likely to include appropriate siting of compound buildings and construction access routes, and implementation of a night-time lighting strategy.

Operation

Key potential impacts

Landscape and visual impacts will continue into the operational phase of the Project due to the presence of the new infrastructure and road traffic.

Key potential mitigation

Landscape mitigation is being included in the design of the route where possible. This is likely to include embankments and cuttings to help integrate the road into the landscape. Tree and scrub planting along the road will provide further visual screening.

The new Thong Lane bridge over Lower Thames Crossing is being designed as a 'heavy green structure' with native species hedgerows and coppiced woodland strip, which will reduce the bridge's visual impact and form a wildlife corridor. Several 'light green structures' are being considered: Brewers Road and Thong Lane overbridges over the A2, a structure to reconnect severed footpaths between Thong and Gravesend, and the Southern Valley Golf Club footbridge. These structures would incorporate wide verges and planting.

The tunnel entrances are being designed to be minimally intrusive and to reflect the surrounding local landscape.

Further assessment

Landscape and visual surveys and desk-based research will continue to increase the understanding of the existing environmental conditions and how these will be affected by the Project.

Plate 4.2 Example of landscaping on embankments



Terrestrial biodiversity

Biodiversity covers living organisms, their relationship with each other and with their environment. Terrestrial biodiversity relates to habitats and species located on land.

Existing conditions

The study area for this topic comprises the proposed Development Boundary and a 500m buffer, but also includes locations further away where indirect effects from the Project could occur. Ecology surveys and studies of records held by local authorities, statutory environmental bodies and environmental organisations are being undertaken to understand the presence and distribution of important flora and fauna in the study area.

There are several statutory internationally and nationally designated sites within the study area, including:

- Thames Estuary and Marshes Special Protection Area and Ramsar site
- South Thames Estuary and Marshes SSSI
- Mucking Flats and Marshes SSSI
- Shorne and Ashenbank Woods SSSI
- Great Crabbles Wood SSSI

There are also Local Nature Reserves, Local Wildlife Sites and ancient woodland areas.

The ecology surveys to date have recorded the presence of protected species including reptiles, great crested newts, bats, otters, dormice, water voles, invertebrates and breeding birds. Farmland birds and important birds associated with the Thames Estuary statutory designated sites have also been identified.

Plate 4.3 Song thrush in Cobham Woods



Construction

Key potential impacts

During construction, habitat loss or fragmentation, damage to designated sites and disturbance of protected or important species could occur. These impacts could be caused by site clearance and land take, noise, lighting, movements of construction vehicles, water or air pollution, contamination of soils, and tunnelling which may potentially disrupt the hydrological regime and functioning of the Special Protection Area and Ramsar site.

Key potential mitigation

Impacts on terrestrial biodiversity will be minimised as much as possible through continued development of the Project's route and consideration of construction site locations. Mitigation is being developed in consultation with various statutory environmental bodies, conservation organisations and local authorities.

The CoCP will contain Project-specific requirements to mitigate construction impacts on biodiversity. Measures could include:

- programming the noisiest activities outside of the winter period to minimise disturbance to overwintering birds within the Thames Estuary and Marshes Special Protection Area and Ramsar site
- programming vegetation clearance outside of bird breeding seasons to minimise disturbance
- having an ecologist on site to supervise works that have the potential to cause significant impacts
- using best practice measures to avoid spillages or contamination

Protected species will be moved off-site to suitable receptor areas before construction starts where necessary. New habitats will be created, and existing habitats will be enhanced along the route. This could include:

- creation of new mosaic habitat
- woodland planting, including replacement planting and translocation of ancient woodland soils for any unavoidable loss of ancient woodland
- creation and enhancement of ditches and watercourses
- planting and enhancement of hedgerows
- creation of flower-rich grassland
- replacement places of shelter for protected species (for example, artificial badger setts and bat roosts, nest boxes for barn owls and hibernacula, or shelters, for reptiles)

Operation

Key potential impacts

Once the road is open, potential impacts on terrestrial biodiversity could arise from noise and visual disturbance from traffic and street lighting, pollution from surface water runoff and accidental spillages, changes in air quality that could affect the habitats of designated sites or ancient woodland, and fragmentation of foraging habitat and key flight lines for various species.

Key potential mitigation

The following mitigation is being considered to address operational impacts on terrestrial biodiversity:

- A green bridge is proposed at Thong Lane and green upgrade bridges are proposed at various locations along the route (for more information, see the Landscape section of this document). The road design will include culverts underneath the carriageway. These structures would help to connect habitats either side of the Lower Thames Crossing route and help wildlife to cross the road.
- Tree planting along both sides of the route will help guide birds and bats across the road.

Surface water runoff from the road will be discharged via balancing ponds, which will filter out pollutants before the water reaches watercourses.

Further assessment

Field surveys will continue throughout 2018 and into 2019, and further desk-based research on the terrestrial biodiversity of the study area will be carried out. A Habitats Regulation Assessment to consider the potential effects of the Project on protected habitats will be done, to assess potential impacts on the Thames Estuary and Marshes Special Protection Area. Mitigation and compensation will continue to be developed and incorporated into the design as required.

