Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Tackling London's Sewer Overflows

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Planning and Environment Working Group Report

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Tackling London's Sewer Overflows

Thames Tideway Tunnel and Treatment - Option Development

Planning and Environment Working Group Report.

Thames Tideway

December 2006

Thames Water

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1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

Thames Water Utilities Limited (TWUL) was requested by DEFRA to undertake a preliminary assessment of a range of environmental & planning variables of the Thames Tideway Tunnel (TTT) Options.

The TTT is designed to capture overflows from Combined Sewer Overflows (CSOs) that during periods of high rainfall would otherwise discharge sewage effluent to the Thames Tideway. The TTT would capture CSOs discharges and enables them to be pumped out and treated at a Sewage Treatment Works (STW) before subsequent discharge of the treated effluent to the Tideway.

There are essentially two main TTT Options: A "full solution" linked to 36 CSOs and with a complete tunnel from Hammersmith to Beckton STW and "partial solution" comprising western and eastern tunnels but which exclude links to 17 or 18 CSOs (option dependant) in Central London that would be included in the full solution. Further details of the Options are given in Section 2 of this report to provide context for subsequent assessment.

The TTT provides an integrated solution, which together with Tideway STW upgrades, is designed to meet river water quality objectives.

A Planning and Environment Working Group has been drawn together by invitation and includes TWUL and its consultants[1], the GLA, the London Thames Gateway Development Corporation (LTGDC), Environment Agency, London Borough of Newham (LBN), the Government Office for London (GOL), Port of London Authority and Association of London Government (representing London Councils). The Planning and Environment Working Group provides a forum for high-level discussion in respect of the strategic planning, key issues, environmental impacts and constraints associated with this project. The agreed Terms of Reference for the Working Group are provided as Appendix 1.

This report draws on the professional expertise and representations from all of the above organisations. They have been instrumental in the preparation of this report but have made clear that they reserve the right to modify or make further representations should a preferred option be pursued.

1.2 BACKGROUND

In 2000, TWUL together with the Environment Agency, the Greater London Authority, DEFRA and Ofwat, began the Thames Tideway Strategic Study (TTSS), in order to assess the environmental impact of intermittent discharges of storm sewage from combined sewer overflows (CSOs), to the Thames Tideway. The key legislative driver behind the TTSS and the proposed solution has been the Urban Waste Water Treatment Directive 1991 (UWWTD).

The TTSS reported its conclusions in 2005 and the central recommendation was the construction of a storage and transfer tunnel under the Thames which would intercept the flow from the CSO's currently discharging direct to the Tideway enabling pump-out and treatment of the stored storm sewage. This was presented as an integrated solution with upgrade of Tideway STWs. A raft of information on the TTSS has been within the public domain for several years and is available online at http://www.thamestidewaystrategicstudy.co.uk/

An independent review of the TTSS and its conclusions was commissioned by Ofwat and undertaken by Jacobs Babtie. The Jacobs Babtie study sought to identify alternative economic solutions available to deal with the problem of CSO discharges to the Tideway. The main solution identified was a partial

[1] Scott Wilson Ltd and Charles Planning Associates

tunnel (west tunnel), with a series of other measures to complement the tunnel function in particular to deal with CSO discharges from Abbey Mills.

On 10 April 2006 the European Commission handed down its Reasoned Opinion in response to a complaint against the United Kingdom concerning its failure to comply with the UWWTD. The Commission concluded that the untreated discharges from the CSO's along the Thames Tideway at the existing frequency of 50 to 60 times per year was unacceptable and that the United Kingdom Government was therefore failing to comply with the requirements of the UWWTD on collecting systems and treatment facilities.

The Government has since conceded that further measures are needed to improve parts of London's sewerage network and to meet the requirements of the UWWTD.

On 27 July 2006, Mr Ian Pearson, Environment Minister wrote to TWUL requesting that TWUL provide a detailed assessment of two options for providing improvements to the Thames Tideway. The purpose of this work is to assist the Government in making an informed decision on the preferred measures. The Government has set a deadline for this work as 31 December 2006 with a final decision on the way forward expected by the Government in early 2007.

The Government has highlighted the two preferred options as:

a) Option 1: a tunnel over 30km long to extend the length of the tidal Thames from Hammersmith to Beckton. The tunnel will intercept flows from the unsatisfactory CSO's and convey the wastewater for treatment in east London.

b) Option 2: two shorter tunnels, in west and east London, to intercept intermittent discharges along these stretches of river and with additional treatment in east London as required.
There are also a number of variants on each of these main options as described briefly in Section 2 of this report.

TWUL has been requested to consider as part of this detailed assessment any feasibility, issues and risks (planning, environmental, engineering and financial) associated with construction and operation of the two preferred options.

TWUL responded to the Government by letter dated 25 August 2006 setting out an action plan outlining the framework for undertaking the development work and delivering the information as requested by the Government. As part of this framework TWUL have invited key stakeholders to sit on a series of working groups to assist TWUL in progressing the studies. The Planning and Environment Working Group is one of these and its composition is given in Section 1.1 above.

TWUL will include planning and environmental feasibility sections within the final report to be submitted to the Government. The current report presents data, mapping, assessment and conclusions that will be reported either in full or in summary form, within that final report to Government.

1.3 Scope of the Planning and Environment Study

The division of responsibilities between the various TWUL project teams is identified on a "Thames Tideway Working Group Matrix" (Draft v2). The planning and environment team is identified as holding the *lead* responsibility for the following tasks:

- Assessment of Sustainability (e.g. Energy)
- East London Regeneration
- Engagement of Planning Authorities
- Identification of Planning and Environment Issues
- Establishment of Planning Strategy

The Planning and Environment team is also identified as contributing to, but not leading, the following tasks:

- Option Development
- Option Assessment and Optimisation
- Tunnel Pump-out Treatment and Location
- Tideway STW Upgrade Evaluation and Impacts
- Feasibility and cost of project phasing
- Climate Change
- Forecast Development
- Implementation Feasibility
- Issues and Risks for Construction / Operation
- Odour Management
- Identification of Land Issues
- Provide input to the Regulatory Impact Assessment (RIA)

This report, together with its appendices, provides the technical inputs in respect of those tasks listed at above, i.e. those for which the Planning and Environment team are identified as having the lead responsibility.

Whilst the key planning and environmental issues specifically identified within the Government letter of 27th July 2006 were taken as of central importance to this study, the TWUL planning and environment team also took the opportunity to review the full scope of potential issues associated with the TTT. This was undertaken by reviewing the most appropriate Environment Agency Scoping Guidelines for EIA (2002) and identifying where significant effects might arise (see below). The requirement for an Assessment of Sustainability of the options identified within the task matrix is provided by the identified study scope, the resultant assessments and the sustainability appraisals of options.

In addition to the study scoping exercise, comments were solicited from members of the Planning and Environment Working Group. The full extent of this engagement is described within Section 17 of this report. The following specific comments were made in reference to the proposed study methodology:

- Significance of effects should be defined where possible;
- Significance of effects with and without mitigation should be given;
- The mitigation measures should be identified in broad terms where possible;
- Consideration should be given to Flood Risk, Climate Change (Response) where possible (see Section 15 of this report);
- Stakeholder engagement should be as wide as possible;
- East London Regeneration issues should be addressed; and
- Due emphasis should be given to both positive and negative impacts.

As well as producing outputs and conclusions in its own right, there was a clear need for the TWUL planning and environment team and its consultants to provide the relevant inputs to the Cost Benefit Analysis (CBA) to enable that study to progress. Inputs in respect of a variety of environmental and planning metrics (e.g. loss of MOL, energy use) were provided to the CBA during the October-December 2006. The data sheets are included as Appendix 3 to this report.

1.4 CONTENT OF THE REPORT

This Draft Technical Report consists of the following Sections:

- Section 1 - Introduction
- Section 2 - Identification of the Options
- Section 3 - Planning Context and Strategy
- Section 4 - Scoping the Planning and Environmental Issues
- Section 5 - Open Space & MOL
- Section 6 - Energy Use & Carbon Dioxide

- Section 7 - Local Air Quality: Odour
- Section 8 - Water Resources
- Section 9 - Biodiversity
- Section 10 - Wastes
- Section 11 - Contamination
- Section 12 - Noise and Vibration
- Section 13 - Traffic and Transportation
- Section 14 - Archaeology & Cultural Heritage
- Section 15 - Flood Risk and Climate Change Response
- Section 16 - Sustainability
- Section 17 - Stakeholder Engagement
- Section 18 – Conclusions

and a series of appendices including:

- Odour Management (OdourNet Report)
- The Sustainability Statement, based upon the GLA SPG
- Spreadsheets and other documentation supporting the draft conclusions reached in the technical sections.
- Environmental Constraints Mapping
- Responses from the Stakeholder Event

2 IDENTIFICATION OF THE OPTIONS

2.1 INTRODUCTION

This short section provides a brief review of the options for the benefit of the reader of the Planning and Environmental Report only. **Full details are provided elsewhere within the technical series of reports.**

There are two basic configurations for the TTT. The first is a tunnel that would extend from Hammersmith to Beckton STW whilst the second comprises two shorter tunnels in west and east London. Within these two configurations are several variants.

The full set of options and variants are:

Full Options

- 1a Full Storage Tunnel – 7.2m Diameter
- 1b Full Storage Tunnel – 6.0m Diameter
- 1c Full Storage Tunnel – 7.2m Diameter (Direct Abbey Mills-Beckton link)

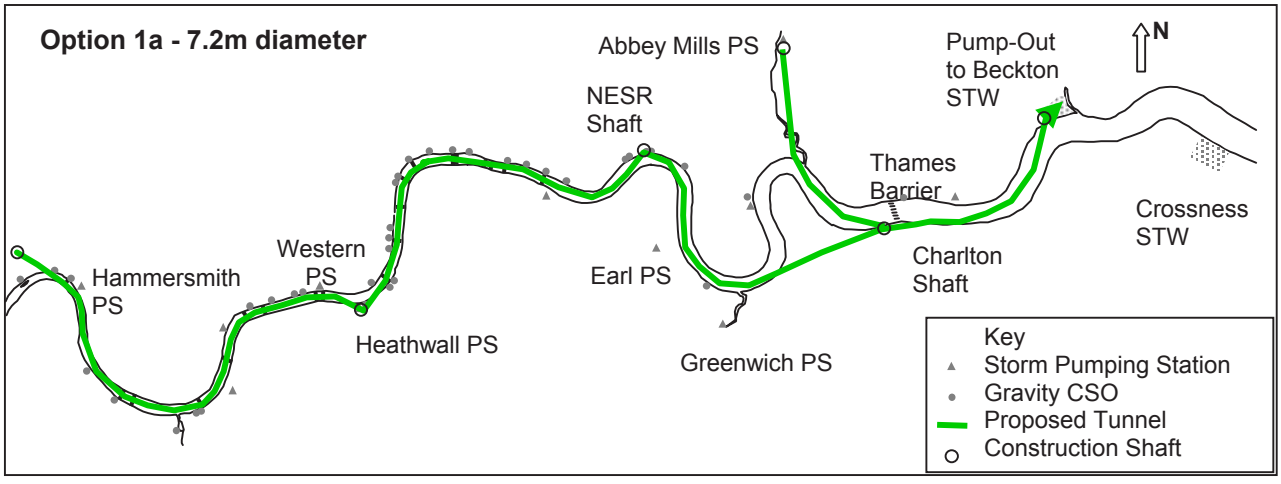
Partial Options

- 2a West Tunnel 7.6m Diameter & East Tunnel 13m Diameter
- 2b West Tunnel 7.6m Diameter & East Tunnel (direct) 10m Diameter, with Additional Treatment Capacity
- 2c West Tunnel 7.6m Diameter & East Tunnel (via Charlton) 10m Diameter

In addition to these options, DEFRA requested that a phased approach be considered in which an option be progressed as two separate schemes with the Abbey Mills to Beckton element constructed as the earlier stage. As the Abbey Mills CSO releases the largest volume of untreated sewage waste to the Tideway (via the River Lee), this approach would deal with the most damaging source first.

2.2 OPTION 1A: FULL STORAGE TUNNEL – 7.2M DIAMETER

This is a 30km tunnel of 7.2m diameter and is the preferred solution identified by the TTSS. The tunnel is designed to intercept 36 CSOs with a 5km link to Abbey Mills. The tunnel would range in depth from 40 to 80 metres and is designed to flow by gravitation from Hammersmith to Beckton where flows will be pumped to Beckton Sewage Treatment Works (STW) for treatment.



The main tunnel would have 5 main construction shafts that would be converted to permanent shafts upon completion to allow access to the tunnel for operational purposes. There would be a further pumping shaft located at Beckton STW. The shaft sites are mapped on the environmental constraints mapping which forms Appendix 4 of this report. At each of the CSO interceptor sites, there would be a chamber located below ground with connections to the main tunnel. At each CSO there would be a vent columns to ensure there is not build up of pressure within the TTT. These can be located remote from the chamber itself at almost any convenient location to blend with the local street furniture and are normally the size of typical lamp post columns.

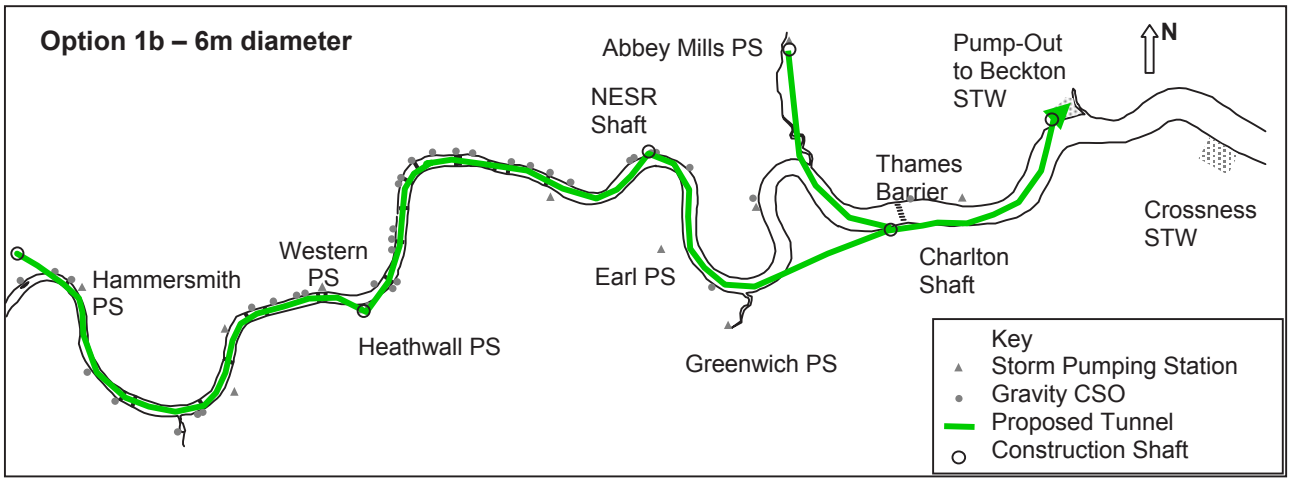
The pumping station shaft at Beckton would incorporate an industrial style building over the head of the shaft to house the switchgear, control and access equipment. This building would also incorporate a vent stack together with ventilation louvers and odour control plant. The other main shafts would incorporate a small building to house ventilation plant and louvers for displaced air on filling. The ventilation building would be approximately 5m x 8m in plan by 4m high and could be located up to 20m away from the main shaft to minimise impact. In addition the main shaft at Heathwall would include a vent stack, approximately 12m high and an odour control plant located adjacent to the existing pumping station building. The odour control plant would be approximately 5m x 15m in plan by 5m high.

