highways england

Lower Thames Crossing

Pre-Consultation Scheme Assessment Report

Volume 7: Appraisal Conclusions and Recommendations

Section 12: Appendices

Volume 7

Lower Thames Crossing
Route Consultation 2016

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Explanation of abbreviations used in the Appraisal Summary Tables

Abbreviation	Full Description
SSSI	Site of Special Scientific Interest
AONB	Area of Outstanding Natural Beauty
AQSO	Air Quality Strategic Objective
SPA	Special Protection Area
BAP	Biodiversity Action Plan
LWS	Local Wildlife Site

Appendix 7.1
Appraisal Summary Table Route 2 WSL (BT)

Appraisal Summary Table Route 2 WSL (BT)

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Appraisal Summary Table | **Route 2, Western Southern Link, Bored Tunnel** | **Date produced:** 22 Jan 2016

Contact:	
Name	Chris Taylor
Organisation	Highways England
Role	Project Sponsor

Name of scheme:	Route 2 Bored Tunnel with Western Southern Link - Core Growth, Central Case costs, Current values of time, additional lane in Tunnel
Description of scheme:	New Dual 2 lane trunk road (70mph) from M25 between J29 and J30, linking with A1089, crossing the Thames in a bored tunnel, with additional lane for future proofing, 2km to the east of Gravesend with a westerly southern link to the A2.

Impacts		Summary of key impacts	Assessment					
			Quantitative				Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	**Value of journey time changes(£)** £2,672m **Net journey time changes (£)** 0 to 2min: -£345m; 2 to 5min: £1,154m; > 5min: £1,863m				N/A	£3,020m	Not appraised yet
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A				N/A	£103m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling	N/A				N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are over 70% higher than those for Route 1. Almost 80% of WI benefits are from the agglomeration of business activities.	**Agglomeration** £981m **Output in imperfectly competitive markets** £282m **Labour supply impacts** £1m				N/A	£1,264m	
Environmental	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	74 people would benefit based on an estimated 12,418 people being annoyed by noise in the without scheme situation decreasing to 12,344 people in the with scheme situation.				N/A	£3m	Not appraised yet
	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors modelled are predicted to exceed the AQSO without the scheme (representing up to approximately 60 receptors), but these receptors experience an improvement compared to the without scheme. The scheme is not predicted to lead to any new exceedences.				N/A	N/A	Not appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-traded carbon over 60y (CO2e) 5,687,161 tonnes Change in traded carbon over 60y (CO2e) 15,890 tonnes				N/A	-£260m	
	Landscape	A new road corridor would adversely affect the landscape character including in the vicinity of Tilbury, Grays and Chadwell St Mary, green belt and intrude slightly into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.	N/A				Large Adverse	N/A	
	Townscape	See Landscape entry	N/A				N/A	N/A	
	Historic Environment	Direct physical impacts to two scheduled monuments, one conservation area and two Grade II listed buildings. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint.	N/A				Moderate Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land), impacts on LWSs & areas of BAP Priority Habitat. Direct loss of ancient woodland at Claylane Wood and loss of deciduous (not ancient) woodland at Shorne and Ashenbank Wood SSSI.	N/A				Large Adverse	N/A	
	Water Environment	Impacts on Mardyke and crosses the Tilbury Flood Storage Area.	N/A				Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing	**Value of journey time changes(£)** £721m **Net journey time changes (£)** 0 to 2min: -£198m; 2 to 5min: £353m; > 5min: £566m				N/A	£296m	Not appraised yet
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A				N/A	£40m	
	Physical activity	The option has no impact on walking and cycling	N/A				N/A	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. With the WSL the A2 junction has a compact junction layout arrangement, due to existing constraints, with slip/ link roads which have a design speed of 30-50 mph. Route 2 uses the A1089 (the access to Tilbury Port) for part of the route, which will involve mixing of strategic traffic with local traffic which has a high percentage of HGVs	N/A				Moderate Beneficial	N/A	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	Because it is a new route 2,453 additional accidents are predicted over 60 years, including 34 fatalities, 265 serious injuries and 3,424 slight casualties				N/A	-£126m	Not appraised yet
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network	N/A				Slight Adverse	N/A	Not appraised yet
	Access to services	Not appraised because this criteria relates to public transport options	N/A				N/A	N/A	N/A
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at Dartford Crossing today	N/A				Neutral	N/A	Not appraised yet
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A				Slight Adverse	N/A	Not appraised yet
	Option and non-use values	Not appraised because this criteria relates to public transport options	N/A				N/A	N/A	
Public Accounts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Investment costs: £2,101m Operating costs £276m Operator revenue £799m (a benefit, offsetting cost over the longer term)				N/A	£1,578m	
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing	N/A				N/A	£550m	

Annex 1 – TEE Table

Annex 1: TEE Table

Economic Efficiency of the Transport System (TEE): Route 2 WSL Bored Tunnel

Non-business: Commuting	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	£87,080,499		£87,080,499			
Vehicle operating costs	-£64,578,699		-£64,578,699			
User charges	£124,683		£124,683			
During Construction & Maintenance	£0					
COMMUTING	£22,626,483	*(1a)*	£22,626,483			

Non-business: Other	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	£633,744,285		£633,744,285			
Vehicle operating costs	-£358,953,283		-£358,953,283			
User charges	-£1,624,818		-£1,624,818			
During Construction & Maintenance	£0					
NET NON-BUSINESS BENEFITS: OTHER	£273,166,184	*(1b)*	£273,166,184			

Business							
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**
Travel time	£2,671,840,846		£646,983,033	£2,024,857,813			
Vehicle operating costs	£454,157,831		£302,404,515	£151,753,316			
User charges	-£105,622,227		-£51,084,465	-£54,537,762			
During Construction & Maintenance	£0						
Subtotal	£3,020,376,451	*(2)*	£898,303,083	£2,122,073,368			

Private sector provider impacts			**Freight**	**Passengers**
Revenue				
Operating costs				
Investment costs				
Grant/subsidy				
Subtotal	£0	*(3)*		

Other business impacts			
Developer contributions		*(4)*	
NET BUSINESS IMPACT	£3,020,376,451	*(5) = (2) + (3) + (4)*	

TOTAL		
Benefits (TEE)	£3,316,169,118	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Annex 2 – PA Table

Annex 2: Public Accounts (PA) Table

Route 2 WSL Bored Tunnel

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue						
Operating Costs						
Investment Costs						
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	-£799,257,784		-£799,257,784			
Operating costs	£276,096,332		£276,096,332			
Investment Costs	£2,100,706,167		£2,100,706,167			
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£1,577,544,716	*(8)*	£1,577,544,716			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-£549,652,276	*(9)*	-£549,652,276			
TOTALS						
Broad Transport Budget	£1,577,544,716	*(10) = (7) + (8)*				
Wider Public Finances	-£549,652,276	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Annex 3 – AMCB Table

Annex 3: AMCB Table

Route 2 WSL Bored Tunnel

Analysis of Monetised Costs and Benefits

Noise	£3,135,613	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	-£259,882,158	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	-£125,900,000	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£22,626,483	*(1a)*
Economic Efficiency: Consumer Users (Other)	£273,166,184	*(1b)*
Economic Efficiency: Business Users and Providers	£3,020,376,451	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	£549,652,276	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£3,483,174,849	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£1,577,544,716	*(10)*
Present Value of Costs (see notes) (PVC)	£1,577,544,716	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£1,905,630,134	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.2	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Annex 4 – Biodiversity Worksheet

Annex 4: TAG Biodiversity Impacts Worksheet

Route 2 WSL Bored

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of *Circus cyaneus*.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Mucking Flats and Marshes SSSI	Botanical interest: Mudlfats and Saltmarsh.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	**Neutral**
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important birds	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site - High importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status. Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens.	Not possible to substitute	High - nationally important ancient woodland.	Intermediate Negative	**Large Adverse**
Shorne and Ashenbank Woods SSSI	Woodland invertebrates.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important invertebrates	Intermediate Negative	**Large Adverse**
Hangman's Wood and Deneholes SSSI	Remains of medieval chalk mines, provide the most important underground hibernation site for bats in Essex. Brown long eared, Natterer's and Daubenton's.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable	Not possible to substitute, medieval chalk and ancient woodland	High - nationally important for bats and ancient woodland	Neutral	**Neutral**
Hangman's Wood and Deneholes SSSI	Area of semi-natural habitat in which bats can feed. A relict fragment of ancient woodland, dominated by Pedunculate Oak Ash, Sycamore with occasional Wild Cherry and Elm.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable	Not possible to substitute, medieval chalk and ancient woodland	High - nationally important for bats and ancient woodland	Neutral	**Neutral**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Thames Estuary recommended MCZ (on hold)	Marine and estuarine habitats and species.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Not possible to substitute	Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992).	Neutral	**Neutral**
Greater Thames Marshes Nature Improvement Area	Complex of habitats of value for biodiversity and as a community resource.	Regional	Attribute of value to local communities, of Medium importance.	Some goals are being achieved.	Not possible to substitute	Medium - community value and extensive area	Minor Negative	**Slight Adverse**
Claylane Wood - Ancient Woodland	Ancient Woodland	National	Ancient woodland habitat, high Importance for biodiversity.	Nationally ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens.	Not possible to substitute	High - important ancient woodland	Intermediate Negative	**Large Adverse**
Priority Habitat - Deciduous Woodland (Disrupted in several places to various degrees - see also individual Local Wildlife Sites (below)). In addition, impact on woodland around Buckland and Brook Farm (north of the East Tilbury Marshes), A126 roundabout near Bretts farm (north of Tilbury), small section on A226 south east of Chalk	Priority BAP habitat. Some will be lost/severely impacted.	Local	Medium importance, BAP habitat	Nationally lowland mixed deciduous woodland is declining due to clearance, over-grazing, and replanting with non-native species.	Replacement planting and/translocation of habitats a possibility.	Medium - BAP priority habitat	Intermediate Negative	**Moderate Adverse**
Priority habitat - Coastal Saltmarshes (south of river, as part of Shorne Marshes and Eastcourt Marshes)	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within who wider network of habitats, likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	**Neutral**
Priority Habitat - Intertidal mudflats (particularly northern bank of the river at crossing, down stream of the Thames Estuary and Marshes (RAMSAR))	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority Habitat - Coastal and Floodplain Grazing Marsh including freshwater ditches/ponds	Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites)	Low to High, dependant on functioning within the wider network of habitats.	Likely to be decreasing due to agricultural improvement, drainage and development.	Replacement habitat creation potentially possible (e.g. managed realignment or creation of freshwater wetland habitats), but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority habitat - Traditional Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance.	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility.	Medium - BAP priority habitat.	Major Negative	**Moderate Adverse**
Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1 interchange)	Priority BAP habitat	Local	Wood-pasture and Parkland BAP habitat - Medium importance.	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to recreate mature habitats	Medium - BAP priority habitat.	Minor Negative	**Slight Adverse**
Th34 Blackshots Nature Area	Local wildlife Site - rough grassland and deciduous woodland.	Local	Large area of rough grassland and important invertebrate population, as well as providing potential nesting habitats for birds such as skylark. UK BAP fly species *Dorycera graminum* found here.	Species rich grasslands are decreasing, unmanaged grassland is likely to be increasing. Nationally deciduous woodland is declining.	Replacement planting a possibility but limited space available.	Medium - BAP priority habitat.	Minor Negative	**Slight Adverse**
Th35 Little Thurrock Reedbeds	Local wildlife Site. Of importance for cohesion between designated sites and for sustaining populations of birds such as bearded reedling.	Local	BAP habitat. Low to Medium, dependant on functioning within the wider network of habitats.	Increasing nationally	Not possible to substitute	Medium - BAP Habitat of Principal Importance in England.	Minor Negative	**Slight Adverse**
Th36 Terrels Heath (contains Chadwell Wood)	Local wildlife Site with Ancient Woodland.	Local	Terrels Heath is a forest structure dominated by pendunculate Oak (*Quercus robar*). Ancient woodland, high importance.	Ancient woods on acid sandy soils are invariably poorer in ancient woodland ground flora than those on damp, neutral soils. However, the flora here is particularly poor, possibly due to decades of heavy recreational pressure and the previous management to the south that has left a very sparse, open canopy.	Not possible to substitute	High - important ancient woodland.	Minor Negative	**Moderate Adverse**
Th38 Broom Hill	Local wildlife Site	Local	Hilltop site, developed partly on shallow sand/gravel workings, of interest for its ancient acid-grassland flora. Significant populations of invertebrate species associated including 7 Red Data Book invertebrate species such as; the ant *Myrmica specioidesand* Great Green Bus-cricket *(Tettigonia viridissima)*. High importance.	7 Red Data Book invertebrate species and a number of UK BAP species. Condition unknown.	Not possible to substitute	High - undesignated site hosts Red Data Book species.	Minor negative	**Slight Adverse**
TH39 Lytag Brownfield	Local Wildlife site	Local	Low to medium importance. Survey work by independent ecological consultants has revealed populations of all four Essex reptiles (Adder, Grass snake, Common Lizard, and Slow-worm) making this one of the more important reptile sites in the borough.	Reptile species in decline in some areas. It is also likely that this site has UK BAP invertebrates given the presence of them on similar habitats in the area. No data currently.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Low to Medium - Local Wildlife Site.	Minor Negative	**Slight adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Th42 West Tilbury Hall	Local wildlife Site	Local	Area of interesting acidic grassland flora. Low importance.	Unknown	Soil translocation a possibility but requires suitable substrate to maintain the required pH for habitats to establish.	Low - Local Wildlife Site.	Major Negative	**Slight Adverse**
Th43 West Tilbury Church	Local wildlife Site	Local	Area behind the now privately owned church. Ancient grassland. Low to medium importance depending on species present.	Maintenance of the botanical interest relies on keeping soil nutrient levels low and removing the cuttings arising from grassland management (as now in private, residential ownership).	Not possible to substitute	Low to Medium - Local Wildlife Site.	Intermediate Negative	**Slight Adverse**
Th47 Low Street Pit	Local wildlife Site	Local	Lies on the regionally important Thames terrace gravels. Deciduous woodland as well as old grassland. Supports the UK BAP species Hornet Robber fly (*Asilus crabroniformis*).	Deciduous woodland is declining. The Hornet Robber fly relies on the presence of animal dung that is relatively free from insecticides and worming agents for the development of its larvae. A grazing regime would also be the most appropriate way of maintaining the floristic interest of the site.	Not possible to substitute	Medium - UK BAP species and Thames Terrace habitats/species.	Minor negative	**Slight Adverse**
Th49 Goshems Farm	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. Medium importance.	Red Data species but unknown at present.	Not possible to substitute	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	**Large Adverse**
Canal and grazing Marsh, Higham (Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat).	Local	Recently established reedbeds, damp disturbed grassland and a dyke system.	Unknown	Not possible to substitute	Medium - BAP priority habitat.	Neutral	**Neutral**
Tentacled lagoon worm (*Alkmaria romijni*)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981.	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal.	Considered scarce wihtin the UK; vulnerable to changes to, or loss of, the habitats in which they live.	Not possible to substitute	High	Neutral	**Neutral**
European eel (*Anguilla anguilla*)	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species).	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	**Neutral**
Smelt (*Osmerus eperlanus*)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species).	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales.	Not possible to substitute	Medium	Neutral	**Neutral**
Harbour Porpoise (*Phocoena phocoena*)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act.	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	**Neutral**

Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations
JNCC website for Ramsar, SPA, SAC and SSSI site designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT_External/#)
Green Infrastructure Asset Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green_Infrastructure_Assets_Baseline_Report_1_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

Summary Assessment Score

Large Adverse*

Qualitative Comments

Route 2 bisects a number of designated and local wildlife sites and areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route bisects a number of important habitats which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a fairly significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of areas of ancient woodland along the southern extents of the new road, where this links to the A2/M2 in the south, would involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable as discussed above.

* Note the Summary Assessment Score is being skewed by the predicted habitat loss for Shorne and Ashenbank Woods SSSI and Claylane Wood.

Annex 5 – Historic Environment Worksheet

Annex 5: Historic Environment Impacts Worksheet

Route 2 WSL Bored

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of urban settlements such as South Ockendon, Grays, West Tilbury and Gravesend and smaller settlements such as Orsett. The study area contains a number of listed buildings (designated heritage assets), either within settlements such as South Ockendon and Orsett or within a more rural context such as small groups of farm buildings. In total there are 42 Grade II, four Grade II* and three Grade I listed buildings within the study area (Grade II*: Orsett House, Orsett; Marshall's Cottages and Church of St James, West Tilbury; Church of St Mary, East Court Manor. Grade I: Church of St Mary Magdelene, North Ockendon; Church of St Nicholas, South Ockendon; Church of St Mary, Chadwell St Mary.). The study area also contains two conservation areas (designated assets): West Tilbury and Thong. Cobham Park is a Grade II registered park and garden. Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are seven scheduled monuments (designated heritage assets) within the study area: a barrow at South Ockendon Hall; a medieval moated site at South Ockenden Old Hall; Orsett crop mark complex; the Springfield style enclosure at Orsett; Dene Holes in Hangmans Wood; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	The listed buildings and conservation areas are designated heritage assets and are afforded protection at a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS. Whilst registered parks and gardens do not have statutory protection, they are a material consideration in the planning process and are considered at a national level in the NPPF and NN-NPS. The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS. The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	The Grade I and Grade II* listed buildings are of high value, whilst the Grade II listed buildings are of medium value. The conservation areas are of medium value. Cobham Park Grade II registered park and garden is of medium value. The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	The Grade I and Grade II* listed buildings, churches and high-status houses, are relatively well represented types on a national and regional level and are of moderate rarity. Conservation areas are relatively well represented regionally and nationally. Cobham Park registered park and garden contains considerable time depth and incorporates or is associated with a number of other high value assets and is rare on a national level. The scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, West Tilbury and Bowater Farm are relatively well represented types of monument and are of moderate rarity. The Dene Holes flint mine complex and the Springfield style enclosure at Orsett are less well represented and are of high rarity. The non-designated archaeological remains are of types that are well represented on a regional level and are of low rarity.	The Scheme will have a direct phyical impact on two Grade II listed buildings: 1 and 2 Gray's Corner cottages and Thatched Cottage, both to the east of Thurrock. Both listed buildings will be removed. The Scheme will have a direct physical impact on West Tilbury Conservation Area through the construction of a new road within the southern portion of the designated area. The scheme may impact on the settings of the Grade II listed buildings to the south and west of Orsett and to the west of West Tilbury. The scheme may also impact on the settings of the West Tilbury and Thong conservations areas and Cobham Park registered park and garden. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. The scheme would have a direct physical impact on the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments through the construction of new roads within the scheduled areas. The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, Ockendon Hall, Orsett, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. Construction excavations associated with proposed new road and tunnel may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good. The survival of Cobham Park reigstered park and garden is generally good. The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area. Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	Surviving listed Grade II listed buildings are not rare regionally or nationally, although surviving Grade I and Grade II* listed buildings are rare on both scales. With the exception of the Springfield style enclosure at Orsett and the Bowater Farm anti-aircraft battery, the survival of which is rare on both regional and national levels, the survival of the scheduled monuments is of moderate rarity value. Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments which would be subject to the direct physical impacts as the result of road construction within the scheduled areas. The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The condition of the listed buildings and conservation areas is generally good. The condition of Cobham Park registered park and garden is genrally good. The condition of the scheduled monuments is generally good, with the exception of the Orsett cropmark complex and Bowaters Farm anti-aircraft battery, the condition of which are poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings and conservation areas and registered park and garden is of moderate significance as they have they have a beneficial effect on the character and amenity value of the study area. The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	Listed buildings and conservation areas in good condition are relatively common in this region and have low rarity value. Registered parks and gardens in good condition are also relatively common, but have moderate rarity due to their relative scarcity. Scheduled monuments of the nature and condition of those within the study area have a high rarity value. Non-designated archaeological remains in good condition are relatively common nationally and have a low rarity value.	The scheme would not impact on the condition of designated assets within the study area, with the exception of the Orsett cropmark complex and Earthworks at West Tilbuty scheduled monuments which would be subject to the direct physical impacts as the result of road construction within the designated areas. The scheme would have not impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings are not unusually complex and represent a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Cobham Park registered park and garden is relatively complex as it represents several phases of development. Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area. The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflect this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Period	The listed buildings and conservation areas date from the post medieval to modern periods. Cobham Park registered park and garden dates from the medieval to modern periods. The scheduled monuments date from the Bronze Age to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	The NPPF and NN-NPS takes the period of heritage assets into account at a national level.	The wide range of periods represented within the historic environment resource is of high significance due to the potential to aid understanding the development of the region.	The range of periods represented by the historic environment resource within the study is common to the region and as such is of low rarity.	The scheme would not impact on the periods represented by the historic environment resource within the study area.

Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Kent Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

Step 5 - Summary Assessment Score

Moderate Adverse

Qualitative Comments

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. Two Grade II listed buildings will experience direct physical impacts through their removal: 1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the east of Thurrock. The effect of these impacts is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, West Tilbury and Bowaters Farm, Grade II listed buildings to the south and west of Orsett and to the west of West Tilbury, West Tilbury and Thong conservations areas, Cobham Park registered park and garden. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas, registered park and garden and scheduled monuments. Road construction within the scheduled areas of the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monumnts will cause direct physical impacts to these designated asset. With regard to the Earthworks at West Tilbury scheduled monument, the effects are predicted to be Large Adverse. However, due to the poor condition of the Orsett Cropmark complex scheduled monument, these effects are predicted to be Moderate Adverse. Construction excavations associated with the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint. Overall, Slight Adverse Effects to any non-designated archaeological remains within the scheme footprint are predicted.

Annex 6 – Landscape / Townscape Worksheet

Annex 6: Landscape Impacts Worksheet

Route 2 WSL Bored

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	South of the Thames corridor the landscape is gently undulating with large open arable fields and few hedgerows and those are mainly along the roads and around the small settlements. The land rises up to the wooded ridge of Shorne Woods Country Park, with the A2 and the high speed rail transport corridor to the south. To the west is the suburban edge of Gravesend with housing and recreational facilities such as a golf course and leisure centre.	Local	Rare in a local context	Varies farmland is medium in a local context, Shorne woods rare and the urban edge common.	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	**Moderate adverse.** Route 2 WSL would have a direct and indirect impact on the pattern of the existing landscape. In places the route would cut through the gently undulating landform as it passes under the A226 Rochester Road and Thong Lane. At the junction with the A2 the road would be raised up on an embankment which would create a visual barrier. Fields which create a distinct pattern on the landscape would be bisected by the road, although these are larger in size than they would have been historically.
	The Thames river corridor consists of flood embankments along the river edge backed by expansive marshland with rough grazing and sparse scrub. On the north side of the river there are extensive areas of former mineral workings some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	**Neutral.** The tunnel portals would be located to the north and south of the Thames corridor and have no impact.
	South of Baker Street Route 2 passes through an urban fringe landscape, with areas of arable land, horse pasture, crossed by roads such as the A13 and A1089 and with areas of suburban housing and school playing fields.	Local	Common	98	High	**Slight adverse**. Where Route 2 passes between existing settlements and follows the line of existing roads. Moderate adverse. Where the existing pattern is more rural, around Baker Street and to the north and north-east of Tilbury.
	Between the proposed junction with the M25 at North Ockendon and Baker Street Route 2 WSL passes through relatively flat open countryside of large arable fields and areas of historic clay pits now used for landfill.	Local	Common	Medium	High	**Moderate adverse**. Route 2 WSL would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape would be bisected by the road.
Tranquillity	South of the Thames corridor the level of tranquillity varies considerably with location. There are peaceful country lanes and small villages, although nowhere is it completely tranquil due to distant road noise and the visual intrusion of urban settlements, roads and pylons.	Local	Locally medium	Medium	Low	**Moderate adverse** in the vicinity of Route 2 WSL. Whilst there is some road noise in most areas at present this would increase considerably. The presence of road infrastructure would also have an impact on visual tranquillity. For residents of Thong, Riverview Park, and Chalk the route will change the view and increase noise, having a detrimental impact on tranquillity.
	Within the Thames corridor there are expansive views over the river and surrounding marshland from riverside paths which are often some distance from the nearest road. There is always some visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	**Slight adverse.** The tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	North of the Thames corridor the level of tranquillity varies considerably with location. There are large roads such as the M25, A13 and A1089 which generate traffic noise und disrupt tranquitity while there are open areas of countryside between that are broken only by the occasional small lane. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of small settlements and pylons.	Local	Common	Low	High	**Large adverse** away from the existing large roads a new road would introduce additional noise and visual clutter into a largely rural scene. For some residents of Tilbury, West Tilbury, Grays, Chadwell St Mary, Orsett Heath, Baker Street and South Ockendon the route will change the view and increase noise, having a detrimental impact on tranquillity.
Cultural	Most of the route is located within Green Belt	Regional	Regionally medium	High in regional context	Low	**Large adverse**. The Green Belt is a valued rural separation between the urban edge of large settlements such as Grays, Tilbury and Gravesend, nearby villages. A new road would introduce a new urban element into this landscape.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Rare	High in a national context	Low	**Neutral**. A slip road at the junction with the A2 would be located within the registered park. However in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Southern Valley Golf Course and driving range and land associated with Cascades Leisure Centre. Included in Gravesham Local Plan 2nd review as an area for Green Grid Site Protection.	Local	Rare locally	High in local context	Medium	**Moderate adverse.** Route 2 WSL passes through the golf course which would have to be partly re-located.
	National Cycle Routes 1 and 13 and other public rights of way.	National / local	Rare / common	High / low	High as easily relocated	**Moderate adverse** for rights of way and national cycle routes located close to Route 2 WSL due to the visual impact of road infrastructure and increased noise levels.
	Saxon Shore way leisure route along the Thames, and public right of way on northern side of the Thames.	Regional / local	Rare regionally	High in a local context	Low	**Neutral.** The tunnel would pass below the paths.
	Kent Downs Area of Outstanding Natural Beauty (AONB) and Shorne Woods Country Park.	National	Rare nationally	High in national context	Low	**Slight adverse**. Route 2 WSL and the junction with the A2 would mostly be located outside of AONB with only a slip road located within it. This would have little impact due to the existing A2 and infrastructure. There would be views from parts of the AONB at Shorne Woods of new road infrastructure to the north and west. There would be an impact on the setting of the AONB from the north west.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	**Neutral** The portal and road would be located some distance to the south.
	Conservation Area at Thong.	Regional	Medium	High in regional context	Low	**Slight adverse.** Route 2 WSL is close enough to the northern part of the conservation area to have an adverse impact on its setting.
	Listed buildings located close to Route 2 WSL south of the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse, the granary at Little Filborough Farm, East Court Manor (all grade II), the Church of St Mary in Chalk (grade II*) and White Horse Cottage in Thong (grade II).	Grade II listed buildings regional grade II* national	Rare	High in regional / national context	Low	There would be a **slight adverse** impact on the setting of the listed buildings in Chalk and a **neutral** impact on the listed building in Thong which would be further from the proposed route.
	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	**Neutral.** A tunnel will have no impact on the setting to the monument.

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
	East Tilbury Battery Scheduled Monument	National	Rare	High at a national level	Low	**Neutral.** Little remains of the monument and Route 2 WSL is a considerable distance away and would have no impact.
	Second World War Battery at Bowaters Farm Scheduled Monument.	National	Rare	High at a national level	Low	**Moderate adverse.** Route 2 WSL runs close to the monument. Although this is largely hidden from view by scrub there would be an impact on its setting.
	West Tilbury Scheduled monument at Hall Hill (has potential to show development from pre-Saxon to the medieval period), West Tilbury conservation area & listed buildings (grade II).	National scheduled monument, regional conservation area, local listed buildings.	Nationally / regionally / locally rare	High in national / regional / local context	Low	**Moderate adverse**. The village of West Tilbury with its various designations is located on the top of hill which is an important landmark standing out from the flat areas of former marsh to the south. Route 2 WSL would have a considerable impact on the setting.
	Chadwell House listed building, Chadwell St. Mary (grade II).	Regional	Regionally rare	High in regional context	Low	**Slight adverse**. Route 2 WSL would have some impact on the setting of the house from the east and south.
	Listed buildings to the south of the Route 2 WSL / A13 junction: Heath Place, Heath Cottage both off Hornsby Lane; Whitecrofts Farmhouse; thatched cottage south of Nevilles Farm; 2 Baker Street. All are grade II.	Regional	Regionally rare	High in regional context	Low	**Slight adverse.** Route 2 WSL would follow the route of existing roads south of the A13. However the roads are likely to be increased in size, with more signage and an intensification in use, all of which would have an impact on the setting of the buildings.
	Grade II Listed buildings at Baker Street.	Regional	Regionally rare	High in regional context	Low	**Moderate adverse.** The A 13 junction would be very close to a listed windmill which will adversely affect its setting. The remainder of the buildings are further away and there would only be a **slight adverse** impact on their setting.
	Crop mark complex, Orsett directly on Route 2 WSL its junction with the A13. Very little visible at surface level.	National	Rare	High in national context	Low	**Neutral** landscape impact as the monument is below ground.
	Scheduled monument and grade II listed building – gatehouse and moat of South Ockendon Hall and Scheduled monument - Roman barrow.	Scheduled monument National / listed building regional	Scheduled monument rare nationally/ listed building rare regionally	Scheduled monument high in national context/ listed building high in regional context	Low	**Moderate adverse -** The current monuments are surrounded by a flat, broad expanse of arable fields. Route 2 WSL, which would be very close, would have a detrimental impact on the setting of the monuments from the north.
	2 grade II Listed buildings at Kemps Farm.	Regional	Regionally rare	High in regional context	Low	**Slight adverse.** The M25 has an impact on the setting of the buildings currently. A new road junction would increase the level of impact.
	3 grade II listed buildings, a grade 1 listed building and a conservation area at North Ockendon.	Regional / national for grade I listed building	Regionally rare	High in regional context	Low	**Neutral** - The proposed Route 2 WSL junction with the M25 is a considerable distance from North Ockendon which is already impacted by the presence of the M25. Route 2 WSL would be largely screened by existing trees and hedges.
Landcover	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	**Neutral.** Part of junction with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary.
	Shorne Woods Country Park is made up of ancient woodland, woodland and heathland. The park has a visitor centre, car park, leisure facilities and walks.	Local	Rare	High in local context	Low	**Neutral.** None of Route 2 WSL would pass through the woodland.
	South of the Thames river corridor the landcover is of arable farmland with hedgerows and trees grouped around small settlements. To the west is the suburban edge of Gravesend with associated recreational land uses such as a leisure centre, golf course and driving range.	Local	Common	Low in local context	Medium	**Moderate adverse.** The current largely agricultural landcover would change along the route to one dominated by transport infrastructure. There would probably be a change in the use of the land between the road and the edge of Gravesend as many of the fields would be too small to farm viably.
	The characteristic landcover of the Thames river corridor consists of open flat grazing marshes, with sparse scrub and tree cover, with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have **neutral** impact immediately adjacent to the river. For the above ground sections the current agricultural landcover would change along Route 2 WSL to one dominated by transport infrastructure. In the long term there would be the potential for the route to create changes as surrounding agricultural land would be bisected and would become less viable to farm.
	From the A13 to the north of Tilbury the landcover is of a mix of arable fields, horse pasture, roads and suburban settlements	Local	Low	Low	High	**Slight adverse.** Most of the route follows the line of the existing A1089.
	From the M25 junction to the A13 junction with Route 2 WSL the landcover is mostly of arable fields, with hedges and boundary trees. There old clay pits to the west of South Ockendon that are now used as landfill.	Local	Medium	Medium in local context	High. The most important features the trees and hedges can easily be replaced.	**Moderate adverse** The current agricultural landcover would change along the route to one dominated by transport infrastructure.
Summary of character	The Thames river corridor has a strong identity with large expansive horizontal vistas dominated by the interplay of water and sky. The area to the north along Route 2 consists of open arable farmland north of the A13, with large suburban settlements and urban fringe areas to the south. South of the Thames corridor consists of large arable fields with hedgerows and trees grouped in association with small settlements. Recreational facilities such as a golf course and leisure centre fringe the suburban edge of Gravesend to the west. The land rises up to the south and the AONB with areas of woodland and heathland beyond which is the A2, HS1 transport corridor.	Regional	Medium regionally	Medium regionally	Medium	A bored tunnel would have a **neutral impact** in the Thames corridor with the remainder of the route having the same impacts as a bridge.