Plate 4.4 A great crested newt



Marine biodiversity

This topic considers the potential impacts of the Project on the marine biodiversity of the Thames Estuary.

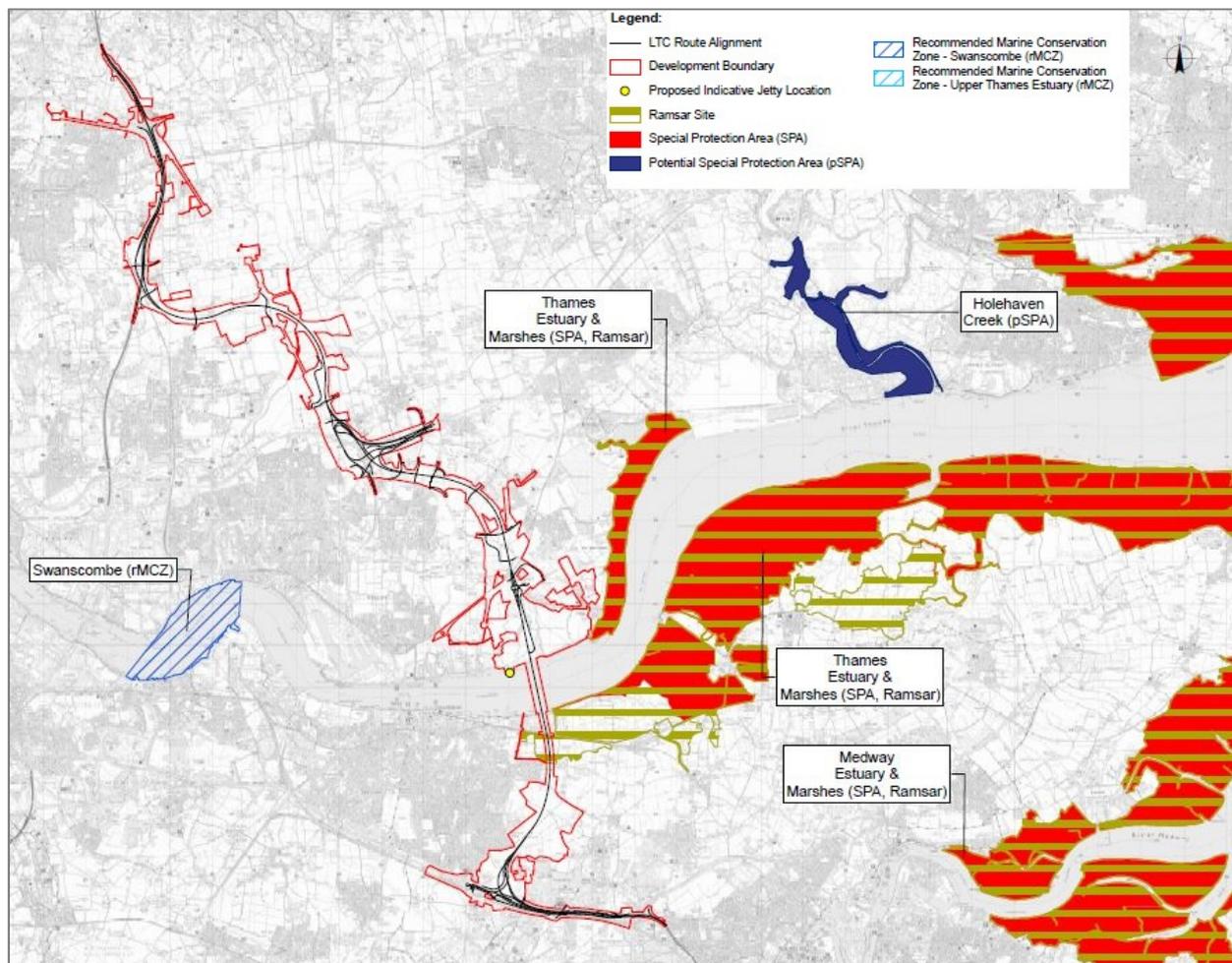
Existing conditions

There are several designated ecological sites with marine components that could be affected by the Project, including:

- Thames Estuary and Marshes Special Protection Area and Ramsar site
- Holehaven Creek potential Special Protection Area
- Holehaven Creek SSSI
- Upper Thames recommended Marine Conservation Zone
- Swanscombe recommended Marine Conservation Zone
- South Thames Estuary and Marshes SSSI
- Mucking Flats and Marshes SSSI

The estuary around the Project has areas of intertidal mudflat, sandflats and saltmarsh that provide key foraging, breeding and nursery habitat for invertebrates and numerous species of fish, which in turn support important bird and mammal populations, including seals and porpoise.