Pump out facilities will be provided so that the tunnel would take up to 48 hours to empty depending on the scale of the rainfall event and the quantity of the stored effluent. The tunnel is designed to be self-flushing. The tunnel is sized such that the number of times it reaches capacity (when the CSOs would spill to river) is approximately three times per year on average.

Option 1a: Full Storage Tunnel (7.2m diameter)	
Main tunnel	32.2km @ 7.2m diameter tunnel
Abbey Mills link	5km @ 7.2m diameter
Construction shafts	Five
Pump-out shafts	One (Beckton)
CSOs intercepted	Thirty-six
Total storage volume	1,618,000m^3
Maximum drain down	9.36m^3/s or 809 Mld
Notional maximum full treatment	2,336 Mld

2.3 Option 1b: Full Storage Tunnel – 6.0m Diameter

This option is similar to Option 1a with the only difference being a smaller diameter for the main tunnel and Abbey Mill Link. The tunnel would have a diameter of 6.0m resulting in a smaller storage capacity.

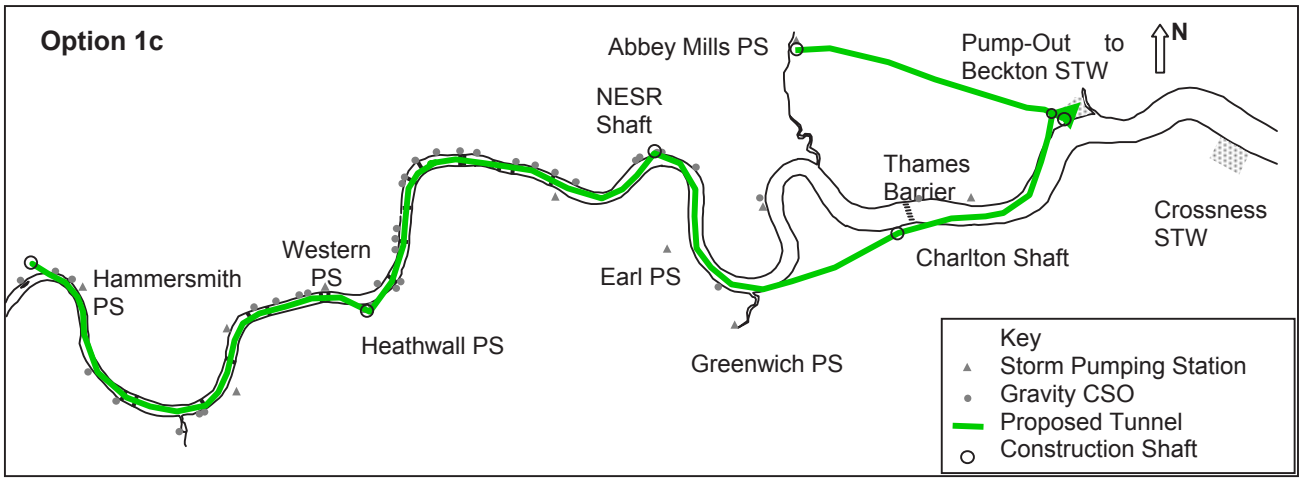


Option 1b: Full Storage Tunnel (6m diameter)	
Main tunnel	32.2km @ 6.0m diameter tunnel
Abbey Mills link	5km @ 6.0m diameter
Construction shafts	Five
Pump-out shafts	One (Beckton)
CSOs intercepted	Thirty-six
Total storage volume	1,155,000m^3
Maximum drain down	6.69m^3/s or 578 Mld
Notional maximum full treatment	2,105 Mld

Because of the smaller total storage volume than 1a, the number of times the tunnel reaches capacity would be greater the number of CSO spills to the river would be approximately 6 times per year on average.

2.4 Option 1c: Full Storage Tunnel with Abbey Mills-Beckton Link

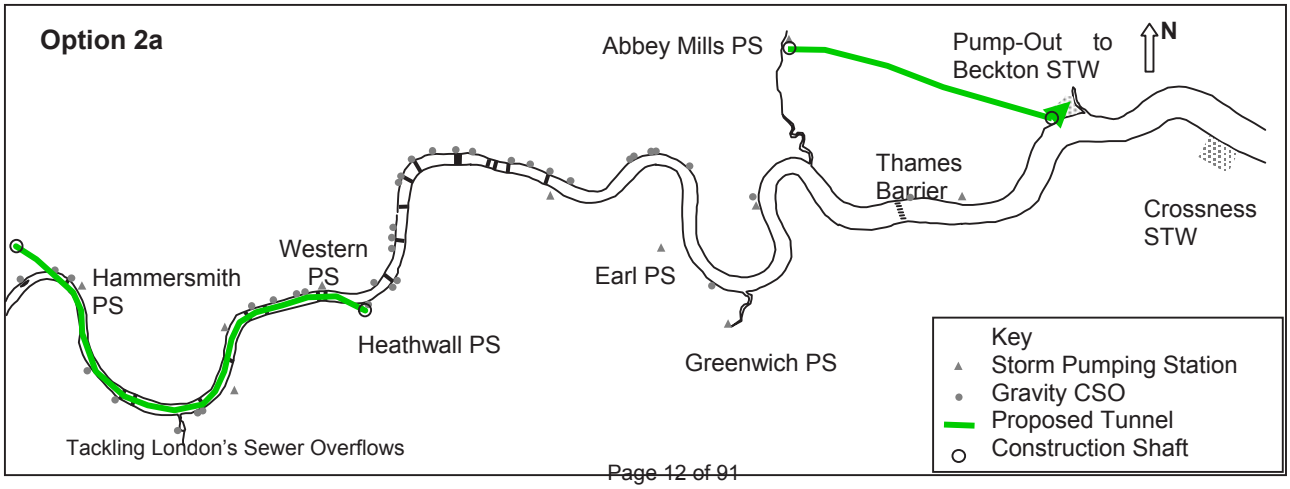
The total storage volume is marginally greater than 1a (about 1%) but spill frequency, pump-out and treatment capacity are all the same.



Option 1c: Full Storage Tunnel (7.2m diameter)	
Main tunnel	32.2km @ 7.2m diameter tunnel
Abbey Mills link	5.7km @ 7.2m diameter
Construction shafts	Five
Pump-out shafts	One (Beckton)
CSOs intercepted	Thirty-six
Total storage volume	1,648,500m^3
Maximum drain down	9.36m^3/s or 809 Mld
Notional maximum full treatment	2,336 Mld

2.5 Option 2a: West tunnel 7.6m diameter & East tunnel 13m diameter

The option includes two separate tunnels for parts of the Tideway. The east tunnel would extend from Abbey Mills to Beckton and would have a diameter of 13m. The east tunnel would only intercept flows from Abbey Mills and would have one construction shaft and one pump out shaft.



The west tunnel would extend from Hammersmith to Heathwall and intercept 17 CSOs. The pipe would have a diameter of 7.6m with one construction shaft and one pump out shaft. The flows from the east tunnel would be pumped to Beckton STW for treatment whereas the flows from the west tunnel would be returned to the existing network with eventual treatment at Beckton and Crossness. Drain down of the west tunnel to the Crossness system would deliver a maximum additional 246Mld to Crossness STW. This flow in addition to the average flow to the works is well within the proposed full treatment capacity for Crossness, therefore no additional capacity required to treat drain down flow from west tunnel.

Since they would not be connected to the tunnel, CSOs on the Tideway east of Heathwall would continue to spill to river as at present. Residual spills from CSOs along the length of the western tunnel and from Abbey Mills would occur approximately three times per year on average. Spills from Abbey Mills would be transferred to the River Thames at Beckton.

The tunnel design for both the East and West tunnels is based on providing the same performance for the connected CSOs as the full tunnel (1a) with pumping and treatment for drain down in 48 hours.

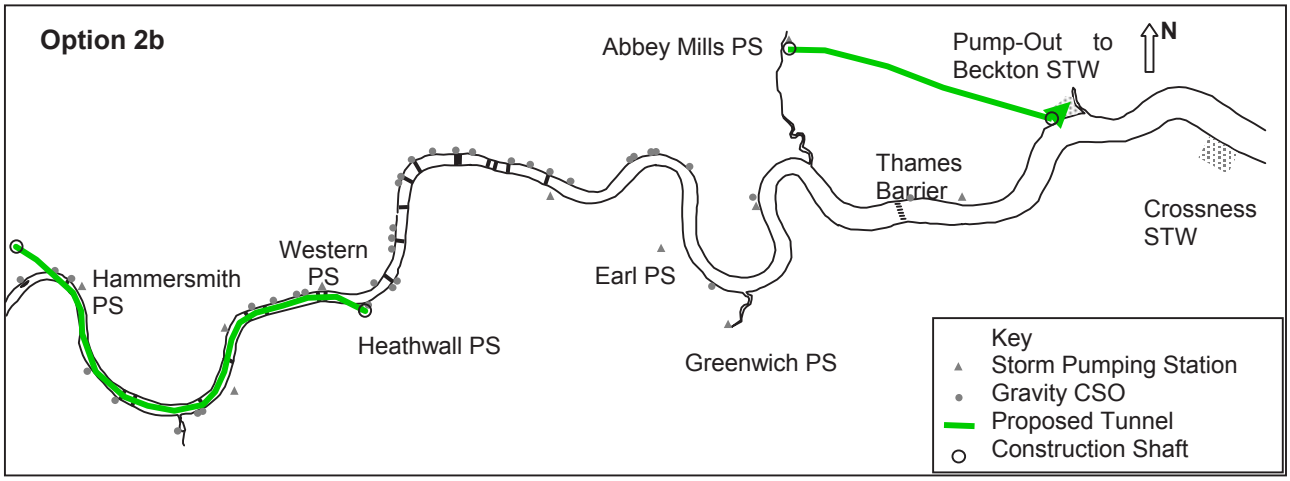
Option 2a: West Tunnel (7.6m diameter)	
Homefield to Heathwall	10.7km @ 7.6m
Construction shafts	Five
Pump-out shafts	One (return to sewer system)
CSOs intercepted	Seventeen
Total storage volume	492,000m^3
Maximum drain down	2.85m^3/s or 246 Mld
Additional Treatment: Crossness	199 Mld
Additional Treatment: Beckton	86 Mld

Option 2a: East Tunnel (13m diameter)	
Abbey Mills to Beckton	5.7km @ 13.0m diameter tunnel
Construction shafts	One
Pump-out shafts	One (Beckton)
CSOs intercepted	Abbey Mills only
Total storage volume	769,000m^3
Maximum drain down	4.46m^3/s or 385 Mld
Notional maximum full treatment	1,912 Mld

2.6 Option 2b: West Tunnel (7.6m diameter) & East Tunnel (10m diameter), with additional treatment capacity

This option is similar to Option 2a but envisages additional treatment capacity at Beckton STW, raising the maximum flow to full treatment to be 2,700Mld. As for Option 2a, drain down of the west tunnel to the Crossness system would deliver a maximum additional 246Mld to Crossness STW. This flow in addition to the average flow to the works is well within the proposed full treatment capacity for Crossness, therefore no additional capacity is required to treat drain down flow from west tunnel.

The smaller volume of this tunnel, compared to Option 2a, is supplemented with greater treatment capacity at Beckton in excess of the minimum required for treating pump-out. Therefore the number of residual spill events from Abbey Mills is still approximately three per year on average and would be transferred to the River Thames at Beckton.



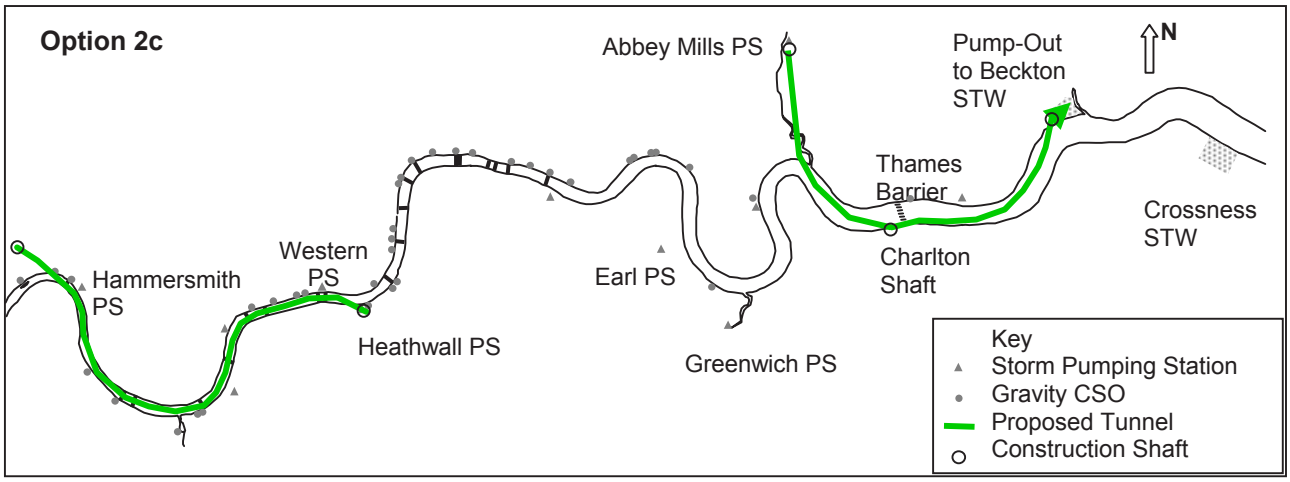
Option 2b: West Tunnel (7.6m diameter)	
Homefield to Heathwall	10.7km @ 7.6m
Construction shafts	Two
Pump-out shafts	One (return to sewer system)
CSOs intercepted	Seventeen
Total storage volume	492,000m^3
Maximum drain down	2.85m^3/s or 246 Mld
Additional Treatment: Crossness	199 Mld
Additional Treatment: Beckton	86 Mld

Option 2b: East Tunnel (10m diameter)	
Abbey Mills to Beckton	5.7km @ 10.0m diameter tunnel
Construction shafts	Two
Pump-out shafts	One (Beckton)
CSOs intercepted	Abbey Mills only
Total storage volume	455,000m^3
Maximum drain down	2.64m^3/s or 228 Mld
Notional maximum full treatment	During event: 2,700 Mld; During drain down: 1,755 Mld

2.7 Option 2c: West Tunnel (7.6m diameter) & East Tunnel, via Charlton (10m diameter)

This option routes the eastern tunnel via Charlton. This option provides the same storage as 2a but with a smaller tunnel over a longer route which also picks up the Charlton CSO which is otherwise excluded from the other partial solutions. As for Options 2a and 2b, drain down of the west tunnel to the Crossness system would deliver a maximum additional 246Mld to Crossness STW. This flow in addition to the average flow to the works is well within the proposed full treatment capacity for Crossness, therefore no additional capacity is required to treat drain down flow from west tunnel.

The smaller volume of this tunnel is supplemented with greater treatment capacity at Beckton. Therefore the number of residual spill events from Abbey Mills is still approximately three per year on average and would be transferred to the River Thames at Beckton.