Reference Sources

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock Local Plan 1997, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary, National Character Area 113 North Kent Plain, The Landscape Assessment of Kent 2004, Essex Landscape Character Assessment, Gravesham Local Plan 2nd review

Step 5 - Summary Assessment Score

Large adverse

Qualitative Comments

Route 2 WSL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt. This is due to the introduction or a major new transport corridor with its associated infrastructure such as signage, lighting, bridges and embankments, into a largely rural area. The new road corridor and junction infrastructure associated with Route 2 WSL would impact on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

Annex 7 – Water Worksheet

Annex 7: Water Environment Impacts Worksheet

Route 2 WSL Bored

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study area: River Thames									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine / transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to economy / navigation	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	Regional / National (excludes biodiversity considerations)	Rare	Not feasible	Very High	**Negligible**	Low significance
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mardyke									
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R1) WFD Water body ID GB106037027990	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**(Moderate adverse)** **Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (R10) WFD water body ID GB106037028200	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes West and East Tilbury main drains	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway Canal									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal (Ca18) (GB70610011)	Biodiversity / transport & dilution waste products / recreation / navigation (potential)	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	Regional (ref WFD water body status)	Moderate	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses and drainage ditches at South Thames Estuary and Marshes (excluding Thames and Medway canal)									
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and Ramsar site	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)									
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and drainage ditches at West / East Tilbury Marshes	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds									
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River Thames including ponds and lakes and standing water in marsh areas	Biodiversity / recreation / amenity / water supply (small reservoirs and dams)	Low - Medium Could support protected ecological species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	**Negligible:** No significant standing waters crossed or intercepted	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible:** Assumes no drainage to standing water in accordance with best practice	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Groundwater north of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zone 3 (Nr J29) Local commercial / industrial / agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status)	Moderate	Not feasible	Medium	**Negligible - slight adverse** Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good)	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible:** Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	**Slight to moderate adverse.** Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures.	North Kent Medway Chalk (GB40601G500300)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	Shallow groundwater (terrace gravels / alluvium) feeding South Thames Estuary and Marshes SSSI	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/ SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	**Slight adverse** Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood Zone 2/3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	**Slight adverse** - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely, further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	**Negligible** (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	**Slight adverse**: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property / assets from flooding	High - provides protection for large urban area	Regional	Moderate	Not feasible: Unlikely to be substitutable	High	**Slight adverse:** Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Study Area: Mardyke Flood Zone 2/ 3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mardyke)	Mardyke crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	**(Moderate Adverse) Slight adverse** (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mardyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain.	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - viaduct spans flood plain.	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain.	Mardyke channel	Conveyance of flood flows	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period.	Local	Moderate	Not feasible	High	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - viaduct spans flood plain.	Low significance (Significant)
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mardyke flood defences	Protection of property / assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Area surrounding Main Rivers, Ordinary Watercourses, land drains and ditches, including marshes									
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Study Area: Entire route.									
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from groundwater	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from drains, sewers, and water mains	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance

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Summary Assessment Score

(Post mitigation)
Slight adverse impacts

Qualitative Comments

Note 1 : Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation.

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall , these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

Impacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse.

Impacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, the impacts on the Tidal waters of the Thames remain moderate adverse.

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial / agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Impact at source protection zones may be mitigated by adopting appropriate construction and drainage practices. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

Flood Risk:
The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span, minimise pier dimensions).

Tunnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 2 bridge design indicates the bridge would be significantly higher than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 2 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 2 crossing are:
P4 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 2 road embankment to provide this structural defence.

CFMP policies for Route 2 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).
CFMP policies for Route 2 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits) . Where Route 2 crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstream.

Route 2 crosses the Mardyke flood plain. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route 2 crosses the identified CDA_008, which includes Tilbury Flood Storage Area, designed to store surface water and so protect Tilbury from flooding. The Environment Agency has stated that no net reduction in available storage within the scheme would be considered acceptable. For Route 2 to be considered further, principles for mitigating any displaced storage within Tilbury FSA would need to be agreed with the EA and / or Thurrock Council.
Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Route 2 alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

Annex 8 – Noise Worksheet

Annex 8: Noise Worksheet
Route 2 WSL Bored Tunnel

APPRAISAL - NOISE POLLUTION

Present value base year: 2010

Current year: 2015

Proposal Opening Year: 2025

Average Household Size: 2.36

Project (Road or Rail): Road

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in Opening Year

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9344	423	277	112	61	42	23	8	10	0	0	0	0	0
45-47.9	1068	4337	322	259	20	34	17	14	5	0	0	0	0	0
48-50.9	13	1283	4923	299	228	54	17	2	4	0	0	0	0	0
51-53.9	1	21	1202	4566	275	117	29	5	0	0	0	0	0	0
54-56.9	0	0	19	913	3331	175	125	26	4	2	0	0	0	0
57-59.9	0	0	0	29	667	2437	180	99	19	0	0	0	0	0
60-62.9	0	0	0	0	34	693	2639	156	91	2	0	0	0	0
63-65.9	0	0	0	0	0	7	528	2752	89	23	0	0	0	0
66-68.9	0	0	0	0	0	0	9	453	1748	76	19	1	0	0
69-71.9	0	0	0	0	0	0	0	17	231	863	21	7	1	0
72-74.9	0	0	0	0	0	0	0	0	11	68	206	2	0	0
75-77.9	0	0	0	0	0	0	0	0	0	1	48	55	0	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	9	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in 15th Year After Opening

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	8963	407	283	110	60	46	24	9	11	0	0	0	0	0
45-47.9	1041	4296	342	244	14	22	25	14	5	0	0	0	0	0
48-50.9	16	1194	5030	361	234	54	18	5	4	0	0	0	0	0
51-53.9	0	16	1070	4706	252	107	17	16	1	0	0	0	0	0
54-56.9	0	0	7	866	3530	181	152	22	5	1	0	0	0	0
57-59.9	0	0	0	38	614	2491	193	109	10	1	0	0	0	0
60-62.9	0	0	0	1	31	623	2663	158	127	3	0	0	0	0
63-65.9	0	0	0	0	0	9	490	2784	120	28	0	0	0	0
66-68.9	0	0	0	0	0	0	7	423	1814	70	7	1	0	0
69-71.9	0	0	0	0	0	0	0	36	231	959	34	7	1	0
72-74.9	0	0	0	0	0	0	0	0	7	92	221	2	0	0
75-77.9	0	0	0	0	0	0	0	0	0	1	32	75	0	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	7	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Net Present Value of Noise of Proposal (60 Year Period) £3,135,613 *positive value reflects a **net benefit** (i.e. noise reduction)

Estimated Population Annoyed (Do-Minimum): 12418
Estimated Population Annoyed (Do-Something): 12344

Net Noise Annoyance Change in 15th Year After Opening (no. of people): -74 *positive value reflects an **increase** in people annoyed by noise

Appendix 7.2
Appraisal Summary Table Route 3 WSL (BT)

Appraisal Summary Table Route 3 WSL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appraisal Summary Table | **Route 3, Western Southern Link, Bored Tunnel**

Date produced:	22	Jan	2016

Contact:	
Name	Chris Taylor
Organisation	Highways England
Role	Project Sponsor

Name of scheme:	Route 3 Bored Tunnel with Western Southern Link - Core Growth, Central Case costs, Current values of time, additional lane in tunnel
Description of scheme:	New Dual 2 lane trunk road (70mph) from M25 between J29 and J30, crossing the Thames in a bored tunnel, with an additional lane for future proofing, 2km to the east of Gravesend with a westerly southern link to the A2.

Impacts		Summary of key impacts	Assessment: Quantitative				Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	**Value of journey time changes(£)** £2,531m **Net journey time changes (£)** 0 to 2min: -£516m; 2 to 5min: £1,124m; > 5min: £1,923m				N/A	£2,954m	Not appraised yet
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A				N/A	£104m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling	N/A				N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are 80% higher than those for Route 1. Almost 80% of WI benefits are from the agglomeration of business activities.	**Agglomeration** £1,056m **Output in imperfectly competitive markets** £295m **Labour supply impacts** £1m				N/A	£1,353m	
Environmental	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	282 people would benefit based on an estimated 12,418 people being annoyed by noise in the without scheme situation decreasing to 12,136 people in the with scheme situation.				N/A	£12m	Not appraised yet
	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors modelled are predicted to exceed the AQSO without the scheme (representing up to approximately 60 receptors), but these receptors experience an improvement compared to the without scheme. The scheme is not predicted to lead to any new exceedences.				N/A	N/A	Not appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-traded carbon over 60y (CO2e) 5,979,862 tonnes Change in traded carbon over 60y (CO2e) 16,783 tonnes				N/A	-£273m	
	Landscape	A new road would adversely affect the landscape character including green belt and intrude slightly into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.	N/A				Moderate Adverse	N/A	
	Townscape	See Landscape entry	N/A				N/A	N/A	
	Historic Environment	Direct physical impacts to one scheduled monument and two Grade II listed buildings. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint.	N/A				Moderate Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land). Impacts on LWSs & areas of BAP Priority Habitat. Direct loss of ancient woodland at Claylane Wood and loss of deciduous (not ancient) woodland at Shorne and Ashenbank Wood SSSI.	N/A				Large Adverse	N/A	
	Water Environment	Impacts on Mardyke and on flood plain.	N/A				Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing	**Value of journey time changes(£)** £588m **Net journey time changes (£)** 0 to 2min: -£371m; 2 to 5min: £352m; > 5min: £607m				N/A	£171m	Not appraised yet
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A				N/A	£39m	
	Physical activity	The option has no impact on walking and cycling	N/A				Neutral	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. With the WSL the A2 junction has a compact junction layout arrangement, due to existing constraints, with slip/ link roads which have a design speed of 30-50 mph.	N/A				Moderate beneficial	N/A	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	Because it is a new route 2,456 additional accidents are predicted over 60 years, including 35 fatalities, 274 serious injuries and 3,415 slight casualties				N/A	-£128m	Not appraised yet
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network	N/A				Slight Adverse	N/A	Not appraised yet
	Access to services	Not appraised because this criteria relates to public transport options	N/A				N/A	N/A	N/A
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at Dartford Crossing today	N/A				Neutral	N/A	Not appraised yet
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A				Slight Adverse	N/A	Not appraised yet
	Option and non-use values	Not appraised because this criteria relates to public transport options	N/A				N/A	N/A	
Public Accounts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Investment costs: £2,098m Operating costs £293m Operator revenue £827m (a benefit, offsetting cost over the longer term)				N/A	£1,564m	
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing	N/A				N/A	£565m	

Annex 1 – TEE Table

Annex 1: TEE Table

Economic Efficiency of the Transport System (TEE): Route 3/WSL

Non-business: Commuting	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	£73,944,064		£73,944,064			
Vehicle operating costs	-£62,276,287		-£62,276,287			
User charges	£109,062		£109,062			
Maintenance	£0					
COMMUTING	£11,776,839	*(1a)*	£11,776,839			

Non-business: Other	**ALL MODES**		**ROAD**	**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**	**Passengers**	**Passengers**	
Travel time	£513,810,308		£513,810,308			
Vehicle operating costs	-£352,847,419		-£352,847,419			
User charges	-£1,724,986		-£1,724,986			
Maintenance	£0					
OTHER	£159,237,903	*(1b)*	£159,237,903			

Business			**Goods**	**Business Cars**				
User benefits			**Vehicles**	**& LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£2,530,994,917		£653,351,657	£1,877,643,261				
Vehicle operating costs	£538,751,450		£371,260,153	£167,491,297				
User charges	-£115,705,561		-£59,107,375	-£56,598,186				
Maintenance								
Subtotal	£2,954,040,806	*(2)*	£965,504,435	£1,988,536,371				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions		*(4)*						
NET BUSINESS IMPACT	£2,954,040,806	*(5) = (2) + (3) + (4)*						

TOTAL		
Economic Efficiency Benefits (TEE)	£3,125,055,548	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Annex 2 – PA Table

Annex 2: Public Accounts (PA) Table

Route 3 WSL Bored Tunnel

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**			
Revenue						
Operating Costs						
Investment Costs						
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	-£827,045,667		-£827,045,667			
Operating costs	£292,904,443		£292,904,443			
Investment Costs	£2,097,700,297		£2,097,700,297			
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£1,563,559,073	*(8)*	£1,563,559,073			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-£564,770,665	*(9)*	-£564,770,665			
TOTALS						
Broad Transport Budget	£1,563,559,073	*(10) = (7) + (8)*				
Wider Public Finances	-£564,770,665	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Annex 3 – AMCB Table

Annex 3: AMCB Table

Route 3 WSL Bored Tunnel

Analysis of Monetised Costs and Benefits

Noise	£11,908,816	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	-£273,307,300	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	-£128,050,000	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£11,776,839	*(1a)*
Economic Efficiency: Consumer Users (Other)	£159,237,903	*(1b)*
Economic Efficiency: Business Users and Providers	£2,954,040,806	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	£564,770,665	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£3,300,377,729	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£1,563,559,073	*(10)*
Present Value of Costs (see notes) (PVC)	£1,563,559,073	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£1,736,818,657	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.1	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Annex 4 – Biodiversity Worksheet

Annex 4: TAG Biodiversity Impacts Worksheet

Route 3 WSL Bored

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of Circus cyaneus	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Mucking Flats and Marshes SSSI	Botanical interest: Mudlfats and Saltmarsh	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	**Neutral**
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important birds	Intermediate Negative	**Large Adverse**
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site - High importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland	National	Ancient woodland is a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status. Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - nationally important ancient woodland	Intermediate Negative	**Large Adverse**
Shorne and Ashenbank Woods SSSI	Woodland invertebrates	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important invertebrates	Intermediate Negative	**Large Adverse**
Thames Estuary recommended MCZ (on hold)	Marine and estuarine habitats and species	National	Attribute a qualifying feature of Nationally designated site so high importance.	Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Not possible to substitute	Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992)	Neutral	**Neutral**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Greater Thames Marshes Nature Improvement Area	Complex of habitats of value for biodiversity and as a community resource	Regional	Attribute of value to local communities, of Medium importance	Some goals are being achieved.	Not possible to substitute	Medium - community value and extensive area	Minor Negative	**Slight Adverse**
Claylane Wood- Ancient Woodland	Ancient Woodland	National	Ancient woodland habitat, high Importance for biodiversity.	Nationally ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Intermediate Negative	**Large Adverse**
Priority Habitat - Deciduous Woodland (local wildlife sites (below) and around Buckland; Brook Farm (north of the East Tilbury Marshes); small section on A226 south east of Chalk)	Priority BAP habitat	Local	Medium importance, BAP habitat	Nationally lowland mixed deciduous woodland is declining due to clearance, over-grazing, and replanting with non-native species.	Replacement planting and/translocation of habitats a possibility.	Medium - BAP priority habitat	Intermediate Negative	**Moderate Adverse**
Priority habitat - Coastal Saltmarshes (south of river, as part of Shorne Marshes and Eastcourt Marshes)	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within who wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	**Neutral**
Priority Habitat - Intertidal mudflats (particularly northern bank of the river at crossing, down stream of the Thames Estuary and Marshes (Ramsar))	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority Habitat - Coastal and Floodplain Grazing Marsh including freshwater ditches/ponds.	Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites)	Low to High, dependant on functioning within the wider network of habitats	Likely to be decreasing due to agricultural improvement, drainage and development	Replacement habitat creation potentially possible (e.g. managed realignment or creation of freshwater wetland habitats), but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority habitat - Traditional Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1 interchange)	Priority BAP habitat	Local	Wood-pasture and Parkland BAP habitat - Medium importance	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to recreate mature habitats	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Blackshots Nature Area (Th34)	Local wildlife Site - rough grassland and deciduous woodland.	Local	Large area of rough grassland and important invertebrate population, as well as providing potential nesting habitats for birds such as skylark. UK BAP fly species *Dorycera graminum* found here.	Species rich grasslands are decreasing, unmanaged grassland is likely to be increasing. Nationally deciduous woodland is declining	Replacement planting a possibility but limited space available.	Medium - BAP priority habitat and species	Major Negative	**Moderate Adverse**
Terrels Heath (Th36) includes Chadwell Wood (ancient woodland)	Local Wildlife site and Ancient Woodland.	Local	Terrels Heath is a forest structure dominated by pendculate Oak (*Quercus robar*). Ancient woodland - high importance.	Nationally ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Neutral	**Neutral**
Lytag Brownfield (Th39)	Local Wildlife Site Acid grassland; reptiles	Local	HCr19; SCr4. Brownfield site with acid grassland that supports all four common species of reptile (adder, grass snake, common lizard and slow worm). Medium importance	Believed to be favourable, but identified as a site a risk from development.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Medium - BAP priority habitat	Minor Negative	**Slight adverse**
Mucking Heath (Th41)	Local Wildlife Site Flora; invertebrates	Local	Thames Terrace grasslands and ancient heathland. Site supports 4 nationally rare and 50 nationally scarce invertebrate species. Medium importance.	Unknown at present, but a rare grassland habitat and associated invertebrate fauna, associated with Thames Terrace soils.	Not possible to substitute	Medium importance Thames Terrace grassland and invertebrates	Intermediate negative	**Moderate Adverse**
Rainbow Shaw (Th45)	Local wildlife Site	Local	Rainbow Shaw is thought to be a small ancient woodland fragment. Low to medium importance.	Unknown at present	Creation of replacement habitat possible.	Low - Local Wildlife Site	Minor negative	**Slight adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Linford Pit (Th46)	Local wildlife Site	Local	This brownfield site supports an important invertebrate fauna and lies within a very significant cluster of such sites.	This Site has a number of Red Data Book (Endangered) invertebrates, including the bees *Andrena florea* and *Nomada fulvicornis* (both RDB3) and the wasps *Cerceris quinquefasciata* (RDB3 and a national BAP species) and *Hedychrum niemelai* (also RDB3), as well as several nationally scarce spiders and the nationally rare fly *Myopa polystigma* (RDB3).	Creation of replacement habitat not possible.	High - Red Data Bok species	Neutral	**Neutral**
Low Street Pit (Th47)	Local wildlife Site	Local	Lies on the regionally important Thames terrace gravels. Deciduous woodland as well as old grassland. Supports the UK BAP species Hornet Robber fly (*Asilus crabroniformis*)	Deciduous woodland is declining. The Hornet Robber fly relies on the presence of animal dung that is relatively free from insecticides and worming agents for the development of its larvae. A grazing regime would also be the most appropriate way of maintaining the floristic interest of the site	Not possible to substitute	Medium - UK BAP species and Thames Terrace habitats/species	Major Negative	**Moderate Adverse**
Goshems Farm (Th49)	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. Medium importance.	Red Data species but unknown at present.	Not possible to substitute	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	**Large Adverse**
Canal and grazing Marsh, Higham (Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat)	Local	Recently established reedbeds, damp disturbed grassland and a dyke system	Unknown	Not possible to substitute	Medium - BAP priority habitat	Neutral	**Neutral**
Tentacled lagoon worm (*Alkmaria romijni*)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal	Considered scarce wihtin the UK; vulnerable to changes to, or loss of, the habitats in which they live	Not possible to substitute	High	Neutral	**Neutral**
European eel (*Anguilla anguilla*)	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	**Neutral**
Smelt (*Osmerus eperlanus*)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales	Not possible to substitute	Medium	Neutral	**Neutral**
Harbour Porpoise (*Phocoena phocoena*)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	**Neutral**

Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations
JNCC website for Ramsar, SPA, SAC and SSSI site designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT_External/#)
Green Infrastructure Asset Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green_Infrastructure_Assets_Baseline_Report_1_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

Summary Assessment Score

Large Adverse*

Qualitative Comments

Route 3 bisects three designated sites, 9 local wildlife sites and an additional 10 areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route also bisects a number of important habitats, which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a fairly significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of areas of ancient woodland along the southern extents of the new road, where this links to the A2/M2 in the south, involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable as discussed above.

* Note the Summary Assessment Score is being skewed by the predicted habitat loss for Shorne and Ashenbank Woods SSSI and Claylane Wood.

Annex 5 – Historic Environment Worksheet

Annex 5: Historic Environment Impacts Worksheet

Route 3 WSL Bored

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of urban settlements such as South Ockendon, Grays, West Tilbury, Gravesend and smaller settlements such as Orsett. The study area contains a number of listed buildings (designated heritage assets), either within settlements such as South Ockendon and Orsett or within a more rural context such as small groups of farm buildings. In total there are 36 Grade II, three Grade II* and two Grade I listed buildings within the study area (Grade II*: Marshalls Cottages and Chruch of St James, both at West Tilbury and Church of St Mary at East Court Manor. Grade I: Church of St Mary of Magdalene, North Ockendon and Church of St Nicholas, South Ockendon). The study area also contains three conservation areas (designated assets): West Tilbury, East Tilbury and Thong. Cobham Park is a Grade II registered park and garden. Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are eight scheduled monuments (designated heritage assets) within the study area: a Barrow at South Ockendon Hall; a medieval moated site at South Ockenden Old Hall; Orsett crop mark complex; the Springfield style enclosure at Orsett; a causewayed enclosure to the south of Thurrock; Dene Holes in Hangmans Wood; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	The listed buildings and conservation areas are designated heritage assets and are afforded protection at a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS. Whilst registered parks and gardens do not have statutory protection, they area a material consideration in the planning process and are considered at a national level in the NPPF and NN-NPS. The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS. The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	The Grade I and Grade II* listed buildings are of high value, whilst the Grade II listed buildings are of medium value. The East Tilbury conservation area is of high value whilst the other three conservation areas are of medium value. Cobham Park Grade II registered park and garden is of medium value. The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	The Grade I and Grade II* listed buildings, two churches and manor houses are relatively well represented types on a national and regional level and are of moderate rarity. East Tilbury conservation area is a rare example of a planned modernist factory town. The other three conservation areas are relatively well represented regionally and nationally. Cobham Park registered park and garden contains considerable time depth and incorporates or is associated with a number of other high value assets and is rare on a national level. The scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, West Tilbury and Bowaters Farm are relatively well represented types of monument and are of moderate rarity. The Dene Holes flint mine complex, Springfield style enclosure at Orsett and causewayed enclosure south of Thurrock are less well represented and are of high rarity. The non-designated archaeological remains are of types that are well represented on a regional level and are of low rarity.	The Scheme will have a direct physical impact on two Grade II listed buildings: 1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the west of Thurrock. The scheme may impact on the settings of the Grade II listed buildings to the south and west of Thurrock and to the west of West Tilbury. The scheme may also impact on the settings of the West Tilbury, East Tilbury and Thong conservations areas and Cobham Park registered park and garden. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, south of Orsett, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. In addition, the scheme would have a direct physical impact on the Orsett cropmark complex scheduled monument through the construction of a new road within the scheduled area. Construction excavations associated with the proposed road and tunnel may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good. The survival of Cobham Park reigstered park and garden is generally good. The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area. Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	Surviving listed Grade II listed buildings are not rare regionally or nationally, although surviving Grade I and Grade II* listed buildings are rare on both scales. With the exception of the Springfield style enclosure at Orsett and the Bowaters Farm anti-aircraft battery, the survival of which is rare on both regional and national levels, the survival of the scheduled monuments is of moderate rarity value. Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of the Orsett cropmark complex which would be subject to the direct physical impacts as the result of road construction within the scheduled area. The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The historic landscape is constantly evolving, the condition of landscape features is considered to be good. The condition of the listed buildings and conservation areas is generally good. The condition of Cobham Park registered park and garden is genrally good. The condition of the scheduled monuments is generally good, with the exception of the Orsett cropmark complex and Bowaters Farm anti-aircraft battery, the condition of which are poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings and conservation areas is of moderate significance as they have a beneficial effect on the character and amenity value of the study area. The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	Listed buildings and conservation areas in good condition are relatively common in this region and have low rarity value. Scheduled monuments of the nature and condition of those within the study area have a high rarity value. Non-designated archaeological remains in good condition are relatively common nationally and have a low rarity value.	The scheme would impact on the condition of three designated assets within the study area: two Grade II listed buildings to the west of Thurrock (1 and 2 Gray's Corner Cottages and Thatched Cottage), which would be removed and the Orsett cropmark complex scheduled monument, which would be subject to the direct physical impacts as the result of road construction within the scheduled area. The scheme would have no impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings are not unusually complex and represents a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Cobham Park registered park and garden is relatively complex as it represents several phases of development. Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area. The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflects this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.
Period	The listed buildings and conservation areas date from the post-medieval to modern periods. The scheduled monuments date from the Neolithic to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	The NPPF and NN-NPS takes the period of heritage assets into account at a national level.	The wide range of periods represented within the historic environment resource is of high significance due to the potential to aid understanding the development of the region.	The range of periods represented by the historic environment resource within the study area is common to the region and as such is of low rarity.	The scheme would not impact on the periods represented by the historic environment resource within the study area.

Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Kent Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

Step 5 - Summary Assessment Score

Moderate Adverse

Qualitative Comments

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. Two Grade II listed buildings (1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the west of Thurrock) would exprience direct physical impacts through their removal. The effect of these impacts is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, south of Thurrock, West Tilbury and Bowaters Farm, Grade II listed buildings to the south and west of Thurrock and to the west of West Tilbury; West Tilbury, East Tilbury and Thong conservations areas. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas, registered park and garden and scheduled monuments. Road construction within the scheduled area of the Orsett cropmark complex will cause a direct physical impact to this designated asset. However, due to the poor condition of the scheduled monument, the effects are predicted to be Moderate Adverse. Construction excavations associated with the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint. In addition, any dredging within the river channel to facilitate the construction of a bored tunnel may impact previously unknown archaeological remains. Overall, Slight Adverse Effects to any non-designated archaeological remains within the scheme footprint are predicted.

Annex 6 – Landscape / Townscape Worksheet

Annex 6: Landscape Impacts Worksheet

Route 3 WSL Bored

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	South of the Thames corridor the landscape is gently undulating with large open arable fields and few hedgerows, which are mainly along the roads and around the small settlements. The land rises up to the wooded ridge of Shorne Woods Country Park, with the A2 and high speed rail transport corridor to the south. To the west is the suburban edge of Gravesend with housing and recreational facilities such as a golf course and leisure centre.	Local	Rare in a local context	Varies, farmland is medium in a local context, Shorne woods rare and the urban edge common.	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	**Moderate adverse.** Route 3 WSL would have a direct and indirect impact on the pattern of the existing landscape. In places the route would cut through the gently undulating landform as it passes under the A226 Rochester Road and Thong Lane. At the junction with the A2 the road would be raised up on an embankment which would create a visual barrier. Fields which create a distinct pattern on the landscape would be bisected by the road, although these are larger in size than they would have been historically, with most hedges removed or poorly maintained.
	The Thames river corridor consists of flood embankments along the river edge backed by expansive marshlands with rough grazing and sparse scrub. On the north side there are extensive areas of old mineral workings some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	**Neutral.** The tunnel portals would be located to the north and south of the Thames corridor.
	South of Orsett to the Thames corridor Route 3 passes, through gently undulating countryside of medium and large fields, with occasional farm buildings. The area is crossed by a number of overhead electric power lines.	Local	Common	Medium locally	High	**Moderate adverse.** The road would break up the existing pattern of the landscape in particular at the A13 junction.
	Adjacent to Orsett the route cuts through a historic parkland landscape that forms the setting of the village.	Local	Locally rare	High in a local context	Medium	**Moderate adverse**. Route 3 WSL would run along the edge of the parkland and would fundamentally change its character.
	Between the proposed junction with the M25 at North Ockendon and Orsett Route 3 WSL would pass through relatively flat open countryside of large arable fields, and close to areas of historic clay pits, now used for landfill.	Local	Common	Medium locally	High	**Moderate adverse**. Route 3 WSL would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape would be bisected by the road.
Tranquillity	South of the Thames corridor the level of tranquillity varies considerably with location. There are peaceful country lanes and small villages, although nowhere is it completely tranquil due to distant road noise and the visual intrusion of urban settlements, roads and pylons.	Local	Locally rare	Varies, medium for most of the route while the country lanes and villages are high	Low	**Moderate adverse** in the vicinity of Route 3 WSL. While there is some road noise in most areas at present this would increase considerably in most locations. The presence of road infrastructure would also have an impact on visual tranquillity. For residents of Thong, Riverview Park, and Chalk the route will change the view and increase noise, having a detrimental impact on tranquillity.
	Within the Thames corridor there are expansive views over the river and surrounding marshland from the riverside paths which are often some distance from the nearest road. There is always the visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	**Slight adverse.** A tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	The level of tranquillity varies considerably with location north of the Thames corridor. There are major arterial roads such as the M25 and A13 which generate traffic noise and disrupt visual tranquillity, while there are open areas of countryside between, that are broken only by the occasional small road. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of urban settlements and pylons.	Local	Common	Medium	High	**Moderate adverse** Away from the existing large roads Route 3 WSL would introduce additional noise and intrusive visual clutter into the scene. For some residents of East Tilbury, West Tilbury, Linford, east of Chadwell St Mary, Baker Street Orsett and South Ockendon the route change the view and increase noise, having a detrimental impact on tranquillity.
	Most of the route is located within Green Belt.	Regional	Regionally medium	High in regional context	Low	**Moderate adverse**. The Green Belt is a valued rural separation between the urban edge of large settlements such as Grays, Tilbury and Gravesend nearby villages. A new road would introduce a new urban element into this landscape.
	Public rights of way.	Local	Common	Medium	High	Impact depends on the right of way but some will be crossed by the route and this would have a **Moderate adverse** impact on the users of the paths.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Rare	High in a national context	Low	**Neutral.** A slip road at the Route 3 WSL A2 junction would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB) and Shorne Woods Country Park.	National	Rare nationally	High in national context	Low	**Slight adverse.** Route 3 WSL and the junction with the A2 would mostly be located outside of AONB with a slip road located within it. This would have little impact due to the existing A2 and infrastructure. There would be views from parts of the AONB at Shorne Woods of new road infrastructure to the north and west. There would be an impact on the setting of the AONB from the north west.