Plate 4.5 Map showing designated marine biodiversity sites in Project study area



Construction

Key potential impacts

Key potential impacts are likely to relate to tunnel construction and the construction, operation and decommissioning of a jetty, which may be required to facilitate the transportation of materials and waste by river. Activities that could cause impacts include land take for the jetty, piling, dredging, surface water discharges (including dewatering), accidental spillages, vessel movements and artificial lighting. Impacts could include:

- disturbance and loss of habitats that support statutory designated sites including the Thames Estuary and Marshes Special Protection Area and Ramsar site
- changes in hydrodynamics and sediment transport regimes due to dredging, which could cause loss of habitats or disturbance to species
- water quality effects on migratory and resident fish
- underwater noise effects on marine mammals and fish
- lighting effects on marine mammals and fish

Key potential mitigation

The jetty design will limit the footprint and the need for piling and dredging where practicable. Soft-start and vibro-piling techniques will be considered to limit the extent and duration of noise emissions. Best practice methods will minimise the impacts of dredging should it be required, and the CoCP will set out pollution prevention and surface water control measures. Consideration will be given to installing directional lighting, and to the timing of the operation of the jetty.

Operation

The operational phase of the Project has been scoped out of the marine biodiversity assessment for the *PEIR*, as the jetty would not be in use once the road is opened, and tunnel dewatering flows would be likely to go to soakaway drains so would not affect marine biodiversity. If scour protection is required for the tunnel to maintain stability in the river, an assessment of impacts on marine biodiversity would be undertaken in the ES.

Further assessment

A more detailed desk-based study and targeted survey and modelling work will inform the assessment for the ES. An assessment of potential effects of the Project on a Marine Conservation Zone will be completed if it is deemed that a proposed Project activity could significantly affect any Marine Conservation Zone feature. Consultation with statutory consultees will continue.

Geology and soils

Geology and soils are an important part of determining the environmental character of an area. This assessment considers potential impacts on rock layers and the soils overlying them.

Existing conditions

Information about the existing ground conditions has been gathered through desk-based research and a site walkover survey. The study area for this topic consists of the Development Boundary plus a 250m buffer zone beyond it.

The Lower Thames Crossing route crosses areas of gravels, clays, sands and alluvium that sit on a bedrock of White Chalk to the south of the river with London Clay to the north.

Made Ground, which is man-made and associated with previous industrial land uses, developments and historic landfill sites, is present across areas of the Project. There are also active landfill sites within the study area.

There are no Geological SSSIs within the study area, but on the north side of the River Thames there are several small Local Geological Sites. These sites have been considered within this assessment.

The Lower Thames Crossing route passes through Mineral Safeguarding Areas on both sides of the River Thames.

Construction

Key potential impacts

During construction, potential impacts include the:

- loss of geological resources
- contamination of soils, groundwater and surface water and risk to human health due to disturbance of contaminated land during construction activities such as piling, or spillages of oil or other substances
- risk to the Project from ground instability, areas of soft ground, sink holes or other geohazards
- disturbance of Unexploded Ordnance (UXO)
- migration of ground gases from landfill sites and build-up in confined spaces

Key potential mitigation

An intrusive ground investigation will be carried out before construction starts. Remediation of contaminated soils would occur if contaminated material is encountered, and any areas of ground instability would be considered within the finalised design of the route. To minimise human health risks of disturbing UXO, detecting equipment will be used during the ground investigation and construction activities in higher risk areas. These activities would also be supervised by a UXO specialist. Gas monitoring will be carried out during the ground investigation and monitoring, alarms and personal protective equipment would be used as required during construction.

The CoCP will include measures to prevent pollution and minimise risks to human health, geology and water bodies during construction activities.

Operation

Key potential impacts

Once the road is open, potential impacts include settlement due to ground movement, migration of ground gases into service ducts or other structures, sterilisation of minerals within safeguarded areas and contamination in the event of a large fuel spill. The risk to road users is likely to be low.

Key potential mitigation

Mitigation will be incorporated into the design to account for settlement, soft ground and land stability issues. Confined spaces such as service ducts will be designed with

appropriate gas mitigation measures to reduce the risk from ground gases on human health and structures. A mineral safeguarding assessment report will be prepared before construction to assess and minimise the impact on safeguarded materials.

Further assessment

Further detailed desk-study work will be carried out. An extensive ground investigation including geophysical surveys and studies of satellite imagery and aerial photography will be undertaken to inform the Project design and findings will be reviewed to assess impacts on geology, soils and contaminated land.

Plate 4.6 Example of ground investigation



Materials

This topic assesses the potential impacts of the Project on material resources (including primary raw materials and manufactured construction products) and waste.

The materials required for construction of the Project include metals, aggregate, pavement, concrete and soils. Most materials will need to be purchased and transported to the site. Some materials may be available on site; for example, soils that will be excavated during the Project may be suitable to reuse elsewhere on the Project.

Existing conditions

Many of the materials required for the Project are finite resources. Use of these resources therefore needs to be minimised where possible, and sustainable sources of material need to be considered. Materials will be sourced locally where available.

A study of landfill capacity around the Lower Thames Crossing area has been carried out. Most construction, demolition and excavation waste in Greater Essex (including Essex and Thurrock), Kent and Medway are currently received by landfill sites (although some of this material may be reused, for example as capping or restoration).

There are no waste facilities for receiving most types of hazardous waste in Kent and Essex, although there is some limited capacity to receive stable non-reactive hazardous waste. There is some capacity for inert (chemically inactive) and non-hazardous waste.