Option 2c: West Tunnel (7.6m diameter)	
Homefield to Heathwall	10.7km @ 7.6m
Construction shafts	Five
Pump-out shafts	One (return to sewer system)
CSOs intercepted	Seventeen
Total storage volume	492,000m^3
Maximum drain down	2.85m^3/s or 246 Mld
Additional Treatment: Crossness	199 Mld
Additional Treatment: Beckton	86 Mld

Option 2c: East Tunnel (10m diameter)	
Abbey Mills to Beckton	5.7km @ 13.0m diameter tunnel
Construction shafts	Two
Pump-out shafts	One (Beckton)
CSOs intercepted	Abbey Mills + Charlton CSO
Total storage volume	769,000m^3
Maximum drain down	4.46m^3/s or 385 Mld
Notional maximum full treatment	1,912 Mld

2.8 COMBINED SEWER OUTFALLS INTERCEPTED

The CSOs intercepted by each variant of the TTT are listed below. The CSOs as well as the Shafts are shown on the environmental constraints mapping included as Appendix 4 to this report:

		Option					
	Combined Sewer Outfall	1a	1b	1c	2a	2b	2c
1	Acton	X	X	X	X	X	X
2	Stamford Brook	X	X	X	X	X	X
3	NW Relief	X	X	X	X	X	X
4	Hammersmith PS	X	X	X	X	X	X

		Option					
	Combined Sewer Outfall	1a	1b	1c	2a	2b	2c
5	West Putney	X	X	X	X	X	X
6	Putney Bridge	X	X	X	X	X	X
7	Frogmore	X	X	X	X	X	X
8	Jews Row & Falconbrook Relief Sewer	X	X	X	X	X	X
9	Falconbrook PS	X	X	X	X	X	X
10	Lots Road	X	X	X	X	X	X
11	Church St	X	X	X	X	X	X
12	Queen St	X	X	X	X	X	X
13	Smith St	X	X	X	X	X	X
14	Ranelagh & Kings Scholar Pond Relief	X	X	X	X	X	X
15	Western PS	X	X	X	X	X	X
16	Heathwall PS	X	X	X	X	X	X
17	SW SR	X	X	X	X	X	X
18	K S P	X	X	X	-	-	-
19 / 20	Clapham & Brixton	X	X	X	-	-	-
21	Grosvenor Ditch	X	X	X	-	-	-
22	Regent Street	X	X	X	-	-	-
23	Northumberland Street	X	X	X	-	-	-
24	Savoy Street	X	X	X	-	-	-
25	Norfolk Street	X	X	X	-	-	-
26	Essex Street	X	X	X	-	-	-
27	Fleet Main	X	X	X	-	-	-
28	Shad Thames	X	X	X	-	-	-
29	NESR	X	X	X	-	-	-
30	Holloway SR	X	X	X	-	-	-
31	Earl PS	X	X	X	-	-	-

		Option					
	Combined Sewer Outfall	1a	1b	1c	2a	2b	2c
32	Deptford Storm Overflow	X	X	X	-	-	-
33	Deptford Storm Discharge - Greenwich PS	X	X	X	-	-	-
34	Charlton SR	X	X	X	-	-	X
35	Abbey Mills	X	X	X	X	X	X
36	Wick Lane	X	X	X	X	X	X

2.9 CONSTRUCTION METHODS

Construction methods would vary from site to site but in general the main impacts would be at the shaft sites. They would also form the means of access to the tunnel when operational and have a role in ventilating it. During construction the shaft sites would be used to excavate the tunnel, to bring arisings to the surface and to handle construction materials. The shafts are expected to be about 15m in diameter.

Six shaft sites have been identified:

Homefield, Beckton, and Charlton: these are drive shafts, from where tunnelling operations would take place,
NESR and Heathwall and Abbey Mills: reception shafts for materials handling.

Temporary construction plant would be required at all these sites, including piling equipment that would be approximately 10m high. Noise would be significant during the initial excavations but once the shafts are completed, noise would be attenuated owing to the depth of the boring operations (40m-80m, depending on the location). Noise and vibration are considered further at Section 12.

For Options 1a and 1b the excavated material from the tunnel construction, as process arisings, would be transported by barge from temporary jetties adjacent to the main shafts at Heathwall and Charlton. For Option 1c the excavated material would also be transported by barge from jetties located adjacent to Beckton STW.

For the west tunnel of Options 2a, 2b and 2c the excavated material would be transported by barge from temporary jetties adjacent to Heathwall. For the east tunnel of Options 2a and 2b the excavated material would be transported by barge from jetties located adjacent to Beckton STW, whereas for Option 2c it would be from Charlton. Preliminary consideration is given to construction waste management in Section 10 of this report.

Main shaft sites where excavated material is removed as part of the tunnel construction are likely to be in use for approximately seven years, whereas the other main shaft sites are likely to be in use for approximately two years. However if sections of the scheme are phased in over a longer period, then construction durations at the main shaft sites would be significantly extended.

Construction activities at CSO sites would be much smaller in scale and duration, typically lasting from four to six months. Arisings from the CSO excavations would, in some instances, be brought to shaft sites for removal or, more frequently, removed altogether by HGV to disposal or re-use sites.

3 PLANNING CONTEXT AND STRATEGY

3.1 INTRODUCTION

The assessment work undertaken to date has identified a number of planning issues that need to be addressed. These include both the potentially negative impacts of TTT and the positive issues, which stem from the water quality improvements to the Tideway that would accrue. Most of these have been identified by the project team (see Section 4: Scoping the Planning & Environmental Issues) although additional issues have emerged through the stakeholder engagement process. In addition, the stakeholder engagement has allowed the project team not only to identify the issues but also to understand their impacts on key stakeholders.

An integral element of the planning and environmental assessment has been a comprehensive constraints mapping exercise along the TTT routes and within a prescribed buffer zone of 500m either side of the tunnel routes. This has used the constraints identified on each of the Borough's UDPs along the tunnel routes. Also included in this mapping exercise were listed buildings and other environmental constraints and opportunities. This exercise provided valuable information on each of the construction sites and has informed this planning assessment. In conjunction with this desk-top assessment work all CSO and shaft sites have been visited by the consultant team. The site visits have enabled the site characteristics of each site to be recorded and these are included as Appendix 5. Photographs of selected sites are also included as Appendix 6.

In addition, the range of stakeholders contacted was extensive and therefore the issues raised are wide ranging and go from those of a site specific nature to major strategic and procedural issues. On this point, this report gives some guidance on the procedural approaches available once a preferred option has been selected.

For the purposes of this assessment it is intended that any planning considerations will focus on issues rather than specific UDP policies. Specific policy references will be restricted to areas such as MOL and Open Space where there is a high degree of consistency across all Boroughs. A more detailed explanation and the implications of this approach is contained within the following paragraph.

3.2 PLANNING POLICY

Section 38 (6) of the Planning and Compulsory Purchase Act (2004) (the Act), sets out the need for planning applications to be determined in accordance with the statutory Development Plan unless material considerations indicate otherwise. This development, at least the full solution, would extend across 12 London Boroughs:
London Borough of Hounslow
London Borough of Richmond
London Borough of Hammersmith & Fulham
London Borough of Wandsworth
London Borough of Kensington & Chelsea
City of Westminster
London Borough of Lambeth
London Borough of Southwark
London Borough of Tower Hamlets
London Borough of Greenwich
London Borough of Newham
City of London

The Development Plan for each of the Boroughs comprises the Approved London Plan and the Boroughs' individual Development Plan Documents (DPD).

The London Plan supersedes Part 1 of each of the London Borough's UDPs and provides the strategic planning framework for the capital. In addition to the 12 Boroughs any TTT planning application would

also be considered by the London Thames Gateway Development Corporation (LTGDC) in relation to proposals at Beckton and surroundings areas. The LTGDC have development control powers but not Development Plan powers.

Each Borough is required to produce a Local Development Framework (LDF) that comprises a series of DPDs. Once approved, the DPDs will replace the existing Borough UDP. However until the DPDs are approved the Borough UDP remains as the principal local planning policy document, whilst the status of the emerging DPDs remain as material planning considerations.

In terms of this evolving process, each London Borough is at a different stage in the preparation of their LDFs and once adopted, there will be significant differences between Boroughs in terms of planning policy objectives and priorities. Accordingly, planning policy across London is undergoing considerable change and there is no certainty as the precise make up of Development Plan policies at the time that any TTT option would be formally submitted for planning approval.

Notwithstanding the above there is an important comment contained with the latest consultation draft of the London Plan which is subject to consultation until 22nd December 2006 and refers to historic pollution problems in the River Thames and states the following:

"4.27..... In some cases the returning wildlife is subject to the threat of periodic pollution from urban run-off following heavy rainfall. There are still a number of tributary streams that are highly polluted, often with domestic sewage, and there is the on-going problem of sewage overflow into the Thames during times of high rainfall. The Thames Tideway Strategic Study has examined the issue of storm sewage discharges to the Thames Tideway and the Government has committed to one of two options to be determined in early 2007. The Mayor supports the option that provides a complete solution to this problem from Chiswick to Crossness with the first phase being to implement the east London works. The Mayor recognises that there are detailed planning and engineering issues to be resolved but the principle of a major storage and transfer sewer to minimise sewer overflows into the Thames and other rivers should be supported by all boroughs."

Whilst this plan is at very early stage it appears to give explicit support for TTT. This is significant because the London Plan may be approved or nearing approval, when a preferred TTT option is under formal consideration.

Although planning policy across London is undergoing major change, there are consistent and generic planning themes that are present in the London Plan, most UDPs and emerging policy. These broadly reflect Government Planning Policy and some statutory planning requirements and are therefore important for the comparative assessment of options.

These themes include the following:

- The protection and enhancement of open space;
- Retention of MOL
- The protection and enhancement of sites with biodiversity value;
- High Quality design and importance of public realm;
- Protection of Listed Buildings and Conservation Areas;
- Importance of the Waste Hierarchy;
- Energy Usage and efficiency;
- Priority for regeneration within the London Thames Gateway;
- Sustainable Development; and
- Sustainable Transport Policies.

Given the above it is intended to assess the key planning issues having due regard to these general policy theme and objectives where relevant, rather than specific planning policy, much of which is in the process of being superseded. In adopting this issue-based approach it must be borne in mind that the planning application process requires a full assessment of planning policy at the time of

submission and throughout the determination period, and therefore this exercise will need to be undertaken at a later date when an option is agreed and more design details are known.

3.3 PLANNING ISSUES

The following section provides a commentary on the land use planning issues identified and areas where policy conflict may arise. A number of the planning issues identified involve issues that are of fundamental importance to the project as a whole. Accordingly, these have been addressed under their separate sections and are as follows:

- Open Space & MOL — Section 5
- Energy Use & Carbon Dioxide — Section 6
- Local Air Quality: Odour — Section 7
- Biodiversity — Section 9
- Wastes — Section 10
- Contamination — Section 11
- Noise and Vibration — Section 12
- Traffic & Transportation — Section 13
- Archaeology & Cultural Heritage — Section 14

Where impacts vary between options these are addressed in the topic sections. It should also be borne in mind that the bulk of the overall project will be below ground and therefore only a small proportion of the overall works will have any appreciable above ground impact.

3.3.1 Open Space

Loss of any open space is generally contrary to planning policy and therefore will need to be specifically justified. In addition, where open space is to be lost either temporarily or permanently, compensatory open space may need to be provided. In the case of permanent land take, enhancement of the remaining open space may also be sought. Mitigation for loss of open space is not formulaic and is determined on a case-by-case basis by the LPA or other planning decision maker. Accordingly, only general guidance can be given in terms of what it may entail. More prescriptive guidance would only be made available once an approach had been made, in the first instance, to the LPA. In addition, mitigation would only be considered once the LPA were happy with the justification case and exceptional circumstances being made and therefore acceptance of the principle of loss of open space.

A compelling justification would need to focus on the wider environmental improvements to the Tideway which would accrue from the project, and that these benefits outweigh any negative impacts through loss of open space. Such arguments are always difficult to present and be accepted by LPAs as the benefits and impacts are not directly related. Loss of open space is also highly sensitive as a planning issue and may well lead to extensive local objections.

This sensitivity applies equally to loss of important trees and vegetation. In this respect important trees which are under threat of development will often be the subject of a tree preservation order (TPO) but Council owned trees within areas of public open space, including highway verges and parks, are often not subject to TPOs irrespective of their importance. This is simply due to lack of threat and should therefore not be interpreted as a lack of amenity value. Accordingly it should be assumed that all important trees should be protected and that any losses will be resisted and will need full justification, irrespective of whether they are formally included within any TPO.

3.3.2 Metropolitan Open Land (MOL)

MOL designation imposes a general presumption against most forms of development and therefore for an exception to be made requires the demonstration of very special circumstances. Any such case

would need to show that the development could not reasonably be located on less constrained land outside MOL and that the development minimised any impact on openness.

In the case of Beckton where development on MOL is likely to be limited, the supporting text of the MOL policies does not remove the presumption against development, but is favourably worded and provide an opportunity for a compelling justification case to be made. This policy approach is expanded upon in Section 5.

3.3.3 Transport

The key planning related transport issues both relate to construction and comprise excavation arisings removal from the construction sites and traffic disruption from works on or near the highway.

In sustainability and disruption terms the removal of as much of the main tunnel arisings as possible via river barges will be welcomed and may well be a requirement of any planning permission. The only alternative would be a large number of HGVs, which would cause congestion, emissions and noise; and at levels that are unlikely to be acceptable at either a local level or strategically.

The other key transport impact relates to works on the highway and the implications this has on more localised disruption. The works with the greatest potential for traffic disruption relate to the CSO works, particularly those in Central London and arise because some of the works will unavoidably be in-carriageway. These works will typically take a maximum of 6 months although this is the maximum duration of disruption at each site. In this respect many of the central London CSOs are close together and therefore this will raise traffic management issues in terms of coordination of works to minimise disruption. There may also be the potential to combine street works with other works, which may be planned by other statutory undertakers.

Whilst some disruption appears inevitable, traffic management will play a key role in minimising this. Such arrangements will be of additional importance where there are bus routes or major roads affected. Pedestrian routes are generally easier to re-route but will also have to be fully assessed and mitigated against where appropriate. Further consideration is given to this issue in Section 13.

3.3.4 Odour

Given the purpose of the proposed tunnel odour (or perception of odour) is clearly a key planning issue. Preliminary odour modelling work has been undertaken and only broad conclusions can be reached at this stage.

In this regard the CSOs will not introduce any additional odour issues over and above those already present at the existing CSO sites. The shaft sites do however raise odour potential although an engineering solution is proposed to minimise and treat potential odour release. More specifically the shaft sites close to sensitive receptors including parks and residential uses will be designed to draw air into the shafts thereby minimising the potential for odour. Air (with potential for odour) will be discharged away from the most sensitive sites, at existing industrial areas or on TWUL operational land. In these locations venting and extraction equipment with odour control will, if required, be installed to minimise odour.

The final area of odour potential relates to any pump out and treatment works at Beckton. In this regard an odour neutral position will be sought and should be achievable via an engineered solution. This has been raised as an important issue in relation to future regeneration objectives and is addressed in more detail below.

3.3.5 Energy and Carbon Dioxide

The current version of the London Plan contains a raft of planning policies designed to minimise London's carbon footprint through a range of measures relating to energy use and provision. More

specifically, Policy 4A.7 of the London Plan promotes the need to reduce carbon emissions, improve energy efficiency and increase the proportion of energy generated from renewable sources. Policy 4A.8 requests that major developments, through an Energy Assessment, should quantify the energy demand from the proposed development and demonstrate how the development has approached the Mayor's energy hierarchy of: using less energy, using renewable energy and supplying energy efficiently. The Mayor, through Policy 4A.9, then requires that major developments should demonstrate how the development would generate a proportion of the site's electricity or heat needs from renewable sources, wherever feasible.