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Cultural	Conservation Area at Thong.	Regional	Medium	High in regional context	Low	**Slight adverse.** Route 3 WSL is close enough to the northern part of the conservation area to have an adverse impact on it.
	Southern Valley Golf Course and driving range and land associated with Cascades Leisure Centre. Included in Gravesham Local Plan 2nd review as an area for Green Grid Site Protection.	Local	Medium	Medium in local context	Medium	**Moderate adverse**. Route 3 WSL passes through the golf course which would have to be partly re-located.
	Listed buildings located close to Route 3 WSL south of the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse , the granary at Little Filborough Farm East Court Manor, Church of St Mary in Chalk (grade II*) and White Horse Cottage in Thong.	National/regional	Nationally/ regionally rare	High in national/regional context	Low	There would be a **slight adverse** impact on the setting of the listed buildings in Chalk and a **neutral** impact on the listed building in Thong which would be further from the proposed route.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	**Neutral** The portal and road would be located some distance to the south.
	National Cycle Routes 1 and 13 and other public rights of way.	National/local	Rare/common	High/low	High as easily relocated	**Moderate adverse** for rights of way and national cycle routes located close Route 3 WSL due to the visual impact of road infrastructure and increased noise levels.
	Saxon Shore Way leisure route along the Thames and public right of way on northern side of the Thames.	Regional/local	Rare regionally	High in a local context	Low	**Neutral.** The tunnel would pass below the paths.
	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	**Neutral.** A tunnel will have no impact on the setting to the monument.
	Tilbury Fort Scheduled monument.	National	Rare	High at a national level	Low	**Neutral.** A tunnel will have no impact on the setting to the monument.
	Scheduled monument at Bowaters Farm WWII anti aircraft battery.	National	Rare	High at a national level	Low	The monument is largely hidden from view by scrub and despite the closeness of Route 3 ESL it would only have a **slight adverse** impact on the setting.
	Grade II listed building at Bucklands Farm.	Regional	Rare	High	Low	The building is surrounded by trees and the road would have only a **slight adverse** impact on its setting.
	East Tilbury Conservation area and listed buildings.	Regional	Rare	High	Low	Some distance away from the conservation area which is an unusual modernist development of housing and factories. For most of the area the impact would be **neutral** with **slight adverse** on the setting of the western edge.
	Grade II listed buildings close to the proposed Route 3 ESL junction with the A13. Whitecrofts, Heath House, Murrels Cottage.	Regional	Rare regionally	High regionally	Low	**Moderate adverse** to the setting of Heath House & Murrels Cottage due to the closeness of the junction. Slight adverse impact to Whitcrofts.
	Scheduled monument. Causewayed enclosure and Anglo-Saxon cemetery close to proposed junction of Route 3 WSL with the A13.	National	Rare	High in national context	Low	**Moderate adverse.** The monument is not clearly visible from ground level but from the air. While not having a direct impact on the structure of the monument the proposed junction would change its landscape setting which could be important in understanding the causewayed enclosure in particular.
	4 listed buildings west of Orsett: two at Orsett House (one grade II and the other grade II*), Poplars Farm (grade II), and south of the B188 (grade II).	Grade 1 and 2* national value, grade II regional	Rare	High	Low	**Moderate adverse** to the setting of those at Orsett House due to the closeness of the road, with Poplars Farm Slight adverse.
	Conservation area, grade I listed building and grade II listed buildings in Orsett.	National for grade 1 listed building. Regional local for conservation area and grade II listed buildings	Rare nationally/locally	High in national/local context	Low	**Neutral**. Although within 500m of Route 3 WSL all of the buildings and the conservation area are screened by surrounding development.

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
	Scheduled monument. Springfield type enclosure and iron age enclosures at Baker Street.	National	Rare	High in national context	Low	**Neutral** - The monument is not visible at ground level.
	Scheduled monument - Bishop Bonners Palace Orsett.	National	Rare	High in national context	Low	**Slight adverse** - The monument is largely screened from Route 3 WSL by trees.
	Scheduled monument and listed building (gatehouse and moat of South Ockendon Hall) and Scheduled Monument Roman barrow. All over 500m from the Route 3 WSL.	National	Rare	High in national context	Low	**Slight adverse** - The current monuments are surrounded by a flat, broad expanse of arable fields. Despite the distance from the proposed route the road infrastructure would have some impact on their setting.
	3 grade II listed buildings, a grade 1 listed building & North Ockendon conservation area	Regional/national for grade 1 listed building	Rare nationally/regionally	High in national/regional context	Low	**Slight adverse** - North Ockendon is already impacted by the presence of the M25. Route 3 WSL would be largely screened by existing trees and hedges.
Landcover	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	**Neutral.** Part of junction with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Shorne Woods Country Park is made up of ancient woodland, woodland and heathland. The park has a visitor centre, car park, leisure facilities and walks.	Local	Rare	High in local context	Low	**Neutral.** None of Route 3 WSL passes through the woodland.
	South of the Thames river corridor the landcover consists of arable farmland with hedgerows and trees grouped around small settlements. To the west is the suburban edge of Gravesend with associated recreational land uses such as a leisure centre, golf course and driving range.	Local	Common	Low in local context	Medium	**Moderate adverse**. The current agricultural landcover would change along the route to one dominated by transport infrastructure. There would probably be a change in the use of the land between the road and the edge of Gravesend as many of the fields would be too small to farm.
	The characteristic landcover of the Thames river corridor consists of open flat grazing marsh with sparse scrub and trees cover with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have **neutral** impact immediacy adjacent to the river. Above ground the current agricultural landcover would change along the route to one dominated by transport infrastructure, in the long term there would be the potential for Route 3 WSL to create changes to the surrounding agricultural land which would be bisected and would become less viable to farm.
	North of the Thames corridor the landcover is mostly of arable fields, with hedges and boundary trees. Crossed by a number of small roads and 2 major roads. Areas of old clay pits now used as landfill. Parkland landscape to the west of Orsett.	Local	common	Medium in local context	Relatively easy to improve/plant hedges and trees nearby	**Moderate adverse** in the immediate vicinity of Route 3 WSL, which would change the existing rural landcover to a transport dominated one.
Summary of character	Open gently rolling arable countryside with sparse hedges and boundary trees, with surviving areas of historic field patterns, minor roads and small settlements. Prominent features consist of arterial roads, pylons, and the distant urban edge of large settlements.	Regional	Regionally medium	Regionally medium	Medium	**Moderate adverse.** Although there are major roads running through the parts landscape Route 3 WSL would introduce a new transport corridor through areas that are largely rural in character.

Reference Sources

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock Local Plan 1997, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary,

Step 5 - Summary Assessment Score

Moderate adverse

Qualitative Comments

Route 3 WSL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt. Infrastructure associated with the road such as embankments, retaining structures, bridges, signage and lighting, would be notable additional built elements within the open rural landscape. The new road corridor and junction infrastructure associated with Route 3 WSL would impact directly and indirectly on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

Annex 7 – Water Worksheet

Annex 7: Water Environment Impacts Worksheet

Route 3 WSL Bored

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study area: River Thames									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine / transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to economy / navigation	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	Regional / National (excludes biodiversity considerations)	Rare	Not feasible	Very High	**Negligible**	Low significance
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mar Dyke									
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R1) WFD Water body ID GB106037027990	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R3) WFD water body ID GB106037028020	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**(Moderate adverse)** **Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes West and East Tilbury main drains	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway Canal									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal (Ca18) (GB70610011)	Biodiversity / transport & dilution waste products / recreation / navigation (potential)	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	Regional (ref WFD water body status)	Moderate	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section passes beneath canal and has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses and drainage ditches at South Thames Estuary and Marshes (excluding Thames and Medway canal)									
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and Ramsar site	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)									
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and drainage ditches at East Tilbury Marshes	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds									
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River Thames including ponds and lakes and standing water in marsh areas	Biodiversity / recreation / amenity / water supply (small reservoirs and dams)	Low - Medium Could support protected ecological species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	**Negligible:** No significant standing waters crossed or intercepted	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible:** Assumes no drainage to standing water in accordance with best practice	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Groundwater north of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zones 2 and 3 (Linford / East Tilbury) Local commercial / industrial /agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice.	Low significance (significant)
	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible - slight adverse** Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium - low WFD water body status (current poor, target good).	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible:** Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice.	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	**Slight to moderate adverse.** Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures	North Kent Medway Chalk WFD Water body ID GB40601G500300	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	Shallow groundwater (terrace gravels / alluvium) feeding South Thames Estuary and Marshes SSSI	groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/ SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	**Slight adverse** Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood Zone 2/3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	**Slight adverse** - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely, further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	**Negligible** (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	**Slight adverse**: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Local	Moderate	Not feasible: Unlikely to be substitutable	High	**Slight adverse:** Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Study Area: Mardyke Flood Zone 2/ 3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mar Dyke)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	**(Moderate Adverse) Slight adverse** (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mardyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - viaduct spans flood plain	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Mardyke channel	Conveyance of flood flows	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period	Local	Moderate	Not feasible	High	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - viaduct spans flood plain	Low significance (Significant)

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mardyke flood defences	Protection of property / assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route
Study Area: Area surrounding Main Rivers, Ordinary Watercourses, land drains and ditches, including marshes									
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Study Area: Entire route.									
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from groundwater	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from drains, sewers, and water mains	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance

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Summary Assessment Score

(Post mitigation)
Moderate Adverse impacts

Qualitative Comments

Note 1 : Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation.

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall , these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

Impacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse.

Impacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, these impacts on the Tidal waters of the Thames remain moderate adverse.

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial/ agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

Flood Risk:
The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span, minimise pier dimensions).

Tunnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 3 bridge design indicates the bridge would be significantly higher (and on viaduct) than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 3 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 3 crossing are:
P4 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (*take further action to keep up with climate change and land use change so that flooding does not increase*)
P3 for Policy Unit East Tilbury and Mucking Marshes, north of the river Thames (*continue with existing or alternative actions to manage flood risk*)
P3 for Policy Unit North Kent Marshes, south of the River Thames (*continue with existing or alternative actions to manage flood risk*). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 3 road embankment to provide this structural defence.

CFMP policies for Route 3 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (*areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures*) and P1 for the North Kent Downs Policy Unit (*areas of little or no flood risk where we will continue to monitor and advise*).
CFMP policies for Route 3 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (*take further FRM actions to keep pace with climate change*) and P6 for the Upper Mardyke Policy Unit (*store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits*) . Where Route 3 crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstream.

Route 3 crosses the Mardyke flood plain. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route option C2 passes through CDA_012, and so the road should be designed so that any drainage problems in this area are not exacerbated (with improvements provided where feasible). Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Option C3 route alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

Annex 8 – Noise Worksheet

Annex 8: Noise Worksheet
Route 3 WSL Bored Tunnel

APPRAISAL - NOISE POLLUTION

Present value base year: 2010

Current year: 2015

Proposal Opening Year: 2025

Average Household Size: 2.36

Project (Road or Rail): Road

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in Opening Year

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	3922	1810	1731	1368	681	403	224	117	26	12	6	0	0	0
45-47.9	1873	1263	1009	767	500	322	182	119	20	18	3	0	0	0
48-50.9	1852	1092	1371	965	626	430	263	155	46	20	3	0	0	0
51-53.9	1476	884	1048	1238	603	442	290	165	54	12	4	0	0	0
54-56.9	724	540	602	721	1115	349	314	156	53	17	4	0	0	0
57-59.9	400	337	402	415	470	856	320	157	45	24	5	0	0	0
60-62.9	224	235	301	285	293	403	1553	227	70	13	11	0	0	0
63-65.9	98	116	153	172	165	170	347	2057	96	18	7	0	0	0
66-68.9	37	50	80	67	82	77	57	287	1518	48	3	0	0	0
69-71.9	3	14	22	16	24	29	24	34	196	762	16	0	0	0
72-74.9	2	4	6	6	7	11	6	9	14	50	170	2	0	0
75-77.9	0	1	0	2	1	0	3	0	0	0	47	50	0	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	9	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in 15th Year After Opening

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	3659	1695	1691	1368	715	384	231	122	29	13	6	0	0	0
45-47.9	1796	1227	998	789	502	329	202	110	27	19	4	0	0	0
48-50.9	1820	1108	1395	990	647	441	281	161	47	23	3	0	0	0
51-53.9	1452	850	1059	1268	582	431	284	181	62	12	4	0	0	0
54-56.9	715	556	593	770	1197	364	340	147	59	19	4	0	0	0
57-59.9	393	318	398	426	460	868	342	172	48	29	2	0	0	0
60-62.9	230	240	315	305	316	351	1491	232	95	17	14	0	0	0
63-65.9	91	109	164	179	158	168	323	2108	107	17	7	0	0	0
66-68.9	36	54	77	77	91	100	62	244	1540	38	3	0	0	0
69-71.9	3	13	26	15	25	27	24	59	202	854	20	0	0	0
72-74.9	2	3	7	6	6	12	7	9	10	73	185	2	0	0
75-77.9	0	1	0	2	1	0	3	0	0	0	30	71	0	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	7	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Net Present Value of Noise of Proposal (60 Year Period) £11,908,816 *positive value reflects a **net benefit** (i.e. noise reduction)

Estimated Population Annoyed (Do-Minimum): 12418

Estimated Population Annoyed (Do-Something): 12136

Net Noise Annoyance Change in 15th Year After Opening (no. of people): -282 *positive value reflects an **increase** in people annoyed by noise

Appendix 7.3
Appraisal Summary Table Route 4 WSL (BT)

Appraisal Summary Table Route 2 WSL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appraisal Summary Table | **Route 4, Western Southern Link, Bored Tunnel**

Date produced:	22 Jan 2016

Contact:	
Name	Chris Taylor
Organisation	Highways England
Role	Project Sponsor

Name of scheme:	Route 4 Bored Tunnel with Western Southern Link - Core Growth, Central Case costs, Current values of time, additional lane in tunnel
Description of scheme:	New Dual 2 lane trunk road (70mph) from M25 J29, linking with A127 and running parallel to A128, crossing the Thames in a bored tunnel, with additional lane for future proofing, 2km to the east of Gravesend with a westerly southern link to the A2.

Impacts		Summary of key impacts	Assessment: Quantitative				Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	Value of journey time changes(£)			£2,603m	N/A	£2,965m	Not appraised yet
			Net journey time changes (£)						
			0 to 2min	2 to 5min	> 5min				
			-£479m	£1089m	£1,994m				
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A				N/A	£106m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling	N/A				N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are more than double those for Route 1. More than 80% of WI benefits are from the agglomeration of business activities.	Agglomeration			£1,390m	N/A	£1,678m	
			Output in imperfectly competitive markets			£287m			
			Labour supply impacts			£1m			
Environmental	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	397 people would benefit based on an estimated 12,418 people being annoyed by noise in the without scheme situation decreasing to 12,021 people in the with scheme situation.				N/A	£15m	Not appraised yet
	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors modelled are predicted to exceed the AQSO without the scheme (representing up to approximately 60 receptors), but these receptors experience an improvement compared to the without scheme. The scheme is not predicted to lead to any new exceedences.				N/A	N/A	Not appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-traded carbon over 60y (CO2e)			6,316,088 tonnes	N/A	-£289m	
			Change in traded carbon over 60y (CO2e)			17,442 tonnes			
	Landscape	A new road would adversely affect the landscape character including green belt and intrude slightly into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.	N/A				Moderate Adverse	N/A	
	Townscape	See Landscape entry	N/A				N/A	N/A	
	Historic Environment	Direct physical impacts to one Grade II* registered park and garden, one conservation area and one Grade II listed building. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint.	N/A				Large Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land). Impacts on LWSs, areas of BAP Priority Habitat & direct loss of habitat from ancient woodlands and loss of deciduous (not ancient) woodland from Shorne and Ashenbank Wood SSSI.	N/A				Very Large Adverse	N/A	
	Water Environment	Negligible impacts on Mardyke.	N/A				Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing	Value of journey time changes(£)			£632m	N/A	£179m	Not appraised yet
			Net journey time changes (£)						
			0 to 2min	2 to 5min	> 5min				
			-£341m	£364m	£609m				
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A				N/A	£40m	
	Physical activity	The option has no impact on walking and cycling	N/A				N/A	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. With the WSL the A2 junction has a compact junction layout arrangement, due to existing constraints, with slip/ link roads which have a design speed of 30-50 mph. Route 4 uses the A127 (a heavily used dual carriageway County road) for part of the route, which will involve mixing of strategic and County road traffic	N/A				Moderate Beneficial	N/A	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	Because it is a new route 2,288 additional accidents are predicted over 60 years, including 35 fatalities, 258 serious injuries and 3,245 slight casualties				N/A	-£121m	Not appraised yet
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network	N/A				Slight Adverse	N/A	Not appraised yet
	Access to services	Not appraised because this criteria relates to public transport options	N/A				N/A	N/A	N/A
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at Dartford Crossing today	N/A				Neutral	N/A	Not appraised yet
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A				Slight Adverse	N/A	Not appraised yet
	Option and non-use values	Not appraised because this criteria relates to public transport options	N/A				N/A	N/A	
Public Accounts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Investment costs: £2,278m Operating costs £302m Operator revenue £823m (a benefit, offsetting cost over the longer term)				N/A	£1,757m	
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing	N/A				N/A	£603m	

Annex 1 – TEE Table

Annex 1: TEE Table

Economic Efficiency of the Transport System (TEE): Route 4/WSL

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£76,530,261		£76,530,261					
Vehicle operating costs	-£67,605,062		-£67,605,062					
User charges	£98,558		£98,558					
During Construction & Maintenance	£0							
COMMUTING	£9,023,757	*(1a)*	£9,023,757					

Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£555,682,179		£555,682,179					
Vehicle operating costs	-£383,358,007		-£383,358,007					
User charges	-£1,870,014		-£1,870,014					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£170,454,158	*(1b)*	£170,454,158					

Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£2,603,048,124		£630,288,024	£1,972,760,100				
Vehicle operating costs	£460,095,818		£299,551,311	£160,544,508				
User charges	-£97,736,627		-£40,800,776	-£56,935,851				
During Construction & Maintenance	£0							
Subtotal	£2,965,407,315	*(2)*	£889,038,558	£2,076,368,757				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions		*(4)*						
NET BUSINESS IMPACT	£2,965,407,315	*(5) = (2) + (3) + (4)*						

TOTAL		
Benefits (TEE)	£3,144,885,230	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Annex 2 – PA Table

Annex 2: Public Accounts (PA) Table

Route 4 WSL Bored Tunnel

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue						
Operating Costs						
Investment Costs						
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	-£823,066,379		-£823,066,379			
Operating costs	£301,710,435		£301,710,435			
Investment Costs	£2,278,670,913		£2,278,670,913			
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£1,757,314,969	*(8)*	£1,757,314,969			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-£603,060,572	*(9)*	-£603,060,572			
TOTALS						
Broad Transport Budget	£1,757,314,969	*(10) = (7) + (8)*				
Wider Public Finances	-£603,060,572	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Annex 3 – AMCB Table

Annex 3: AMCB Table

Route 4 WSL Bored Tunnel

Analysis of Monetised Costs and Benefits

Noise	£14,907,398	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	-£288,689,684	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	-£121,008,400	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£9,023,757	*(1a)*
Economic Efficiency: Consumer Users (Other)	£170,454,158	*(1b)*
Economic Efficiency: Business Users and Providers	£2,965,407,315	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	£603,060,572	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£3,353,155,116	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£1,757,314,969	*(10)*
Present Value of Costs (see notes) (PVC)	£1,757,314,969	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£1,595,840,148	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.9	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Annex 4 – Biodiversity Worksheet

Annex 4: TAG Biodiversity Impacts Worksheet

Route 4 WSL Bored

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of Circus cyaneus	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Mucking Flats and Marshes SSSI	Botanical interest: Mudflats and Saltmarsh	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	**Neutral**
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important ancient woodland	Intermediate Negative	**Large Adverse**
Shorne and Ashenbank Woods SSSI	Woodland invertebrates	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important invertebrates	Intermediate Negative	**Large Adverse**
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important birds	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
Thorndon Park SSSI	Botanical importance (semi-natural broad-leaved woodland)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, some areas Unfavourable Declining	Not possible to substitute	High - nationally important	Minor Negative	**Slight Adverse**
Thames Estuary recommended MCZ (on hold)	Marine and estuarine habitats and species	National	Attribute a qualifying feature of Nationally designated site so high importance.	Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Not possible to substitute	Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992)	Neutral	**Neutral**
Claylane Wood	Ancient Woodland	National	Ancient woodland habitat, high Importance for biodiversity	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Greater Thames Marshes Nature Improvement Area	Complex of habitats of value for biodiversity and as a community resource	Regional	Attribute of value to local communities, of Medium importance	Some goals are being achieved.	Not possible to substitute due to the extensive nature of the area involved	Medium - community value and extensive area	Minor Negative	**Slight Adverse**
Hobbs Hole (Bre66)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland - high importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**
Codham Hall Woods (Bre59)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland - high importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**
Warley Hall Wood (Bre85)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland - high importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Intermediate Negative	**Large Adverse**
Thorndon Country Park South (Bre106) includes Mill wood (ancient woodland)	Local Wildlife Site Wood-pasture and parkland; lowland meadows; neutral grassland; small-component mosaics; accessible natural greenspace	Local	Lowland meadows; Lowland mixed deciduous woodland; Hedgerows (BAP Habitats) and ancient woodland - high importance	Wood-pasture believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat. Nationally, ancient woodland is being lost or	Not possible to substitute	High - important ancient woodland	Minor Negative	**Slight Adverse**
Barrett's Shaw (Bre105)	Local Wildlife Site Lowland Mixed Deciduous Woodland on Non-ancient Sites	Local	Lowland mixed deciduous woodland - Medium (BAP Habitat)	Nationally, deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Not possible to substitute mature habitats	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Round Shaw (Bre112)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland - high importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Minor Negative	**Slight Adverse**
Straight Path Shaw (Bre113)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland - Medium (BAP Habitat)	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**
Thick/Hollow Bottom Shaws (Bre115)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland - high importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**
All Saints Churchyard and Keepers Cottages Meadow (Bre118)	Local Wildlife Site Neutral grassland	Local	Neutral grassland and hedgerows - Medium (BAP Habitats)	Favourable condition	Habitat/soil translocation a possibility but requires suitable substrate to maintain required pH.	Medium - BAP priority habitat	Neutral	**Neutral**
Eastlands Spring (Bre134)	Local Wildlife Site Ancient woodland; habitat extension mosaics	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland - high importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Minor Negative	**Slight Adverse**
Orsett Camp Quarry (Th44)	Local Wildlife Site Invertebrates; reptiles	Local	HCr19; SCr4; SCr11; SCr12; SCr13. Important acid grassland; six Red Data Book invertebrates 16 nationally scarce species and three UK BAP bees species; reptiles include adder, common lizard and slow worm. High importance	Red Data Book (Endangered) invertebrate species.	Not possible to substitute	High - undesignated site hosts Red Data Book species and UK BAP species	Neutral	**Neutral**
Mucking Heath (Th41)	Local Wildlife Site Flora; invertebrates	Local	Thames Terrace grasslands and ancient heathland. Site supports 4 nationally rare and 50 nationally scarce invertebrate species. Medium importance.	Unknown at present, but a rare grassland habitat and associated invertebrate fauna, associated with Thames Terrace soils.	Not possible to substitute	Medium importance Thames Terrace grassland and invertebrates	Neutral	**Neutral**
Buckingham Hill (Th50)	Local Wildlife Site Acid grassland	Local	Acid grassland which supports BAP invertebrate (Bombus humilis). Medium importance.	Developing site (former sand pit)	Habitat/soil translocation a possibility but requires suitable substrate to maintain required pH.	Medium - BAP priority habitat	Neutral	**Neutral**
Rainbow Shaw (Th45)	Local Wildlife Site Ancient woodland	Local	Ancient woodland habitat - high importance for biodiversity	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Minor Negative	**Slight Adverse**
Linford Pit (Th46)	Local Wildlife Site Invertebrates	Local	SCr11; SCr12. An important brownfield site that supports 5 Red Data Book invertebrates including two bees (*Andrena florea* and *Nomada fulvicornis*) two wasps (*Cerceris quinquefasciata* (a BAP species) and *Hedychrum niemelai*) and a rare fly (*Myopa polystigma*). High importance	A mix of favourable and unfavourable (caused by extremes of management and adverse heavily localised recreational pressure)	Difficult to substitute established brownfield sites	High - undesignated site hosts Red Data Book species	Minor Negative	**Slight Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Linford Wood (Th51)	Local Wildlife Site Wet woodland complex	Local	HCr2(b); HCr5; HCr6(b); HCr6(d). Wet woodland UK BAP habitat. Medium importance.	Current condition not known, but habitat requires management to maintain diversity of scrub and woodland types.	Not possible to substitute without similar hydrology to maintain water table required for wet woodland	Medium - BAP priority habitat	Neutral	**Neutral**
Low Street Pit (Th47)	Local Wildlife Site Invertebrates; flora	Local	HCr11; SCr11; SCr12; SCr13. Thames Terrace grassland supports a diverse invertebrate fauna including UK BAP invertebrate (Hornet Robber fly (*Asilus crabroniformis*)) Medium importance.	Unknown at present, but a rare grassland habitat and associated invertebrate fauna, associated with Thames Terrace soils.	Not possible to substitute	Medium importance Thames Terrace grassland and invertebrates	Major Negative	**Moderate Adverse**
Lytag Brownfield (Th39)	Local Wildlife Site Acid grassland; reptiles	Local	HCr19; SCr4. Brownfield site with acid grassland that supports all four common species of reptile (adder, grass snake, common lizard and slow worm). Medium importance	Believed to be favourable, but identified as a site a risk from development.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Goshems Farm (Th49)	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. High importance.	Red Data species but unknown at present.	Creation of replacement habitat possible?	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	**Large Adverse**
Canal and grazing Marsh, Higham (Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat)	Local	Recently established reedbeds, damp disturbed grassland and a dyke system. Medium importance	Site recently improved with active management by RSPB.	Not possible to substitute	Medium - BAP priority habitat	Neutral	**Neutral**
ancient woodland immediately to the north west of M25 J29	Ancient Woodland	National	Ancient woodland habitat high importance for biodiversity.	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Large Adverse**
Priority Habitat - Deciduous Woodland (south west of M25 J29; north east of M25 J29; south of A127 East Horndon interchange; adjacent to railway line south of Dunton Hall; north west of Linford; east of Low Street; areas included in East Tilbury Marshes; north of the A226 opposite Church Lane; adjacent to the A2 immediately west of Shorne and Ashenbank Woods SSSI)	Priority habitat	Local	Medium importance, BAP habitat	Nationally, deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Not possible to substitute mature habitats. Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority Habitat - Deciduous Woodland (north of A127 opposite Great Warley Hall; adjacent to railway line south of Dunton Hall; north of Horndon on the Hill; south west of Dame Elyns; east of Buckland; north east of East Court Manor; adjacent to the A2 immediately west of Shorne and Ashenbank Woods SSSI; adjacent to A2 west of Claylane Wood)	Priority habitat	Local	Medium importance, BAP habitat	Nationally, deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Not possible to substitute mature habitats. Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Priority Habitat - Wood-pasture and Parkland (between Round Shaw and Hollow Bottom Shaw/Thick Shaw north of the A127)	Priority habitat	Local	Medium importance, BAP habitat	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Priority Habitat - Wood-pasture and Parkland (between Round Shaw and Hollow Bottom Shaw/Thick Shaw south of the A127)	Priority habitat	Local	Medium importance, BAP habitat	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority Habitat - Traditional Orchards (south of Horndon on the Hill; south west of Dame Elyns)	Priority habitat	Local	Medium importance, BAP habitat	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Priority Habitat - Traditional Orchards (on Church Lane north of A226)	Priority habitat	Local	Medium importance, BAP habitat	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority Habitat Coastal and Floodplain Grazing Marsh (East Tilbury Marshes north of Thames; MoD firing range, Thames Estuary and Marshes Ramsar and South Thames Estuary and Marshes SSSI south of Thames)	Priority habitat. Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites)	Medium to high importance, dependant on functioning within the wider network of habitats	Likely to be decreasing due to agricultural improvement, drainage and development	Not possible to substitute easily as reliant on suitable groundwater conditions (hydrology) for replacement habitat to establish.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority Habitat - Coastal Saltmarsh (east of Tilbury Power Station)	Priority habitat. Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within the wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	**Neutral**
Priority Habitat - Mudflats (East of Tilbury Power Station)	Priority habitat. Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within the wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Tentacled lagoon worm (*Alkmaria romijni*)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal	Considered scarce wihtin the UK; vulnerable to changes to, or loss of, the habitats in which they live	Not possible to substitute	High	Neutral	**Neutral**
European eel (*Anguilla anguilla*)	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	**Neutral**
Smelt (*Osmerus eperlanus*)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales	Not possible to substitute	Medium	Neutral	**Neutral**
Harbour Porpoise (*Phocoena phocoena*)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	**Neutral**

Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations
JNCC website for Ramsar, SPA, SAC and SSSI site designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT_External/#)
Green Infrastructure Assets Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green_Infrastructure_Assets_Baseline_Report_1_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

Summary Assessment Score

Very Large Adverse*

Qualitative Comments

Route 4 bisects 3 designated sites, 11 local wildlife sites and and additional 14 areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route bisects a number of important habitats which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of five areas of ancient woodland along the northern extent and one along the southern extent of the new road would involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable (as discussed above).

* Note the Summary Assessment Score is skewed by impacts on ancient woodland (six areas of ancient woodland affected) from the proposed route alignment.