Construction

Key potential impacts

The Project will require material resources for construction and therefore will deplete supplies of these materials. The Project is anticipated to produce waste, including large quantities of excavation of soils and tunnelling waste. If all Project waste arisings were sent off-site for disposal or recovery, there would be an impact on the local waste management infrastructure capacity. For materials and waste that are transferred on and off-site by road, congestion on the road network and impacts on local noise and air quality could occur.

Key potential mitigation

The Project is being designed to minimise the use of materials and production of waste. Potential mitigation to minimise new material use includes reusing materials on site (such as uncontaminated soils from excavation works) where possible, using secondary and recycled aggregate, reclamation of sand and gravel from within the Development Boundary, and including requirements for contractors to monitor and report progress on sustainability targets.

Waste production will be avoided where possible through the design, and opportunities to reuse or recycle material on or off-site will be assessed. There would be appropriate segregation, treatment and disposal of any waste that cannot be reused in the Project. By minimising material use and waste production, transport movements during construction would be reduced. Impacts on the local road network would be reduced by installation of temporary haul roads at key access points. Consideration is also being given to the use of the river for transporting waste.

Operation

Key potential impacts

Waste would be produced during the operation of the Project, for example, from site offices at the tunnel entrances and from maintenance repairs to the road and highways structures. Materials would be needed for maintenance repairs.

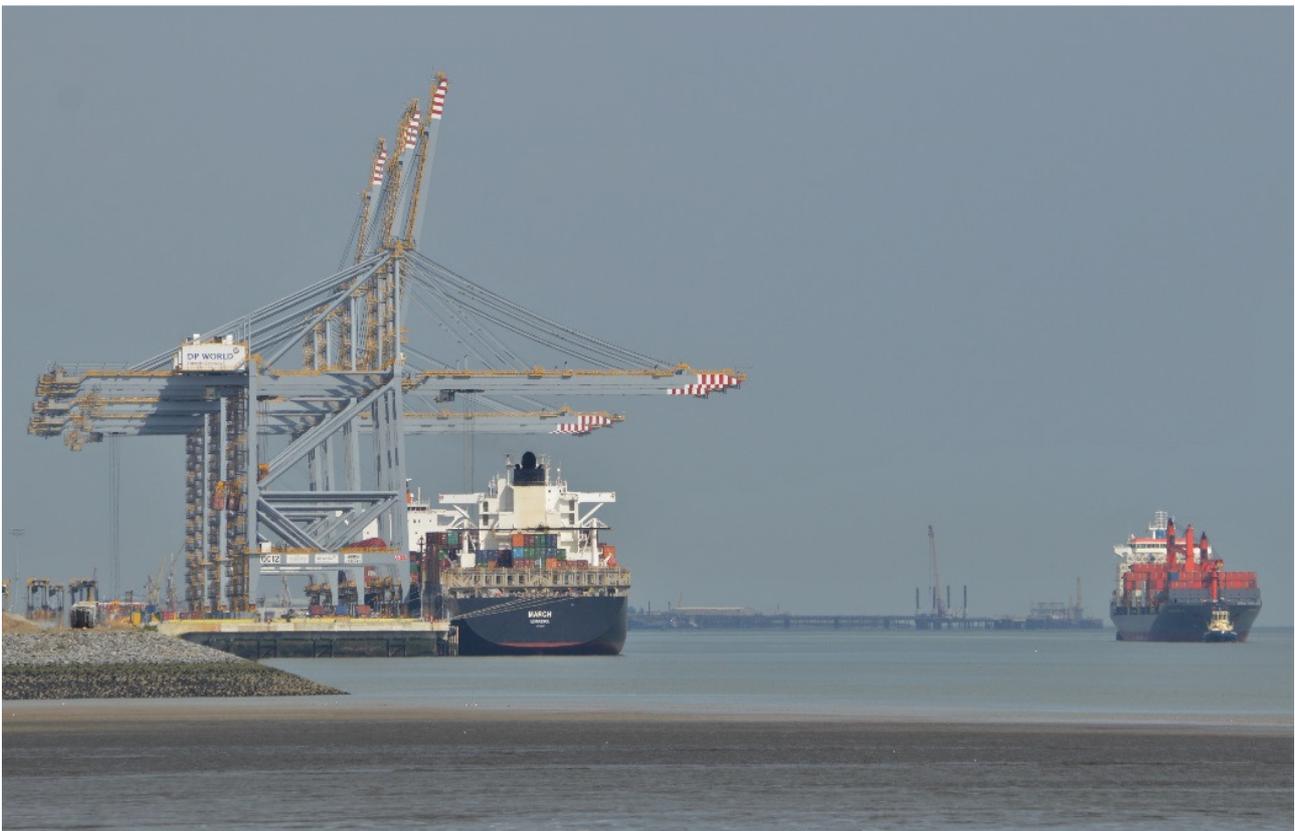
Key potential mitigation

Waste would be managed in accordance with Highways England standards and UK legislation. Operational targets would be set to reduce material use and waste generation. Volumes of materials and waste would be minor compared to the volumes anticipated for the construction phase of the Project, and no additional mitigation measures are expected to be needed.