The current proportion of renewable energy required is 10%. It is anticipated that this will rise to 20% given the current Consultation Draft version of the London Plan. By the time any tunnel option is under formal consideration this higher figure is likely to be approved. Accordingly, energy efficiency and the requisite contribution to renewable energy are likely to be a requirement of any planning submission. In procedural terms the planning and environmental impacts of this renewable energy provision will also need to be assessed. The scheme will attempt to meet renewable energy requirements through either the provision of wind turbines or through linkage to future proposals to extend facilities for energy-recovery from sludge.

3.3.6 Ecology and Biodiversity

This project is predicated on the extensive improvements to water quality in the Thames Tideway and the positive impact this will have on aquatic ecology. The achievement of these gains will be at the expense of what appear through preliminary assessment to be some more minor terrestrial and aquatic ecological impacts. These impacts are likely to include some landtake of semi-natural habitats at Beckton STW and temporary jetty sites within the Thames Tideway during the construction period. These impacts are assessed within Section 9: Biodiversity.

The London Plan contains a raft of policies collectively referred to as Blue Ribbon policies. These relate to the River Thames and its importance to London in Environmental, Visual and Recreational terms.

3.3.7 Waste and Resources

Waste management during both construction and operational phases of development plays an important role in achieving sustainable development. This is reflected in existing and emerging planning policy at all levels and is likely to become increasingly important in light of enhanced environmental awareness and policy response to this.

The underpinning principle for waste management is the waste hierarchy, which comprises the following:

Waste Reduction
Reuse
Recycling
Energy Recovery
Disposal.

All options will generate large quantities of construction arisings that will need to be assessed against the above waste hierarchy. The potential for minimising arisings is however limited by the required size of the tunnel and shafts. However there is scope for a large proportion of any arisings to be reused in conjunction with other construction projects. A waste strategy has yet to be developed but adherence to the waste hierarchy will need to be demonstrated. Further consideration is given to construction wastes within Section 10.

By intercepting more sewage for treatment, the operational TTT will increase the amount of recovered sludge. This will be disposed of using existing waste management approaches and it is hoped that much of the embodied calorific value can be recovered from the sludge. The wider issue of sludge is

currently being assessed via the East London Sludge Strategy Group. This group is looking at long term issues related to future growth and disposal issues including recovering of calorific value as a contribution towards renewable energy provision.

3.3.8 Contamination

Overall the considerable depth of the tunnel excavation means that the vast majority of arisings will have no risk of contamination, but given that the extent of proposed shaft works and the excavation involved, particularly in areas with industrial uses, the potential for contamination exists and must be addressed. This will involve detailed land quality surveys of all excavations sites and mitigation measures devised to deal with any contaminants found. A brief review of shaft sites is given within Section 11: Contamination.

3.3.9 Noise and Vibration

The construction of the tunnel and associated works will require significant excavation, which in turn will have the potential to cause noise and vibration. This raises two issues namely those relating to amenity and possible damage to buildings. Further consideration in respect of the potential for noise and vibration impacts is given in Section 12: Noise and Vibration.

Regarding amenity and noise issues, LPAs are likely to seek to control construction hours at the more sensitive locations and therefore it is possible that not all works will be able to be undertaken on a 24-hour basis. This will have implications for programme, as any limit on construction times will extend the duration of works.

The depth of the tunnel itself should ensure that noise and vibration will not be detectable from the surface and therefore 24 hour working should not be problematic. Conversely, activity at the shaft sites and to a lesser extent the CSOs will be detectable at the surface and have the potential to cause disturbance. Any planning submission would need to be accompanied by a detailed noise and vibration assessment. This would be used to assess the need for any constraints and special mitigation on construction.

The impact on buildings through vibration is a significant planning issue in the context of Listed Buildings. Mitigation against any such damage is essentially a technical exercise although any submission would need to show how this issue has been addressed. Structural damage to a Listed Building could be irreversible and therefore must be pre-emptively mitigated against.

3.3.10 Archaeology

The River Thames has been the historic focus of activity in London and therefore works alongside the river are likely to have archaeological potential. The precise nature of this potential will be informed by more detailed assessment. Once this assessment is complete appropriate mitigation can be defined and agreed. The package of mitigation measures will be determined by the any findings made in the assessment work. Further consideration is given to Archaeology and Cultural Heritage in Section 14.

Archaeology represents a significant planning issue and may have implications in terms of cost and programme.

3.4 Other Planning Issues

In addition to the above issues identified by Planning and Environment team (see Section 4 for the full Scoping Exercise), there are a number of planning issues raised by the proposed options, which need to be addressed. The importance of these issues has been amplified by representations made through the stakeholder engagement process and in particular through the Planning & Environment Project Working Group.

3.5 Regeneration

The issue of regeneration applies in two separate dimensions, both of which need to be addressed. The first applies to the ability of any TTT to cope with future demand based on development committed to in the Thames Gateway regeneration area. This is essentially an issue of "future-proofing" which falls outside the key Planning and Environment consideration.

The second regeneration issue concerns the STW related development at Beckton and its implications for the wider regenerations objectives in the area. The London Thames Gateway Development Corporation (LTGDC) views further development at Beckton STW as potentially contrary to the regeneration objectives they are pursuing. The tunnel reception works proposed at Beckton are common to all options (although with modest variations in scale) and comprise conventional treatment works.

More specifically, the LTGDC note that the Secretary of State for Communities and Local Government in her recently launched Thames Gateway Interim Plan (November 2006) has stated that the Gateway has thriving and diverse local communities, brownfield land for new jobs and homes and beautiful green spaces with the Thames estuary at its heart and it is a place of great potential. The Plan sets out the Government's intention to transform the environment in a way that creates a new identity for the Gateway as the Thames Gateway Parklands. By extending the concept of the Green Grids, it is intended that the Parklands will attract – not restrict – investment.

The Plan refers at paragraph 5.12 to the urgent need to address the problem of wastewater overflows in parts of the Gateway and to the work on options being undertaken by TWUL, which is the subject of this report. At paragraph 5.13 the Plan refers to the requirement for the preferred TWUL scheme to be subject to normal planning and approval processes.

The planning authority for the determination of planning applications for the majority of the works in east London including the proposed extension of the Beckton Sewage Treatment Works is the London Thames Gateway Development Corporation (LTGDC). The LTGDC is also identified in paragraph 9.9 of the Plan as the lead delivery body for regeneration in its area. The LTGDC works closely with the Greater London Authority (GLA) and the London Borough of Newham (LBN) within which the Abbey Mills to Beckton direct link and the Beckton STW and proposed extensions are located. Both the GLA and LBN are represented on the LTGDC Board.

The statutory plan-making authorities are the GLA and LBN. As noted above, the latest consultation draft of the London Plan supports the Thames Tideway option that provides a complete solution to the problem of storm sewage discharges from Chiswick to Crossness with the first phase being to implement the east London works. Further, the Mayor of London recognises that there are detailed planning and engineering issues to be resolved.

The GLA's recently published (November 2006) East London Green Grid Draft Supplementary Planning Guidance identifies a number of strategic open space opportunities in the Beckton area including the creation of a Metropolitan Park from Ilford to the Thames (including Cross River Park), linking to the River Roding, the Beckton Park link, the proposed Thames Gateway Bridge and on to the south side of the river.

The Cross River Park Steering Group agreed a vision for the park in October 2006. It is seen by the group as a major opportunity to create a significant new public space embracing the Thames, enhancing the health and wellbeing of existing communities and helping to promote sustainable regeneration in the Thames Gateway. This meets the objectives set out by the Secretary of State for Communities and Local Government. The LBN remain unconvinced about the Cross River Park although embrace the objective of developing East Beckton as a mixed community and improving open space and the interconnectivity of these spaces in the area. The main priority of the LBN is to improve odour issues associated with Beckton STW and looking at future works holistically rather than in a piecemeal way. This approach would ensure that the objective of advancing regeneration was properly considered.

It is not thought that a direct link from Abbey Mills to Beckton is likely to prejudice existing or emerging planning policy. The LTGDC has indicated a number of concerns around the proposed extension of the Beckton STW onto the Beckton Rectangle site, specifically:

A. The extension would be contrary to existing LBN UDP policy, which allocates the area as a Major Opportunity Zone for mixed employment development.
B. The extension could potentially have a prejudicial effect on regeneration in the area, were odour problems relating to Beckton STW that were experienced in recent years in the Beckton and Barking areas to be exacerbated by the proposed extension. TWUL are committed to implementing works that will significantly reduce the likelihood of such problems recurring in respect of the existing works but there remains a significant sensitivity about extending a largely open and land-extensive STW, around which historically there have been undeveloped buffers of land in the heart of the Thames Gateway Regeneration Area.
C. The extension would fail to address emerging policy in respect of the Green Grid, the Cross River Park and the Thames Gateway Parklands.

In acknowledgement of these concerns, TWUL is working with the LTGDC, GLA and LBN on the investigation of alternative treatment options at Beckton including the possibility of developing covered works associated with commercial development such as at Besos in Barcelona. Were such alternatives to be viable both financially and in planning terms, they could bring potentially significant regeneration benefits in terms of housing and jobs in a parkland setting and improving the sustainability of the existing Gallions Park retail centre. The LTGDC would expect this feasibility work to be completed before the submission of any planning application for the Beckton STW extension.

3.6 TTT Extension at Beckton STW

To address the issues associated with Beckton requires consideration of both land-use planning policies relating to TWUL sites at Beckton STW and Crossness STW as these two reception sites represent the only technically viable options for TTT related pump-out and treatment.

The operational areas of both Beckton and Crossness STW are tightly constrained by MOL. Accordingly any significant development at Crossness would have to be on MOL. In the case of Beckton any development would be forced onto MOL or the MOZ. On this point MOZ policies are aspirational and promote development, whereas MOL policies are prescriptive and resist development. In light of these fundamental policy differences the MOZ designation is considered less of a planning constraint on future development and supports an extension at Beckton in preference to Crossness.

In addition to the MOL constraints both Beckton and Crossness are constrained, in whole or part, by nature conservation designations. In the case of Beckton (and specifically the Beckton Rectangle) these are of Borough Importance (and are not adopted within the UDP where the MOZ allocation is shown) whilst for Crossness, the TWUL owned land is of Metropolitan Importance. In hierarchical terms Metropolitan Importance has a higher value and therefore presents a higher degree of constraint in the context of nature conservation designations at Crossness. Accordingly Beckton (Rectangle) is, in broad nature conservation policy terms, the least constrained of the two sites.

Crossness is further constrained by a Conservation Area in its northwest corner, which contains a Grade I Listed Building (the Beam Engine House) and other curtilage listed buildings of less value.

In summary of the remaining undeveloped operational land at Crossness 100% falls within MOL, about 20% is also a Conservation Area, 20% is an Area of Borough Importance for Nature Conservation and the remaining 80% is of Metropolitan importance for Nature Conservation. This represents a highly constrained planning policy framework. Interestingly the developed core of Crossness STW is excluded from MOL.

In contrast all of the operational land at Beckton is MOL. To the north is land designated as being of Borough Importance for Nature Conservation (the Northern Sludge Lagoons), whilst to the west is the MOZ. The MOZ (the preferred location for the TTT related development) also contains a small area of

"Green Space", although this clearly represents an area where some form of development is acceptable in principle.

Overall the land use planning policies that apply to the Beckton Rectangle combine to give a substantially less constrained site than any location at Crossness STW.

In cost terms terminating the TTT at Beckton represents a considerable saving as it reduces the overall length of tunnel by some 4km and eliminates one construction shaft. The reduced tunnel length also reduces the total construction impact of the development notably in respect of construction wastes, their management and transport but also in respect of resource use for construction. Whilst the financial cost might not be a determining planning consideration it is deemed material, particularly in light of the greater land use planning constraints at Crossness. This means that choosing Crossness ahead of Beckton would incur both additional cost, greater environmental impact during construction *and* greater conflict with land use and environmental planning policies.

From a technical point of view treatment capacity for tunnel pump-out is better located at Beckton STW. It provides a balance of treatment capability between Beckton and Crossness taking account the upgrades required at both works to meet river quality objectives. Additionally if tunnel pump-out was provided at Crossness the proportional increase in load would be significantly greater raising concerns on the impact on treatment during pump-out events. It should also be noted that the majority of CSO flow is from the Beckton catchment with half the total flows from Abbey Mills, which is the terminal pumping station for Beckton STW. Optimum use of the existing infrastructure (e.g. use of the existing Northern Outfall Sewer) would also be compromised with a treatment solution at Crossness.

In light of the above consideration it is contended that a compelling case for choosing Beckton ahead of Crossness for pump out and treatment can be made. Conversely the additional constraints coupled with the additional environmental impacts and cost of terminating any tunnel at Crossness, weigh heavily against selecting Crossness ahead of Beckton.

It should be noted that any land vacated by the existing STW would still remain MOL under existing UDP designations and there is no certainty that this designation would be removed via the emerging LDF process to enable alternative development. Indeed, one of the original reasons for the MOL designation is believed to be a desire by LBN specifically to exclude TWUL from re-developing parts of its operational site for non-operational purposes. Accordingly, there are major issues to address in respect of the LTGDC vision for Beckton STW particularly as this vision does not currently have any clear planning policy mandate.

3.7 Design and Public Realm

All tunnel options involve works close to areas of townscape sensitivity. These include Listed Buildings, Conservation Areas, Historic Parks and Gardens and areas of general high townscape value such as the Thames Embankment through central London (although the latter is excluded from the partial options). Whilst these potential constraints are unlikely to have any significant bearing on any specific option it does impose a constraint in terms of securing high quality design. In addition, it should be borne in mind that any planning application is likely to be accompanied by a Design and Access Statement.

In practical terms this issue will prevent the use of standardised buildings and other fixtures in favour of bespoke buildings, which respect the local vernacular and use high quality materials. This emphasis on high quality design applies equally to surface treatments and means of enclosure and may require coordination of work with other agencies. More specifically, in the case of Victoria Embankment it is understood that extensive public realm work is proposed in advance of 2012. This will involve highway realignment, new paths and landscaped areas, lighting, installation of street furniture, landscaping and tree planting. Ideally any TTT works in this area should take place before the public realm work. Failing that, any TTT works would need to provide high quality reinstatement of any of the public realm works.

In addition it is likely that in the months leading up to and during the 2012 Olympics all non-essential street works will be removed on congestion and visual grounds. Accordingly, this requirement could have programme implications as TTT related works in Central London may be ruled out during much of 2012 and therefore would need to be completed before that date or not commenced until after that date.

3.8 River Users

The principal objective of the TTT project is to reduce the number of discharges of untreated sewage from CSOs. This objective leads to key benefits relating to improvement to water quality in the Tideway and the visual improvements to the tidal water through the reduction in levels of sewage- derived-litter.

This visual impact is particularly important for leisure uses of the river and would result in a significant improvement to the amenity and leisure value of the Thames Tideway. This benefit also accrues to all those for see the River in their day-to-day activities. There is a strong link between personal well being and a high quality environment and therefore the removal of sewage-derived-litter in the River will be significant benefit to the large numbers of people who see the River at close quarters.

3.9 Process and Procedures

Over and above the key planning issues addressed above there are two issues, Stakeholder Engagement and Planning Strategy, which are an essential and integral component of this TTT optioneering process.