Annex 5 – Historic Environment Worksheet

Annex 5: Historic Environment Impacts Worksheet

Route 4 WSL Bored

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of settlements such as West Horndon, Horndon on the Hill, West Tilbury and Gravesend. The study area contains a number of listed buildings (designated heritage assets), largely in rural settings, although there are small clusters in settlements such as East Tilbury. In total there are 45 Grade II, six Grade II* and one Grade I listed buildings within the study area (Grade II*: Little Warley Hall, Little Warley; Church of All Saints, East Hornden; Old Plough House, Bulphan; Marshall's Cottages and Church of St James, West Tilbury; Church of St Mary, East Court Manor. Grade I: Church of St Peter, Little Warley). The study area contains four conservation areas (designated assets): Thorndon Park, Thong, West Tilbury and East Tilbury. Thorndon Park is also a Grade II* registered park and garden. Cobham Park is a Grade II registered park and garden. Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are five scheduled monuments (designated heritage assets) within the study area: a former parish church and churchyard of St Nicholas; Thorndon Old Hall and gardens; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	The listed buildings and conservation areas are designated heritage assets and are afforded protection at a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS. The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS. Whilst registered parks and gardens do not have statutory protection, they area a material consideration in the planning process and are considered at a national level in the NPPF and NN-NPS. The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	The Grade I and Grade II* listed buildings are of high value, whilst the Grade II listed buildings are of medium value. The East Tilbury conservation area if of high value whilst the other four conservation areas are of medium value. Thorndon Park Grade II* registered park and garden is of high value whilst Cobham Park registered park and garden is of medium value. The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	The Grade I and Grade II* listed buildings, churches and manor houses are relatively well represented types on a national and regional level and are of moderate rarity. East Tilbury conservation area is a rare example of a planned modernist factory town. The other four conservation areas are relatively well represented regionally and nationally. Thorndon Park and Cobham Park registered park and gardens contains considerable time depth and incorporates or is associated with a number of other high value assets and is rare on a national level. The scheduled monuments at Thorndon Old Hall, West Tilbury and Bowaters Farm are relatively well represented types of monument and are of moderate rarity. The former parish church and churchyard of St Nicholas is less well represented and is high rarity. The non-designated archaeological remains are of types that are well represented on a regional level and are of low rarity.	The Scheme will have a direct physical impact on the Grade II listed Dunton Hills Farm, which will be removed. The scheme may impact on the settings of the listed buildings along the route. The scheme will have direct physical impact on the Thorndon Park conservation area and registered park and garden. The scheme may also impact on the settings of the Thong, West Tilbury and East Tilbury conservation areas and Cobham Park registered park and garden. The setting impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape The scheme may also impact on the settings of the scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. Construction excavations associated with the prposed road and tunnel portals may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good. The survival of Thorndon Park registered park and garden is generally good. The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area. Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	With the exception of the former parish church and churchyard of St Nicholas and the Bowaters Farm anti-aircraft battery, the survival of which is rare at both regional and national levels, the survival of the scheduled monuments is of moderate rarity value. Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of Thorndon Park registered park and garden and conservation area, which would be subject to the direct physical impacts as the result of road construction within the designated area. The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The condition of the listed buildings and conservation areas is generally good. The condition of Thorndon Park and Cobham Park registered park and garden are generally good. The condition of the scheduled monuments is generally good, with the exception of the Bowaters Farm anti-aircraft battery, the condition of which is poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings, conservation areas and registered park and gardens is of moderate significance as they have they have a beneficial effect on the character and amenity value of the study area. The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	Listed buildings and conservation areas in good condition are relatively common in this region and have low rarity value. Registered parks and gardens in good condition are also relatively common, but have moderate rarity due to their relative scarcity Scheduled monuments of the nature and condition of those within the study area have a high rarity value. Non-designated archaeological remains in good condition are relatively common nationally and have a low rarity value.	The scheme would not impact on the condition of designated assets within the study area, with the exception of Thorndon Park registered park and garden and conservation area, which would be subject to the direct physical impacts as the result of road construction within the scheduled area. The scheme would have not impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings and conservation areas are not unusually complex and represents a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Thorndon Park and Cobham ParkI are relatively complex as it represents several phases of development. Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area. The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflect this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Period	The listed buildings and conservation areas date from the medieval to modern periods. Thorndon Park and Cobham Park registered park and garden dates from the early medieval to modern periods. The scheduled monuments date from the Neolithic to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	The NPPF and NN-NPS takes the period of heritage assets into account at a national level.	The wide range of periods represented within the historic environment resource is of high significance due to the potential to aid understanding the development of the region.	The range of periods represented by the historic environment resource within the study is common to the region and as such is of low rarity.	The scheme would not impact on the periods represented by the historic environment resource within the study area.

Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Kent Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

Step 5 - Summary Assessment Score

Large Adverse

Qualitative Comments

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. One Grade II listed building (Dunton Hills Farm) will suffer a direct physical impact through its removal, the effect of which is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm, listed buildings along the route; Thong, West Tilbury and East Tilbury conservation areas; Cobham Park registered park and garden. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas, registered park and garden and scheduled monuments. Road construction within the registered area of the Thorndon Park registered park and garden and conservation area will cause a direct physical impact to this designated asset. Due to the high value of the assets, the effects are predicted to be Large Adverse. Construction excavations associated the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint. In addition, any dredging within the river channel to facilitate the construction of a bored tunnel may impact previously unknown archaeological remains. Overall, Slight Adverse Effects to any non-designated archaeological remains within the scheme footprint are predicted.

Annex 6 – Landscape / Townscape Worksheet

Annex 6: Landscape Impacts Worksheet

Route 4 WSL Bored

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	South of the Thames corridor the landscape is gently undulating with, large open arable fields and few hedgerows, which are mainly along the roads and around the small settlements. The land rises up to the wooded ridge of Shorne Woods Country Park, with the A2 and high speed rail transport corridor to the south. To the west is the suburban edge of Gravesend with housing and recreational facilities such as a golf course and leisure centre.	Local	Rare in a local context	Varies, farmland is medium in a local context, Shorne woods rare and the urban edge common.	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	**Moderate adverse.** Route 4 WSL would have a direct and indirect impact on the pattern of the existing landscape. In places the route would cut through the gently undulating landform as it passes under the A226 Rochester Road and Thong Lane. At the junction with the A2 the road would be raised up on an embankment which would create a visual barrier. Fields which create a distinct pattern on the landscape would be bisected by the road, although these are larger in size than they would have been historically, with most hedges removed or poorly maintained.
	The Thames river corridor consists of flood embankments along the river edge backed by expansive marshlands with rough grazing and sparse scrub. On the north side there are extensive areas of old mineral workings some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	**Neutral.** The tunnel portals would be located to the north and south of the Thames corridor.
	From the junction of the A127 with the M25 Route 4 WSL would pass through open gently rolling countryside of medium sized, enclosed fields and small settlements. Further south the settlements become larger as do the size of the fields. Power lines become a more prominent feature.	Local	Common	Medium	High	**Moderate Adverse.** Route 4 WSL would impose a linear transport corridor through a largely rural area and break up the existing scale of the field pattern. Where it follows the line of the existing A127 the impact would be **slight adverse.**
Tranquillity	South of the Thames corridor the level of tranquillity varies considerably with location. There are peaceful country lanes and small villages, although nowhere is it completely tranquil due to distant road noise and the visual intrusion of urban settlements, roads and pylons.	Local	Locally rare.	Varies, medium for most of the route while the country lanes and villages are high.	Low	**Moderate adverse** in the vicinity of Route 4 WSL. Whilst there is some road noise in most areas at present this would increase considerably in most locations. The presence of road infrastructure would also have an impact on visual tranquillity. For residents of Thong, Riverview Park, and Chalk the route change the view and increase noise, having a detrimental impact on tranquillity.
	Within the Thames corridor there are expansive views over the river and surrounding marshland from the riverside paths which are often some distance from the nearest road. There is always the visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	**Slight adverse.** A tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	North of the Thames corridor the level of tranquillity varies considerably with location. There are large roads such as the M25, A13 and A127 which generate traffic noise and disrupt tranquillity whilst there are open areas of countryside between that are broken only by the occasional small road. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of small settlements, roads and pylons.	Local	Common	Low	High	**Moderate adverse** in the vicinity of Route 4 WSL. While there is some road noise in most areas at present this would increase considerably in the majority of locations. The presence of road infrastructure would also have an impact on the rural character of the area. For some residents of East Tilbury, West Tilbury, Linford, Southfield, Horndon on the Hill and west Horndon the route change the view and increase noise, having a detrimental impact on tranquillity.
Cultural	Most of Route 4 WSL is located within Green Belt.	Regional	Regionally medium	High in regional context	Low	**Moderate adverse**. The Green Belt is a valued rural separation between settlements. In this location Route 4 WSL would introduce a new urban element into the Green Belt that has been planned to separate Basildon, Grays, Tilbury and Gravesend from nearby villages.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Rare	High in a national context	Low	**Neutral.** A slip road at the junction with the A2 would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB) and Shorne Woods Country Park.	National	Rare nationally	High in national context	Low	**Slight adverse.** Route 4 WSL and the junction with the A2 would mostly be located outside of AONB with a slip road located within it. This would have little impact due to the existing A2 and infrastructure. There would be views from parts of the AONB at Shorne Woods of new road infrastructure to the north and west. There would be an impact on the setting of the AONB from the north west.
	Conservation Area at Thong.	Regional	Medium	High in regional context	Low	**Slight adverse.** Route 4 WSL would be close enough to the northern part of the conservation area to have an adverse impact on it.
	Southern Valley Golf Course and driving range and land associated with Cascades Leisure Centre. Included in Gravesham Local Plan 2nd review as an area for Green Grid Site Protection.	Local	Medium	Medium in local context	High	**Slight adverse**. Route 4 WSL would pass through the golf course which would have to be partly re-located.
	National Cycle Routes 1 and 13 and other public rights of way.	National/local	Rare/common	High/low	High as easily relocated	**Moderate adverse** for rights of way and national cycle routes located close Route 4 WSL due to the visual impact of road infrastructure and increased noise levels.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	**Neutral** The portal and road would be located some distance to the south.
	Saxon Shore Way leisure route along the Thames and public right of way on northern side of the Thames.	Regional/local	Rare regionally	High in a local context	Low	**Neutral.** The tunnel would pass below the paths.
	Listed buildings located close to Route 4 south of the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse , the granary at Little Filborough Farm East Court Manor, Church of St Mary in Chalk (grade II*) and White Horse Cottage in Thong.	National/regional	Nationally/ regionally rare	High in national/regional context	Low	There would be a **slight adverse** impact on the setting of the listed buildings in Chalk and a **neutral** impact on the listed building in Thong which would be further from the proposed route.
	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	**Neutral.** A tunnel will have no impact on the setting to the monument.
	Scheduled monument at Bowaters Farm WWII anti aircraft battery.	National	Rare	High at a national level	Low	The monument is largely hidden from view by scrub and despite the closeness of Route 4 WSL it would only have a **slight adverse** impact on the setting.
	Grade II listed building at Bucklands Farm.	Regional	Rare	High	Low	The building is surrounded by trees and the road would have only a **slight adverse** impact on its setting.
	East Tilbury Conservation area and listed buildings.	Regional	Rare	High	Low	Some distance away from the conservation area which is an unusual modernist development of housing and factories. For most of the area the impact would be **neutral** with **slight adverse** on the setting of the western edge.
	Grade II listed buildings in the vicinity of Hordon on the Hill within 500m of Route 4 WSL. 2 at Ongar Hall Farm, 2 at Wyfields Farm, Linsteads Farm, Chorleys farm, 2 at Saffron Gardens.	Regional	Rare	High	Low	Generally a **slight adverse** impact on the setting of the buildings due to the distance from Route 4 WSL. At Chorleys farm the impact will be **moderate adverse** as the route is close to the building and would considerable change the setting from arable field to the east.
	Bulphan WWII bombing decoy scheduled monument, south of Doesgate Lane.	National	Rare	High at a national level	Low	**Large adverse** impact on the setting of the scheduled monument due to the closeness of the road to an extremely rare example of a bombing decoy.
	Dunton Halls Golf Course.	Local	Medium	Low	Medium	**Moderate adverse**. Route 4 WSL would run through part of the golf course which would have to be relocated.

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
	All saints Church grade II* , Freman Monument grade II & Stabling at Church of all Saints grade II, listed buildings.	National/regional	Rare	High	Low	**Slight adverse** The new junction with the distributer road would have an impact on the setting of the buildings.
	Grade II listed buildings at East Horndon Hall, Dunton Hills Farm & 2 at Dunton Hall.	Regional	Rare	High	Low	**Moderate adverse** to East Horndon Hall as the building would become surrounded by roads severely affecting its setting. Dunton Hills Farm would be demolished and the impacts will be addressed as part of the heritage worksheet. The other listed buildings are further from the route which would only have a **slight adverse** impact on their setting.
	Thordon Hall scheduled monument.	National	Rare	High	Low	**Slight adverse.** The slip roads connecting Route 4 WSL with the A127 and the new distributer road would have some impact on the setting of the monument although it will be largely hidden by vegetation.
	Thordon park registered park and conservation area.	National	Rare	High	Low	**Moderate adverse.** The southern part of the registered park and the conservation area will be affected by the 2 new slip roads to linking route 4 with the A127 and a new distributer road will cut through the southern part of the conservation area and the registered park. This will isolate small sections of both from the remainder.
	A grade I & II* listed buildings at Little Warley.	Regional/national	Rare	High	Low	**Slight beneficial.** The removal of the junction with the A127 and the demolition of the exiting service station would have a small improvement on the setting of the listed buildings.
	2 grade II Listed buildings, Hulmers and The Kilns Hotel on the B186 north of the A127.	Regional/national	Rare	High	Low	**Neutral.** The removal of the junction between the B186 and the A127 would have an advantages impact on the setting of the buildings. The proposed slip road between the A127 and the M25 and the junction of the distributer road with the B186 would have a slight adverse impact on the setting of the buildings. Overall the impact would be neutral.
Landcover	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	**Neutral.** Part of the Route 4 WSL / A2 junction would be located inside of the registered park, although in reality this is outside of the of the current park boundary.
	Shorne Woods Country Park is made up of ancient woodland, woodland and heathland. The park has a visitor centre, car park, leisure facilities and walks.	Local	Rare	High in local context	Low	**Neutral.** None of Route 4 WSL would pass through the woodland.
	South of the Thames river corridor the landcover consists of arable farmland with hedgerows and trees grouped around small settlements. To the west is the suburban edge of Gravesend with associated recreational land uses such as a leisure centre, golf course and driving range.	Local	Common	Low in local context	Medium	**Moderate adverse**. The current agricultural landcover would change along Route 4 WSL to one dominated by transport infrastructure. There would probably be a change in the use of the land between the road and the edge of Gravesend as many of the fields would be too small to farm.
	The characteristic landcover of the Thames river corridor consists of open flat grazing marsh with sparse scrub and trees cover with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have **neutral** impact immediacy adjacent to the river. Above the current agricultural landcover would change along the route to one dominated by transport infrastructure, in the long term there would be the potential for Route 4 WSL to create changes to the surrounding agricultural land which would be bisected and would become less viable to farm.
	South of the A13 there are more settlements. Arable fields are still a feature but this are mixed with rough grassland, golf courses and gravel extraction. Overhead power lines become a common feature.	Local	Medium	Medium in local context	High	**Moderate adverse**. Despite the urban fringe character the introduction of Route 4 WSL would significantly change the land use in the immediate vicinity of the road and some arable fields would no longer be viable.
	From the M25 junction with the A127 to the A13 the landcover is mostly of arable fields, with hedges and boundary trees, with settlements some distance away. There is a golf course at Dunton. Areas of woodland at the junction with the M25 including a small area of ancient woodland would be destroyed by the new slip roads.	Local	Medium	Medium in local context	High. The most important features the trees and hedges can easily be replaced. Ancient woodland low.	**Moderate adverse** The current agricultural landcover would change along the route to one dominated by transport infrastructure.
Summary of character	The Thames river corridor has a strong identity with large expansive horizontal visits dominated by the interplay of water and sky. The area to the north along Route 4 WSL consists of open arable farmland north of the A13, with settlements and urban fringe areas becoming more dominant to the south. South of the Thames corridor consists of large arable fields with hedgerows and trees grouped in association with small settlements. Recreational facilities such as a golf course and leisure centre fringe the suburban edge of Gravesend to the west. The land rises up to the south and the AONB with areas of woodland and heathland beyond which is the A2, HS1 transport corridor.	Regional	Medium regionally	Medium regionally	Medium	A bored tunnel would have a **neutral impact** in the Thames corridor. For the remainder of the route, in more rural areas the route would have a moderate adverse impact as it would change the character of the surrounding area. Closer to urban settlements it would have a slight adverse impact due to the presence of existing large roads.

Reference Sources

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock Local Plan 1997, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary, National Character Area 113 North Kent Plain, The Landscape Assessment of Kent 2004, Essex Landscape Character Assessment, Gravesham Local Plan 2nd review

Step 5 - Summary Assessment Score

Moderate adverse

Qualitative Comments

Route 4 WSL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt. Route 4 WSL would introduce a significant change to the existing landscape character for much of the route, which is designated as Green Belt, due to the introduction of a major new transport corridor with its associated infrastructure such as signage, lighting, bridges and embankments, into a largely rural area. The new road corridor and junction infrastructure associated with Route 4 WSL would impact on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

Annex 7 – Water Worksheet

Annex 7: Water Environment Impacts Worksheet

Route 4 WSL Bored

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study area: River Thames									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine/ transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to economy / navigation	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	Regional / National (excludes biodiversity considerations)	Rare	Not feasible	Very High	**Negligible**	Low significance
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mardyke									
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R4) WFD Water body ID GB106037028030	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (East Tributary- R8) WFD water body ID GB106037028070	Water supply / biodiversity / transport & dilution waste products / recreation	Low Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**(Moderate adverse)** (Larger tributary crossing) **Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (West Tributary) R9 WFD water Body ID GB106037028080	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes East Tilbury main drains	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway Canal									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal (Ca18) (GB70610011)	Biodiversity / transport & dilution waste products /recreation / navigation (potential)	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	Regional (ref WFD water body status)	Moderate	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses and drainage ditches at South Thames Estuary and Marshes (excluding Thames and Medway canal)									
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and Ramsar site.	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)									
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and drainage ditches at East Tilbury Marshes	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds									
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River Thames including ponds and lakes and standing water in marsh areas	Biodiversity / recreation / amenity / water supply (small reservoirs and dams)	Low - Medium Could support protected ecological species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	**Negligible:** No significant standing waters crossed or intercepted.	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible:** Assumes no drainage to standing water in accordance with best practice	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Groundwater north of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zones 2 and 3 (Linford / East Tilbury) Local commercial / industrial / agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible - slight adverse** Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium - low WFD water body status (current poor, target good)	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible:** Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	**Slight to moderate adverse**. Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures	North Kent Medway Chalk WFD Water body ID GB40601G500300	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial / agricultural licenced supplies	Regional (ref WFD water body status	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	Shallow groundwater (terrace gravels/ alluvium) feeding South Thames Estuary and Marshes SSSI	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar / SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	**Slight adverse** Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood Zone 2/3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	**Slight adverse** - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely, further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	**Negligible** (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	**Slight adverse**: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Local	Moderate	Not feasible: Unlikely to be substitutable	High	**Slight adverse:** Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Study Area: Mardyke Flood Zone 2/ 3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mar Dyke)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	**(Moderate Adverse) Slight adverse** (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mar Dyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - where crossings span flood plain	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Mar Dyke channel	Conveyance of flood flows	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period	Local	Moderate	Not feasible	High	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - where crossings span flood plain	Low significance (Significant)
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mar Dyke flood defences	Protection of property/assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Area surrounding Main Rivers, Ordinary Watercourses, land drains and ditches, including marshes									
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Study Area: Entire route.									
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from groundwater	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from drains, sewers, and water mains	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance

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Summary Assessment Score

(Post mitigation)
Moderate Adverse impacts

Qualitative Comments

Note 1 : Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation.

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall , these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

Impacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse.

Impacts on the Thames and Medway canal (WFD water body) depend on the construction methods adopted, a cut and cover tunnel through this area (immersed tunnel option) would lead to a loss of part of the water body and could impact its WFD status, however if mitigation in the form of full canal restoration post construction is adopted, these impacts could be reduced from moderate (or even large) adverse to slight adverse

Impacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, the impacts on the Tidal waters of the Thames remain moderate adverse.

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial / agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Impact at source protection zones may be mitigated by adopting appropriate construction and drainage practices. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

Flood Risk:
The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span, minimise pier dimensions).

Tunnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 4 bridge design indicates the bridge would be significantly higher than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 4 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 4 crossing are:
P4 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit East Tilbury and Mucking Marshes, north of the river Thames (continue with existing or alternative actions to manage flood risk)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 4 road embankment to provide this structural defence.

CFMP policies for Route 4 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).
CFMP policies for Route 4 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits). Route 4 crosses the Mardyke floodplain near the upstream extent of Mardyke catchment. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP Policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route 4 passes through CDA_010a and CDA_010b (located west of Stanford-le-Hope) and CDA_011 (located in the upper Mardyke catchment in and around Bulphan. For these areas there is potential for the road design to act to reduce local flood risk e.g. by providing attenuation of road drainage, providing flood storage directly upstream of the road. None of these CDAs are crossed by the proposed Route 4. Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Route 4 route alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

Annex 8 – Noise Worksheet

Annex 8: Noise Worksheet
Route 4 WSL Bored Tunnel

APPRAISAL - NOISE POLLUTION

Present value base year: 2010

Current year: 2015

Proposal Opening Year: 2025

Average Household Size: 2.36

Project (Road or Rail): Road

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in Opening Year

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9571	331	146	108	66	48	23	7	0	0	0	0	0	0
45-47.9	1210	4544	174	47	13	8	53	18	7	1	1	0	0	0
48-50.9	12	1351	5078	225	89	39	23	4	2	0	0	0	0	0
51-53.9	0	29	1267	4652	237	17	12	2	0	0	0	0	0	0
54-56.9	0	0	17	989	3375	142	52	20	0	0	0	0	0	0
57-59.9	0	0	0	47	703	2498	146	29	7	1	0	0	0	0
60-62.9	0	0	0	0	35	711	2697	154	18	0	0	0	0	0
63-65.9	0	0	0	0	0	17	557	2768	55	1	1	0	0	0
66-68.9	0	0	0	0	0	0	16	469	1751	69	1	0	0	0
69-71.9	0	0	0	0	0	0	0	41	245	837	17	0	0	0
72-74.9	0	0	0	0	0	0	0	0	13	68	204	2	0	0
75-77.9	0	0	0	0	0	0	0	0	0	1	49	53	1	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	9	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in 15th Year After Opening

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9178	312	160	115	67	48	24	8	1	0	0	0	0	0
45-47.9	1190	4487	188	45	10	7	49	18	6	2	1	0	0	0
48-50.9	17	1266	5208	263	86	39	29	6	2	0	0	0	0	0
51-53.9	0	20	1125	4803	204	13	9	10	1	0	0	0	0	0
54-56.9	0	0	9	947	3580	157	55	12	4	0	0	0	0	0
57-59.9	0	0	0	51	629	2599	132	37	7	1	0	0	0	0
60-62.9	0	0	0	1	33	625	2769	140	38	0	0	0	0	0
63-65.9	0	0	0	0	0	16	489	2837	84	4	1	0	0	0
66-68.9	0	0	0	0	0	0	14	439	1807	61	1	0	0	0
69-71.9	0	0	0	0	0	0	0	63	241	939	25	0	0	0
72-74.9	0	0	0	0	0	0	0	0	8	90	221	2	1	0
75-77.9	0	0	0	0	0	0	0	0	0	1	33	73	1	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	7	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Net Present Value of Noise of Proposal (60 Year Period) £13,358,865 *positive value reflects a **net benefit** (i.e. noise reduction)

Estimated Population Annoyed (Do-Minimum): 12418

Estimated Population Annoyed (Do-Something): 12091

Net Noise Annoyance Change in 15th Year After Opening (no. of people): -327 *positive value reflects an **increase** in people annoyed by noise

Appendix 7.4
Appraisal Summary Table Route 2 ESL (BT)

Appraisal Summary Table Route 2 ESL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appraisal Summary Table | **Route 2, Eastern Southern Link, Bored Tunnel** | **Date produced:** 22 Jan 2016

Name of scheme:	Route 2 Bored Tunnel with Eastern Southern Link - Core Growth, Central Case costs, Current values of time, additional lane in tunnel
Description of scheme:	New Dual 2 lane trunk road (70mph) from M25 between J29 and J30, linking with A1089, crossing the Thames in a bored tunnel, with an additional lane for future proofing, 2km to the east of Gravesend with an easterly southern link to the M2.

Contact:

Name	Chris Taylor
Organisation	Highways England
Role	Project Sponsor

Impacts		Summary of key impacts	Assessment: Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	**Value of journey time changes(£)** £2,776m **Net journey time changes (£)** 0 to 2min: -£403m; 2 to 5min: £1,109m; > 5min: £2,070m	N/A	£3,257m	Not appraised yet
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A	N/A	£107m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling	N/A	N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are more than double those for Route 1. 80% of WI benefits are from the agglomeration of business activities.	**Agglomeration** £1,299m **Output in imperfectly competitive markets** £326m **Labour supply impacts** £2m	N/A	£1,626m	
Environmental	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	114 people would benefit based on an estimated 12,418 people being annoyed by noise in the without scheme situation decreasing to 12,304 people in the with scheme situation.	N/A	£4m	Not appraised yet
	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors modelled are predicted to exceed the AQSO without the scheme (representing up to approximately 60 receptors), but these receptors experience an improvement compared to the without scheme. The scheme is not predicted to lead to any new exceedences.	N/A	N/A	Not appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-traded carbon over 60y (CO2e) 6,213,068 tonnes Change in traded carbon over 60y (CO2e) 16,978 tonnes	N/A	-£284m	
	Landscape	A new road would adversely affect the landscape character including in the vicinity of Tilbury, Grays and Chadwell St Mary, Shorne and Shorne Ridgeway, green belt and intrude into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.	N/A	Large Adverse	N/A	
	Townscape	See Landscape entry	N/A	N/A	N/A	
	Historic Environment	Direct physical impacts to two scheduled monuments, one conservation area and two Grade II listed buildings. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint.	N/A	Moderate Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land). Impacts on LWSs & areas of BAP Priority Habitat. Direct loss of ancient woodland at Great Crabbles Wood SSSI and Court Wood.	N/A	Very large Adverse	N/A	
	Water Environment	Impacts on Mardyke and crosses the Tilbury Flood Storage Area.	N/A	Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing	**Value of journey time changes(£)** £692m **Net journey time changes (£)** 0 to 2min: -£304m; 2 to 5min: £366m; > 5min: £629m	N/A	£300m	Not appraised yet
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A	N/A	£39m	
	Physical activity	The option has no impact on walking and cycling	N/A	N/A	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. The ESL is the only option which provides a motorway to motorway link, connecting the M2 with the M25. Route 2 uses the A1089 (the access to Tilbury Port) for part of the route, which will involve mixing of strategic traffic with local traffic which has a high percentage of HGVs	N/A	Moderate Beneficial	N/A	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	Because it is a new route 2,319 additional accidents are predicted over 60 years, including 31 fatalities, 246 serious injuries and 3,259 slight casualties	N/A	-£118m	Not appraised yet
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network	N/A	Slight Adverse	N/A	Not appraised yet
	Access to services	Not appraised because this criteria relates to public transport options	N/A	N/A	N/A	N/A
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at Dartford Crossing today	N/A	Neutral	N/A	Not appraised yet
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A	Slight Adverse	N/A	Not appraised yet
	Option and non-use values	Not appraised because this criteria relates to public transport options	N/A	N/A	N/A	
Public Accounts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Investment costs: £2,202m Operating costs £283m Operator revenue £816m (a benefit, offsetting cost over the longer term)	N/A	£1,670m	
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing	N/A	N/A	£585m	

Annex 1 – TEE Table

Annex 1: TEE Table

Economic Efficiency of the Transport System (TEE): Route 2/ESL

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£91,175,130		£91,175,130					
Vehicle operating costs	-£59,213,842		-£59,213,842					
User charges	£123,062		£123,062					
During Construction & Maintenance	£0							
COMMUTING	£32,084,350	*(1a)*	£32,084,350					

Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£600,605,538		£600,605,538					
Vehicle operating costs	-£330,703,841		-£330,703,841					
User charges	-£1,830,523		-£1,830,523					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£268,071,174	*(1b)*	£268,071,174					

Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£2,776,293,744		£684,996,652	£2,091,297,092				
Vehicle operating costs	£602,235,975		£405,443,250	£196,792,725				
User charges	-£121,120,400		-£59,396,760	-£61,723,639				
During Construction & Maintenance	£0							
Subtotal	£3,257,409,319	*(2)*	£1,031,043,142	£2,226,366,178				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions		*(4)*						
NET BUSINESS IMPACT	£3,257,409,319	*(5) = (2) + (3) + (4)*						

TOTAL		
Efficiency Benefits (TEE)	£3,557,564,844	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Annex 2 – PA Table

Annex 2: Public Accounts (PA) Table

Route 2 ESL Bored Tunnel

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue						
Operating Costs						
Investment Costs						
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	-£815,628,635		-£815,628,635			
Operating costs	£283,299,984		£283,299,984			
Investment Costs	£2,202,464,880		£2,202,464,880			
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£1,670,136,229	*(8)*	£1,670,136,229			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-£584,916,674	*(9)*	-£584,916,674			
TOTALS						
Broad Transport Budget	£1,670,136,229	*(10) = (7) + (8)*				
Wider Public Finances	-£584,916,674	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Annex 3 – AMCB Table

Annex 3: AMCB Table

Route 2 ESL Bored Tunnel

Analysis of Monetised Costs and Benefits

Noise	£4,205,925	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	-£284,000,920	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	-£118,064,600	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£32,084,350	*(1a)*
Economic Efficiency: Consumer Users (Other)	£268,071,174	*(1b)*
Economic Efficiency: Business Users and Providers	£3,257,409,319	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	£584,916,674	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£3,744,621,923	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£1,670,136,229	*(10)*
Present Value of Costs (see notes) (PVC)	£1,670,136,229	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£2,074,485,694	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.2	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Annex 4 – Biodiversity Worksheet