Further assessment

Further study of the use of the river for transporting materials and waste will be carried out. Work will continue to identify waste facilities that could be used for the Project and to consider ways of reusing excavated material, including material from the tunnelling. The design will continue to be reviewed to reduce material use where possible.

Plate 4.7 Example of transport by river



Noise and vibration

Potential noise and vibration impacts are considered for both the construction and operation phases of the Project. These impacts would affect communities and the surrounding environment.

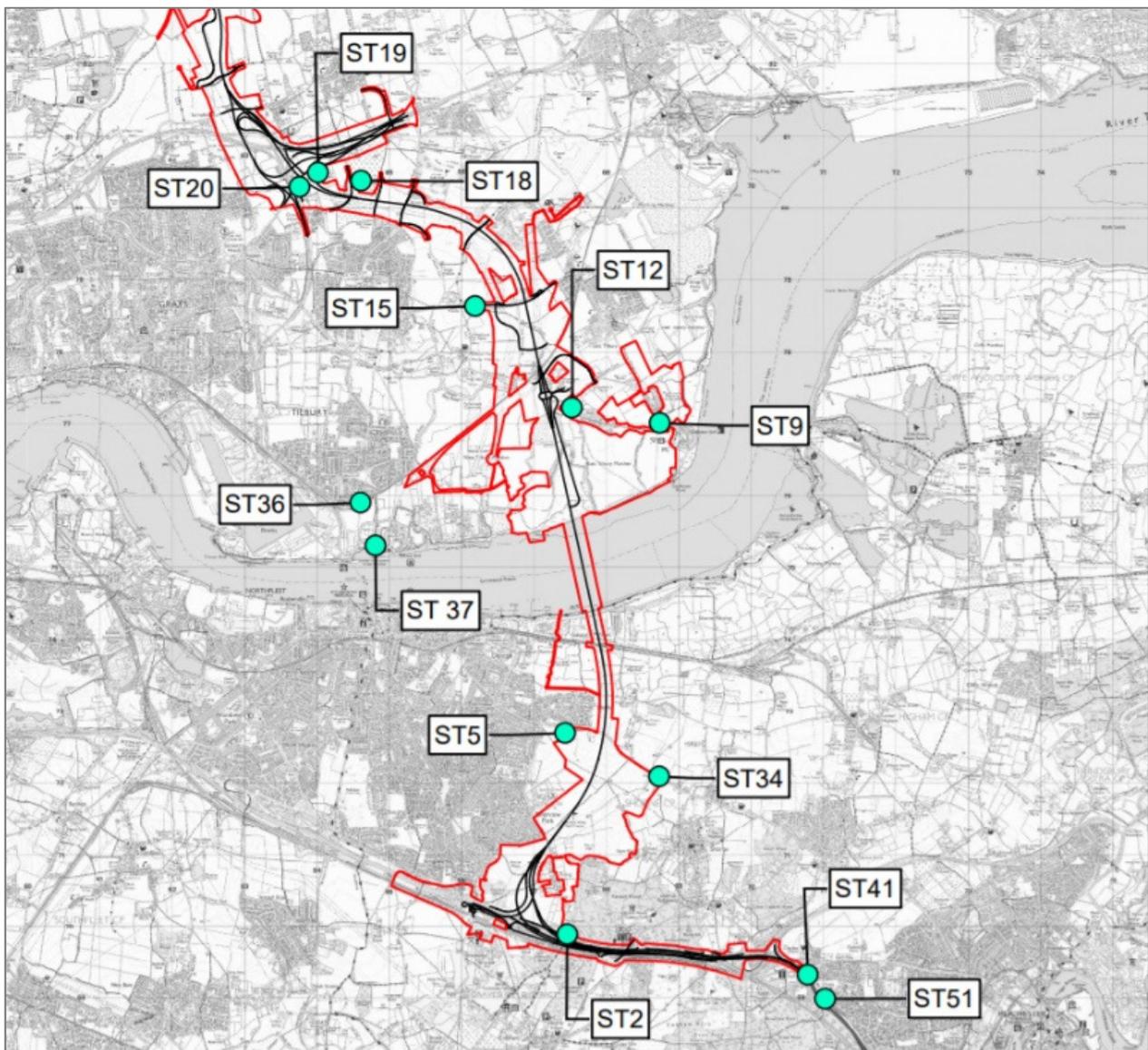
Existing conditions

The Lower Thames Crossing will pass close to populated areas, and rural areas with outlying dwellings, with noise sensitive receptors such as residential properties, schools, nurseries, care homes, places of worship, hotels, recreational areas and community centres.

There are 26 Noise Important Areas designated by the Department for Environment, Food and Rural Affairs which are likely to be within the final noise assessment calculation area. These are areas where the top 1% of the population that are affected by the highest noise levels in England are located.

Noise monitoring has been carried out to understand the existing noise climate in the Lower Thames Crossing area. The main sources of noise are road traffic, and in some places rail movements. Background noise levels vary across the area, depending on how close locations are to roads or railways, and whether they are rural or urban.

Plate 4.8 Noise monitoring areas



Three-dimensional noise modelling has been carried out for the construction phase of the Project, for future road traffic noise levels without the Lower Thames Crossing and for future road traffic noise levels with the Lower Thames Crossing.