3.10 Stakeholder Engagement

The importance of active Stakeholder Engagement at all stages of the planning process is now recognised. This focus is now enshrined in legislation in the form of Statements of Community Involvement as required by Section 18 of the Act 2004. All TTT options will require extensive stakeholder engagement both prior to and throughout any planning application and other consenting procedures.

Initial but widespread Stakeholder Involvement has been undertaken in respect of this optioneering exercise and this is reported in more depth in Section 17 of this report. It is also recognised that Stakeholder Engagement will be essential in the promotion of any agreed TTT option and could ultimately be the mechanism for securing substantial time saving as Stakeholder consensus on projects can ease their passage through the planning process and ensure that public concerns can be picked up during the design process, which can then respond. The approach to future Stakeholder Engagement is addressed below.

3.11 Planning Strategy - Complete Scheme

A project of this engineering scale and complexity inevitably raises complex planning and environmental issues and therefore requires a series of strategic decisions to be made. More specifically, the implementation of any TTT options is dependent on gaining the requisite planning and environmental consents along with all other necessary consents.

A further complexity relates to the number of Boroughs and other consenting authorities potentially involved in the decision making process. Since a partial consent would not be acceptable, any planning strategy will need to ensure that a comprehensive planning consent can be obtained with a set of consistent planning requirements and within an appropriate timescale.

In this respect legal Counsel has been actively engaged to provide advice on this project and have advised that, in the first instance, individual planning applications to each of the Boroughs affected would be required. Counsel reached this view given that:

a. Individual planning applications will be required to be submitted to each local planning authority;
b. There is no formal mechanism to appoint a lead authority to process the applications but voluntary arrangements could be explored further;
c. The preferred consenting procedure would be for the planning applications to be called in as quickly as possible by the Secretary of State as a Major Infrastructure Project.
d. The new procedures outlined in Circular 07/2005 Planning Inquiries into Major Infrastructure Projects would be ideally suited to the project as the objective of these new procedures were to speed up the Inquiry process.

Further details of the procedural and consenting issues associated with TTT are addressed elsewhere in this Section. It has previously been confirmed that the project could not be authorised by an order under the Transport and Works Act 1992. It is also considered unlikely that the project could be promoted by way of a Private Bill.

At the present time the Mayor is able to direct refusal on major applications of strategic significance where it is deemed that they are contrary to London Plan Policy. It is now proposed that the Mayor's planning powers are extended so that the GLA determines major strategic planning applications instead of the individual Boroughs. This provision is contained within The Greater London Authority Bill, which is currently going through Parliament. These new powers could potentially apply to a TTT option although the emerging Bill is at an early stage and may therefore be subject to substantial amendment as it progresses.

Without higher Government intervention there are a number of planning risks associated with the submission of individual applications most notably:

- Refusal of all or part of the tunnel, which could potentially stop or delay the whole scheme.
- Delays as individual applications are determined to different LPA timetables
- Unacceptable and inconsistent planning conditions imposed by different Boroughs.

To overcome these risks requires one of two options, namely intervention in the planning decision making so that any TTT application is looked at by a single decision making body or convincing assurances from each of the Boroughs are received in terms of actual decision, the terms of any decision and timeframe. Given the number of Boroughs involved, the latter approach is deemed unrealistic and therefore any TTT option is likely to require a higher level planning decision to be made to secure the necessary coordination and integrated approach to deliver this essential pan-London infrastructure.

This favours a Secretary of State Call-in. Section 76A of the Town and Country Planning Act 1990 allows Major Infrastructure Projects to be Called-in. The Rules in relation to call-in are further explained in ODPM Circular 07/2005. Planning Inquiries into Major Infrastructure Projects allows projects such as TTT to be called-in almost upon submission to the respective LPAs and determined via either a single or series of pre-booked Public Inquiries. This is a relatively new and largely untried provision, which is designed to fast track important infrastructure projects that may be in the national interest and would appear to be ideally suited to TTT.

This new procedure is attractive as it ensures that the project is looked at holistically and avoids the issues discussed above in regard to the GLA's recently published East London Green Grid Draft Supplementary Planning Guidance. It does however mean that an Inquiry is unavoidable and therefore the time and cost implications of this will apply. The fast tracking gains from this new procedure derives from a range of pre-submission actions which ensure that as many issues as possible are resolved prior to formal submission and inquiry arrangements are in place before Call-in is instigated. This pre-emptive approach is recommended but would rely on the cooperation of the Planning Inspectorate and the Government Office for London.

In view of the above a Call-in under the Circular 07/2005 is considered the preferred planning determination route for any TTT option, which involves a large number of individual boroughs and other stakeholders.

3.12 Planning Strategy - Early Development of the Abbey Mills-Beckton Link

Notwithstanding the above, early delivery to achieve significant water quality benefits sooner rather than later may lead to the promotion of a separate tunnel scheme which links Abbey Mills directly to Beckton, including pump out and treatment at Beckton (One element of Option 1c, see Section 2). Advice to date suggests that this scheme can be promoted as a separate and distinct project and would therefore be subject to its own EIA and planning application. This Eastern Tunnel option could form an early phase of a future scheme (i.e.1c) but has not been reviewed *in isolation* within the Environment appraisal that follows in Section 4 onwards.

Should an Eastern Tunnel be pursued as a part of a single option, the Environment Agency has indicated that it would only support this with assurances that the remainder of the project would be implemented in accordance with the relevant full solution in due course. Accordingly, they do not view this short Eastern Tunnel as a means for fully meeting the wider project objectives of the Urban Waste Water Treatment Directive.

This short Eastern Tunnel scheme is substantially smaller yet would address 50% of all CSO discharge volume and therefore gives significant environmental gains. In terms of planning and environmental constraints it would include only two above ground construction sites both of which would be on land owned by TWUL connected with the existing sewage treatment process. In addition, due to other project proposals at Beckton there is substantial environmental baseline data relating to the site and therefore this raises the potential for time savings in the preparation of any Environmental Statement.

This short tunnel scheme between Abbey Mills and Beckton (1c in part), would need only to be considered by one London Borough (Newham) and the LTGDC. Accordingly, the issues associated with multiple applications to a large number of Boroughs highlighted above would not apply. Accordingly, with local consensus fast tracking could be possible without recourse to Call-in. However it is not clear at this stage whether any such consensus can be achieved quickly due to need to dovetail the scheme proposals with the regeneration aspirations of LTGDC outlined above.

In view of the regeneration aspirations raised by LTGDC in relation to further extension of any conventionally constructed treatment works at Beckton STW the short tunnel solution may also need to be called-in and pursued via the latest major Infrastructure Inquiry Procedures. The likely stance of LTGDC and LBN will be further gauged but initial indications through the PEWG are that potential impacts on regeneration aspirations could provide grounds for LTGDC to refuse an application, if the land at Beckton Rectangle is used, but not if all TTT related development can be accommodated within the existing STW. Threat of a refusal from either LBN or LTGDC would prevent any fast track local decision being obtained and could therefore direct any planning application to Call-in.

The consensus referred to above is reliant upon extensive and detailed stakeholder engagement from the outset. The identification and resolution of any planning or environmental concerns at the earliest possible juncture is essential and this can only be achieved through early stakeholder engagement.

3.13 Other Consents

Notwithstanding the need to obtain the requisite planning permission for any TTT option and the accompanying EIA requirements a range of other consents may also be required. The technical assessment of the requirements for these additional consents falls outside the scope of this report. Accordingly, the additional consents are simply highlighted and will be investigated further once a preferred option is selected. The consents may include the following:

- For any works and dredging in, on or under the Mean High Water Mark of the River Thames or its tidal tributaries (up to PLA landward limits) - river works licence from PLA under Port of London Act 1968 (this obviates the requirement for consent under the Coast Protection Act 1949)

- For all works in, on or under Main River or within the byelaw width of 8 metres or within 16 metres of the flood defence line (often beyond the flood wall) - consent from the EA under Land Drainage Act 1991 and Water Resources Act 1991.
- For all constructions and deposits below Mean High Water Springs - consent from the Marine Consents and Environment Unit under the Food and Environment Protection Act 1985
- Consent from the Crown Estate is also required before planning applications affecting Crown Estate land are submitted
- For the removal and treating of excavation arising a Waste Management license would be required
- For any water abstraction in association with either construction or operation a Water Abstraction License would be required.
- For any discharges into tidal waters, rivers or water courses a Water Quality Discharge License would be required.

3.14 TIMETABLE

The timing of any TTT option is an important consideration. As a major project with the inherent planning, environmental and engineering constraints it raises, it is difficult to accurately gauge timescales. In addition, the decision making stage is largely outside the control of TWUL and is therefore difficult to gauge accurately.

The following table is intended to give an indication of possible timetables for the project.

	Abbey Mills to Beckton (Short Tunnel)	TTT 1 or 2 Tunnel Solution
1.Design (including additional optioneering)	9	18
2. Environmental Statement including pre application discussions	9	18
	12*	24
3. Planning Stage	6	18
4. Implementation	48 (+6 commissioning)	96
5. Operational i.e. total time (including overlaps)	72 months	126 –144 months

The above timetable is considered achievable but optimistic. It therefore could not be foreshortened but could well be extended depending on issues raised during the determination procedure. The Abbey Mills to Beckton Short Tunnel determination time assumes a locally obtained permission. Determination via the new Major Infrastructure Project procedures would add at least 6 months. The timetable for the entire TTT assumes determination via these procedures.

3.15 LAND ISSUES

This section provides a preliminary assessment of the land and property issues relating to the Thames Tideway Tunnel (TTT) options.

3.15.1 The construction shaft sites

For each design, construction shafts will be required to excavate the tunnel and bring spoil to the surface. Once the tunnel is operational, the shafts will be retained and used for access to the tunnel and ventilation. In order to ensure long term security of tenure, it is considered prudent to acquire the

freehold of the individual sites where possible, or at a minimum, a 150 year lease where there may be issues with an outright freehold sale by London Boroughs.
Six sites have been identified under the current design options for the construction shafts. The sites have been identified as follows:

Table A: Construction Shaft Sites

Shaft Site	Landowner
Homefield Recreation Ground	London Borough of Hounslow
Heathwall Pumping Station	TWUL
King Edward Memorial Park (NESR)	London Borough of Tower Hamlets
Charlton	Komoto Group
Abbey Mills Pumping Station	TWUL
Beckton STW	TWUL

For the full tunnel option, each of the above six sites will be required for the construction shafts. Of these, three are owned by third parties and will need to be acquired by TWUL to carry out the works. It is expected that at least two of these sites will need to be acquired by TWUL if it is to implement the partial tunnel option.

3.15.2 Current status of land negotiations/ acquisitions

TWUL has been unable to progress land acquisitions at this stage of the assessment process. This is because in the absence of funding from Ofwat, TWUL does not consider that the Minister's letter gives sufficient security to commit to spending on each site. Approaches have been made to each of the current landowners for those sites identified under the current design options.

Homefield Recreation Ground – Chiswick

Meetings have been held with the London Borough of Hounslow to discuss the likely issues surrounding the acquisition of the site. The following issues have been raised by the council:

a. The likelihood of an outright freehold purchase is low, with the probability that a long lease may be more acceptable to the Council should they be willing vendors.
b. In a negotiated acquisition, the lifting of any existing 'open space' land use covenants would also have to be addressed in a timely fashion by the Council.
c. With a compulsory acquisition, any restrictive covenants would be cleansed from the title on the grant of the order. Potential claims may then still arise.

Other residential amenity issues will need to be resolved relating to loss of open space, traffic, noise and dust. This could potentially influence compensation levels.

King Edward Memorial Park, Shadwell (NESR)

Following discussion with the Policy and Asset Management Department, the London Borough of Tower Hamlets is fully aware of the likely impact of the works on the public use of the park and associated facilities. The council raised similar issues to those cite above.

The amenity and planning policy issues associated with possible works on areas of public open space is expanded upon in Sections 3 and 5 of this report.

Greenwich/Charlton Site

The Komoto Group Limited owns the freehold of this site. The site is split into two areas. The western two-thirds section, including the buildings, is let on a medium term lease to 'Raceway Ltd' (indoor

corporate go karting). The remaining eastern section is let as open space car parking/ storage. The following issues have been identified:

a. The whole of the Komoto site to the north of Herringham Road is split into two separate purchases. TWUL would require most of one of the sites.
b. Both areas were sold to Komoto Group Limited (incorporated in Liberia with a London address) on 12 December 2003 for £4 million for each respective site.
c. In discussion with the Managing Director of the company, there was a willingness only to grant a short term (7 year) lease, with no assurances given that a long lease or a freehold purchase would be acceptable.

Land valuation

It is not considered possible to provide an estimate of the likely costs for the acquisition of each of the three sites at this early stage. Any valuation would be dependent on the date of the sale and the current use of the land identified for the sites. In the case of the Charlton site, consideration would also need to be given to the existing lease arrangements at the time.

Summary of land negotiations

TWUL anticipates that there will be considerable opposition to any negotiated purchase of the sites at Homefield Recreation Park, King Edward Memorial Park, and Charlton. In addition the Charlton site or other adjacent commercial sites could be lost to development in the time that a final scheme is approved.

Taking into account all of these issues, it is considered likely that TWUL will need to resort to compulsory purchase of the land in order to acquire the sites.

Compulsory Purchase Order (CPO)

Section 155 of the Water Industry Act 1991 (the Act) gives TWUL the power to acquire land compulsorily for its statutory purposes. An order made under s155 of the Act (CPO) will need to be considered and, if acceptable, confirmed by the Secretary of State for the Environment, Food and Rural Affairs (the confirming authority).

Key issues associated with CPO are as follows:-

- Instigation of CPO does not preclude on-going negotiations for purchase, which is TWUL's preferred option.
- A compelling public interest case for CPO must be made.
- TWUL will need to show that the scheme has good prospects of being funded, implemented and of gaining planning consent in order to justify the CPO.
- CPO will almost certainly trigger the need for a Public Inquiry.
- It is possible to hold concurrent inquiries for both the planning application and CPO. This could save time.
- Compensation will be payable to the landowners and any other party having an interest in the land under a confirmed CPO.
- It is not possible to provide an estimate of the likely compensation payable under a CPO without having full details of the scheme.

3.16 ANCILLARY LAND ISSUES

3.16.1 Compensation under the Water Industry Act 1991

It is expected that TWUL will carry out the CSO interceptor works under its statutory powers in sections 158 and 159 of the Water Industry Act 1991 (WIA). TWUL is under a statutory duty to pay compensation for any lose caused or damage done in the exercise of its statutory powers (see

Schedule 12, WIA). Without the full details of the scheme it is not possible to estimate the likely amount of statutory compensation.

3.16.2 Protected Undertakers

Where TWUL exercises its statutory powers in, under or over land owned by the Crown or any other protected undertaker, it is required to obtain their consent before carrying out the works (see section 221 and Schedule 13 of the WIA).

Both the Crown and the Port of London Authority (PLA) own parts of the riverbed of the River Thames. The PLA has protected undertaker status for the purposes of the WIA and therefore both parties consent will be required to carry out the tunnel works under the river.

In the case of the Crown, consent may be given on such financial (compensation) and other conditions as may be considered appropriate. There is no requirement for the Crown to act reasonably in the negotiations with TWUL. Whereas, the PLA may only insist on reasonable conditions and should not unreasonably withhold consent.