Annex 4: TAG Biodiversity Impacts Worksheet

Route 2 ESL Bored

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of *Circus cyaneus.*	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Mucking Flats and Marshes SSSI	Botanical interest: Mudlfats and Saltmarsh.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	**Neutral**
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important birds	Intermediate Negative	**Large Adverse**
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site - High importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important ancient woodland	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Woodland invertebrates.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
Hangman's Wood and Deneholes SSSI	Remains of medieval chalk mines, provide the most important underground hibernation site for bats in Essex. Brown long eared, Natterer's and Daubenton's.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable	Not possible to substitute, medieval chalk and ancient woodland	High - nationally important for bats and ancient woodland	Neutral	**Neutral**
Hangman's Wood and Deneholes SSSI	Area of semi-natural habitat in which bats can feed. A relict fragment of ancient woodland, dominated by Pedunculate Oak Ash, Sycamore with occasional Wild Cherry and Elm.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable	Not possible to substitute, medieval chalk and ancient woodland	High - nationally important for bats and ancient woodland	Neutral	**Neutral**
Great Crabbles Wood SSSI	Botanical importance - broadleaved mixed and yew lowland woodland - designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Unfavourable - Recovering. The whole area is classified as being in a 'no change' condition due to the lack of forestry and woodland management.	Not possible to substitute ancient woodland	High - nationally important ancient woodland	Major Negative	**Very Large Adverse**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute ancient woodland plant species without ancient woodland.	High - nationally important botany	Minor Negative	**Slight Adverse**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - woodland edge/ arable land plant species.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Woodland birds.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important birds	Minor Negative	**Slight Adverse**
Thames Estuary recommended MCZ (on hold)	Marine and estuarine habitats and species.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Not possible to substitute	Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992).	Neutral	**Neutral**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Greater Thames Marshes Nature Improvement Area	Complex of habitats of value for biodiversity and as a community resource.	Regional	Attribute of value to local communities, of Medium importance.	Some goals are being achieved.	Not possible to substitute	Medium - community value and extensive area.	Minor Negative	**Slight Adverse**
Court Wood, Shorne (GR01) - includes Starmore Wood and Peartree Wood (ancient woodlands)	Local Wildlife Site Ancient and Ancient Semi-natural Woodland; derelict orchard and semi-improved neutral grassland.	Local	Area of degraded ancient woodland, high importance with a derelict orchard and area of unmanaged semi-improved neutral grassland of limited botanical interest that supports invertebrates.	Much of this woodland has been converted to chestnut but still retains a good diversity of flowering plants, including many ancient woodland indicator species.	Not possible to substitute ancient woodland	High - ancient woodland	Major Negative	**Very Large Adverse**
Shorne Pasture (GR18)	Local Wildlife Site Grassland, scrub.	Local	Area of unimproved pasture on acid, dry pebbly soils. Supports a herb-rich flora - Low importance.	Unknown - not indicated on Kent Local Wildlife Site schedule.	Soil translocation a possibility	Low - local value grassland and scrub	Neutral	**Neutral**
Un-named ancient woodland (at centre of M2 J1 interchange)	Ancient Woodland	National	Area of degraded ancient woodland of Low to Medium importance.	Unknown, but likely to be declining due to isolation and impact of poor air quality.	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	**Moderate Adverse**
Un-named ancient woodland (south of M2 J1 interchange, to the west of the M2)	Ancient Woodland	National	Area of degraded ancient woodland of Low to Medium importance.	Unknown - but likely to be declining due to impact of poor air quality given proximity to M2.	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	**Moderate Adverse**
Hangman's Wood and Deneholes - Ancient Woodland	Ancient Woodland	National	Ancient woodland habitat, likely to be of Low to Medium Importance for biodiversity due to small size.	Nationally ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens.	Not possible to substitute	High - important ancient woodland	Neutral	**Neutral**
Priority Habitat - Deciduous Woodland (Disrupted in several places to various degrees - see individual Local Wildlife Sites (below)). Impacts on woodland around Buckland and Brook Farm (north of the East Tilbury Marshes), A126 roundabout near Bretts farm (north of Tilbury), and a small section on A226 south east of Chalk	Priority BAP habitat. Some will be lost/severely impacted.	Local	Medium importance, BAP habitat	Nationally lowland mixed deciduous woodland is declining due to clearance, over grazing, and replanting with non-native species.	Replacement planting and/translocation of habitats a possibility.	Medium - BAP priority habitat	Intermediate Negative	**Moderate Adverse**
Priority habitat - Coastal Saltmarshes (south of river, as part of Shorne Marshes and Eastcourt Marshes)	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites).	Importance will be dependant on functioning within who wider network of habitats, likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	**Neutral**
Priority Habitat - Intertidal mudflats (particularly northern bank of the river at crossing, down stream of the Thames Estuary and Marshes (Ramsar))	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites).	Likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority Habitat - Coastal and Floodplain Grazing Marsh including freshwater ditches/ponds	Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites).	Low to High, dependant on functioning within the wider network of habitats.	Likely to be decreasing due to agricultural improvement, drainage and development.	Replacement habitat creation potentially possible (e.g. managed realignment or creation of freshwater wetland habitats), but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority habitat - Traditional Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance.	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility.	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1 interchange)	Priority BAP habitat	Local	Wood-pasture and Parkland BAP habitat - Medium importance	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to recreate mature habitats	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Priority habitat - Traditional Orchards (adjacent to the A289 at M2 J1 interchange; on Church Lane and adjacent to the A226 north of Shorne)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority habitat - Deciduous Woodland (adjacent to M2 J1 interchange; Great Crabbles Wood; and along northern edge of the A226 near Church Lane)	Priority BAP habitat	Local	Deciduous Woodland BAP habitat - Medium importance	Nationally lowland mixed deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Blackshots Nature Area (Th34)	Local wildlife Site - rough grassland and deciduous woodland.	Local	Large area of rough grassland and important invertebrate population, as well as providing potential nesting habitats for birds such as skylark. UK BAP fly species *Dorycera graminum* found here.	Species rich grasslands are decreasing, unmanaged grassland is likely to be increasing. Nationally deciduous woodland is declining.	Replacement planting a possibility but limited space available.	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Little Thurrock Reedbeds (Th35)	Local wildlife Site. Of importance for cohesion between designated sites and for sustaining populations of birds such as bearded reedling.	Local	BAP habitat. Low to Medium, dependant on functioning within the wider network of habitats.	Increasing nationally	Not possible to substitute	Medium - BAP Habitat of Principal Importance in England.	Minor Negative	**Slight Adverse**
Terrels Heath (Th36) - incudes Chadwell Wood (ancient woodland)	Local wildlife Site with Ancient Woodland.	Local	Terrels Heath is a forest structure dominated by pendunculate Oak (*Quercus robar*). High importance - ancient woodland.	Nationally deciduous woodland is declining due to clearance, over-grazing, and replanting with non-native species.	Not possible to substitute	High - important ancient woodland.	Minor Negative	**Moderate Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Broom Hill (Th38)	Local wildlife Site	Local	Hilltop site, developed partly on shallow sand/gravel workings, of interest for its ancient acid-grassland flora. Significant populations of invertebrate species associated including 7 Red Data Book invertebrate species such as; the ant *Myrmica specioidesand* Great Green Bus-cricket *(Tettigonia viridissima).*	7 Red Data Book invertebrate species and a number of UK BAP species. Condition unknown.	Not possible to substitute.	High - undesignated site hosts Red Data Book species.	Minor negative	**Slight Adverse**
Lytag Brownfield (Th39)	Local Wildlife site	Local	Low to medium importance. Survey work by independent ecological consultants has revealed populations of all four Essex reptiles(Adder, Grass snake, Common Lizard, and Slow-worm) making this one of the more important reptile sites in the borough.	Reptile species in decline in some areas. It is also likely that this site has UK BAP invertebrates given the presence of them on similar habitats in the area. No data currently.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Low to Medium - Local Wildlife Site.	Minor Negative	**Slight adverse**
West Tilbury Hall (Th42)	Local wildlife Site	Local	Area of interesting acidic grassland flora. Low importance.	Unknown	Soil translocation a possibility but requires suitable substrate to maintain the required pH for habitats to establish.	Low - Local Wildlife Site	Major Negative	**Slight Adverse**
West Tilbury Church (Th43)	Local wildlife Site	Local	Area behind the now privately owned church. Ancient grassland. Low to medium importance depending on species present.	Maintenance of the botanical interest relies on keeping soil nutrient levels low and removing the cuttings arising from grassland management (as now in private, residential ownership).	Not possible to substitute	Low to Medium - Local Wildlife Site	Intermediate Negative	**Slight Adverse**
Low Street Pit (Th47)	Local wildlife Site	Local	Lies on the regionally important Thames terrace gravels. Deciduous woodland as well as old grassland. Supports the UK BAP species Hornet Robber fly (*Asilus crabroniformis*).	Deciduous woodland is declining. The Hornet Robber fly relies on the presence of animal dung that is relatively free from insecticides and worming agents for the development of its larvae. A grazing regime would also be the most appropriate way of maintaining the floristic interest of the site.	Not possible to substitute	Medium - UK BAP species and Thames Terrace habitats/species	Minor negative	**Slight Adverse**
Goshems Farm (Th49)	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. Medium importance.	Red Data species but unknown at present.	Not possible to substitute	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	**Large Adverse**
Canal and grazing Marsh, Higham (Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat).	Local	Recently established reedbeds, damp disturbed grassland and a dyke system.	Unknown	Not possible to substitute	Medium - BAP priority habitat.	Neutral	**Neutral**
Tentacled lagoon worm (*Alkmaria romijni*)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981.	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal.	Considered scarce wihtin the UK; vulnerable to changes to, or loss of, the habitats in which they live.	Not possible to substitute	High	Neutral	**Neutral**
European eel (*Anguilla anguilla*)	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species).	National	Medium importance, BAP species.	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	**Neutral**
Smelt (*Osmerus eperlanus*)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species).	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales.	Not possible to substitute	Medium	Neutral	**Neutral**
Harbour Porpoise (*Phocoena phocoena*)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act.	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	**Neutral**

Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations
JNCC website for Ramsar, SPA, SAC and SSSI site designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT_External/#)
Green Infrastructure Asset Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green_Infrastructure_Assets_Baseline_Report_1_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

Summary Assessment Score

Very Large Adverse*

Qualitative Comments

Route 2 bisects a number of designated and local wildlife sites and areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route bisects a number of important habitats which depending on the crossing type will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a fairly significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of areas of ancient woodland along the southern extents of the new road, where this links to the M2 in the south, would involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable as discussed above.

* Note the Summary Assessment Score is being skewed by impacts on Great Crabbles Wood SSSI and Court Wood where areas of ancient woodland will be lost to the route alignment.

Annex 5 – Historic Environment Worksheet

Annex 5: Historic Environment Impacts Worksheet

Route 2 ESL Bored

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of urban settlements such as South Ockendon, Grays, West Tilbury and Gravesend and smaller settlements such as Orsett. The study area contains a number of listed buildings (designated heritage assets), either within settlements such as South Ockendon and Orsett or within a more rural context such as small groups of farm buildings. In total there are 64 Grade II, six Grade II* and three Grade I listed buildings within the study area (Grade II*: Orsett House, Orsett; Marshall's Cottages and Church of St James, West Tilbury; Church of St Mary, East Court Manor, Little St Katerines and Chuch of St Peter and St Paul, Shorne. Grade I: Church of St Mary Magdelene, North Ockendon; Church of St Nicholas, South Ockendon; Church of St Mary, Chadwell St Mary.). The study area also contains three conservation areas (designated assets): West Tilbury, Shorne Village and Chestnut Green, Shorne Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are seven scheduled monuments (designated heritage assets) within the study area: a barrow at South Ockendon Hall; a medieval moated site at South Ockenden Old Hall; Orsett crop mark complex; the Springfield style enclosure at Orsett; Dene Holes in Hangmans Wood; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	The listed buildings and conservation areas are designated heritage assets and are afforded protection at a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS. The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS. The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	The Grade I and Grade II* listed buildings are of high value, whilst the Grade II listed buildings are of medium value. The conservation areas are of medium value. The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	The Grade I and Grade II* listed buildings, churches and high-status houses, are relatively well represented types on a national and regional level and are of moderate rarity. Conservation areas are relatively well represented regionally and nationally. The scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, West Tilbury and Bowater Farm are relatively well represented types of monument and are of moderate rarity. The Dene Holes flint mine complex and the Springfield style enclosure at Orsett are less well represented and are of high rarity. The non-designated archaeological remains are of types that are well represented on a regional level and are of low rarity.	The Scheme will have a direct phyical impact on two Grade II listed buildings: 1 and 2 Gray's Corner cottages and Thatched Cottage, both to the east of Thurrock. Both listed buildings will be removed. The Scheme will have a direct physical impact on West Tilbury Conservation Area through the construction of a new road within the southern portion of the designated area. The scheme may impact on the settings of the Grade II listed buildings to the south and west of Orsett and to the west of West Tilbury. The scheme may also impact on the settings of the West Tilbury and Shorne Village conservations areas. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. The scheme would have a direct physical impact on the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments through the construction of new roads within the scheduled areas. The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, Ockendon Hall, Orsett, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. Construction excavations associated with the new road and tunnel portals may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good. The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area. Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	Surviving listed Grade II listed buildings are not rare regionally or nationally, although surviving Grade I and Grade II* listed buildings are rare on both scales. With the exception of the Springfield style enclosure at Orsett and the Bowater Farm anti-aircraft battery, the survival of which is rare on both regional and national levels, the survival of the scheduled monuments is of moderate rarity value. Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments which would be subject to the direct physical impacts as the result of road construction within the scheduled areas. The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The condition of the listed buildings and conservation areas is generally good. The condition of the scheduled monuments is generally good, with the exception of the Orsett cropmark complex and Bowaters Farm anti-aircraft battery, the condition of which are poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings and conservation areas is of moderate significance as they have they have a beneficial effect on the character and amenity value of the study area. The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	Listed buildings and conservation areas in good condition are relatively common in this region and have low rarity value. Scheduled monuments of the nature and condition of those within the study area have a high rarity value. Non-designated archaeological remains in good condition are relatively common nationally and have a low rarity value.	The scheme would not impact on the condition of designated assets within the study area, with the exception of the Orsett cropmark complex and Earthworks at West Tilbury scheduled monuments which would be subject to the direct physical impacts as the result of road construction within the scheduled areas. The scheme would have not impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings are not unusually complex and represent a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area. The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflect this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Period	The listed buildings and conservation areas date from the post medieval to modern periods. The scheduled monuments date from the Bronze Age to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	The NPPF and NN-NPS takes the period of heritage assets into account at a national level.	The wide range of periods represented within the historic environment resource is of high significance due to the potential to aid understanding the development of the region.	The range of periods represented by the historic environment resource within the study is common to the region and as such is of low rarity.	The scheme would not impact on the periods represented by the historic environment resource within the study area.

Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Kent Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

Step 5 - Summary Assessment Score

Moderate Adverse

Qualitative Comments

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. Two Grade II listed buildings will experience direct physical impacts through their removal: 1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the east of Thurrock. The effect of these impacts is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, West Tilbury and Bowaters Farm, Grade II listed buildings to the south and west of Orsett and to the west of West Tilbury, West Tilbury and Shorne Village conservations areas. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas and scheduled monuments. Road construction within the scheduled areas of the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments will cause direct physical impacts to these designated assest. With regard to the Earthworks at West Tilbury scheduled monument, the effects are predicted to be Large Adverse. However, due to the poor condition of the Orsett Cropmark complex scheduled monument, these effects are predicted to be Moderate Adverse. Construction excavations associated with the proposed road and the tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint. In addition, any dredging within the river channel to facilitate the construction of a bored tunnel may impact previously unknown archaeological remains. Overall, Slight Adverse Effects to any non-designated archaeological remains within the scheme footprint are predicted.

Annex 6 – Landscape / Townscape Worksheet

Annex 6: Landscape Impacts Worksheet

Route 2 ESL Bored

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	Between the A2 corridor and the A226 the landform is undulating and rises towards the south. The higher land is well wooded, some of the woods are ancient woodlands, with the settlements of Shorne and Shorne Ridgeway running along ridges. Arable fields defined by hedges and trees fill the lower land close to the A226 and in the valleys either side of Shorne. Properties along Pear tree Lane have extensive gardens/grounds, some with horse paddocks.	Local	Rare	Medium	Low. It is not possible to replace ancient woodland.	**Large adverse.** Route 2 ESL would cut across the pattern of the landscape particularly to the east of Shorne where it would run across a valley and then through a hill requiring extensive earthworks. An area of ancient woodland in Great Crabbles Wood would be destroyed.
	Between the A226 and the Thames Corridor the landscape is gently undulating, with large open arable fields and few hedgerows. These are mainly along the roads and around the small settlements.	Local	Rare in a local context	Medium	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	**Moderate adverse**. Route 2 ESL has a direct and indirect impact on the pattern of the existing landscape. In places the it cuts through the gently undulating landform.
	The Thames river corridor consists of flood embankments along the river edge backed by expansive marshland with rough grazing and sparse scrub. On the north side of the river there are extensive areas of former mineral workings some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	**Neutral.** The tunnel portals would be located to the north and south of the Thames corridor and have no impact.
	South of Baker Street Route 2 ESL passes through an urban fringe landscape, with areas of arable land, horse pasture, crossed by roads such as the A13 and A1089 and with areas of suburban housing and school playing fields.	Local	Common	98	High	**Slight adverse**. Where Route 2 ESL passes between existing settlements and follows the line of existing roads. Moderate adverse. Where the existing pattern is more rural, around Baker Street and to the north and north-east of Tilbury
	Between the proposed junction with the M25 at North Ockendon and Baker Street Route 2 ESL passes, through relatively flat open countryside of large arable fields and areas of historic clay pits now used for landfill.	Local	Common	Medium	High	**Moderate adverse**. Route 2 ESL would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape would be bisected by the road.
Tranquillity	South of Shorne and Shorne Ridgeway, noise from the A2 and M2 becomes increasing intrusive, although visually due to the screening effect of trees the area is rural in appearance. The immediate area around the M2, A2, A289 junction is dominated by the roads despite extensive planting.	Local	Medium	Medium	Low	**Moderate adverse** in the vicinity of Route 2 ESL. Whilst there is some road noise in most areas at present this would increase considerably. The presence of road infrastructure would also have an impact on visual tranquillity. For residents of Thong, Riverview Park, and Chalk the route will change the view and increase noise, having a detrimental impact on tranquillity.
	The area around Shorne and Shorne Ridgeway has an unspoilt rural feel considering its closeness to Gravesend and the Medway towns. It is relatively free from traffic noise and the visual intrusion of industry and power lines. There are distant views over the Thames corridor to Essex and Tilbury power station.	Local	Medium	Medium	Low.	**Large adverse**. Route 2 ESL would introduce high levels of traffic noise and transport infrastructure into a currently tranquil rural scene. Some residents of Pear Tree Lane, Shorne Ridgeway, Shorne and Lower Shorne would have a significantly reduced level of tranquillity.
	Within the Thames corridor there are expansive views over the river and surrounding marshland from riverside paths which are often some distance from the nearest road. There is always some visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	**Slight adverse.** The tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	North of the Thames corridor the level of tranquillity varies considerably with location. There are large roads such as the M25, A13 and A1089 which generate traffic noise und disrupt tranquitity while there are open areas of countryside between that are broken only by the occasional small lane. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of small settlements and pylons.	Local	Common	Low	High	**Large adverse** away from the existing large roads a new road would introduce additional noise and visual clutter into a largely rural scene. For some residents of Tilbury, West Tilbury, Grays, Chadwell St Mary, Orsett Heath, Baker Street and South Ockendon the route will change the view and increase noise, having a detrimental impact on tranquillity.
	Most of the route is located within Green Belt	Regional	Regionally medium	High in regional context	Low	**Large adverse.** The Green Belt is a valued rural separation between the urban edge of large settlements such as Grays, Tilbury and Gravesend, nearby villages. A new road would introduce a new urban element into this landscape.
	Public rights of way and National Cycle Route no. 1	National / local	Rare / common	High / low	High as easily relocated	Impact depends on the right of way but some will be crossed by the route and this would have a **Moderate adverse** impact on the users of the paths.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Nationally rare	High nationally	Low	**Neutral.** Part of the Route 2 ESL/A2/M2 junction would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB).	National	Rare nationally	High nationally	Low. It would not be possible to replicate the features of the AONB elsewhere	The Route 2 ESL junction with the A2, A289 and M2 would affect an area on the edge of the AONB and an area immediately around it which is important in terms of its landscape character, although not designated. The new junction would totally destroy this area and part of Great Crabbles Woods having a **large adverse** impact despite the existing large roads nearby.
	Grade II listed building in Old Watling Street.	Regional	Regionally rare	High in regional context	Low	**Slight adverse.** The proposed changes to the existing junction would mean that roads are closer to the building.
	Well Tree Cottage & Bushylees grade II listed buildings off Pear Tree Lane.	Regional	Regionally rare	High in regional context	Low	There would be a **slight adverse** impact on the setting of the rear of the buildings.
	Shorne conservation area. Listed buildings in Shorne within 500m of Route 2 ESL: Front garden wall & gate piers to Pipes Place, Pipes place , Chapel of St Katherine, St Katherine's House, all grade II & Little St Katherine's grade II*.	Grade II * listed building national. Grade II listed buildings local. Conservation area regional	Grade II* listed building nationally rare, listed buildings and conservation area regionally rare	High in national / local context	Low	**Slight adverse** impact on the northern most part of Shorne conservation area. Neutral for the remainder of Shorne conservation area and the listed buildings
	Listed buildings located close to Route 2 ESL between the A226 and the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse , the granary at Little Filborough Farm East Court Manor (all grade II & Church of St Mary in Chalk (grade II*).	National / regional	Nationally / regionally rare	High in national / regional context	Low	There would be a **moderate adverse** impact of Route 2 ESL on the setting of the listed buildings.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	**Neutral** The portal and road would be located some distance to the south.

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Cultural	Saxon Shore way leisure route along the Thames, and public right of way on northern side of the Thames.	Regional / local	Rare regionally	High in a local context	Low	**Neutral.** The tunnel would pass below the paths.
	Scheduled monument. Coalhouse Fort battery and artillery defences	National	Rare	High at a national level	Low	**Neutral.** A tunnel will have no impact on the setting to the monument.
	East Tilbury Battery Scheduled Monument	National	Rare	High at a national level	Low	**Neutral**. Little remains of the monument and Route 2 ESL is a considerable distance away and would have no impact.
	Second World War Battery at Bowaters Farm Scheduled Monument.	National	Rare	High at a national level	Low	**Moderate adverse.** Route 2 ESL runs close to the monument. Although this is largely hidden from view by scrub there would be an impact on its setting.
	West Tilbury Scheduled monument at Hall Hill (has potential to show development from pre-Saxon to the medieval period), West Tilbury conservation area & listed buildings (grade II).	National scheduled monument, regional conservation area, local listed buildings.	Nationally / regionally / locally rare	High in national / regional / local context	Low	**Moderate adverse.** The village of West Tilbury with its various designations is located on the top of hill which is an important landmark standing out from the flat areas of former marsh to the south. Route 2 ESL would have a considerably impact on the setting.
	Chadwell House listed building, Chadwell St. Mary (grade II).	Regional	Regionally rare	High in regional context	Low	**Slight adverse.** Route 2 ESL would have some impact on the setting of the house from the east and south.
	Listed buildings to the south of the Route 2 ESL / A13 junction: Heath Place, Heath Cottage both off Hornsby Lane; Whitecrofts Farmhouse; thatched cottage south of Nevilles Farm; 2 Baker Street. All are grade II.	Regional	Regionally rare	High in regional context	Low	**Slight adverse.** Route 2 ESL would follow the route of existing roads south of the A13. However the roads are likely to be increased in size, with more signage and an intensification in use, all of which would have an impact on the setting of the buildings.
	Grade II Listed buildings at Baker Street.	Regional	Regionally rare	High in regional context	Low	**Moderate adverse**. The junction is very close to a listed windmill which will adversely affect its setting. The remainder of the buildings are further away and there would only be a **slight adverse** impact on their setting.
	Crop mark complex, Orsett directly on Route 2 ESL its junction with the A13. Very little visible at surface level.	National	Rare	High in national context	Low	**Neutral** landscape impact as the monument is below ground
	Scheduled monument and grade II listed building – gatehouse and moat of South Ockendon Hall and Scheduled monument - Roman barrow.	Scheduled monument National / listed building regional	Scheduled monument rare nationally / listed building rare regionally	Scheduled monument high in national context / listed building high in regional context	Low	**Moderate adverse -** The current monuments are surrounded by a flat, broad expanse of arable fields. Route 2 ESL, which would be very close, would have a detrimental impact on the setting of the monuments from the north.
	2 grade II Listed buildings at Kemps Farm.	Regional	Regionally rare	High in regional context	Low	**Slight adverse.** The M25 has an impact on the setting of the buildings currently. A new road junction would increase the level of impact.
	3 grade II listed buildings, a grade 1 listed building and a conservation area at North Ockendon.	Regional / national for grade I listed building	Regionally rare	High in regional context	Low	**Neutral -** The proposed Route 2 ESL junctionwith the M25 would be a considerable distance from North Ockendon which is already impacted by the presence of the M25. Route 2 ESL would be largely screened by existing trees and hedges.
Landcover	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	**Neutral.** Part of the Route 2 ESL junction with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	The A2 / M / HS1 transport corridor dominates the surrounding rural landscape.	Local	Common	Low	High	**Slight adverse.** A new road junction would have little impact on land use other than to remove areas of planting and increase the area of road surface.
	The villages of Shorne and Shorne Ridgeway are on the higher land which is also well wooded and includes Shorne and Great Crabbles Woods amongst others.	Local	Medium locally	Medium	Low	**Large adverse.** A road would change the current land cover next to Southern Alternative from a predominantly rural one to one dominated by transport infrastructure. Large earthworks would be necessary to cut through the high land at Pear Tree Land requiring an extensive footprint.
	South of the A226 the lower areas are predominantly of arable fields bounded by hedges and woodlands.	Local	Medium locally	Medium	Low	**Moderate adverse.** A road would change the current land cover next to Southern Alternative from a predominantly rural one of fields and woodlands to one dominated by transport infrastructure.
	Between the A226 and the Thames corridor landcover is of large arable fields and small groups of houses. To the west is the suburban edge of Chalk.	Local	Low	Medium	High	**Moderate adverse.** A road would change the current land cover next to Southern Alternative from a predominantly rural one of arable fields to one dominated by transport infrastructure.
	The characteristic landcover of the Thames river corridor consists of open flat grazing marshes, with sparse scrub and tree cover, with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have **neutral** impact immediately adjacent to the river. Above ground the current agricultural landcover would change along Route 2 ESL to one dominated by transport infrastructure. In the long term there would be the potential for the route to create changes as surrounding agricultural land would be bisected and would become less viable to farm.
	From the A13 to the north of Tilbury the landcover is of a mix of arable fields, horse pasture, roads and suburban settlements.	Local	Low	Low	High	**Slight adverse.** Most of the Route 2 ESL would follow the line of the existing A1089.
	From the M25 junction to the A13 junction with Route 2 ESL the landcover is mostly of arable fields, with hedges and boundary trees. There old clay pits to the west of South Ockendon that are now used as landfill.	Local	Medium	Medium in local context	High. The most important features the trees and hedges can easily be replaced	**Moderate adverse** The current agricultural landcover would change along the route to one dominated by transport infrastructure.
Summary of character	The Thames river corridor has a strong identity with large expansive horizontal vistas dominated by the interplay of water and sky. The area to the north along Route 2 ESL consists of open arable farmland north of the A13, with large suburban settlements and urban fringe areas to the south. South of the Thames corridor consists of large arable fields with hedgerows and trees grouped in association with small settlements. The land rises south of the A226 with villages and woodland on the higher land. Further south still is the busy A2/M2 road corridor.	Regional	Medium regionally	Medium regionally	Medium	**Large adverse.** Although there are major roads running through the parts landscape, Route2 ESL would introduce a new transport corridor through areas that are largely rural in character. In places this would dramatically change the character of the landscape from a rural one to one dominated by transport infrastructure and have a wider effect on the surrounding area than the immediate footprint of the road.

Reference Sources

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock Local Plan 1997, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary, National Character Area 113 North Kent Plain, The Landscape Assessment of Kent 2004, Essex Landscape Character Assessment, Gravesham Local Plan 2nd review

Step 5 - Summary Assessment Score

Large Adverse

Qualitative Comments

Route 2 ESL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt and part of which is an AONB. Infrastructure associated with the road such as embankments, retaining structures, bridges, signage and lighting, would be notable additional built elements within the open rural landscape. The new road corridor and junction infrastructure associated with Route 2 ESL would impact directly and indirectly on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

Annex 7 – Water Worksheet

Annex 7: Water Environment Impacts Worksheet

Route 2 ESL Bored

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study area: River Thames									
Potential Impacts: Morphological, and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine/ transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to economy / navigation	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	Regional/ National (excludes biodiversity considerations)	Rare	Not feasible	Very High	**Negligible**	Low significance
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mardyke									
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R1) WFD Water body ID GB106037027990	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**(Moderate adverse)** **Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (R10) WFD water body ID GB106037028200	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes West and East Tilbury main drains	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway Canal									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal (Ca18) (GB70610011)	Biodiversity / transport & dilution waste products / recreation / navigation (potential)	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	Regional (ref WFD water body status)	Moderate	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses and drainage ditches at South Thames Estuary and Marshes (excluding Thames and Medway canal)									
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and Ramsar site	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)									
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and drainage ditches at West / East Tilbury Marshes	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds									
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River Thames including ponds and lakes and standing water in marsh areas	Biodiversity / recreation / amenity / water supply (small reservoirs and dams)	Low - Medium Could support protected ecological species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	**Negligible:** No significant standing waters crossed or intercepted	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible:** Assumes no drainage to standing water in accordance with best practice	Insignificant
Study Area: Groundwater north of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zone 3 (Nr J29) Local commercial/industrial/agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible - slight adverse** Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good)	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible:** Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	**Slight to moderate adverse.** Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Groundwater south of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures	North Kent Medway Chalk (GB40601G500300)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	High WFD water body status (current poor, target good). Source Protection Zones 1, 2 and 3 (SE of Shorne) Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	Shallow groundwater (terrace gravels / alluvium) feeding South Thames Estuary and Marshes SSSI	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/ SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	**Slight adverse** Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood Zone 2/3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	**Slight adverse** - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely, further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	**Negligible** (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	**Slight adverse**: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Regional	Moderate	Not feasible: Unlikely to be substitutable	High	**Slight adverse:** Assumes minimal loss of floodplain storage within defended River Thames floodplain.	Insignificant
Study Area: Mardyke Flood Zone 2/ 3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mardyke)	Mardyke crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	**(Moderate Adverse) Slight adverse** (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mardyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - viaduct spans flood plain	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Mardyke channel	Conveyance of flood flows	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period	Local	Moderate	Not feasible	High	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - viaduct spans flood plain	Low significance (Significant)
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mardyke flood defences	Protection of property / assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route
Study Area: Area surrounding Main Rivers, Ordinary Watercourses, land drains and ditches, including marshes									
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Study Area: Entire route.									
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from groundwater	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from drains, sewers and water mains.	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance

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Highways Agency Drainage Data Management System (HA DDMS)

Summary Assessment Score

(Post mitigation)
Moderate Adverse impacts

Qualitative Comments

Note 1 : Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation.