Construction

Key potential impacts

During construction, noise is likely to result from construction machinery, compounds containing static features, tunnelling activities and site deliveries. Vibration may occur during piling activities and during the operation of the TBMs. Sensitive receptors within 300m of the Development Boundary could be affected by these activities. There is potential for both daytime and night-time noise and vibration impacts to occur; for example, the TBMs will need to operate 24/7 during the tunnelling period.

Key potential mitigation

Construction noise and vibration levels will be minimised by adopting best practice measures and through consultation with local authorities. These measures will be implemented through the CoCP. Examples of these measures include:

- locating generators and other static plant as far away from noise sensitive receptors as possible
- installing temporary fencing or barriers around particularly noisy construction activities
- providing contact details for a site representative and ensuring that any complaints are dealt with proactively

Operation

Key potential impacts

During operation, short-term and long-term perceptible adverse changes in road traffic noise levels are predicted to occur at dwellings and other noise sensitive receptors at various locations along the route. There may also be localised noise impacts associated with the tunnel ventilation systems.

Key potential mitigation

The following mitigation measures to reduce noise levels will be investigated:

- Barriers: installing barriers, where required, in the form of earth mounding or acoustic fencing or a combination of the two
- Low-noise road surfaces: these surfaces can reduce noise from vehicles travelling at high speeds
- Design of tunnel ventilation systems: to include low noise equipment where possible and silencer units/acoustic screening where required

Further assessment

Additional noise monitoring will be carried out across the study area. A fully detailed modelling study of noise levels will be carried out to predict construction and operational noise levels to determine potential impacts and the need for mitigation. This will be based on forecasted traffic flows.

People and communities

This topic considers the impact of the Project on people in their daily lives, for example where they live and work, services they use, places they visit, and the connections between these places. It also considers potential impacts on agriculture.

Existing conditions

The Lower Thames Crossing will pass close to residential properties, businesses, public rights of way and other access routes, Open Access Land and other amenity and recreation areas. Agricultural land and farm businesses are present across the Development Boundary. The route will pass through or near to rural and urban areas, with a mixture of highly populated areas and areas with a sparser population.

Construction

Key potential impacts

During construction, potential impacts may include:

- land take from businesses or private landowners, including land allocated for development, community open space and sports and leisure facilities
- demolition of certain commercial and residential properties within the Development Boundary
- changes in access to commercial and residential properties
- loss of agricultural land and disruption to agricultural business operations
- access restrictions and diversions to public rights of way, cycle routes and national trails
- noise, air quality and visual impacts for people living in or visiting the area
- beneficial impacts on the local and wider economy through job creation and demand for goods and services

Key potential mitigation

Consultation with landowners, occupiers and agents will continue as the Project develops to manage and reduce impacts as much as possible. Eligibility of landowners for compensation for loss of land will be determined in accordance with the Compensation Code. Temporary access routes to commercial and residential properties will be put in place where necessary.

Noise and air quality impacts during construction will be minimised by using best practice measures to ensure contractors act considerately in relation to residents. Construction sites will be required to be kept tidy and waste will be stored and disposed of correctly, which will help reduce visual impacts for local communities. Sites will be kept secure, with the use of hoardings and locking gates. Site safety rules will include supervising construction vehicles leaving and entering the site and marshalling pedestrians as necessary. These measures will be documented in the CoCP.

Where possible, land needed for construction will be returned to agricultural use once construction is complete. Potential impacts on the viability of farm businesses are being discussed with land owners and compensation agreements will be reached where appropriate.

Temporary diversions to public rights of way, cycle routes and national trails will be put in place.

Operation

Key potential impacts

Impacts that would continue into the operation phase of the Project include permanent loss of land, changes in noise levels, air quality and views and local and wider economic benefits.

Key potential mitigation

The Project is being designed to minimise the amount of land needed both temporarily and permanently. All routes such as public rights of way, bridleways, cycle routes and national trails that have been severed by the Project during the construction phase would be reinstated by means of bridges or underpasses, which would need to be accessible for wheelchair users.

Further assessment

Consultation with communities, landowners and businesses likely to be affected by the Project will continue to identify ways of minimising the impacts and determine compensation requirements.

A number of assessments are being carried out to look at the potential impacts of the Project, including:

- how communities and road users will be affected by the Project, for example, how the cost of travel may change for different communities
- ensuring that the Project does not discriminate against, or disadvantage, people or communities
- considering how people other than car users could be impacted by the Project, for example, pedestrians, cyclists and horse riders
- minimising negative health and environmental impacts – including air quality, noise levels and protecting areas of open space
- exploring the impacts on people's ability to access jobs, schools and healthcare facilities



Road drainage and the water environment

The water environment includes surface water bodies such as rivers, streams and lakes, and groundwater bodies such as aquifers.

Existing conditions

The main surface water features in the Lower Thames Crossing area are the River Thames, watercourses draining through the ecologically designated sites adjacent to the

Thames, the Mardyke and its tributaries, and the Tilbury Main and other watercourses which drain West and East Tilbury Marshes.

There are several groundwater aquifers along the Lower Thames Crossing route. The most important aquifer in terms of abstraction for public water supply, industry and agriculture is the Chalk aquifer, which is present both north and south of the River Thames.