It is normal practice for this consent to take the form of an easement with the conditions to be negotiated between the parties. It is anticipated that TWUL will be required to pay compensation to the Crown and PLA for any damage or loss that results from the works.

Section 221 of the WIA does not provide any dispute resolution mechanism as a result of which there is a risk that negotiations with the Crown could become protracted. Any dispute with the PLA as to the reasonableness of conditions can be referred to arbitration under Schedule 13 of the WIA.

Without the full details of the scheme it is not possible to estimate the likely amount of compensation to be paid under any easement with the Crown or PLA.

3.16.3 Work Compounds and Jetties

Where work compounds are located on third party land, TWUL will be required to negotiate a licence agreement with the respective landowner. It is anticipated that TWUL will be required to pay compensation to the landowner for the acquisition of any licence.

In addition, the agreement of the relevant landowner will be required for the construction of any jetties along the River Thames. This is likely to involve the PLA and any other landowners adjacent to the river. It is anticipated that compensation will be required to be paid for the period in which the jetties remain in place. An allowance will also need to be made for any reinstatement costs. Where reinstatement is not possible, compensation will be paid for any damage caused.

Without the full details of the scheme it is not possible to estimate the likely amount of compensation to be paid for the work compounds and jetties.

3.17 Land Issues Summary

In assessing the land and property issues, TWUL considers that the only assured route in which to acquire the land needed for the TTT will be to proceed by way of compulsory purchase. This will have significant impacts for the project in terms of both programming and costs. In the interim, fully minuted and exhaustive negotiations with third party landowners will be required which take account of a ‘willing vendor’ valuation.

Should CPO powers need to be invoked; up to 2 years will be required. Negotiations with stakeholders may continue in parallel during the CPO process.

Ancillary land issues will also need to be resolved with negotiations for appropriate consents, easements and licences required. Where a landowner's consent is required to carry out works, this will need to be secured before works commence with the potential to cause delays to the programme. Statutory compensation issues will be capable of resolution following completion of the works.

4 SCOPING THE PLANNING AND ENVIRONMENTAL ISSUES

4.1 INTRODUCTION

Initial guidance on likely key issues was provided within the letter from Ian Pearson, Environment Minister to TWUL in July 2006. Further identification of issues was subsequently possible through the both the Planning and Environment Working Group and the Stakeholder Event.

In order to ensure that issues were reviewed systematically, it was judged appropriate to prepare a list of key issues using the EA scoping guidance notes (2002):

- L2: Scoping the Environmental Impacts of Sewage Treatment Works
- E2: Scoping the Environmental Impacts of Pipelines (oil and gas)

The latter guidelines are considered to include many of the likely impacts associated with the TTT itself, there being no Scoping Guidelines for Sewage Storage & Transfer Tunnels.

The exercise that follows is **not** a formal EIA scoping exercise. It was used to identify (i) Those issues, which may lead to significant effects (either with or without mitigation), and (ii) Those effects that may be quantified given the limited option definition available (as of October 2006). The latter was particularly important in respect of generating inputs to the CBA.

It is clear from feedback from the CBA working group that any issues in relation to monetisation fall clearly within that group's remit. The Planning and Environment team therefore focused on the definition of the environmental impact or effect for each option, where possible in units that might be monetised.

4.2 ASSUMPTIONS AND ASSESSMENT OF SIGNIFICANCE

As described in Section 2, the options comprise a) a tunnel / tunnels, b) CSO connections, c) shaft sites for construction & maintenance and d) a STW extension at Beckton STW (and at Crossness in respect of the partial options). The "options" as defined here do not include the other supporting infrastructure, e.g. any renewable energy component or sludge treatment infrastructure that may also be required.

As a general rule, Operational Impacts & Effects are more important than Construction Effects, since their duration is substantially greater (effectively permanent). Greater consideration was given to operational effects where resources and time was limited. In the scoping exercise that follows, Operational Impacts and Effects are considered in Table 4.1, followed by Construction Impacts and Effects in Table 4.2.

All determinations of "likely significance" are tentative only, made using professional judgement for the purposes of this exercise only and do not constitute a full confirmation that an issue will be significant within the context of the EIA Regulations. **Accurate determinations of significance will require the professional assessment of impacts by relevant specialists in full accordance with EIA procedures at the appropriate point in time.**

A significant effect may be very broadly defined as one that should be brought to the attention of those involved in the decision-making process. This definition is prescribed to varying degree by statute

(including EC and national guidelines and standards) and influenced by the precedents established in previous EIAs.

Guidance on significance has been mainly of a generic nature, for example Circular 2/99 (ODPM, 1999), and practitioners have been obliged to develop definitions for specific topics and projects. It is broadly accepted, however, that significance reflects the relationship between two factors:

- The magnitude or severity of an impact (i.e. the actual change taking place to the environment); and
- The sensitivity, importance or value of the affected resource or receptor.

The magnitude of an impact is often quantifiable in terms of, for example, extent of land take, or predicted change in noise levels, and can be either positive or negative. The sensitivity, importance or value of the resource or receptor is normally derived from:

- Its designated status within the land use planning system;
- The number of individual receptors such as residents;
- An empirical assessment on the basis of characteristics such as rarity or condition; and
- Its ability to absorb change without impact.

Significant effects occur where valuable or sensitive resources, or numerous receptors, are subject to impacts of considerable magnitude. Effects are unlikely to be significant where low value or non-sensitive resources, or a small number of receptors, are subject to minor impacts. Allocation of significant effects in intermediate situations is a matter for professional judgement in each topic area.

Within this report, where an effect is considered to be significant, this significance will generally be classified as High, Moderate, Low or Negligible (with these descriptions again being based on precedent or current guidance). Effects may be either beneficial or detrimental, although where no qualification is given, a negative effect can generally be assumed. In general, and in respect of the TTT, highly significant effects will generally extend across the TTT route (and perhaps beyond) although during construction in particular, these may result from the aggregation of all effects from the large number of constructions sites (at CSOs, Shafts and Beckton STW). Isolated effects that arise more discretely and at few locations are unlikely to be judged highly significant in the context of this assessment.

4.3 Scope of Operational Impacts

Table 4.1 that follows is coded as follows:
Green – no assessment to be undertaken as less significant
Orange – no quantitative assessment to be undertaken as information unavailable
Red – assessment to be undertaken
Red (hatched) – assessment input *outside* P&E group

Table 4.1: Scoping Operational Impacts

Topic	Issue	Likely Significance	Metric output from P&E
Surface Water Hydrology and Channel Morphology	Temporary storage of surface waters (during CSO events, with sewage), transfer to Beckton and subsequent release as effluent further down Tideway.	Volume of temporary removal from Tideway insignificant for all options; **no assessment proposed.**	

Topic	Issue	Likely Significance	Metric output from P&E
	Local changes to surface run-off & permeability with new structures and hard standing	Areas (Shaft compounds, CSO manholes) not significant in already generally impermeable environment for all options; **no assessment proposed**	
	CSO improvements alleviating local flood risks	Some local improvements can be expected where there are existing local flooding problems but the data does not exist to quantify this	
Surface Water Quality	Capture and treatment of CSO spills	**Highly significant** beneficial in respect of DO, Litter and Health Objectives; **covered by Modelling team but should be summarised briefly within this report.**	
Groundwater Hydrology	Changes to underground movements as a result of new structures and loss of aquifer storage	Although a large structure, in the context of groundwater movements and storage the tunnel volume and barrier effects will be minimal for all options; **no assessment proposed**	
Groundwater Quality	Changes to groundwater quality as a result of accidental fracture or seepage	The TTT will be of modern construction and designed for zero failures and risks will be minimal for all options; **no assessment proposed**	
Landscape	Changes to landscape and visual impact of new structures	Impacts of CSOs and tunnel will be zero-negligible; For those shafts where venting / mechanical ventilation is required, new structures will be required. In some cases these may be in existing urban parks / recreational areas and impacts may be significant for all relevant options; There will be a STW extension at Beckton and visual impacts will be associated with that for all options although the size will vary with the options. Impacts may be significant. **Assessment proposed**	Ha of MOL / Green Space / other areas of open ground etc lost [Qualitative judgements of use, quality, value of each location]
Soils	Compaction and erosion	There should be no such impacts during the operational phase of the TTT for any option; **no assessment proposed.**	
Geology	Removal of rock	There will be no such impacts during the operational phase of the TTT for any option; **no assessment proposed.**	
Local Air Quality	Odour	**Potentially significant** in respect of all options, new shaft sites & any ventilation requirements; also Beckton STW extension. Assumption that potential for odour release will be engineered out and hence mitigation will be effective; **OdourNet undertaking assessment**	OdourNet undertaking assessments
Regional Air Quality	Energy related emissions of Carbon Dioxide	Significant in London policy context; will require assessment for all options to include, the pumping and ventilation energy requirements and any renewables contribution (i.e. 20% of energy required	Annual emissions of Carbon Dioxide in tonnes

Topic	Issue	Likely Significance	Metric output from P&E
		could be offset by energy recovery from sludge); **Assessment proposed.**	
Aquatic Ecology	Capture and treatment of CSO spills	**Highly significant** (beneficial) in respect of DO and thus presumably fish populations and overall Tideway ecological health for all options; **covered by Modelling team but to be summarised briefly within this report.**	
Terrestrial Ecology	Alteration or loss of habitats and species.	Any habitat and species loss will occur during the construction phase, some of which will be temporary, although can be viewed as an operational effect if permanent – but see construction table for these impacts. **no assessment for operational phase proposed.**	
Socio-economic	Employment	Minimal additional staffing for operational maintenance; **no assessment proposed**	
Health and Safety	Risk of disease or other health impacts from the TTT and the Beckton STW extension	**Unknown impact from TTT; but considerable positive benefit to river users.** Impacts from Extended Beckton STW presumably minimal in context of existing STW, which is at present well separated from local residential areas. **Heath Impact Assessment Issue falls outside the skill set of the P&E team.**	
Amenity	Barriers to rights of way and access	Operational adverse impacts should be minimal although some loss of recreational amenity will occur where shaft sites and ventilation points are located within existing parks. **Assessment of impact proposed.**	Ha of recreational space lost [Qualitative judgements on use, value and impact of each location]
	Improvements in reduced sewage derived litter on foreshore	Considerable positive benefit in amenity (Visual & Recreational benefits) from reduction in sewage derived litter on foreshore; **Assessment of impact proposed**	% Reduction in sewage derived litter (TBC)
Nuisance	Noise	Operational impacts at Beckton STW will be minimal in the context of the existing STW and there are few nearby receptors, variation between options will also be limited as all will require pumping – no assessment proposed; At the shaft sites, impacts may arise if mechanical ventilation is required; **generic assessment of a shaft site may be worthwhile if ventilation proposals were known; no assessment proposed at this stage. Under review**	[Under review pending identification of plant]
	Traffic delays, increased traffic	Some increased traffic may arise from additional sludge / grate ash movements away from Beckton STW, which will vary with the disposal options. **Assessment of**	

Topic	Issue	Likely Significance	Metric output from P&E
		impact by CBA team	
	Waste	Landfill void usage for residual operational wastes from sludge treatment (early indications are that these will be low). **Assessment of impact proposed.**	m^3 of landfill void use for each technology option.
Cultural Heritage	Damage to features of importance	None during operation**; no assessment proposed**	

4.4 CONSTRUCTION IMPACTS

Table 3.2 that follows is coded as follows:
Green – no assessment to be undertaken as less significant
Orange – no assessment to be undertaken as info unavailable
Red – assessment to be undertaken as (perceived importance ranked)
Red (hatched) – assessment input *outside* P&E group

Table 4.2: Scoping Construction Impacts

	Issue	Likely Significance	Metric Output
Surface Water Hydrology and Channel Morphology	Increase in run off from surface compaction; Changes to run-off characteristics and infiltration rates.	Areas (construction compounds and sites) not significant in already generally impermeable environment for all options**; no assessment proposed.**	
	Change in flow velocities, erosion and flood risk; Increased sedimentation in watercourses.	Judged unlikely to be significant during construction for all options since most construction works would be remote from bank side areas; **no assessment proposed.**	
Surface Water Quality	Pollution from suspended material and disturbance of contaminated land	Some minor impacts from remobilising contamination in overburden soils to excavate shafts, and CSO connections, and prepare site of works extension; **limited assessment proposed.**	Broad estimate of extent of contamination m^3 of hazardous waste arisings (to nearest 1000m3?) TBC [Qualitative judgement of levels of contamination]
	Pollution from spills or leaks	Unlikely to be significant as most works are remote from surface waters and risks can be managed by good practice for all options; **no assessment proposed.**	

	Issue	Likely Significance	Metric Output
Groundwater Hydrology	Changes to underground movements as a result of construction	Although a large structure, in the context of groundwater movements and storage the construction of the TTT will have minimal effects for all options; **no assessment proposed**	
Groundwater Quality	Changes to groundwater quality as a result of fuel leaks or spills	Unlikely to be significant as risks can be managed by good practice for all options; **Limited assessment proposed.**	Qualitative assessment of risk proposed
	Disturbance of contamination impacting Groundwater	Likely to be a risk at all construction sites (CSOs, Shafts, Tunnel) and particularly at Beckton STW where contamination is known to be present; **limited assessment proposed**	Broad estimate of extent of contamination Qualitative judgement of levels of contamination
Landscape	Changes to landscape and visual impact of new structures	Landscape and Visual impacts of construction will be relatively limited give the urban context of the locations although may be significant where extended works at shaft locations impact on local landscape character (e.g. shaft sites at Homefield, NESR); **limited assessment proposed.**	**Ha of MOL / Green Space / other areas of open ground etc lost for construction period [Qualitative judgements of use, quality, value of each location]**
Soils	Compaction and erosion	Areas (construction compounds and sites) not significant in already generally impermeable environment for all options; erosion similarly unlikely to be problematic given limited extent of surface works; **no assessment proposed.**	
Geology	Removal of rock	The volume arisings removed will be substantial although no important visible exposures or designated sites will be impacted and there should be no significant impacts; **no assessment proposed**; [the effects of the transport and disposal / trade of this material may however be significant; see below.]	

	Issue	Likely Significance	Metric Output
Local Air Quality	Dust	Dust may be generated when ground is broken at each construction site and when materials are moved or stockpiles on the surface; whilst the possible impacts will vary with the number of construction sites (and thus options), since dust generation can be mitigated by simple operational procedures, significant residual effects are unlikely; **no assessment proposed.**	
	Air Quality Impacts of Construction Transportation	Construction traffic including HGVs, barges, construction plant and Tunnel Boring Machines will generate emissions of NOx, PM10s etc. Whilst these impacts may be significant, they will be temporary. Given the uncertain nature of the plant items & programme it will not be possible to calculate meaningful results; **No assessment proposed.**	
Regional Air Quality	Energy related emissions of Carbon Dioxide	The generation of embodied CO2 is considered to be a possibly significant construction impact; **Limited assessment proposed. This will be extended to construction energy use where possible (material transport, excavation etc)**	Embodied carbon dioxide in concrete and steel will be estimated
Aquatic Ecology	Sediment loading and fuel run-off & spills	Most works are remote from surface waters and risks can be managed by good practice for all options; residual effects will not be significant and **Limited Assessment of installation of temporary mooring jetties for waste transfer to river over sensitive Tideway foreshore is proposed.**	Ha of habitat loss to be determined [Qualitative judgements of value of habitats] Habitat Mitigation (if any) to be identified.
Terrestrial Ecology	Habitat removal, fragmentation or severance.	Loss of habitats in shaft locations will be minimal; there will be some losses at Beckton STW, which will vary between options although the habitats in the likely extension location are considered to be of relatively low value and significant effects are unlikely. With mitigation residual effects should be negligible. **Limited Assessment of habitat landtake proposed.**	Ha of habitat loss to be determined [Qualitative judgements of value of habitats] Habitat Mitigation (if any) to be identified.