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall , these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

Impacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse.

Impacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, the impacts on the Tidal waters of the Thames remain moderate adverse.

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial / agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Impact at source protection zones may be mitigated by adopting appropriate construction and drainage practices. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion. Impact at source protection zones (especially SPZ 1 near Shorne) may be mitigated by adopting appropriate construction and drainage practices.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

Flood Risk:
The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span, minimise pier dimensions).

Tunnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 2 bridge design indicates the bridge would be significantly higher than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 2 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 2 crossing are:
P4 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 2 road embankment to provide this structural defence.

CFMP policies for Route 2 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).
CFMP policies for Route 2 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits) . Where Route 2 crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstream.

Route 2 crosses the Mardyke flood plain. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route 2 crosses the identified CDA_008, which includes Tilbury Flood Storage Area, designed to store surface water and so protect Tilbury from flooding. The Environment Agency has stated that no net reduction in available storage within the scheme would be considered acceptable. For Route 2 to be considered further, principles for mitigating any displaced storage within Tilbury FSA would need to be agreed with the EA and / or Thurrock Council.
Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Route 2 alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

Annex 8 – Noise Worksheet

Annex 8: Noise Worksheet
Route 2 ESL Bored Tunnel

APPRAISAL - NOISE POLLUTION

Present value base year: 2010

Current year: 2015

Proposal Opening Year: 2025

Average Household Size: 2.36

Project (Road or Rail): Road

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in Opening Year

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9589	321	169	85	54	34	25	9	12	1	1	0	0	0
45-47.9	1064	4338	330	249	23	7	46	16	3	0	0	0	0	0
48-50.9	9	1369	4915	306	168	27	21	5	3	0	0	0	0	0
51-53.9	0	13	1226	4564	254	113	35	10	1	0	0	0	0	0
54-56.9	0	0	5	902	3367	182	108	23	6	2	0	0	0	0
57-59.9	0	0	0	44	694	2444	152	86	11	0	0	0	0	0
60-62.9	0	0	0	0	13	711	2637	147	100	6	1	0	0	0
63-65.9	0	0	0	0	0	6	523	2734	106	30	0	0	0	0
66-68.9	0	0	0	0	0	0	9	481	1729	67	20	0	0	0
69-71.9	0	0	0	0	0	0	0	18	241	854	21	5	1	0
72-74.9	0	0	0	0	0	0	0	0	12	74	198	3	0	0
75-77.9	0	0	0	0	0	0	0	0	0	1	53	49	1	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	9	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in 15th Year After Opening

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9218	307	154	95	53	36	25	10	13	1	1	0	0	0
45-47.9	1029	4290	357	240	16	11	42	15	3	0	0	0	0	0
48-50.9	13	1200	5107	356	181	23	26	7	3	0	0	0	0	0
51-53.9	0	7	1086	4696	243	108	27	17	1	0	0	0	0	0
54-56.9	0	0	0	862	3553	201	123	14	9	2	0	0	0	0
57-59.9	0	0	0	7	680	2504	178	82	5	0	0	0	0	0
60-62.9	0	0	0	0	7	645	2662	167	111	13	1	0	0	0
63-65.9	0	0	0	0	0	9	469	2786	136	31	0	0	0	0
66-68.9	0	0	0	0	0	0	7	430	1814	63	7	1	0	0
69-71.9	0	0	0	0	0	0	0	37	231	959	31	9	1	0
72-74.9	0	0	0	0	0	0	0	0	7	94	214	7	0	0
75-77.9	0	0	0	0	0	0	0	0	0	1	37	69	1	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	7	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Net Present Value of Noise of Proposal (60 Year Period) £4,205,925 *positive value reflects a **net benefit** (i.e. noise reduction)

Estimated Population Annoyed (Do-Minimum): 12418
Estimated Population Annoyed (Do-Something): 12304

Net Noise Annoyance Change in 15th Year After Opening (no. of people): -114 *positive value reflects an **increase** in people annoyed by noise

Appendix 7.5
Appraisal Summary Table Route 3 ESL (BT)

Appraisal Summary Table Route 3 ESL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appraisal Summary Table | **Route 3, Eastern Southern Link, Bored Tunnel**

Date produced:	22 Jan 2016

Contact:	
Name	Chris Taylor
Organisation	Highways England
Role	Project Sponsor

Name of scheme:	Route 3 Bored Tunnel with Eastern Southern Link - Core Growth, Central Case costs, Current values of time, additional lane in tunnel
Description of scheme:	New Dual 2 lane trunk road (70mph) from M25 between J29 and J30, crossing the Thames in a bored tunnel, with an additional lane for future proofing, 2km to the east of Gravesend with an easterly southern link to the M2.

Impacts		Summary of key impacts	Assessment				
			Quantitative			Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	**Value of journey time changes(£)** £2,813m **Net journey time changes (£)** 0 to 2min: -£437m; 2 to 5min: £1,096m; > 5min: £2,154m			N/A	£3,374m	Not appraised yet
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A			N/A	£108m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling	N/A			N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are more than double those for Route 1. 80% of WI benefits are from the agglomeration of business activities.	**Agglomeration** £1,337m **Output in imperfectly competitive markets** £339m **Labour supply impacts** £1m			N/A	£1,677m	
Environmental	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	249 people would benefit based on an estimated 12,418 people being annoyed by noise in the without scheme situation decreasing to 12,169 people in the with scheme situation.			N/A	£10m	Not appraised yet
	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors modelled are predicted to exceed the AQSO without the scheme (representing up to approximately 60 receptors), but these receptors experience an improvement compared to the without scheme. The scheme is not predicted to lead to any new exceedences.			N/A	N/A	Not appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-traded carbon over 60y (CO2e) 6,297,821 tonnes Change in traded carbon over 60y (CO2e) 17,256 tonnes			N/A	-£288m	
	Landscape	A new road corridor would adversely affect the landscape character including in the vicinity of Shorne and Shorne Ridgeway, green belt and intrude into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.	N/A			Large Adverse	N/A	
	Townscape	See Landscape entry	N/A			N/A	N/A	
	Historic Environment	Direct physical impacts to one scheduled monument and two Grade II listed buildings. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint.	N/A			Moderate Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land) and Cobham Woods SSSI. Potential impacts on ancient woodlands, LWSs & areas of BAP Priority Habitat. Direct loss of ancient woodland at Great Crabbles Wood SSSI and Court Wood.	N/A			Very Large Adverse	N/A	
	Water Environment	Impacts on Mardyke and on flood plain.	N/A			Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing	**Value of journey time changes(£)** £676m **Net journey time changes (£)** 0 to 2min: -£325m; 2 to 5min: £360m; > 5min: £641m			N/A	£291m	Not appraised yet
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A			N/A	£39m	
	Physical activity	The option has no impact on walking and cycling	N/A			Neutral	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. The ESL is the only option which provides a motorway to motorway link, connecting the M2 with the M25.	N/A			Moderate beneficial	N/A	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	Because it is a new route 2,313 additional accidents are predicted over 60 years, including 33 fatalities, 254 serious injuries and 3,239 slight casualties			N/A	-£120m	Not appraised yet
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network	N/A			Slight Adverse	N/A	Not appraised yet
	Access to services	Not appraised because this criteria relates to public transport options	N/A			N/A	N/A	N/A
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at Dartford Crossing today	N/A			Neutral	N/A	Not appraised yet
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A			Slight Adverse	N/A	Not appraised yet
	Option and non-use values	Not appraised because this criteria relates to public transport options	N/A			N/A	N/A	
Public Accounts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Investment costs: £2,199m Operating costs £300m Operator revenue £843m (a benefit, offsetting cost over the longer term)			N/A	£1,656m	
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing	N/A			N/A	£589m	

Annex 1 – TEE Table

Annex 1: TEE Table

Economic Efficiency of the Transport System (TEE): Route 3/ESL

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£85,904,201		£85,904,201					
Vehicle operating costs	-£56,409,250		-£56,409,250					
User charges	£120,641		£120,641					
During Construction & Maintenance	-£1,256,454		-£1,256,454					
COMMUTING	£28,359,139	*(1a)*	£28,359,139					

Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£589,641,853		£589,641,853					
Vehicle operating costs	-£317,478,831		-£317,478,831					
User charges	-£2,012,471		-£2,012,471					
During Construction & Maintenance	-£7,773,652		-£7,773,652					
NET NON-BUSINESS BENEFITS: OTHER	£262,376,898	*(1b)*	£262,376,898					

Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£2,813,255,443		£715,366,233	£2,097,889,210				
Vehicle operating costs	£707,086,970		£482,670,830	£224,416,140				
User charges	-£128,714,212		-£63,510,391	-£65,203,822				
During Construction & Maintenance	-£17,179,049							
Subtotal	£3,374,449,152	*(2)*	£1,134,526,673	£2,257,101,528				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions		*(4)*						
NET BUSINESS IMPACT	£3,374,449,152	*(5) = (2) + (3) + (4)*						

TOTAL		
Efficiency Benefits (TEE)	£3,665,185,189	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Annex 2 – PA Table

Annex 2: Public Accounts (PA) Table

Route 3 ESL Bored Tunnel

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue						
Operating Costs						
Investment Costs						
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	-£843,093,903		-£843,093,903			
Operating costs	£300,025,957		£300,025,957			
Investment Costs	£2,199,437,719		£2,199,437,719			
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£1,656,369,773	*(8)*	£1,656,369,773			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-£588,995,607	*(9)*	-£588,995,607			
TOTALS						
Broad Transport Budget	£1,656,369,773	*(10) = (7) + (8)*				
Wider Public Finances	-£588,995,607	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Annex 3 – AMCB Table

Annex 3: AMCB Table

Route 3 ESL Bored Tunnel

Analysis of Monetised Costs and Benefits

Noise	£9,958,130	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	-£287,927,026	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	-£119,925,000	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£28,359,139	*(1a)*
Economic Efficiency: Consumer Users (Other)	£262,376,898	*(1b)*
Economic Efficiency: Business Users and Providers	£3,374,449,152	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	£588,995,607	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£3,856,286,900	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£1,656,369,773	*(10)*
Present Value of Costs (see notes) (PVC)	£1,656,369,773	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£2,199,917,128	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.3	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Annex 4 – Biodiversity Worksheet

Annex 4: TAG Biodiversity Impacts Worksheet

Route 3 ESL Bored

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of Circus cyaneus.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Mucking Flats and Marshes SSSI	Botanical interest: Mudlfats and Saltmarsh	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	**Neutral**
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important birds	Intermediate Negative	**Large Adverse**
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site - High importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important ancient woodland	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Woodland invertebrates	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
Great Crabbles Wood SSSI	Botanical importance - broadleaved mixed and yew lowland woodland - designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Unfavourable - Recovering. The whole area is classified as being in a 'no change' condition due to the lack of forestry and woodland management.	Not possible to substitute ancient woodland	High - nationally important ancient woodland	Major Negative	**Very Large Adverse**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute ancient woodland plant species without ancient woodland.	High - nationally important botany	Minor Negative	**Slight Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - woodland edge/ arable land plant species	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Woodland birds	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important birds	Minor Negative	**Slight Adverse**
Thames Estuary recommended MCZ (on hold)	Marine and estuarine habitats and species	National	Attribute a qualifying feature of Nationally designated site so high importance.	Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Not possible to substitute	Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992).	Neutral	**Neutral**
Greater Thames Marshes Nature Improvement Area	Complex of habitats of value for biodiversity and as a community resource	Regional	Attribute of value to local communities, of Medium importance.	Some goals are being achieved.	Not possible to substitute	Medium - community value and extensive area	Minor Negative	**Slight Adverse**
Court Wood, Shorne (GR1) - includes Starmore Wood and Peartree Wood (ancient woodlands)	Local Wildlife Site Ancient and Ancient Semi-natural Woodland; derelict orchard and semi-improved neutral grassland	Local	Area of degraded ancient woodland, high importance with a derelict orchard and area of unmanaged semi-improved neutral grassland of limited botanical interest that supports invertebrates.	Much of this woodland has been converted to chestnut but still retains a good diversity of flowering plants, including many ancient woodland indicator species.	Not possible to substitute ancient woodland	High - ancient woodland	Major Negative	**Very Large Adverse**
Shorne Pasture (GR18)	Local Wildlife Site Grassland, scrub	Local	Area of unimproved pasture on acid, dry pebbly soils. Supports a herb-rich flora - Low importance.	unknown - not indicated on Kent Local Wildlife Site schedule.	Soil translocation a possibility	Low - local value grassland and scrub	Neutral	**Neutral**
Un-named ancient woodland (at centre of M2 J1 interchange)	Ancient Woodland	National	Area of degraded ancient woodland of Low to Medium importance.	unknown, but likely to be declining due to isolation and impact of poor air quality.	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	**Moderate Adverse**
Un-named ancient woodland (south of M2 J1 interchange, to the west of the M2)	Ancient Woodland	National	Area of degraded ancient woodland of Low to Medium importance.	unknown - but likely to be declining due to impact of poor air quality given proximity to M2.	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	**Moderate Adverse**
Priority Habitat - Deciduous Woodland around Buckland, Brook Farm (north of the East Tilbury Marshes), small section on A226 south east of Chalk. See also local wildlife sites (below).	Priority BAP habitat	Local	Medium importance, BAP habitat	Nationally lowland mixed deciduous woodland is declining due to clearance, over-grazing, and replanting with non-native species.	Replacement planting and/translocation of habitats a possibility.	Medium - BAP priority habitat	Intermediate Negative	**Moderate Adverse**
Priority habitat - Coastal Saltmarshes (south of river, as part of Shorne Marshes and Eastcourt Marshes)	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites).	Importance will be dependant on functioning within who wider network of habitats, likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	**Neutral**
Priority Habitat - Intertidal mudflats (particularly northern bank of the river at crossing, down stream of the Thames Estuary and Marshes (Ramsar))	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites).	Likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority Habitat - Coastal and Floodplain Grazing Marsh including freshwater ditches/ponds.	Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites).	Low to High, dependant on functioning within the wider network of habitats.	Likely to be decreasing due to agricultural improvement, drainage and development.	Replacement habitat creation potentially possible (e.g. managed realignment or creation of freshwater wetland habitats), but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority habitat - Traditional Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance.	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility.	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1 interchange)	Priority BAP habitat	Local	Wood-pasture and Parkland BAP habitat - Medium importance.	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to recreate mature habitats	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Priority habitat - Traditional Orchards (adjacent to the A289 at M2 J1 interchange; on Church Lane and adjacent to the A226 north of Shorne)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority habitat - Deciduous Woodland (adjacent to M2 J1 interchange; Great Crabbles Wood; and along northern edge of the A226 near Church Lane)	Priority BAP habitat	Local	Deciduous Woodland BAP habitat - Medium importance	Nationally lowland mixed deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Blackshots Nature Area (Th34)	Local wildlife Site - rough grassland and deciduous woodland.	Local	Large area of rough grassland and important invertebrate population, as well as providing potential nesting habitats for birds such as skylark. UK BAP fly species *Dorycera graminum* found here.	Species rich grasslands are decreasing, unmanaged grassland is likely to be increasing. Nationally deciduous woodland is declining	Replacement planting a possibility but limited space available.	Medium - BAP priority habitat and species	Major Negative	**Moderate Adverse**
Terrels Heath (Th36) - incudes Chadwell Wood (ancient woodland)	Local Wildlife site and Ancient Woodland.	Local	Terrels Heath is a forest structure dominated by pendunculate Oak (*Quercus robar*) High importance.	Nationally deciduous woodland is declining due to clearance, over-grazing, and replanting with non-native species.	Not possible to substitute	High - important ancient woodland	Minor Negative	**Neutral**
Lytag Brownfield (Th39)	Local Wildlife Site Acid grassland; reptiles	Local	HCr19; SCr4. Brownfield site with acid grassland that supports all four common species of reptile (adder, grass snake, common lizard and slow worm). Medium importance	Believed to be favourable, but identified as a site a risk from development.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Medium - BAP priority habitat	Minor Negative	**Slight adverse**
Mucking Heath (Th41)	Local Wildlife Site Flora; invertebrates	Local	Thames Terrace grasslands and ancient heathland. Site supports 4 nationally rare and 50 nationally scarce invertebrate species. Medium importance.	Unknown at present, but a rare grassland habitat and associated invertebrate fauna, associated with Thames Terrace soils.	Not possible to substitute	Medium importance Thames Terrace grassland and invertebrates	Intermediate negative	**Moderate Adverse**
Rainbow Shaw (Th45)	Local wildlife Site	Local	Rainbow Shaw is thought to be a small ancient woodland fragment. Low to medium importance.	Unknown at present	Creation of replacement habitat possible.	Low - Local Wildlife Site	Minor negative	**Slight adverse**
Linford Pit (Th46)	Local wildlife Site	Local	This brownfield site supports an important invertebrate fauna and lies within a very significant cluster of such sites.	This Site has a number of Red Data Book (Endangered) invertebrates, including the bees *Andrena florea* and *Nomada fulvicornis* (both RDB3) and the wasps *Cerceris quinquefasciata* (RDB3 and a national BAP species) and *Hedychrum niemelai* (also RDB3), as well as several nationally scarce spiders and the nationally rare fly *Myopa polystigma* (RDB3).	Creation of replacement habitat not possible.	High - Red Data Bok species	Neutral	**Neutral**
Low Street Pit (Th47)	Local wildlife Site	Local	Lies on the regionally important Thames terrace gravels. Deciduous woodland as well as old grassland. Supports the UK BAP species Hornet Robber fly (*Asilus crabroniformis*)	Deciduous woodland is declining. The Hornet Robber fly relies on the presence of animal dung that is relatively free from insecticides and worming agents for the development of its larvae. A grazing regime would also be the most appropriate way of maintaining the floristic interest of the site	Not possible to substitute	Medium - UK BAP species and Thames Terrace habitats/species	Major Negative	**Moderate Adverse**
Goshems Farm (Th49)	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. Medium importance.	Red Data species but unknown at present.	Not possible to substitute	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	**Large Adverse**
Canal and grazing Marsh, Higham (Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat)	Local	Recently established reedbeds, damp disturbed grassland and a dyke system	Unknown	Not possible to substitute	Medium - BAP priority habitat	Neutral	**Neutral**
Tentacled lagoon worm (*Alkmaria romijni*)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal	Considered scarce wihtin the UK; vulnerable to changes to, or loss of, the habitats in which they live	Not possible to substitute	High	Neutral	**Neutral**
European eel (*Anguilla anguilla*)	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	**Neutral**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Smelt (*Osmerus eperlanus*)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales	Not possible to substitute	Medium	Neutral	**Neutral**
Harbour Porpoise (*Phocoena phocoena*)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	**Neutral**

Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations
JNCC website for Ramsar, SPA, SAC and SSSI site designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT_External/#)
Green Infrastructure Asset Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green_Infrastructure_Assets_Baseline_Report_1_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

Summary Assessment Score

Very Large Adverse*

Qualitative Comments

Route 3 bisects four designated, seven local wildlife sites and 12 areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route bisects a number of important habitats which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a fairly significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of ancient woodland along the southern extents of the new road, where this links the M2, would involve a very large adverse effect on Great Crabbies Wood SSSI and large adverse effect on Shorne and Ashenbank Wood SSSI ancient woodlands and large adverse effect on a number of Ancient Woodland habitats that are irreplaceable (see detail below). While not legally protected, planning policy is very clear that such sites should only be developed as a last resort.

Impacts on woodlands, specifically Ancient Woodland, is greater for all crossing options if the ESL is adopted as this would directly impact on part of Court Wood (Shorne Local Wildlife Site) and Great Crabbles SSSI, which would be affected by direct habitat loss and fragmentation as part of the connection with the M2 involving a large adverse effect on Ancient Woodland that is replaceable. UK BAP Habitat (Traditional Orchards) will also be affected by habitat loss and fragmentation of the orchard at the connection with the M2 involving a moderate adverse effect on a UK BAP Habitat. While not legally protected, planning policy is very clear that such sites should only be developed as a last resort. There are als potential impacts on Cobham Woods SSSI, 5 areas of ancient woodland (often part of local wildlife sites) and 2 UK BAP Habitats (Wood-pasture and Parkland; Deciduous Woodland) from impacts associated with increased air pollution/nitrogen deposition.

* Note the Summary Assessment Score is being skewed by impacts on Great Crabbles Wood SSSI and Court Wood where ancient woodland will be lost to the route alignment.

Annex 5 – Historic Environment Worksheet

Annex 5: Historic Environment Impacts Worksheet

Route 3 ESL Bored

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of urban settlements such as South Ockendon, Grays, West Tilbury, Gravesend and smaller settlements such as Orsett. The study area contains a number of listed buildings (designated heritage assets), either within settlements such as South Ockendon and Orsett or within a more rural context such as small groups of farm buildings. In total there are 58 Grade II, five Grade II* and two Grade I listed buildings within the study area (Grade II*: Marshalls Cottages and Chruch of St James, both at West Tilbury, Church of St Mary, East Court Manor and Little St Katerines and Chuch of St Peter and St Paul, Shorne. Grade I: Church of St Mary of Magdalene, North Ockendon and Church of St Nicholas, South Ockendon). The study area also contains five conservation areas (designated assets): West Tilbury, East Tilbury, Shorne Village and Chestnut Green, Shorne. Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are eight scheduled monuments (designated heritage assets) within the study area: a Barrow at South Ockendon Hall; a medieval moated site at South Ockenden Old Hall; Orsett crop mark complex; the Springfield style enclosure at Orsett; a causewayed enclosure to the south of Thurrock; Dene Holes in Hangmans Wood; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	The listed buildings and conservation areas are designated heritage assets and are afforded protection at a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS. The scheduled monuments are also designated heritage and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS. The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	The Grade I and Grade II* listed buildings are of high value, whilst the Grade II listed buildings are of medium value. The East Tilbury conservation area is of high value whilst the other three conservation areas are of medium value. The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	The Grade I and Grade II* listed buildings, two churches and manor houses are relatively well represented types on a national and regional level and are of moderate rarity. East Tilbury conservation area is a rare example of a planned modernist factory town. The other three conservation areas are relatively well represented regionally and nationally. The scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, West Tilbury and Bowaters Farm are relatively well represented types of monument and are of moderate rarity. The Dene Holes flint mine complex, Springfield style enclosure at Orsett and causewayed enclosure south of Thurrock are less well represented and are of high rarity. The non-designated archaeological remains are of types that are well represented on a regional level and are of low rarity.	The Scheme will have a direct physical impact on two Grade II listed buildings: 1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the west of Thurrock. The scheme may impact on the settings of the Grade II listed buildings to the south and west of Thurrock and to the west of West Tilbury. The scheme may also impact on the settings of the West Tilbury, East Tilbury and Shorne Village conservations areas. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, south of Orsett, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. In addition, the scheme would have a direct physical impact on the Orsett cropmark complex scheduled monument through the construction of a new road within the scheduled area. Construction excavations associated with the new road and tunnel portals may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good. The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area. Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	Surviving listed Grade II listed buildings are not rare regionally or nationally, although surviving Grade I and Grade II* listed buildings are rare on both scales. With the exception of the Springfield style enclosure at Orsett and the Bowaters Farm anti-aircraft battery, the survival of which is rare on both regional and national levels, the survival of the scheduled monuments is of moderate rarity value. Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of the Orsett cropmark complex which would be subject to the direct physical impacts as the result of road construction within the scheduled area. The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The historic landscape is in constantly evolving, the condition of landscape features is considered to be good. The condition of the listed buildings and conservation areas is generally good. The condition of the scheduled monuments is generally good, with the exception of the Orsett cropmark complex and Bowaters Farm anti-aircraft battery, the condition of which are poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings and conservation areas is of moderate significance as they have a beneficial effect on the character and amenity value of the study area. The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	Listed buildings and conservation areas in good condition are relatively common in this region and have low rarity value. Scheduled monuments of the nature and condition of those within the study area have a high rarity value. Non-designated archaeological remains in good condition are relatively common nationally and have a low rarity value.	The scheme would impact on the condition of three designated assets within the study area: two Grade II listed buildings to the west of Thurrock (1 and 2 Gray's Corner Cottages and Thatched Cottage), which would be removed and the Orsett cropmark complex scheduled monument, which would be subject to the direct physical impacts as the result of road construction within the scheduled area. The scheme would have no impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings are not unusually complex and represents a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area. The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflects this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Period	The listed buildings and conservation areas date from the post-medieval to modern periods. The scheduled monuments date from the Neolithic to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	The NPPF and NN-NPS takes the period of heritage assets into account at a national level.	The wide range of periods represented within the historic environment resource is of high significance due to the potential to aid understanding the development of the region.	The range of periods represented by the historic environment resource within the study area is common to the region and as such is of low rarity.	The scheme would not impact on the periods represented by the historic environment resource within the study area.

Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Kent Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

Step 5 - Summary Assessment Score

Moderate Adverse

Qualitative Comments

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. Two Grade II listed buildings (1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the west of Thurrock) would exprience direct physical impacts through their removal. The effect of these impacts is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of the scheme: scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, south of Thurrock, West Tilbury and Bowaters Farm, Grade II listed buildings to the south and west of Thurrock and to the west of West Tilbury; West Tilbury, East Tilbury and Shorne Village conservations areas. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas and scheduled monuments. Road construction within the scheduled area of the Orsett cropmark complex will cause a direct physical impact to this designated asset. However, due to the poor condition of the scheduled monument, the effects are predicted to be Moderate Adverse. Construction excavations associated with the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint. In addition, any dredging within the river channel to facilitate the construction of a bored tunnel may impact previously unknown archaeological remains. Overall, Slight Adverse Effects to any non-designated archaeological remains within the scheme footprint are predicted.

Annex 6 – Landscape / Townscape Worksheet

Annex 6: Landscape Impacts Worksheet

Route 3 ESL Bored

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	Between the A2 corridor and the A226 the landform is undulating and rises towards the south. The higher land is well wooded, some of the woods are ancient woodlands, with the settlements of Shorne and Shorne Ridgeway running along ridges. Arable fields defined by hedges and trees fill the lower land close to the A226 and in the valleys either side of Shorne. Properties along Pear tree Lane have extensive gardens/grounds, some with horse paddocks.	Local	Rare	Medium	Low. It is not possible to replace ancient woodland.	**Large adverse.** Route 3 ESL would cut across the pattern of the landscape particularly to the east of Shorne where it would run across a valley and then through a hill requiring extensive earthworks. An area of ancient woodland in Great Crabbles Wood would be destroyed.
	Between the A226 and the Thames Corridor the landscape is gently undulating, with large open arable fields and few hedgerows. These are mainly along the roads and around the small settlements.	Local	Rare in a local context	Medium	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	**Moderate adverse.** Route 3 ESL would have a direct and indirect impact on the pattern of the existing landscape. In places the it would cut through the gently undulating landform.
	The Thames river corridor consists of flood embankments along the river edge, backed by expansive marshlands with rough grazing and sparse scrub. On the north side of the river there are extensive areas of old mineral workings, some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	**Neutral.** The tunnel portals would be located to the north and south of the Thames corridor.
	From the North of the Thames corridor to Orsett, Route 3 ESL passes, through gently undulating countryside of medium and large fields, with occasional farm buildings. The area is crossed by a number of overhead electric power lines.	Local	Common	Medium locally	High	**Moderate adverse.** The road would break up the existing pattern of the landscape in particular at the A13 junction.
	Adjacent to Orsett the route cuts through a historic parkland landscape that forms the setting of the village.	Local	Locally rare	High in a local context	Medium	**Moderate adverse**. Route 3 ESL would run along the edge of the parkland and would fundamentally change its character.
	Between the proposed junction with the M25 at North Ockendon and Orsett Route 3 passes, through relatively flat open countryside of large arable fields, and close to areas of historic clay pits, now used for landfill.	Local	Common	Medium locally	High	**Moderate adverse**. Route 3 would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape would be bisected by the road.
Tranquillity	South of Shorne and Shorne Ridgeway, noise from the A2 and M2 becomes increasing intrusive, although visually due to the screening effect of trees the area is rural in appearance. The immediate area around the M2, A2, A289 junction is dominated by the roads despite extensive planting.	Local	Medium	Medium	Low	**Moderate adverse** away from the existing A2/M2 transport corridor. Route 3 ESL would introduce high levels of traffic noise and transport infrastructure into the currently rural scene. Closer to the existing roads the impact would be less. Some residents on the western edge of Strood would experience an increase in noise and increased visual impact of road infrastructure.
	The area around Shorne and Shorne Ridgeway has an unspoilt rural feel considering its closeness to Gravesend and the Medway towns. It is relatively free from traffic noise and the visual intrusion of industry and power lines. There are distant views over the Thames corridor to Essex and Tilbury power station.	Local	Medium	Medium	Low.	**Large adverse**. Route 3 ESL would introduce high levels of traffic noise and transport infrastructure into a currently tranquil rural scene. Some residents of Pear Tree Lane, Shorne Ridgeway, Shorne and Lower Shorne would have a significantly reduced level of tranquillity.
	Between the Thames corridor to the A226 there is visual intrusion on the landscape of urban settlements, roads and pylons. There is constant, although mostly distant, road noise. The sweeping views across the Thames are dominated by Tilbury power station.	Local	Common	Medium	Medium	**Moderate adverse.** A new road would increase the levels of road noise considerably and introduce transport infrastructure into the view. Some residents of Chalk and Church Lane would have a significantly reduced level of tranquillity.
	Within the Thames corridor there are expansive views over the river and surrounding marshland from the riverside paths which are often some distance from the nearest road. There is always the visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	**Slight adverse.** A tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	The level of tranquillity north of the Thames corridor varies considerably with location . There are major arterial roads such as the M25 and A13 which generate traffic noise and disrupt visual tranquillity, while there are open areas of countryside between, that are broken only by the occasional small road. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of urban settlements and pylons.	Local	Common	Medium	High	**Moderate adverse** Away from the existing large roads Route 3 ESL would introduce additional noise and intrusive visual clutter into the scene. For some residents of East Tilbury, West Tilbury, Linford, east of Chadwell St Mary, Baker Street Orsett and South Ockendon the route will change the view and increase noise, having a detrimental impact on tranquillity.
	Most of the route is located within Green Belt.	Regional	Regionally medium	High in regional context	Low	**Moderate adverse**. The Green Belt is a valued rural separation between the urban edge of large settlements such as Grays, Tilbury and Gravesend nearby villages. A new road would introduce a new urban element into this landscape.
	Public rights of way.	Local	Common	Medium	High	Impact depends on the right of way but some would be crossed by the route and this would have a **Moderate adverse** impact on the users of the paths.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Nationally rare	High nationally	low	**Neutral.** Part of the Route 3 ESL/ A2/M2 junction would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB).	National	Rare nationally	High nationally	Low. It would not be possible to replicate the features of the AONB elsewhere.	The route 3 ESL junction with the A2, A289 and M2 would affect an area on the edge of the AONB and an area immediately around it which is important in terms of its landscape character, although not designated. The new junction would totally destroy this area and part of Great Crabbles Woods having a **large adverse** impact despite the existing large roads nearby.
	Grade II listed building in Old Watling Street.	Regional	Regionally rare	High in regional context	Low	**Slight adverse.** The proposed changes to the existing junction will mean that roads are closer to the building.

Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
Cultural	Well Tree Cottage & Bushylees grade II listed buildings off Pear Tree Lane.	Regional	Regionally rare	High in regional context	Low	There would be a **slight adverse** impact on the setting of the rear of the buildings.
	Shorne conservation area. Listed buildings in Shorne within 500m of Route 3 ESL: Front garden wall & gate piers to Pipes Place, Pipes place , Chapel of St Katherine, St Katherine's House, all grade II & Little St Katherine's grade II*.	Grade II * listed building national. Grade II listed buildings local. Conservation area regional.	Grade II* listed building nationally rare, listed buildings and conservation area regionally rare.	High in national/local context	Low	**Slight adverse** impact on the northern most part of Shorne conservation area. **Neutral** for the remainder of Shorne conservation area and the listed buildings.
	Listed buildings located close to Route 3 ESL between the A226 and the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse , the granary at Little Filborough Farm East Court Manor (all grade II & Church of St Mary in Chalk (grade II*).	National/regional	Nationally/ regionally rare	High in national/regional context	Low	There would be a **moderate adverse** impact of Route 3 ESL on the setting of the listed buildings.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	**Neutral** The portal and road would be located some distance to the south.
	National Cycle Routes 1 and 13.	National	Rare	Medium	High as easily relocated	**Moderate adverse** where cycle routes would be close Route 3 ESL due to the visual impact of road infrastructure and increased noise levels.
	Saxon Shore Way leisure route along the Thames and public right of way on northern side of the Thames.	Regional/local	Rare regionally	High in a local context	Low	**Neutral.** The tunnel would pass below the paths.
	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	**Neutral.** A tunnel will have no impact on the setting to the monument.
	Tilbury Fort Scheduled monument.	National	Rare	High at a national level	Low	**Neutral.** A tunnel will have no impact on the setting to the monument.
	Scheduled monument at Bowaters Farm WWII anti aircraft battery.	National	Rare	High at a national level	Low	The monument is largely hidden from view by scrub and despite the closeness of Route 3 ESL it would only have a **slight adverse** impact on the setting.
	Grade II listed building at Bucklands Farm.	Regional	Rare	High	Low	The building is surrounded by trees and the road would have only a **slight adverse** impact on its setting.
	East Tilbury Conservation area and listed buildings.	Regional	Rare	High	Low	Route 3 ESL is Some distance away from the conservation area which is an unusual modernist development of housing and factories. For most of the area the impact would be **neutral** with **slight adverse** on the setting of the western edge.
	Grade II listed buildings close to the proposed Route 3 ESL junction with the A13: Whitecrofts, Heath House, Murrels Cottage.	Regional	Rare regionally	High regionally	Low	**Moderate adverse** to the setting of Heath House & Murrels Cottage due to the closeness of the junction. Slight adverse impact to Whitcrofts.
	Scheduled monument. Causewayed enclosure and Anglo-Saxon cemetery close to proposed junction of Route 3 ESL with the A13.	National	Rare	High in national context	Low	**Moderate adverse.** The monument is not clearly visible from ground level but from the air. While not having a direct impact on the structure of the monument the proposed junction would change its landscape setting which could be important in understanding the causewayed enclosure in particular.
	4 listed buildings west of Orsett: two at Orsett House (one grade II and the other grade II*), Poplars Farm (grade II), and south of the B188 (grade II).	Grade 1 and II* national value, grade II regional	Rare	High	Low	**Moderate adverse** to the setting of those at Orsett House due to the closeness of the road, with Poplars Farm **Slight adverse.**
	Conservation area, grade I listed building and grade II listed buildings in Orsett.	National for grade 1 listed building. Regional local for conservation area and grade II listed buildings	Rare nationally/locally	High in national/local context	Low	**Neutral**. Although within 500m of Route 3 ESL all of the buildings and the conservation area are screened by surrounding development.
	Scheduled monument. Springfield type enclosure and iron age enclosures at Baker Street.	National	Rare	High in national context	Low	**Neutral** - the monument is not visible at ground level.
	Scheduled monument - Bishop Bonners Palace Orsett.	National	Rare	High in national context	Low	**Slight adverse** - The monument is largely screened from Route 3 ESL by trees.
	Scheduled monument and listed building (gatehouse and moat of South Ockendon Hall) and Scheduled Monument Roman barrow. All over 500m from the Route 3 ESL.	National	Rare	High in national context	Low	**Slight adverse** - The current monuments are surrounded by a flat, broad expanse of arable fields. Despite the distance from the proposed route the road infrastructure would have some impact on their setting.
	3 grade II listed buildings, a grade 1 listed building & North Ockendon conservation area.	Regional/national for grade 1 listed building	Rare nationally/regionally	High in national/regional context	Low	**Slight adverse** - North Ockendon is already impacted by the presence of the M25. Route 3 ESL would be largely screened by existing trees and hedges.

Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
Landcover	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	**Neutral.** Part of junction of Route 3 ESL with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	The A2/M2 transport corridor dominates the surrounding rural landscape.	Local	Common	Low	High	**Slight adverse.** A new road junction would have little impact on land use other than to remove areas of planting and increase the area of road surface.
	The villages of Shorne and Shorne Ridgeway are on the higher land which is also well wooded and includes Shorne and Great Crabbles Woods amongst others.	Local	Medium locally	Medium	Low	**Large adverse.** A road would change the current land cover next to Southern Alternative from a predominantly rural one to one dominated by transport infrastructure. Large earthworks would be necessary to cut through the high land at Pear Tree Land requiring an extensive footprint.
	South of the A226 the lower areas are predominantly of arable fields bounded by hedges and woodlands.	Local	Medium locally	Medium	Low	**Moderate adverse.** A road would change the current land cover next to Southern Alternative from a predominantly rural one of fields and woodlands to one dominated by transport infrastructure.
	Between the A226 and the Thames corridor landcover is of large arable fields and small groups of houses. To the west is the suburban edge of Chalk.	Local	Low	Medium	High	**Moderate adverse.** A road would change the current land cover next to Southern Alternative from a predominantly rural one of arable fields to one dominated by transport infrastructure.
	The characteristic landcover of the Thames river corridor consists of open flat grazing marsh with sparse scrub and trees cover with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side of the Thames there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have **neutral** impact immediacy adjacent to the river. Above ground the current agricultural landcover would change along the route to one dominated by transport infrastructure, in the long term there would be the potential for Route 3 to create changes to the surrounding agricultural land which would be bisected and would become less viable to farm.
	North of the Thames corridor the landcover is mostly of arable fields, with hedges and boundary trees. Crossed by a number of small roads and 2 major roads. Areas of old clay pits now used as landfill. Parkland landscape to the west of Orsett.	Local	common	Medium in local context	Relatively easy to improve/plant hedges and trees nearby	**Moderate adverse** in the immediate vicinity of Route 3 ESL, which would change the existing rural landcover to a transport dominated one.
Summary of character	Open gently rolling arable countryside with sparse hedges and boundary trees, with surviving areas of historic field patterns, minor roads and small settlements. Prominent features consist of arterial roads, pylons, and the distant urban edge of large settlements. The land rises south of the A226 with villages and woodland on the higher land. Further south still is the busy A2/M2 road corridor.	Regional	Regionally medium	Regionally medium	Medium	**Large adverse.** Although there are major roads running through the parts landscape, Route 3 ESL would introduce a new transport corridor through areas that are largely rural in character in particular around Shorne and the AONB. In places this would dramatically change the character of the landscape from a rural one to one dominated by transport infrastructure and have a wider effect on the surrounding area than the immediate footprint of the road.

Reference Sources

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock Local Plan 1997, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary,

Step 5 - Summary Assessment Score

Large adverse

Qualitative Comments

Route 3 ESL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt and part of which is an AONB. Infrastructure associated with the road such as embankments, retaining structures, bridges, signage and lighting, would be notable additional built elements within the open rural landscape. The new road corridor and junction infrastructure associated with Route 3 ESL would impact directly and indirectly on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

Annex 7 – Water Worksheet

Annex 7: Water Environment Impacts Worksheet

Route 3 ESL Bored

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study area: River Thames									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine/ transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to economy / navigation	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	Regional / National (excludes biodiversity considerations)	Rare	Not feasible	Very High	**Negligible**	Low significance
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mar Dyke									
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R1) WFD Water body ID GB106037027990	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R3) WFD water body ID GB106037028020	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**(Moderate adverse)** **Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes West and East Tilbury main drains	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway Canal									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal (Ca18) (GB70610011)	Biodiversity / transport & dilution waste products / recreation / navigation (potential)	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	Regional (ref WFD water body status)	Moderate	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section passes beneath canal and has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses and drainage ditches at South Thames Estuary and Marshes (excluding Thames and Medway canal)									
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and Ramsar site	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)									
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and drainage ditches at East Tilbury Marshes	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Lakes and ponds									
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River Thames including ponds and lakes and standing water in marsh areas	Biodiversity / recreation / amenity / water supply (small reservoirs and dams)	Low - Medium Could support protected ecological species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	**Negligible:** No significant standing waters crossed or intercepted	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible:** Assumes no drainage to standing water in accordance with best practice.	Insignificant
Study Area: Groundwater north of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zones 2 and 3 (Linford / East Tilbury) Local commercial / industrial /agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible - slight adverse** Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium - low WFD water body status (current poor, target good)	Regional (ref WFD water body status	Moderate	Not feasible	Medium	**Negligible:** Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	**Slight to moderate adverse.** Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures	North Kent Medway Chalk WFD Water body ID GB40601G500300	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	High WFD water body status (current poor, target good). Source Protection Zones 1, 2 and 3 (SE of Shorne) Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	Shallow groundwater (terrace gravels/ alluvium) feeding South Thames Estuary and Marshes SSSI	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/ SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	**Slight adverse** Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood Zone 2/3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	**Slight adverse** - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely , further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	**Negligible** (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	**Slight adverse**: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Local	Moderate	Not feasible: Unlikely to be substitutable	High	**Slight adverse:** Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Mardyke Flood Zone 2/ 3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mar Dyke)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	**(Moderate Adverse) Slight adverse** (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mardyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - viaduct spans flood plain	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Mardyke channel	Conveyance of flood flows.	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period	Local	Moderate	Not feasible	High	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - viaduct spans flood plain	Low significance (Significant)
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mardyke flood defences	Protection of property / assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route
Study Area: Area surrounding Main Rivers, Ordinary Watercourses, land drains and ditches, including marshes									
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Study Area: Entire route.									
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from groundwater	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from drains, sewers, and water mains	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance

Reference Sources

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Summary Assessment Score

(Post mitigation)
Moderate Adverse impacts

Qualitative Comments

Note 1 : Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation.

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall , these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

Impacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse.

Impacts on the Thames and Medway canal (WFD water body) depend on the construction methods adopted, a cut and cover tunnel through this area (immersed tunnel option) would lead to a loss of part of the water body and could impact its WFD status, however if mitigation in the form of full canal restoration post construction is adopted, these impacts could be reduced from moderate (or even large) adverse to slight adverse

Impacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, these impacts on the Tidal waters of the Thames remain moderate adverse.

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial/ agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion. Impact at source protection zones (especially SPZ 1 near Shorne) may be mitigated by adopting appropriate construction and drainage practices.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

Flood Risk:
The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span, minimise pier dimensions).

Tunnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 3 bridge design indicates the bridge would be significantly higher (and on viaduct) than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 3 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 3 crossing are:
P4 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit East Tilbury and Mucking Marshes, north of the river Thames (continue with existing or alternative actions to manage flood risk)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 3 road embankment to provide this structural defence.

CFMP policies for Route 3 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).
CFMP policies for Route 3 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits) . Where Route 3 crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstream.

Route 3 crosses the Mardyke flood plain. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route option C2 passes through CDA_012, and so the road should be designed so that any drainage problems in this area are not exacerbated (with improvements provided where feasible). Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Option C3 route alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

Annex 8 – Noise Worksheet

Annex 8: Noise Worksheet
Route 3 ESL Bored Tunnel

APPRAISAL - NOISE POLLUTION

Present value base year: 2010

Current year: 2015

Proposal Opening Year: 2025

Average Household Size: 2.36

Project (Road or Rail): Road

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in Opening Year

Without scheme / With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9699	307	68	83	62	41	30	6	2	1	1	0	0	0
45-47.9	1030	4595	293	60	17	17	48	15	0	0	1	0	0	0
48-50.9	2	1348	5043	316	42	25	31	15	1	0	0	0	0	0
51-53.9	0	10	1211	4646	272	22	21	32	2	0	0	0	0	0
54-56.9	0	0	4	915	3416	184	34	39	3	0	0	0	0	0
57-59.9	0	0	0	43	676	2532	166	12	2	0	0	0	0	0
60-62.9	0	0	0	0	13	710	2707	150	30	5	0	0	0	0
63-65.9	0	0	0	0	0	8	524	2767	93	6	1	0	0	0
66-68.9	0	0	0	0	0	0	9	466	1750	79	2	0	0	0
69-71.9	0	0	0	0	0	0	0	17	239	866	18	0	0	0
72-74.9	0	0	0	0	0	0	0	0	12	74	197	4	0	0
75-77.9	0	0	0	0	0	0	0	0	0	1	53	49	1	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	9	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in 15th Year After Opening

Without scheme / With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9334	270	76	89	62	41	29	8	2	1	1	0	0	0
45-47.9	985	4586	275	66	10	21	44	15	0	0	1	0	0	0
48-50.9	4	1169	5243	379	44	25	33	18	1	0	0	0	0	0
51-53.9	0	4	1073	4785	248	18	20	35	2	0	0	0	0	0
54-56.9	0	0	0	875	3626	182	38	36	7	0	0	0	0	0
57-59.9	0	0	0	7	683	2582	169	13	2	0	0	0	0	0
60-62.9	0	0	0	0	7	654	2746	165	22	12	0	0	0	0
63-65.9	0	0	0	0	0	9	478	2818	119	6	1	0	0	0
66-68.9	0	0	0	0	0	0	7	426	1825	63	1	0	0	0
69-71.9	0	0	0	0	0	0	0	37	230	976	25	0	0	0
72-74.9	0	0	0	0	0	0	0	0	7	94	213	8	0	0
75-77.9	0	0	0	0	0	0	0	0	0	1	39	67	1	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	7	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Net Present Value of Noise of Proposal (60 Year Period) £9,958,130 *positive value reflects a **net benefit** (i.e. noise reduction)

Estimated Population Annoyed (Do-Minimum): 12418
Estimated Population Annoyed (Do-Something): 12169

Net Noise Annoyance Change in 15th Year After Opening (no. of people): -249 *positive value reflects an **increase** in people annoyed by noise

Appendix 7.6
Appraisal Summary Table Route 4 ESL (BT)

Appraisal Summary Table Route 4 ESL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appraisal Summary Table | **Route 4, Eastern Southern Link, Bored Tunnel** | **Date produced:** 22 Jan 2016

Name of scheme:	Route 4 Bored Tunnel with Eastern Southern Link - Core Growth, Central Case costs, Current values of time, additional lane in tunnel
Description of scheme:	New Dual 2 lane trunk road (70mph) from M25 J29, linking with A127 and running parallel to A128, crossing the Thames in a bored tunnel, with an additional lane for future proofing, 2km to the east of Gravesend with an easterly southern link to the M2.

Contact:

Name	Chris Taylor
Organisation	Highways England
Role	Project Sponsor

Impacts		Summary of key impacts	Assessment: Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	**Value of journey time changes(£)** £2,838m **Net journey time changes (£)** 0 to 2min: -£443m; 2 to 5min: £1,074m; > 5min: £2,207m	N/A	£3,352m	Not appraised yet
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A	N/A	£110m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling	N/A	N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are more than double those for Route 1. More than 80% of WI benefits are from the agglomeration of business activities.	**Agglomeration** £1,398m **Output in imperfectly competitive markets** £335m **Labour supply impacts** £1m	N/A	£1,735m	
Environmental	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	312 people would benefit based on an estimated 12,418 people being annoyed by noise in the without scheme situation decreasing to 12,107 people in the with scheme situation.	N/A	£12m	Not appraised yet
	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors modelled are predicted to exceed the AQSO without the scheme (representing up to approximately 60 receptors), but these receptors experience an improvement compared to the without scheme. The scheme is not predicted to lead to any new exceedences.	N/A	N/A	Not appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-traded carbon over 60y (CO2e) 6,637,840 tonnes Change in traded carbon over 60y (CO2e) 17,848 tonnes	N/A	-£304m	
	Landscape	A new road would adversely affect the landscape character including in the vicinity of Shorne and Shorne Ridgeway, green belt and intrude into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.	N/A	Large Adverse	N/A	
	Townscape	See Landscape entry	N/A	N/A	N/A	
	Historic Environment	Direct physical impacts to one Grade II* registered park and garden, one conservation area and one Grade II listed building. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint	N/A	Large Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land) and areas of ancient woodland, including Cobham Woods SSSI. Impacts on LWSs, areas of BAP Priority Habitat & direct loss of habitat from ancient woodland sites, including Great Crabbles Wood SSSI & Court Wood.	N/A	Very Large Adverse	N/A	
	Water Environment	Negligible impacts on Mardyke.	N/A	Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing	**Value of journey time changes(£)** £676m **Net journey time changes (£)** 0 to 2min: -£293m; 2 to 5min: £344m; > 5min: £625m	N/A	£260m	Not appraised yet
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A	N/A	£40m	
	Physical activity	The option has no impact on walking and cycling	N/A	N/A	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. The ESL is the only option which provides a motorway to motorway link, connecting the M2 with the M25. Route 4 uses the A127 (a heavily used dual carriageway County road) for part of the route, which will involve mixing of strategic and County road traffic	N/A	Moderate Beneficial	N/A	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	Because it is a new route 2,147 additional accidents are predicted over 60 years, including 32 fatalities, 238 serious injuries and 3,071 slight casualties	N/A	-£113m	Not appraised yet
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network	N/A	Slight Adverse	N/A	Not appraised yet
	Access to services	Not appraised because this criteria relates to public transport options	N/A	N/A	N/A	N/A
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at Dartford Crossing today	N/A	Neutral	N/A	Not appraised yet
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A	Slight Adverse	N/A	Not appraised yet
	Option and non-use values	Not appraised because this criteria relates to public transport options	N/A	N/A	N/A	
Public Accounts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Investment costs: £2,380m Operating costs £309m Operator revenue £ 835m (a benefit, offsetting cost over the longer term)	N/A	£1,855m	
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing	N/A	N/A	£629m	

Annex 1 – TEE Table

Annex 1: TEE Table

Economic Efficiency of the Transport System (TEE): Route 4/WSL

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£76,530,261		£76,530,261					
Vehicle operating costs	-£67,605,062		-£67,605,062					
User charges	£98,558		£98,558					
During Construction & Maintenance	£0							
COMMUTING	£9,023,757	*(1a)*	£9,023,757					

Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£555,682,179		£555,682,179					
Vehicle operating costs	-£383,358,007		-£383,358,007					
User charges	-£1,870,014		-£1,870,014					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£170,454,158	*(1b)*	£170,454,158					

Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£2,603,048,124		£630,288,024	£1,972,760,100				
Vehicle operating costs	£460,095,818		£299,551,311	£160,544,508				
User charges	-£97,736,627		-£40,800,776	-£56,935,851				
During Construction & Maintenance	£0							
Subtotal	£2,965,407,315	*(2)*	£889,038,558	£2,076,368,757				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions		*(4)*						
NET BUSINESS IMPACT	£2,965,407,315	*(5) = (2) + (3) + (4)*						

TOTAL		
Benefits (TEE)	£3,144,885,230	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2010 prices and values

Annex 2 – PA Table

Annex 2: Public Accounts (PA) Table

Route 4 ESL Bored Tunnel

	ALL MODES TOTAL		ROAD INFRASTRUCTURE	BUS and COACH	RAIL	OTHER
Local Government Funding						
Revenue						
Operating Costs						
Investment Costs						
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	-£834,580,979		-£834,580,979			
Operating costs	£308,940,780		£308,940,780			
Investment Costs	£2,380,397,594		£2,380,397,594			
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£1,854,757,394	*(8)*	£1,854,757,394			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	-£628,774,533	*(9)*	-£628,774,533			
TOTALS						
Broad Transport Budget	£1,854,757,394	*(10) = (7) + (8)*				
Wider Public Finances	-£628,774,533	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Annex 3 – AMCB Table

Annex 3: AMCB Table

Route 4 ESL Bored Tunnel

Analysis of Monetised Costs and Benefits

Noise	£12,356,117	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	-£303,611,808	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	-£112,854,800	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£23,436,712	*(1a)*
Economic Efficiency: Consumer Users (Other)	£236,996,267	*(1b)*
Economic Efficiency: Business Users and Providers	£3,351,849,965	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	£628,774,533	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£3,836,946,987	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£1,854,757,394	*(10)*
Present Value of Costs (see notes) (PVC)	£1,854,757,394	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£1,982,189,592	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.1	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Annex 4 – Biodiversity Worksheet

Annex 4: TAG Biodiversity Impacts Worksheet

Route 4 ESL Bored

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of Circus cyaneus	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	**Slight Adverse**
Mucking Flats and Marshes SSSI	Botanical interest: Mudflats and Saltmarsh	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	**Neutral**
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important ancient woodland	Minor Negative	**Slight Adverse**
Shorne and Ashenbank Woods SSSI	Woodland invertebrates	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important birds	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important invertebrates	Minor Negative	**Slight Adverse**
Thorndon Park SSSI	Botanical importance (semi-natural broad-leaved woodland)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, some areas Unfavourable Declining	Not possible to substitute	High - nationally important	Minor Negative	**Slight Adverse**
Great Crabbles Wood SSSI	Botanical importance - broadleaved mixed and yew lowland woodland - designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site - High importance.	Unfavourable - Recovering. The whole area is classified as being in a 'no change' condition due to the lack of forestry and woodland management	Not possible to substitute ancient woodland	High - nationally important ancient woodland	Major Negative	**Very Large Adverse**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute ancient woodland plant species without ancient woodland	High - nationally important botany	Minor Negative	**Slight Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - woodland edge/ arable land plant species	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute	High - nationally important botany	Minor Negative	**Slight Adverse**
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Woodland birds	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important birds	Minor Negative	**Slight Adverse**
Thames Estuary recommended MCZ (on hold)	Marine and estuarine habitats and species	National	Attribute a qualifying feature of Nationally designated site so high importance.	Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Not possible to substitute	Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992)	Neutral	**Neutral**
Greater Thames Marshes Nature Improvement Area	Complex of habitats of value for biodiversity and as a community resource	Regional	Attribute of value to local communities, of Medium importance	Some goals are being achieved.	Not possible to substitute due to the extensive nature of the area involved	Medium - community value and extensive area	Minor Negative	**Slight Adverse**
Court Wood, Shorne (GR1) - includes Starmore Wood and Peartree Wood (ancient woodlands)	Local Wildlife Site Ancient and Ancient Semi-natural Woodland; derelict orchard and semi-improved neutral grassland	Local	Area of degraded ancient woodland, high importance with a derelict orchard and area of unmanaged semi-improved neutral grassland of limited botanical interest that supports invertebrates.	Much of this woodland has been converted to chestnut but still retains a good diversity of flowering plants, including many ancient woodland indicator species	Not possible to substitute ancient woodland	High - ancient woodland	Major Negative	**Very Large Adverse**
Shorne Pasture (GR18)	Local Wildlife Site Grassland, scrub	Local	Area of unimproved pasture on acid, dry pebbly soils. Supports a herb-rich flora - Low importance	unknown - not indicated on Kent Local Wildlife Site schedule.	Soil translocation a possibility	Low - local value grassland and scrub	Neutral	**Neutral**
Un-named ancient woodland (at centre of M2 J1 interchange)	Ancient Woodland	National	Area of degraded ancient woodland - High importance	unknown, but likely to be declining due to isolation and impact of poor air quality	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	**Slight Adverse**
Un-named ancient woodland (south of M2 J1 interchange, to the west of the M2)	Ancient Woodland	National	Area of degraded ancient woodland - High importance	unknown - but likely to be declining due to impact of poor air quality given proximity to M2	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	**Slight Adverse**
Hobbs Hole (Bre66)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland - High importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**
Codham Hall Woods (Bre59)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland - High importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**
Warley Hall Wood (Bre85)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland - High importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Intermediate Negative	**Large Adverse**
Thorndon Country Park South (Bre106) Includes Mill Wood (ancient woodland)	Local Wildlife Site ancient woodland; wood-pasture and parkland; lowland meadows; neutral grassland; small-component mosaics; accessible natural greenspace	Local	Lowland meadows; Lowland mixed deciduous woodland; Hedgerows (BAP Habitats) and ancient woodland - High importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens. Parkland habitat believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to substitute	High - important ancient woodland	Minor Negative	**Slight Adverse**
Barrett's Shaw (Bre105)	Local Wildlife Site Lowland Mixed Deciduous Woodland on Non-ancient Sites	Local	Lowland mixed deciduous woodland - Medium (BAP Habitat)	Nationally, deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Not possible to substitute mature habitats	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Round Shaw (Bre112)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland - High importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Minor Negative	**Slight Adverse**
Straight Path Shaw (Bre113)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland - high importance.	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Thick/Hollow Bottom Shaws (Bre115)	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland - High importance	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**
All Saints Churchyard and Keepers Cottages Meadow (Bre118)	Local Wildlife Site Neutral grassland	Local	Neutral grassland and hedgerows - Medium (BAP Habitats)	Favourable condition	Habitat/soil translocation a possibility but requires suitable substrate to maintain required pH.	Medium - BAP priority habitat	Neutral	**Neutral**
Eastlands Spring (Bre134)	Local Wildlife Site Ancient woodland; habitat extension mosaics	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland - high importance.	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	Hight - important ancient woodland	Minor Negative	**Slight Adverse**
Orsett Camp Quarry (Th44)	Local Wildlife Site Invertebrates; reptiles	Local	HCr19; SCr4; SCr11; SCr12; SCr13. Important acid grassland; six Red Data Book invertebrates 16 nationally scarce species and three UK BAP bees species; reptiles include adder, common lizard and slow worm. High importance	Red Data Book (Endangered) invertebrate species.	Not possible to substitute	High - undesignated site hosts Red Data Book species and UK BAP species	Neutral	**Neutral**
Mucking Heath (Th41)	Local Wildlife Site Flora; invertebrates	Local	Thames Terrace grasslands and ancient heathland. Site supports 4 nationally rare and 50 nationally scarce invertebrate species. Medium importance.	Unknown at present, but a rare grassland habitat and associated invertebrate fauna, associated with Thames Terrace soils.	Not possible to substitute	Medium importance Thames Terrace grassland and invertebrates	Neutral	**Neutral**
Buckingham Hill (Th50)	Local Wildlife Site Acid grassland	Local	Acid grassland which supports BAP invertebrate (Bombus humilis). Medium importance.	Developing site (former sand pit)	Habitat/soil translocation a possibility but requires suitable substrate to maintain required pH.	Medium - BAP priority habitat	Neutral	**Neutral**
Rainbow Shaw (Th45)	Local Wildlife Site Ancient woodland	Local	Ancient woodland habitat, high importance for biodiversity	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Minor Negative	**Slight Adverse**
Linford Pit (Th46)	Local Wildlife Site Invertebrates	Local	SCr11; SCr12. An important brownfield site that supports 5 Red Data Book invertebrates including two bees (*Andrena florea* and *Nomada fulvicornis*) two wasps (*Cerceris quinquefasciata* (a BAP species) and *Hedychrum niemelai*) and a rare fly (*Myopa polystigma*). High importance	A mix of favourable and unfavourable (caused by extremes of management and adverse heavily localised recreational pressure)	Difficult to substitute established brownfield sites	High - undesignated site hosts Red Data Book species	Minor Negative	**Slight Adverse**
Linford Wood (Th51)	Local Wildlife Site Wet woodland complex	Local	HCr2(b); HCr5; HCr6(b); HCr6(d). Wet woodland UK BAP habitat. Medium importance.	Current condition not known, but habitat requires management to maintain diversity of scrub and woodland types.	Not possible to substitute without similar hydrology to maintain water table required for wet woodland	Medium - BAP priority habitat	Neutral	**Neutral**
Low Street Pit (Th47)	Local Wildlife Site Invertebrates; flora	Local	HCr11; SCr11; SCr12; SCr13. Thames Terrace grassland supports a diverse invertebrate fauna including UK BAP invertebrate (Hornet Robber fly (*Asilus crabroniformis*)) Medium importance.	Unknown at present, but a rare grassland habitat and associated invertebrate fauna, associated with Thames Terrace soils.	Not possible to substitute	Medium importance Thames Terrace grassland and invertebrates	Major Negative	**Moderate Adverse**
Lytag Brownfield (Th39)	Local Wildlife Site Acid grassland; reptiles	Local	HCr19; SCr4. Brownfield site with acid grassland that supports all four common species of reptile (adder, grass snake, common lizard and slow worm). Medium importance	Believed to be favourable, but identified as a site a risk from development.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Goshems Farm (Th49)	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. Medium importance.	Red Data species but unknown at present.	Creation of replacement habitat possible?	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	**Large Adverse**
Canal and grazing Marsh, Higham (Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat)	Local	Recently established reedbeds, damp disturbed grassland and a dyke system. Medium importance	Site recently improved with active management by RSPB.	Not possible to substitute	Medium - BAP priority habitat	Neutral	**Neutral**
ancient woodland immediately to the north west of M25 J29	Ancient Woodland	National	Ancient woodland habitat, high importance for biodiversity	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	**Very Large Adverse**
Priority Habitat - Deciduous Woodland (south west of M25 J29; north east of M25 J29; south of A127 East Horndon interchange; adjacent to railway line south of Dunton Hall; north west of Linford; east of Low Street; areas included in East Tilbury Marshes; north of the A226 opposite Church Lane; adjacent to the A2 immediately west of Shorne and Ashenbank Woods SSSI)	Priority habitat	Local	Medium importance, BAP habitat	Nationally, deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Not possible to substitute mature habitats. Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority Habitat - Deciduous Woodland (north of A127 opposite Great Warley Hall; adjacent to railway line south of Dunton Hall; north of Horndon on the Hill; south west of Dame Elyns; east of Buckland; north east of East Court Manor; adjacent to the A2 immediately west of Shorne and Ashenbank Woods SSSI)	Priority habitat	Local	Medium importance, BAP habitat	Nationally, deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Not possible to substitute mature habitats. Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**

Step 2		Step 3					Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Substitution possibilities**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Priority Habitat - Wood-pasture and Parkland (between Round Shaw and Hollow Bottom Shaw/Thick Shaw north of the A127)	Priority habitat	Local	Medium importance, BAP habitat	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Priority Habitat - Wood-pasture and Parkland (between Round Shaw and Hollow Bottom Shaw/Thick Shaw south of the A127)	Priority habitat	Local	Medium importance, BAP habitat	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority Habitat - Traditional Orchards (south of Horndon on the Hill; south west of Dame Elyns)	Priority habitat	Local	Medium importance, BAP habitat	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Priority Habitat - Traditional Orchards (on Church Lane north of A226)	Priority habitat	Local	Medium importance, BAP habitat	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority Habitat Coastal and Floodplain Grazing Marsh (East Tilbury Marshes north of Thames; MoD firing range, Thames Estuary and Marshes Ramsar and South Thames Estuary and Marshes SSSI south of Thames)	Priority habitat. Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites)	Low to High, dependant on functioning within the wider network of habitats	Likely to be decreasing due to agricultural improvement, drainage and development	Not possible to substitute easily as reliant on suitable groundwater conditions (hydrology) for replacement habitat to establish.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority Habitat - Coastal Saltmarsh (east of Tilbury Power Station)	Priority habitat. Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within the wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	**Neutral**
Priority Habitat - Mudflats (East of Tilbury Power Station)	Priority habitat. Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within the wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	**Slight Adverse**
Priority habitat - Traditional Orchards (adjacent to the A289 at M2 J1 interchange; on Church Lane and adjacent to the A226 north of Shorne)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	**Moderate Adverse**
Priority habitat - Deciduous Woodland (adjacent to M2 J1 interchange; Great Crabbles Wood; and along northern edge of the A226 near Church Lane)	Priority BAP habitat	Local	Deciduous Woodland BAP habitat - Medium importance	Nationally lowland mixed deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Minor Negative	**Slight Adverse**
Tentacled lagoon worm (*Alkmaria romijni*)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal	Considered scarce wihtin the UK; vulnerable to changes to, or loss of, the habitats in which they live	Not possible to substitute	High	Neutral	**Neutral**
European eel (*Anguilla anguilla*)	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	**Neutral**
Smelt (*Osmerus eperlanus*)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales	Not possible to substitute	Medium	Neutral	**Neutral**
Harbour Porpoise (*Phocoena phocoena*)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	**Neutral**

Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations
JNCC website for Ramsar, SPA, SAC and SSSI site designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT_External/#)
Green Infrastructure Assets Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green_Infrastructure_Assets_Baseline_Report_1_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

Summary Assessment Score

Very Large Adverse*

Qualitative Comments

Route 4 bisects a number of designated and local wildlife sites and areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and is also a RSPB reserve. The route bisects a number of important habitats which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of five areas of ancient woodland along the northern extent and two along the southern extent of the new road, would involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable (as discussed above).