The Lower Thames Crossing will cross the River Thames floodplain, which is classified as Flood Zone 3 (high risk of flooding) but benefits from the protection of tidal flood defences. The route will also cross the Mardyke fluvial floodplain, which is classified as Flood Zone 3 (high risk of flooding) with flood defences in some locations. There are also localised risks of flooding from surface water in some areas.

Construction

Key potential impacts

During construction, impacts on the water environment could include:

- pollution of watercourses and groundwater due to spillages, incorrect storage of materials and waste or mobilisation of sediments. This could be due to construction of the temporary jetty in the River Thames and potential scour protection for the tunnel as well as temporary pumping of groundwater, sometimes known as dewatering, during construction of deep excavations (including the tunnel entrances)
- increased demand for water which would lower river or groundwater levels
- changes to surface water drainage

These impacts have the potential to degrade existing groundwater sourced abstractions, such as permitted potable water supply at Linford and unlicensed or private sources of water supply. They could also affect ecologically designated sites including the Thames Estuary and Marshes Ramsar site and the South Thames Estuary and Marshes SSSI.

Temporary loss of floodplain storage in the Thames Estuary tidal floodplain and the Mardyke river floodplain may occur due to construction within these floodplains.

Key potential mitigation

Use of best practice measures during construction will minimise the likelihood of spillages and other incidents which could adversely affect the water quality of surface watercourses. Dewatering will include best practice methods to reduce effects on surrounding groundwater levels, groundwater quality and existing sources of water supply. Flood compensation areas (earthworks to increase the capacity of the floodplain) will be created in consultation with the Environment Agency to avoid increasing flood risk.

Operation

Key potential impacts

During operation, potential impacts include:

- long-term changes in groundwater levels and groundwater pollution
- degradation of water quality in water bodies that receive runoff from the highway
- increased flood risk due to works within the floodplain and new watercourse crossings

Plate 4.9 Example of flood defences



Key mitigation

Flood compensation areas, along with appropriate watercourse crossings or diversions, will ensure flood risk is not increased. All highway drainage, whether draining to existing watercourses or to the ground, will have pollution control systems. Attenuation ponds and swales will be used to regulate drainage from the highway and filter out pollutants.

Further assessment

A Flood Risk Assessment will be prepared to inform the design of any flood risk management measures that may be necessary. A hydrogeological risk assessment will identify requirements for monitoring and mitigation. A Water Framework Directive assessment will also be prepared.

Climate

The climate assessment is divided into two sections:

- Greenhouse gas emissions – assesses how the Project would impact the climate in relation to greenhouse gas emissions
- Climate change adaptation – assesses the vulnerability of the Project to climate change in the south-east of England and how climate change is likely to change in the future

This assessment is closely linked to other environmental topics, such as air quality, biodiversity, materials and people and communities.

Existing conditions

The total CO₂e (carbon dioxide equivalent) emissions from transport was 126 million tonnes for the UK in 2016 and 20 million tonnes for the South East in 2015 (latest data available).

Statistical results suggest that the UK daily maximum and minimum temperature extremes have increased by just over 1°C since the 1950s, and that heavy seasonal and annual rainfall events have also increased. Kent, Essex, Thurrock and Havering have all experienced extreme weather events including heavy rainfall and flooding, storms and extreme summer and winter temperatures which have affected infrastructure, homes, businesses and communities.

It is predicted that climate will increase the frequency and severity of some types of extreme weather events in England. The UK Climate Projections 2009 generally show that warmer, drier summers are more likely along with warmer, wetter winters.

Construction

Key potential impacts

The Project will contribute towards greenhouse gas emissions and therefore climate change through use of materials and energy, construction vehicle emissions, and water consumption. However, it is estimated that additional vehicle movements and emissions associated with the construction of the Project would be a very small percentage of the total emissions in the area, so it would have a negligible effect on regional climate change.

Due to the short-term nature of the construction phase it is considered unlikely that there will be significant changes to the climate during this period. Any vulnerabilities associated with flooding will be assessed within the ES. As the design evolves between now and the DCO submission, a further risk assessment will be undertaken to ensure that the construction design of the Project is sufficiently resilient to climate change vulnerability.

Key potential mitigation

Sufficient measures will be included within the CoCP to minimise water use, prevent water pollution, minimise dust emissions during construction, and prepare for extreme weather events. Material use will be minimised where possible through the design, which will reduce the greenhouse gas emissions associated with material production and transportation.

Operation

Key potential impacts

Greenhouse gas emissions from the operation of the Project would mainly result from vehicle emissions.