	Issue	Likely Significance	Metric Output
	Disturbance / Loss of species	Few if any protected species are likely to be present in the shaft location sites; reptiles are present in low numbers at Beckton STW; impact will vary between options although the populations in the likely extension location are small and significant effects are unlikely. With mitigation residual effects should be negligible. **Limited Assessment of impact on species proposed.**	Populations impacted to be identified [qualitative judgements of value of habitats] Species mitigation (e.g. translocation) to be defined.
	Invasive Species	Japanese Knotweed is widespread at Beckton and scattered elsewhere and will require removal; **Limited assessment proposed.**	Stands to be identified andRemoval requirements to be summarised
Socio-economic	Disruption to services	Disruption to services within street works (cabling, telecommunications etc) for CSOs is likely and cumulatively might generate significant effects; this is impossible to determine at this stage; **Since no meaningful results can be generated no assessment is proposed.**	
	Traffic Delays	Disruption to traffic during construction will be a major issue and relates to both additional HGVs but more importantly in-highway construction works for many of the CSO locations; Sources of guidance on the significance of these have been consulted including an assessment by Cascade Consultants 2005 to determine the social costs of delays for a full option but not partial options. Another study by WS Atkins which applied methodologies applicable here, which estimated disruption impact costs associated with TWUL's current Victorian Mains Replacement Programme. **Assessment proposed.**	Calculation of social cost by rearranging Cascade and Atkins study inputs.
	Employment	Employment during construction phase is likely to be significant with about 1000 jobs for each year of construction; **Limited Assessment proposed based solely on estimate of construction jobs**	Total number of person years employment
Health and Safety	Adverse reaction to perceived health issues	Unknown impact**; Issue falls outside the P&E team.**	
	Risk of injury	Unknown impact**; Issue falls outside the P&E team.**	
Amenity	Temporary Barriers to rights of way and access	Effects may be significant in relation to footpaths & pavements, recreational areas and other areas with open access, in respect of some shaft sites (where	Ha of recreational space lost Diversion/ closure

	Issue	Likely Significance	Metric Output
		construction periods will be substantial) and a number of CSO construction compounds. **Assessment of impact proposed.**	of footpaths by location and number [Qualitative judgements on use, value and impact of each location]
Nuisance	Noise	Construction impacts at Beckton STW should not be significant in the context of the existing STW and the baseline noise environment and there are few nearby receptors; variation between options will also be limited as all will require similar construction plant; no assessment proposed; At the shaft sites and CSO sites, construction noise impacts may be significant depending on the plant used and the proximity of receptors; **generic assessment of a shaft site would be worthwhile if plant could be identified; no assessment proposed at this stage. Under review.**	Generic assessment of a shaft site would be worthwhile if plant could be identified; **no assessment proposed at this stage. Under review.**
	Vibration impacts to: • Particularly Sensitive Locations (hospitals, laboratories etc) • residential properties & schools • Historic buildings & structures • Other infrastructure	Vibration impacts arising from tunnelling activities are likely to be significant depending on the proximity of sensitive receptors and assessment would be required within any EIA of a defined project; **if plant could be identified assessment might be worthwhile; Under review.**	Might be worthwhile if plant could be identified; **no assessment proposed at this stage. Under review.**
	Mud on roads	Significant effects unlikely and no assessment proposed	
	Traffic delays, increased traffic	**See above [Assessment of impact proposed]**	
Cultural Heritage	Damage to features of importance	Known archaeological resources might be damaged during construction but with a programme of mitigation by avoidance no significant effects are likely (no such resources yet identified) Unknown resources might also be damaged and this will be presumably be minimised by appropriate research during EIA and a watching brief during construction. Given the extensive nature of construction at a large number of sites	Approximate extent and duration of any archaeology-watching brief.

	Issue	Likely Significance	Metric Output
		significant effects are possible; **a limited consideration of these effects (especially in relation to mitigation costs) is proposed – see below.**	

4.5 SUMMARY OF PROPOSED ASSESSMENTS

The following assessments and related metrics were therefore identified for the planning and environment study and are reported in subsequent Sections and appendices:

Issue	Operation	Construction
Landscape: Loss of MOL / Green Space	✓	✓
Amenity: Loss of recreational space	✓	✓
Local Air Quality: Odour	✓	X
Regional Air Quality: Carbon Dioxide	✓	✓
Aquatic Ecology	✓*	X
Terrestrial Ecology	X	✓
Waste	✓	✓
Existing contamination	X	✓
Traffic Delays	X	✓
Employment	X	✓
Nuisance: Noise	X	✓**
Nuisance: Vibration	X	✓**
Cultural Heritage & Archaeology	X	✓

* Summary provided of modelling outputs & benefits only
** In absence of plant details, brief qualitative summary only.

5 OPEN SPACE AND METROPOLITAN OPEN LAND (MOL)

5.1 OPEN SPACE – BACKGROUND

Open space is defined in the Town and Country Planning Act 1990 as land laid out as a public garden, or used for the purposes of public recreation, or land which is a disused burial ground, including (based on PPG 17 and its Companion guide: Assessing Needs and Opportunities):

- Parks and gardens - including urban parks, country parks and formal gardens
- Natural and semi-natural urban greenspaces - including woodlands, urban forestry, scrub, grasslands (e.g. downlands, commons and meadows) wetlands, open and running water, wastelands and derelict open land and rock areas (e.g. cliffs, quarries and pits)
- Green corridors - including river and canal banks, cycleways, and rights of way
- Outdoor sports facilities (with natural or artificial surfaces and either publicly or privately owned) - including tennis courts, bowling greens, sports pitches, golf courses, athletics tracks, school and other institutional playing fields, and other outdoor sports areas
- Amenity greenspace (most commonly, but not exclusively in housing areas) - including informal recreation spaces, greenspaces in and around housing, domestic gardens and village greens
- Provision for children and young people - including play areas, skateboard parks, outdoor basketball hoops, and other more informal areas (e.g. 'hanging out' areas, teenage shelters)
- Allotments, community gardens, and city (urban) farms
- Cemeteries, churchyards and other burial grounds
- Accessible countryside in urban fringe areas
- Civic spaces, including civic and market squares, and other hard surfaced areas designed for pedestrians.

In the first instance all open space likely to be affected by the proposed TTT has been identified and is mapped on the accompanying figures. This includes both permanent and temporary impacts and most importantly identifies likely areas of landtake. Whilst some of this assessment can be quantified any assessment is also reliant upon a series of qualitative assessments. In selecting a preferred option comparative assessments may also be required. These assessments are inevitably highly subjective and may introduce a political component based on stakeholder reactions to the sites themselves and possible alternatives.

In looking at the qualitative assessments each of the potential development sites (including shaft sites and CSOs) have been visited and conclusions reached in terms of the nature, quality and use of any open spaces affected as reported below.

Though policies across London for development on open space vary there is a general presumption against most forms of development and therefore special justification would usually be required, particularly in respect of any permanent (operational) loss of open land. In this respect the overall environmental objectives of TTT are likely to form the mainstay of any such justification case. The relevant LPAs or potentially the Secretary of State will be the arbiter of whether any justification case is compelling and justifies a making an exception to established policy.

Whilst the function and value of open space differs from site to site and within individual areas of open space, the starting point is that all open space is valuable and ordinarily should not be lost. This reflects the enhanced importance of open space in a large city where open countryside is distant and not readily accessible to all, and private amenity space in the form of private gardens, are either small or non-existent.

In addition, it should be borne in mind the duration of works in relation to this project and the bearing this has on the significance of impacts. In the case of individual shaft sites construction may last for a

number of years. This duration adds to the significance of impacts and therefore temporary impacts should not be underestimated simply because they are not permanent.

5.2 METROPOLITAN OPEN LAND (MOL)

The bulk of the existing TWUL operational land at Beckton is designated as Metropolitan Open Land (MOL). The functions of MOL designation are:

- Protecting open space to provide a clear break in the urban fabric and contributing to the green character of London
- Protecting open space to serve the needs of Londoners outside their local area
- Protecting open space that contains a feature or landscape of national or regional significance.

This designation imposes a general presumption against all forms of development other than those specifically identified as potentially exceptions. The list of exceptions includes uses, which retain the openness of MOL. There is some debate whether the existing STW use, which is dominated by plant and tanks rather than actual buildings, retains the openness of MOL or not. The fact that the STW predates the designation suggests that it does. TWUL has sought the removal of the MOL designation through representations to the Newham Core Strategy.

Any relaxation of the general presumption against development requires a very special circumstances case to be made. In the case of Beckton any such case is likely to have to demonstrate that there is no available land outside MOL, which could be used instead, and that efforts have been made to minimise any loss of openness. This might include minimising the height, bulk and footprint of any buildings and structures.

In the case of the respective MOL policies for both Beckton (LB Newham) and Crossness (LB Bexley) the policies and supporting text make particular mention of the need for STW related development by TWUL in order to discharge their statutory functions. Whilst these policies do not remove the general presumption against development they are favourably worded and do provide the basis for a very special circumstances case to be made.

All options under consideration have the TTT (full tunnel or Eastern tunnel for the partial solutions) terminating at Beckton. The planning rationale for this location as opposed to the alternative at Crossness STW relates in part to consideration of MOL and is discussed for Section 3 onwards in this report onwards.

In terms of emerging planning policy TWUL will continue to seek to influence emerging MOL policy to ensure that either MOL designations are removed where it is no longer considered to be appropriate or, failing that, make special reference to the need for operational development and acknowledge that exceptions to MOL policy made need to be made in relation to TWUL's operational requirements.

With current indicative layouts, the majority of the footprint of the TTT related extension at Beckton is likely to lie outside the area designated as MOL.

The West Putney CSO interception also includes development on MOL. This relates to a relatively small area of a private sports ground which falls outside the area covered by actual sports pitches and therefore does not have any functional sports use. Any impact on this land will be during construction only and therefore the overall impact is deemed low. That said, the general presumption against development remains and a justification must therefore be made.

5.3 PARKS AND GARDENS

This definition comprises all formal parks and gardens including sports grounds. In addition, it applies to both public open and private open space although the key impacts in relation to TTT apply only to publicly accessibly land. More specifically two possible shaft sites are on public parks namely Homefield Recreation Ground to the west (LB Hounslow) and King Edward VII Park (LB Tower

Hamlets) to the east. Both of these parks are located in areas of relatively high residential densities and therefore provide important open space irrespective of the specific facilities each may provide. Given the similarities between the two the following assessment applies equally to both parks.

The impact of TTT on parks and gardens is dependent in part on the way in which any park functions. Assessment therefore needs to be made as to the least valuable areas of individual parks. Parks with only limited facilities tend to function as sanctuaries where people can enjoy relative peace and tranquillity. Conversely many parks are the focus for considerable activity, usually where there are play facilities. In addition elements of the two are often present in different parts of the same park.

In terms of the actual impacts neither site will result in the permanent loss of major facilities such as children's play areas. However, the size of construction compounds will result in a significant impact throughout the duration of construction. In addition, the impacts of construction go beyond the construction site alone and extend to noise, disruption and traffic related to the works. In practice this is likely to negatively impact upon the whole park and all users. The active uses would be less affected, whilst the peace and quiet value would be severely diminished throughout construction.

The impact of any permanent development introduces new issues. Any permanent land lost is likely to reduce the functional value of a park. The degree to which any value is lost depends on the size of permanent land take and the function of the relevant section of the park. The design and size of any permanent structure is also a central issue.

In assessing the impact the relevant LPAs will look at the overall permanent and temporary impacts, the duration of the impacts and the scope for possible mitigation in the form of a possible planning gain. If the LPAs are resigned to TTT related development in a park they may well make a judgement whether there are parts of the same park where impacts may be less. Planning gain measures may include enhancements to other parts of the park to compensate for any land lost and may be sought for both temporary and permanent impacts. Most LPAs would, as an absolute minimum, insist upon the reinstatement of any lost facilities such as benches and play equipment irrespective of whether the loss is temporary or permanent.

The importance of parks to local communities is reflected in planning policy at all levels and within the communities they serve. In practical terms this means that the loss of or negative impact upon any park may well be met with local resistance irrespective of the precise policy wording in place. In addition, parks often have protection through covenants and may have trusts or committees whose sole interest is the enhancement and protection of a specific park.

In view of the above the elements of TTT proposed on parks, albeit a small yet essential part of the overall scheme, will be highly contentious and represent a considerable planning risk. The permanent loss, and to a lesser extent the temporary loss of open space, will only be countenanced if the wider environmental enhancement objectives of the TTT as a whole are understood and a compelling case can be made.
Given that the two highly sensitive parks have been identified in the options (Homefield and NESR) it is important to note that the two tunnel options do not include a shaft site at NESR and therefore the planning risk is relation to impact on open space is significantly less.

Two of the Central London CSO sites (Smith Street and Ranelagh and Kings Scholar Pond Relief) impact upon historic parks and gardens. The works to these sites relates solely to CSO interception and therefore no material permanent impact would arise. However, these areas are an important amenity and historic feature of Central London and therefore high quality reinstatement would be essential. The partial options omit these two sites and therefore remove this potential impact.

5.4 Other Green Space

These are any areas of open space not included under parks and gardens and would include green corridors and grass verges.

As for parks and gardens there will be certain sensitivities to development that results in losses of such areas, particularly where they may impact on rights of way. The development of such areas is not considered as sensitive as parks and gardens but in sensitive locations may require special and compelling justification. The areas involved are small and have therefore not been quantified.

5.5 Construction Impacts

The likely temporary land take at CSO and shaft sites is quantified in the following table. Given the comments in the above paragraph, the area of land take is only a small part of the overall assessment.

CSO / Shaft	Open Space	MOL	Historic Park / Garden
Homefield (all options)	11,269m^2		
Stamford Brook (all options)	1,009m^2		
West Putney (all options)		1,038m^2	
Smith St (all options)			1,889m^2
Ranelagh & Kings Scholar Pond Relief (all options)			2,292m^2
NESR (full options only)	2,985m^2		
Beckton (worst case, varies)	98,513m^2		

The following table provides a summary of the key impacts in relation to construction on all Open Space and MOL.