* Note the Summary Assessment Score is skewed by impacts on ancient woodland (seven areas of ancient woodland affected, including Great Crabbles Wood SSSI) from the proposed route alignment.

Annex 5 – Historic Environment Worksheet

Annex 5: Historic Environment Impacts Worksheet

Route 4 ESL Bored

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of settlements such as West Horndon, Horndon on the Hill, West Tilbury and Gravesend. The study area contains a number of listed buildings (designated heritage assets), largely in rural settings, although there are small clusters in settlements such as East Tilbury. In total there are 67 Grade II, eight Grade II* and one Grade I listed buildings within the study area (Grade II*: Little Warley Hall, Little Warley; Church of All Saints, East Hornden; Old Plough House, Bulphan; Marshall's Cottages and Church of St James, West Tilbury; Church of St Mary, East Court Manor and Little St Katerines and Chruch of St Peter and St Paul, Shorne. Grade I: Church of St Peter, Little Warley). The study area contains five conservation areas (designated assets): Thorndon Park, West Tilbury, East Tilbury, Shorne Village and Chestnut Green, Shorne. Thorndon Park is also a Grade II* registered park and garden. Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are five scheduled monuments (designated heritage assets) within the study area: a former parish church and churchyard of St Nicholas; Thorndon Old Hall and gardens; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	The listed buildings and conservation areas are designated heritage assets and are afforded protection at a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS. The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS. Whilst registered parks and gardens do not have statutory protection, they area a material consideration in the planning process and are considered at a national level in the NPPF and NN-NPS The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	The Grade I and Grade II* listed buildings are of high value, whilst the Grade II listed buildings are of medium value. The East Tilbury conservation area if of high value whilst the other four conservation areas are of medium value. Thorndon Park Grade II* registered park and garden is of high value. The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	The Grade I and Grade II* listed buildings, churches and manor houses are relatively well represented types on a national and regional level and are of moderate rarity. East Tilbury conservation area is a rare example of a planned modernist factory town. The other four conservation areas are relatively well represented regionally and nationally. Thorndon Park registered park and garden contains considerable time depth and incorporates or is associated with a number of other high value assets and is rare on a national level. The scheduled monuments at Thorndon Old Hall, West Tilbury and Bowaters Farm are relatively well represented types of monument and are of moderate rarity. The former parish church and churchyard of St Nicholas is less well represented and is high rarity. The non-designated archaeological remains are of types that are well represented on a regional level and are of low rarity.	The Scheme will have a direct physical impact on the Grade II listed Dunton Hills Farm, which will be removed. The scheme may impact on the settings of the listed buildings along the route. The scheme will have direct physical impact on the Thorndon Park conservation area and registered park and garden. The scheme may also impact on the settings of the West Tilbury, East Tilbury and Shorne Village conservation areas. The setting impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape The scheme may also impact on the settings of the scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. Construction excavations associated with the proposed road and tunnel may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good. The survival of Thorndon Park registered park and garden is generally good. The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area. Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	With the exception of the former parish church and churchyard of St Nicholas and the Bowaters Farm anti-aircraft battery, the survival of which is rare at both regional and national levels, the survival of the scheduled monuments is of moderate rarity value. Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of Thorndon Park registered park and garden and conservation area, which would be subject to the direct physical impacts as the result of road construction within the designated area. The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The condition of the listed buildings and conservation areas is generally good. The condition of Thorndon Park registered park and garden is generally good. The condition of the scheduled monuments is generally good, with the exception of the Bowaters Farm anti-aircraft battery, the condition of which is poor. The condition of the non-designated archaeological remains is currently unknown	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings, conservation areas and registered park and garden is of moderate significance as they have they have a beneficial effect on the character and amenity value of the study area. The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	Listed buildings and conservation areas in good condition are relatively common in this region and have low rarity value. Registered parks and garden in good condition are also relatively common, but have moderate rarity due to their relative scarcity Scheduled monuments of the nature and condition of those within the study area have a high rarity value. Non-designated archaeological remains in good condition are relatively common nationally and have a low rarity value.	The scheme would not impact on the condition of designated assets within the study area, with the exception of Thorndon Park registered park and garden and conservation area, which would be subject to the direct physical impacts as the result of road construction within the scheduled area. The scheme would have not impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings and conservation areas are not unusually complex and represents a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Thorndon Park is relatively complex as it represents several phases of development. Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area. The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflect this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Period	The listed buildings and conservation areas date from the medieval to modern periods. Thorndon Park registered park and garden dates from the early medieval to modern periods. The scheduled monuments date from the Neolithic to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	The NPPF and NN-NPS takes the period of heritage assets into account at a national level.	The wide range of periods represented within the historic environment resource is of high significance due to the potential to aid understanding the development of the region.	The range of periods represented by the historic environment resource within the study is common to the region and as such is of low rarity.	The scheme would not impact on the periods represented by the historic environment resource within the study area.

Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Kent Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

Step 5 - Summary Assessment Score

Large Adverse

Qualitative Comments

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. One Grade II listed building (Dunton Hills Farm) will suffer a direct physical impact through its removal, the effect of which is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm, listed buildings along the route; West Tilbury, East Tilbury and Shorne Village conservation areas. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas and scheduled monuments. Road construction within the registered area of the Thorndon Park registered park and garden and conservation area will cause a direct physical impact to this designated asset. Due to the high value of the assets, the effects are predicted to be Large Adverse. Construction excavations associated with the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint. In addition, any dredging within the river channel to facilitate the construction of a bored tunnel may impact previously unknown archaeological remains. Overall, Slight Adverse Effects to any non-designated archaeological remains within the scheme footprint are predicted.

Annex 6 – Landscape / Townscape Worksheet

Annex 6: Landscape Impacts Worksheet

Route 4 ESL Bored

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	Between the A2 corridor and the A226 the landform is undulating and rises towards the south. The higher land is well wooded, some of the woods are ancient woodlands, with the settlements of Shorne and Shorne Ridgeway running along ridges. Arable fields defined by hedges and trees fill the lower land close to the A226 and in the valleys either side of Shorne. Properties along Pear tree Lane have extensive gardens/grounds, some with horse paddocks.	Local	Rare	Medium	Low. It is not possible to replace ancient woodland.	**Large adverse.** Route 4 ESL would cut across the pattern of the landscape particularly to the east of Shorne where it would run across a valley and then through a hill requiring extensive earthworks. An area of ancient woodland in Great Crabbles Wood would be destroyed.
	Between the A226 and the Thames Corridor the landscape is gently undulating, with large open arable fields and few hedgerows. These are mainly along the roads and around the small settlements.	Local	Rare in a local context	Medium	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	**Moderate adverse.** Route 4 ESL would have a direct and indirect impact on the pattern of the existing landscape. In places the it would cut through the gently undulating landform.
	The Thames river corridor consists of flood embankments along the river edge backed by expansive marshlands with rough grazing and sparse scrub. On the north side there are extensive areas of old mineral workings some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	**Neutral.** The tunnel portals would be located to the north and south of the Thames corridor.
	From the junction of the A127 with the M25 Route 4 ESL would pass through open gently rolling countryside of medium sized, enclosed fields and small settlements. Further south the settlements become larger as do the size of the fields. Power lines become a more prominent feature.	Local	Common	Medium	High	**Moderate Adverse.** Route 4 ESL would impose a linear transport corridor through a largely rural area and break up the existing scale of the field pattern. Where it follows the line of the existing A127 the impact would be **slight adverse.**
Tranquillity	South of Shorne and Shorne Ridgeway, noise from the A2 and M2 becomes increasing intrusive, although visually due to the screening effect of trees the area is rural in appearance. The immediate area around the M2, A2, A289 junction is dominated by the roads despite extensive planting.	Local	Medium	Medium	Low	**Moderate adverse** away from the existing A2/M2 transport corridor. Route 4 ESL would introduce high levels of traffic noise and transport infrastructure into the currently rural scene. Closer to the existing roads the impact would be less. Some residents on the western edge of Strood would experience an increase in noise and increased visual impact of road infrastructure.
	The area around Shorne and Shorne Ridgeway has an unspoilt rural feel considering its closeness to Gravesend and the Medway towns. It is relatively free from traffic noise and the visual intrusion of industry and power lines. There are distant views over the Thames corridor to Essex and Tilbury power station.	Local	Medium	Medium	Low.	**Large adverse.** Route 4 ESL would introduce high levels of traffic noise and transport infrastructure into a currently tranquil rural scene. Some residents of Pear Tree Lane, Shorne Ridgeway, Shorne and Lower Shorne would have a significantly reduced level of tranquillity.
	Between the Thames corridor to the A226 there is visual intrusion on the landscape of urban settlements, roads and pylons. There is constant, although mostly distant, road noise. The sweeping views across the Thames are dominated by Tilbury power station.	Local	Common	Medium	Medium	**Moderate adverse.** A new road would increase the levels of road noise considerably and introduce transport infrastructure into the view. Some residents of Chalk and Church Lane would have a significantly reduced level of tranquillity.
	Within the Thames corridor there are expansive views over the river and surrounding marshland from the riverside paths which are often some distance from the nearest road. There is always the visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	**Slight adverse.** A tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	North of the Thames corridor the level of tranquillity varies considerably with location. There are large roads such as the M25, A13 and A127 which generate traffic noise and disrupt tranquillity whilst there are open areas of countryside between that are broken only by the occasional small road. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of small settlements, roads and pylons.	Local	Common	Low	High	**Moderate adverse** in the vicinity of Route 4 ESL. While there is some road noise in most areas at present this would increase considerably in the majority of locations. The presence of road infrastructure would also have an impact on the rural character of the area. For some residents of East Tilbury, West Tilbury, Linford, Southfield, Horndon on the Hill and west Horndon the route change the view and increase noise, having a detrimental impact on tranquillity.

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Cultural	Most of Route 4 ESL is located within Green Belt.	Regional	Regionally medium	High in regional context	Low	**Moderate adverse**. The Green Belt is a valued rural separation between settlements. In this location Route 4 ESL would introduce a new urban element into the Green Belt that has been planned to separate Basildon, Grays, Tilbury and Gravesend from nearby villages.
	Public rights of way.	Local	Common	Medium	High	Impact depends on the right of way but some will be crossed by the route and this would have a **Moderate adverse** impact on the users of the paths.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in a national context	Low	**Neutral.** Part of the Route 4 ESL/ A2/M2 junction would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB).	National	Rare nationally	High nationally	Low. It would not be possible to replicate the features of the AONB elsewhere.	The route 4 ESL junction with the A2, A289 and M2 would affect an area on the edge of the AONB and an area immediately around it which is important in terms of its landscape character, although not designated. The new junction would totally destroy this area and part of Great Crabbles Woods having a **large adverse** impact despite the existing large roads nearby.
	Grade II listed building in Old Watling Street.	Regional	Regionally rare	High in regional context	Low	**Slight adverse.** The proposed changes to the existing junction will mean that roads are closer to the building.
	Well Tree Cottage & Bushylees grade II listed buildings off Pear Tree Lane.	Regional	Regionally rare	High in regional context	Low	There would be a **slight adverse** impact on the setting of the rear of the buildings.
	Shorne conservation area. Listed buildings in Shorne within 500m of Route 3 ESL: Front garden wall & gate piers to Pipes Place, Pipes place, Chapel of St Katherine, St Katherine's House, all grade II & Little St Katherine's grade II*.	Grade II * listed building national. Grade Ii listed buildings local. Conservation area regional.	Grade II* listed building nationally rare, listed buildings and conservation area regionally rare.	High in national/local context	Low	**Slight adverse** impact on the northern most part of Shorne conservation area. **Neutral** for the remainder of Shorne conservation area and the listed buildings.
	Listed buildings located close to Route 4 ESL between the A226 and the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse, the granary at Little Filborough Farm East Court Manor (all grade II & Church of St Mary in Chalk (grade II*).	National/regional	Nationally/ regionally rare	High in national/regional context	Low	There would be a **moderate adverse** impact of Route 4 ESL on the setting of the listed buildings.
	National Cycle Routes 1 and 13 and other public rights of way.	National/local	Rare/common	High/low	High as easily relocated.	**Moderate adverse** for rights of way and national cycle routes located close Route 4 ESL due to the visual impact of road infrastructure and increased noise levels.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	**Neutral** The portal and road would be located some distance to the south.
	Saxon Shore Way leisure route along the Thames and public right of way on northern side of the Thames.	Regional/local	Rare regionally	High in a local context	Low	**Neutral.** The tunnel would pass below the paths.
	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	**Neutral.** A tunnel will have no impact on the setting to the monument.
	Scheduled monument at Bowaters Farm WWII anti aircraft battery.	National	Rare	High at a national level	Low	The monument is largely hidden from view by scrub and despite the closeness of Route 4 ESL it would only have a **slight adverse** impact on the setting.
	Grade II listed building at Bucklands Farm.	Regional	Rare	High	Low	The building is surrounded by trees and the road would have only a **slight adverse** impact on its setting.
	East Tilbury Conservation area and listed buildings.	Regional	Rare	High	Low	Some distance away from the conservation area which is an unusual modernist development of housing and factories. For most of the area the impact would be **neutral** with **slight adverse** on the setting of the western edge.

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
	Grade II listed buildings in the vicinity of Hordon on the Hill within 500m of Route 4 ESL. 2 at Ongar Hall Farm, 2 at Wyfields Farm, Linsteads Farm, Chorleys farm, 2 at Saffron Gardens.	Regional	Rare	High	Low	Generally a **slight adverse** impact on the setting of the buildings due to the distance from Route 4 ESL. At Chorleys farm the impact will be **moderate adverse** as the route is close to the building and would considerable change the setting from arable field to the east.
	Bulphan WWII bombing decoy scheduled monument, south of Doesgate Lane.	National	Rare	High at a national level	Low	**Large adverse** impact on the setting of the scheduled monument due to the closeness of the road to an extremely rare example of a bombing decoy.
	Dunton Halls Golf Course.	Local	Medium	Low	Medium	**Moderate adverse**. Route 4 ESL would run through part of the golf course which would have to be relocated.
	All saints Church grade II* , Freman Monument grade II & Stabling at Church of all Saints grade II, listed buildings.	National/regional	Rare	High	Low	**Slight adverse** The new junction with the distributer road would have an impact on the setting of the buildings.
	Grade II listed buildings at East Horndon Hall, Dunton Hills Farm & 2 at Dunton Hall.	Regional	Rare	High	Low	**Moderate adverse** to East Horndon Hall as the building would become surrounded by roads severely affecting its setting. Dunton Hills Farm would be demolished and the impacts will be addressed as part of the heritage worksheet. The other listed buildings are further from the route which would only have a **slight adverse** impact on their setting.
	Thordon Hall scheduled monument.	National	Rare	High	Low	**Slight adverse.** The slip roads connecting Route 4 ESL with the A127 and the new distributer road would have some impact on the setting of the monument although it will be largely hidden by vegetation.
	Thordon park registered park and conservation area.	National	Rare	High	Low	**Moderate adverse.** The southern part of the registered park and the conservation area will be affected by the 2 new slip roads to linking Route 4 ESL with the A127 and a new distributer road will cut through the southern part of the conservation area and the registered park. This will isolate small sections of both from the remainder.
	A grade I & II* listed buildings at Little Warley.	Regional/national	Rare	High	Low	**Slight beneficial.** The removal of the junction with the A127 and the demolition of the exiting service station would have a small improvement on the setting of the listed buildings.
	2 grade II Listed buildings, Hulmers and The Kilns Hotel on the B186 north of the A127.	Regional/national	Rare	High	Low	**Neutral.** The removal of the junction between the B186 and the A127 would have an advantages impact on the setting of the buildings. The proposed slip road between the A127 and the M25 and the junction of the distributer road with the B186 would have a slight adverse impact on the setting of the buildings. Overall the impact would be neutral.
	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	**Neutral.** Part of junction of Route 4 ESL with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	The A2/M2 transport corridor dominates the surrounding rural landscape.	Local	Common	Low	High	**Slight adverse.** A new road junction would have little impact on land use other than to remove areas of planting and increase the area of road surface.
	The villages of Shorne and Shorne Ridgeway are on the higher land which is also well wooded and includes Shorne and Great Crabbles Woods amongst others.	Local	Medium locally	Medium	Low	**Large adverse**. A road would change the current land cover next to Southern Alternative from a predominantly rural one to one dominated by transport infrastructure. Large earthworks would be necessary to cut through the high land at Pear Tree Land requiring an extensive footprint.
	South of the A226 the lower areas are predominantly of arable fields bounded by hedges and woodlands.	Local	Medium locally	Medium	Low	**Moderate adverse**. A road would change the current land cover next to Southern Alternative from a predominantly rural one of fields and woodlands to one dominated by transport infrastructure.
	Between the A226 and the Thames corridor landcover is of large arable fields and small groups of houses. To the west is the suburban edge of Chalk.	Local	Low	Medium	High	**Moderate adverse**. A road would change the current land cover next to Southern Alternative from a predominantly rural one of arable fields to one dominated by transport infrastructure.
Landcover	The characteristic landcover of the Thames river corridor consists of open flat grazing marsh with sparse scrub and trees cover with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have **neutral** impact immediacy adjacent to the river. Above ground the current agricultural landcover would change along the route to one dominated by transport infrastructure, in the long term there would be the potential for Route 4 ESL to create changes to the surrounding agricultural land which would be bisected and would become less viable to farm.
	South of the A13 there are more settlements. Arable fields are still a feature but this are mixed with rough grassland, golf courses and gravel extraction. Overhead power lines become a common feature.	Local	Medium	Medium in local context	High.	**Moderate adverse**. Despite the urban fringe character the introduction of Route 4 ESL would significantly change the land use in the immediate vicinity of the road and some arable fields would no longer be viable.

	Step 2	Step 3				Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
	From the M25 junction with the A127 to the A13 the landcover is mostly of arable fields, with hedges and boundary trees, with settlements some distance away. There is a golf course at Dunton. Areas of woodland at the junction with the M25 including a small area of ancient woodland would be destroyed by the new slip roads.	Local	Medium	Medium in local context	High. The most important features the trees and hedges can easily be replaced. Ancient woodland low.	**Moderate adverse** The current agricultural landcover would change along Route 4 ESL, to one dominated by transport infrastructure.
Summary of character	The Thames river corridor has a strong identity with large expansive horizontal visits dominated by the interplay of water and sky. The area to the north along Route 4 ESL consists of open arable farmland north of the A13, with settlements and urban fringe areas becoming more dominant to the south. Prominent features consist of arterial roads, pylons, and the distant urban edge of large settlements. The land rises up to the south and the AONB with areas of woodland and heathland beyond which is the A2/M2 transport corridor.	Regional	Medium regionally	Medium regionally	Medium	**Large adverse**. Although there are major roads running through the parts landscape, Route 4 ESL would introduce a new transport corridor through areas that are largely rural in character in particular around Shorne and the AONB. In places this would dramatically change the character of the landscape from a rural one to one dominated by transport infrastructure and have a wider effect on the surrounding area than the immediate footprint of the road.

Reference Sources

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Step 5 - Summary Assessment Score

Large adverse

Qualitative Comments

Route 4 ESL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt. Route 4 ESL would introduce a significant change to the existing landscape character for much of the route, which is designated as Green Belt, due to the introduction of a major new transport corridor with its associated infrastructure such as signage, lighting, bridges and embankments, into a largely rural area. Route 4 ESL would have a considerable impact on the area around Shorne and the AONB The new road corridor and junction infrastructure associated with Route 4 ESL would impact on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

Annex 7 – Water Worksheet

Annex 7: Water Environment Impacts Worksheet

Route 4 ESL Bored

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study area: River Thames									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine/ transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to economy / navigation	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	Regional/ National (excludes biodiversity considerations)	Rare	Not feasible	Very High	**Negligible**	Low significance
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mardyke									
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R4) WFD Water body ID GB106037028030	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (East Tributary- R8) WFD water body ID GB106037028070	Water supply / biodiversity / transport & dilution waste products / recreation	Low Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**(Moderate adverse)** (Larger tributary crossing) **Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (West Tributary) R9 WFD water Body ID GB106037028080	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes East Tilbury main drains	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway Canal									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal (Ca18) (GB70610011)	Biodiversity / transport dilution waste products /recreation / navigation (potential)	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	Regional (ref WFD water body status)	Moderate	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses and drainage ditches at South Thames Estuary and Marshes (excluding Thames and Medway canal)									
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and Ramsar site.	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Negligible** Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)									
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and drainage ditches at East Tilbury Marshes	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	**Slight adverse** Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**(Moderate adverse)** **Negligible** Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds									
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River Thames including ponds and lakes and standing water in marsh areas	Biodiversity / recreation / amenity / water supply (small reservoirs and dams)	Low - Medium Could support protected ecological species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	**Negligible:** No significant standing waters crossed or intercepted.	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								**Negligible:** Assumes no drainage to standing water in accordance with best practice	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Groundwater north of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zones 2 and 3 (Linford / East Tilbury) Local commercial / industrial /agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status)	Moderate	Not feasible	Medium	**Negligible - slight adverse** Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium - low WFD water body status (current poor, target good)	Regional (ref WFD water body status)	Moderate	Not feasible	Medium	**Negligible:** Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	**Slight to moderate adverse**. Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south of River Thames									
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures.	North Kent Medway Chalk WFD Water body ID GB40601G500300	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	High WFD water body status (current poor, target good). Source Protection Zones 1, 2 and 3 (SE of Shorne) Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	**(Moderate adverse)** Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow **Slight adverse** with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	Shallow groundwater (terrace gravels / alluvium) feeding South Thames Estuary and Marshes SSSI	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/ SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	**Slight adverse** Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood Zone 2/3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	**Slight adverse** - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely , further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	**Negligible** (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	**Slight adverse**: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Local	Moderate	Not feasible: Unlikely to be substitutable	High	**Slight adverse:** Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Study Area: Mardyke Flood Zone 2/ 3 and associated defences									
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mar Dyke)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	**(Moderate Adverse) Slight adverse** (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mar Dyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route. TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain.	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain.	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - where crossings span flood plain.	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain.	Mar Dyke channel	Conveyance of flood flows.	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period.	Local	Moderate	Not feasible	High	**(Moderate adverse)** -potential to increase flood risk upstream for mostly rural area. **Slight adverse** with mitigation - where crossings span flood plain.	Low significance (Significant)
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mar Dyke flood defences	Protection of property/assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route
Study Area: Area surrounding Main Rivers, Ordinary Watercourses, land drains and ditches, including marshes									
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk). **Slight adverse to negligible** with mitigation	Insignificant Low significance
Study Area: Entire route.									
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from groundwater	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from drains, sewers, and water mains	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	**(Moderate adverse)** (potential increase in flood risk) **Slight adverse** after mitigation	Insignificant Low significance

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Thurrock Surface Water Management Plan (SWMP). URS. 2013.
Thameside Surface Water Management Plan (SWMP). JBA. 2013.
Brentwood Surface Water Management Plan (SWMP). JBA. 2015.
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North Kent Rivers Catchment Flood Management Plan (CFMP). Environment Agency. 2009.
Highways Agency Drainage Data Management System (HA DDMS)

Summary Assessment Score

(Post mitigation)
Moderate Adverse impacts

Qualitative Comments

Note 1 : Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation.

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall , these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

Impacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse.

Impacts on the Thames and Medway canal (WFD water body) depend on the construction methods adopted, a cut and cover tunnel through this area (immersed tunnel option) would lead to a loss of part of the water body and could impact its WFD status, however if mitigation in the form of full canal restoration post construction is adopted, these impacts could be reduced from moderate (or even large) adverse to slight adverse

Impacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, the impacts on the Tidal waters of the Thames remain moderate adverse.

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial / agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Impact at source protection zones may be mitigated by adopting appropriate construction and drainage practices. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion. Impact at source protection zones (especially SPZ 1 near Shorne) may be mitigated by adopting appropriate construction and drainage practices.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

Flood Risk:
The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span, minimise pier dimensions).

Tunnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 4 bridge design indicates the bridge would be significantly higher than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 4 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 4 crossing are:
P4 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit East Tilbury and Mucking Marshes, north of the river Thames (continue with existing or alternative actions to manage flood risk)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 4 road embankment to provide this structural defence.

CFMP policies for Route 4 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).
CFMP policies for Route 4 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits). Route 4 crosses the Mardyke floodplain near the upstream extent of Mardyke catchment. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP Policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route 4 passes through CDA_010a and CDA_010b (located west of Stanford-le-Hope) and CDA_011 (located in the upper Mardyke catchment in and around Bulphan. For these areas there is potential for the road design to act to reduce local flood risk e.g. by providing attenuation of road drainage, providing flood storage directly upstream of the road. None of these CDAs are crossed by the proposed Route 4. Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Route 4 route alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

Annex 8 – Noise Worksheet

Annex 8: Noise Worksheet
Route 4 ESL Bored Tunnel

APPRAISAL - NOISE POLLUTION

Present value base year: 2010

Current year: 2015

Proposal Opening Year: 2025

Average Household Size: 2.36

Project (Road or Rail): Road

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in Opening Year

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9807	227	63	69	60	36	26	8	2	1	1	0	0	0
45-47.9	1166	4561	202	41	18	6	55	20	5	1	1	0	0	0
48-50.9	11	1416	5065	252	33	18	22	5	1	0	0	0	0	0
51-53.9	0	22	1218	4698	237	18	14	8	1	0	0	0	0	0
54-56.9	0	0	9	961	3384	191	30	19	1	0	0	0	0	0
57-59.9	0	0	0	53	690	2524	151	12	1	0	0	0	0	0
60-62.9	0	0	0	0	19	728	2647	185	16	20	0	0	0	0
63-65.9	0	0	0	0	0	10	541	2760	81	6	1	0	0	0
66-68.9	0	0	0	0	0	0	18	512	1702	73	1	0	0	0
69-71.9	0	0	0	0	0	0	0	21	245	859	15	0	0	0
72-74.9	0	0	0	0	0	0	0	0	11	75	198	3	0	0
75-77.9	0	0	0	0	0	0	0	0	0	1	55	46	2	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	9	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB_{Leq}) in 15th Year After Opening

Without scheme \ With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
<45	9442	190	65	78	62	37	25	10	2	1	1	0	0	0
45-47.9	1068	4600	194	41	12	11	51	19	4	2	1	0	0	0
48-50.9	12	1183	5352	283	34	20	24	7	1	0	0	0	0	0
51-53.9	0	7	1054	4876	206	13	11	17	1	0	0	0	0	0
54-56.9	0	0	0	867	3677	175	29	12	4	0	0	0	0	0
57-59.9	0	0	0	7	643	2671	120	14	1	0	0	0	0	0
60-62.9	0	0	0	0	7	620	2800	146	22	11	0	0	0	0
63-65.9	0	0	0	0	0	8	453	2865	97	7	1	0	0	0
66-68.9	0	0	0	0	0	0	7	434	1821	59	1	0	0	0
69-71.9	0	0	0	0	0	0	0	36	221	987	24	0	0	0
72-74.9	0	0	0	0	0	0	0	0	7	93	214	7	1	0
75-77.9	0	0	0	0	0	0	0	0	0	1	38	67	2	0
78-80.9	0	0	0	0	0	0	0	0	0	0	2	7	3	0
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Net Present Value of Noise of Proposal (60 Year Period) £12,356,117 *positive value reflects a **net benefit** (i.e. noise reduction)

Estimated Population Annoyed (Do-Minimum): 12418

Estimated Population Annoyed (Do-Something): 12107

Net Noise Annoyance Change in 15th Year After Opening (no. of people): -312 *positive value reflects an **increase** in people annoyed by noise

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