Potential impacts relating to the vulnerability of the Project to climate change include:

- damage to the road and structures such as bridges due to increased rainfall causing flooding or ground movement
- increased stress on bridge joints caused by higher temperatures, meaning they need to be repaired more regularly
- flooded drains, collapsed culverts, contaminated water and the need for road or tunnel closures due to heavy rain or flooding

- collapsed earth embankments due to heavy rain
- decrease in the suitability of the area for tree species planted as part of the Project, due to increased temperatures and decreased rainfall
- impact on habitats enhanced as part of the Project and areas that protected species have been relocated to, due to increased temperatures
- increase in traffic incidents due to higher temperatures causing an increase in vehicle fires and overheating engines
- more dangerous working conditions for highways maintenance staff as maintenance could be required more regularly and in more extreme weather conditions

Key potential mitigation

The design will need to be resilient to extreme weather events such as flooding and drought. The sections of the Project that will be built within a floodplain will need to be able to withstand future river and tidal flooding. The Project design includes sustainable drainage system measures which would help to recharge groundwater supplies. Mitigation measures identified for specific environmental topics will take account of climate change to reduce the vulnerability of the Project. For example, trees that are proposed for landscaping purposes could be chosen based on their ability to cope with hotter, drier conditions.

Further assessment

The UK Climate Projections 2018 will be released later this year and will provide the latest information on future climate. These projections will be reviewed and used to assess the impact of the Project on climate and how climate may affect the Project. Further consultation with key organisations will be carried out to gather further information on the existing climate and how it is changing.

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5 What happens next?

The design of the Project will continue to be developed and will consider the feedback from this consultation. The EIA will be carried out and will be used to inform the design. Environmental mitigation will be developed further, and key organisations will be consulted throughout the process.

Once the DCO application is submitted to the Planning Inspectorate, they will examine it and make a recommendation to the Secretary of State about whether the Project should go ahead. If the application is approved, the Project can be built.

For more information on how to participate in this consultation, and how to stay involved with the Project afterwards, please see our booklet *Your guide to consultation* or visit our website www.lowerthamescrossing.co.uk/haveyoursay

Plate 5.1 Digital representation of the Lower Thames Crossing tunnel



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Glossary

Term	Explanation
Area of Outstanding Natural Beauty	A statutory designation intended to conserve and enhance the ecology, natural heritage and landscape value of an area of countryside.
Air Quality Management Areas	An area, declared by a local authority, where air quality monitoring does not meet Department for Environment, Food and Rural Affairs national air quality objectives.
CoCP	Code of Construction Practice: a written document to be provided at DCO which will include measures to minimise impacts relating to construction activity.
Department for Environment, Food and Rural Affairs	The government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the UK.
DfT	Department for Transport: the government department responsible for the English transport network and a limited number of transport matters in Scotland, Wales and Northern Ireland that have not been devolved.
EIA	Environmental Impact Assessment: an analytical process that systematically examines the likely significant environmental effects of a project.
ES	Environmental Statement: a written document which sets out the findings of the EIA process, and particularly a description of the likely significant effects of the proposed development on the environment and a description of any measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment.
Flood Risk Assessment	A flood risk assessment (FRA) is an assessment of the risk of flooding from all flooding mechanisms, the identification of flood mitigation measures and should provide advice on actions to be taken before and during a flood.
Habitats Regulation Assessment	A tool developed by the European Commission to help competent authorities (as defined in the Habitats Regulations) to carry out assessment to ensure that a project, plan or policy will not have an adverse effect on the integrity of any Natura 2000 or European sites (Special Areas of Conservation, Special Protection Areas and Ramsar sites), (either in isolation or in combination with other plans and projects), and to begin to identify appropriate mitigation strategies where such effects were identified.
Historic Landscape Character	Historic Landscape Characterisation is a formal process of the study of the historic landscape, utilising an array of sources including historic maps, archaeological data and aerial photographs. HLC identifies and describes the essential characteristics of the land being studied. The studied areas are recorded chiefly in GIS format as polygons.
MCZ	Marine Conservation Zone: protects a range of nationally important marine wildlife, habitats, geology and geomorphology, and can be designated anywhere in English and Welsh territorial and UK offshore waters.
Mineral Safeguarding Area	Mineral Safeguarding Area: an area designated by Minerals Planning Authorities which covers known deposits of minerals which are desired to be kept safeguarded from unnecessary sterilisation by non-mineral development.
Noise Important Area(s)	Defra published noise maps for England's roads in 2008, with the noise action plans following 2 years later in 2010. The action plans set out a framework for managing noise, rather than propose specific mitigation measures, and were designed to identify 'Important Areas' that are impacted by noise from major sources and therefore must be investigated. These are where the 1% of the population that are affected by the highest noise levels from major roads are located, according to the results of Defra's strategic noise maps.

Term	Explanation
Planning Inspectorate	An executive agency that deals with Nationally Significant Infrastructure Project planning applications in England and Wales.
Public rights of way	A right possessed by the public to pass along routes over land at all times. Although the land may be owned by a private individual, the public may still gain access across that land along a specific route. The mode of transport allowed differs according to the type of public right of way which consist of footpaths, bridleways and open and restricted byways.
Ramsar	A wetland of international importance, designated under the Ramsar convention.
Special Protection Area	A designation under the European Union Directive on the Conservation of Wild Birds.
SSSI	Site of Special Scientific Interest: a conservation designation denoting an area of ecological or geological importance.
TBM	Tunnel boring machine: a machine used to excavate tunnels with a circular cross-section.
Water Framework Directive	A European Community Directive (2000/60/EC) of the European Parliament and council designed to integrate the way water bodies are managed across Europe.

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