CSO / Shaft	Summary of Effects
Homefield	Effects of High Significance will arise due to area of land take, long duration of works, level of use and function of the park and proximity of sensitive receptors (residential uses).
Stamford Brook	Effects of Moderate Significance will arise due to limited land take, short duration of works and greater distances to sensitive receptors (residential uses). Park is well used and development will impact on its functional value.
West Putney	Low effect on MOL due to limited land take, distant and screened from sensitive receptors and no function loss to sports ground use.
Smith St	Moderate effect due to limited land take, short duration of works and sensitivity of receptors.
Ranelagh & Kings Scholar Pond Relief	Moderate effect due to limited land take, short duration of works and sensitivity of receptors.
NESR	Effects of High Significance will arise due to area of land take, long duration of works, level of use and function of the park and proximity of sensitive receptors (residential uses). High residential densities and lack of alternative open space provision add to the sensitivity of this site.
Beckton	Low effect due to limited impact on openness and distance from receptors

The likely significance of the options in respect of the key issues is summarised in the following tables:

Full options: 1a, 1b & 1c

	Significance without mitigation	Likely Mitigation Measures*	Residual Significance
Open Space	High	Footprint reduction, possible remote compound & identification of least sensitive locations within Homefield and NESR. Potential for traffic and construction management measures. Use of attractive hoardings	Moderate
MOL	Low	None required	Low
MOL at Beckton	Low	None Required	Low
Historic Parks and Gardens	Moderate	Footprint reduction & identification of least sensitive locations, appropriate high quality restoration	Low
Other Green Space	Low	Localised construction an traffic management measures to minimise impact on verges and other small areas.	Low

* in all cases good practice will apply

Partial Options: 2a, 2b & 2c

	Significance without mitigation	Likely Mitigation Measures*	Residual Significance
Open Space	High	Footprint reduction, possible remote compound & identification of least sensitive locations within Homefield. Potential for traffic and construction management measures. Use of attractive hoardings	Moderate
MOL	Low	None required	Low
MOL at Beckton	Low	None required	Low
Historic Parks and Gardens	Moderate	Footprint reduction & identification of least sensitive locations, appropriate high quality restoration	Low
Other Green Space	Low	Localised construction an traffic management measures to minimise impact on verges and other small areas.	Low

* in all cases good practice will apply

5.6 Operational Impacts

The likely operational land take at shaft sites is quantified in the following table (assumes a 30m x 30m compound at both Homefield and NESR).

Shaft / STW	Open Space	MOL	Historic Park / Garden
Homefield	900m^2		
NESR	900m^2		
Beckton	12,512m^2		

The following table provides a summary of the key operational impacts in relation all Open Space and MOL.

Shaft / STW	Effects
Homefield	Moderate Effect. Visual impact of any buildings and structures including any enclosure. Loss of grassed areas and replacement with hardstanding including access route to shaft for maintenance. Infrequent visual and noise disturbance during maintenance.
NESR	Moderate Effect. Visual impact of any buildings and structures including any enclosure. Loss of grassed areas and replacement with hardstanding including access route to shaft for maintenance. Infrequent visual and noise disturbance during maintenance.
Beckton	Low Effect when viewed in the context of existing STW development and other development in the area including roads, bridges, pylons and buildings not relating to the STW.

The likely significance of the options in respect of the key issues is summarised in the following tables:

Full options: 1a, 1b & 1c

	Significance without mitigation	Likely Mitigation Measures*	Residual Significance
Open Space	Moderate	Footprint reduction of operational footprint & identification of least sensitive locations at Homefield, NESR and Beckton. Minimum building sizes, discreet and high quality surface treatments, minimum hardstanding areas	Low
MOL	Low	None required*	Low
MOL at Beckton	Low	Minimal footprint and bulk, optimal location to minimise impact on openness.	Low
Historic Parks and Gardens	Low	Footprint reduction & identification of least sensitive locations, appropriate high quality restoration and surface treatments	Low
Other Green Space	Low	Sensitive surface treatments	Low

* in all cases good practice will apply

Partial Options: 2a, 2b & 2c

	Significance without mitigation	Likely Mitigation Measures*	Residual Significance
Open Space	Moderate	Footprint reduction of operational footprint & identification of least sensitive locations at Homefield and Beckton. Minimum building sizes, discreet and high quality surface treatments, minimum hardstanding areas	Low
MOL	Low	None required	Low
MOL at Beckton	Low	Minimal footprint and bulk, optimal location to minimise impact on openness.	Low
Historic Parks and Gardens	N/A	N/A	N/A
Other Green Space	Low	Sensitive surface treatments	Low

* in all cases good practice will apply

5.7 Option Sensitivity

The full options differ from the partial options primarily in respect of the greater extent of open space that will be impacted, during construction and to a lesser extent during operation. The additional impacts arise primarily within open space at the works at the NESR, which is included within all the full options but not required by the partial options. The additional impacts that arise at the NESR are not seen as critical to any discrimination between options, since the impacts are primarily within the construction phase and can be reduced to acceptable levels with appropriate mitigation.

6 ENERGY USE AND CARBON DIOXIDE

6.1 BACKGROUND

The aim of this element of the appraisal is to capture the differences between the options in terms of energy use and the resulting carbon dioxide emissions.
The following energy costs have been estimated for construction:

- Energy embodied in the materials used in construction
- Energy used in boring the tunnels, shafts and CSOs
- Energy used in transporting arisings removed from the CSOs and shafts

The following operational energy costs have been estimated:

- Energy used in pumping out the tunnel
- Energy used in mechanical ventilation

The tunnel will drain naturally towards the Beckton STW (or the Heathwall PS in respect of the Partial Solutions - West Tunnel) but will then require pump out to treatment at the surface. This will involve raising the flow approximately 80m at Beckton STW. There is scope for offsetting some of the energy needed by using energy recovered from the sludge derived from the tunnel pump-out.

The Mayor of London currently requires 10% of the energy demands of new development to be met from renewable energy sources. This requirement is likely to have risen to 20% by the time that TWUL seeks planning permission for the TTT. The volume of sludge derived from the tunnel is not likely to be sufficient to achieve this target using energy-recovery alone.

6.2 ENERGY EMBODIED IN CONSTRUCTION MATERIALS

Reinforced concrete, lining the CSO, shaft and tunnel walls, will be the principal material used in the construction of the TTT. Therefore the energy used in its manufacture is a close approximation of the energy used in the manufacture of all the construction materials.

Energy embodied in 2% steel reinforced concrete is estimated to be 2.36MJ per kg, while embodied carbon is 0.265 kg CO_2 per kg of reinforced concrete[2].

TWUL estimates that the following amounts of concrete and steel will be required for the options:

	Mass			
Option	Concrete	Steel	Embodied Energy	CO_2 Equivalent
1a	2,085,019 tonnes	142,160 tonnes	5,256,142,440 MJ	590,202,435 KG
1b	1,822,769 tonnes	124,280 tonnes	4,595,035,640 MJ	515,967,985 KG
1c	2,124,217 tonnes	144,832 tonnes	5,354,955,640 MJ	601,297,985 KG
2a	1,403,310 tonnes	95,680 tonnes	3,537,616,400 MJ	397,232,350 KG
2b	1,158,663 tonnes	79,000 tonnes	2,920,884,680 MJ	327,980,695 KG
2c	1,281,194 tonnes	87,354 tonnes	3,229,773,280 MJ	362,665,220 KG

[2] Reference: Inventory of Carbon and Energy (ICE), University of Bath, 2006

6.3 ENERGY USED IN EXCAVATIONS

Energy used in tunnel boring and lining is given in the table below. It is based on the power rating of the TBM together multiplied by the amount of time that it is in operation. At CSO sites and 8 hour working day has been assumed, whereas work on the main tunnel is assumed to be taking place 24 hours per day.

Energy used in raising the arisings to the surface will depend mainly on two factors: the mass of the material excavated and elevation from the bottom of the shaft to the surface. Assuming that each cubic metre of material masses 2 tonnes per m^3 and that the material is raised an average 60m, the energy required to lift the material to the surface is given by volume x 20000 x 9.81 x 60.

	Arisings Volume		Energy Use	
Option	Tunnel	CSOs	Boring	Extraction
1a	2,314,264m^3	192,868m^3	1,517,616,000 MJ	3,042,219 MJ
1b	1,732,265m^3	192,868m^3	1,517,616,000 MJ	2,387,344 MJ
1c	2,357,772m^3	192,868m^3	1,540,425,600 MJ	3,099,413 MJ
2a	1,802,385m^3	134,956m^3	1,043,107,200MJ	2,475,373 MJ
2b	1,382,285m^3	134,956m^3	1,043,107,200MJ	1,980,831 MJ
2c	1,338,203m^3	141,213m^3	1,097,280,000 MJ	1,928,938 MJ

6.4 ENERGY USED IN REMOVING ARISINGS FROM CSO SITES

In general the bulk of the arisings (from the tunnel and shaft sites) will be removed by barge. Where possible arisings from most of the CSO sites would be transferred to the temporary jetties and also removed by barge. It is however recognised that in some cases this may not be possible or desirable and that it may be more sustainable for arisings taken from CSO sites to be driven directly by HGV to the site(s) where it will be re-used. Wherever possible the arisings will be reused in new construction, although for a limited volume, where contamination is present, landfill disposal may be the only appropriate waste management option.

6.5 SUMMARY OF CONSTRUCTION IMPACTS

The embodied energy of construction materials naturally varies as a function of the diameter and length of the tunnel. Although there is some variation between the options (2.3 - 5.7 x 10^9 MJ), the values are a similar order of magnitude and all (and their related effects) are regarded as of moderate significance. Whilst it might be equally valid to describe the values (and the related effects) as of high significance this would perhaps overstate the importance of embodied energy in materials where relatively little control can be exerted during procurement (and where mitigation is difficult), compared to operational energy use. With any major construction project it is difficult to dramatically reduce the embodied energy of materials.

Despite the comments above, it is possible to reduce the embodied energy of materials by maximising local sourcing of virgin materials, by active supply chain control on sourcing and by reducing transport miles. The use of locally sourced recycled materials, notably metals, should also reduce the embodied energy of final materials. Such mitigation is however unlikely to be effective enough to reduce the assessment of residual significance below that of moderate significance for all options.

6.6 Operational energy use and related CO_2 emissions

The energy used annually in pump out has been calculated based on the total flow from CSOs intercepted by the tunnel. TWUL's modellers have calculated the total volume intercepted annually to be as follows:

- Option 1a: 48,038,235m^3
- Option 1b: 45,255,882m^3
- Option 1c: 48,038,235m^3
- Option 2a: 36,570,588m^3
- Option 2b: 36,570,588m^3
- Option 2c: 36,570,588m^3

The total energy required for pumping clearly varies directly with the total volume of the captured sewage & rainwater from CSOs pumped out for treatment. In addition there will also be a need for mechanical ventilation at each shaft site (see Section 2). It is likely that the ventilation fans will be of similar size at each shaft and have a power rating of between 5-10 KW. There will also be some energy use for the two odour control plants for each option but this will be minimal and the energy use has been excluded from this assessment. The overall energy use will be dominated by the pumping requirements at Beckton STW.

TWUL's engineers[3] have calculated the total annual energy requirement for each option as shown in the following table. Using the Carbon Trust's conversion factor for grid electricity (0.43kg CO_2 per kWh), gives the following figures for the resulting carbon emissions for the pumping in relation to each option.

Option	Energy requirement	Resulting carbon dioxide emissions	Emissions assuming 20% renewable energy
1a	14.7 GWh~~6,485,146 KWh~~	6,321,000 $KgCO_2$~~2,788,613 $KgCO_2$~~	5,056,800 $KgCO_2$~~2,230,890 $KgCO_2$~~
1b	15.2 GWh~~6,031,234 KWh~~	6,536,000 $KgCO_2$~~2,593,431 $KgCO_2$~~	5,228,800 $KgCO_2$~~2,074,745 $KgCO_2$~~
1c	14.7 GWh~~6,498,476 KWh~~	6,321,000 $KgCO_2$~~2,794,345 $KgCO_2$~~	5,056,800 $KgCO_2$~~2,235,476 $KgCO_2$~~
2a	12.7 GWh~~4,929,374 KWh~~	5,461,000 $KgCO_2$~~2,119,631 $KgCO_2$~~	4,368,800 $KgCO_2$~~1,695,705 $KgCO_2$~~
2b	7.4 GWh~~4,929,374 KWh~~	3,182,000 $KgCO_2$~~2,119,631 $KgCO_2$~~	2,545,600 $KgCO_2$~~1,695,705 $KgCO_2$~~
2c	12.7 GWh~~4,929,374 KWh~~	5,461,000 $KgCO_2$~~2,119,631 $KgCO_2$~~	4,368,800 $KgCO_2$~~1,695,705 $KgCO_2$~~

6.7 Summary of Operational Impacts

The energy use and the related carbon dioxide emissions vary primarily as function of the annual volume of tunnel pump-out and to a lesser extent the number of shafts where ventilation will be required. The annual Carbon Dioxide emissions for each option (without any assumed renewable

[3] For detail, see the Engineering Design Reports

component) vary between 3.2-6.5 million kg. In global or national terms, the energy use and related emissions will barely be perceptible, however for all options given the London Plan policy context, the emission are judged to be a significant effect. It can however be offset by the provision of a renewable component in accordance with the Mayor of London's Renewable Policy, once all appropriate measures have been taken to reduce the actual energy usage through energy efficiency measures and the use of the Energy Toolkit. By way of comparison the existing energy use figure for Beckton STW is in the region of 130 GWh, which equates to an annual generation of 55.9 million kg of CO_2. Accordingly, the worst-case energy demand for TTT (1b) represents only about an increase of 12% of the energy demands of the existing STW.

TWUL's preferred solution is, where possible, to generate any Renewable component through the use of the calorific value of sewage sludge. Wind turbines or bio-diesel generators may however be considered as alternatives to linkage with energy recovery from sludge, particularly if an early phase such as the Abbey Mills-Beckton link is pursued. TWUL's approach is to meet or exceed the minimum policy GLA requirement that exists at the appropriate point in the consenting process.

Even with a 10% or 20% renewable component as mitigation, the operational Carbon Dioxide emissions for all options would remain as a significant effect.

6.8 Option Sensitivity

The above assessment identifies the construction effects of all options as of moderate significance and the operational effects of all options as of significance. Whilst some mitigation is possible, residual effects are likely to be similar. In both cases, energy use and carbon dioxide emissions for all options are similar and do not provide a particularly effective way of discriminating between options.

7 LOCAL AIR QUALITY: ODOUR

7.1 INTRODUCTION

The odour control methods for the TTT are designed to ensure that there will be no odour impacts. An odour dispersion risk assessment study which was applied by OdourNet UK Ltd to assist in the development of a costed odour control strategy for the proposed tunnel.

7.2 SUMMARY OF THE ODOURNET STUDY

The specific objectives of the study were defined as follows:

- To investigate the concentration of odour (expressed in terms of the hydrogen sulphide concentration) at which emissions from each shaft would present a risk of impact at nearby sensitive receptors, assuming that the tunnel was naturally vented at approximately 1 air change per day.
- To identify what odour control measures are likely to be required to mitigate the risk of impact from the shafts whilst utilising the forced air extraction system and maintaining a ventilation rate from the tunnel of approximately 1 air change per day.

The assessment was conducted using a Gaussian screening model SCREEN3 published by the US Environmental Protection Agency. The model was applied to make predictions of the concentration of odour that could occur downwind of each shaft location when the tunnel is operating, assuming varying concentrations of hydrogen sulphide within the ventilated air. For the purposes of this study, worst-case dispersion conditions were considered.

The risk of odour impact was evaluated using the World Health Organisation hydrogen sulphide guideline value of 7 $\mu g/m^3$ (expressed as a 30 minute average), which is intended to protect against 'substantial annoyance for odour nuisance'. The predictions of the model were then compared to data defining the distance of nearby sensitive receptors to each shaft, based on the locations and designs provided by TWUL.

The study indicates that the maximum permissible concentration of hydrogen sulphide under the natural ventilation condition (assuming an air exchange rate of 1 air change per day) varies at each of the proposed shaft locations, depending upon the distance and nature of the nearest sensitive receptor.
If residential properties only are considered, the results suggest that the Charlton, Heathwall and Beckton Shaft locations are likely to be the least sensitive from an odour impact perspective (requiring the emission concentration of naturally ventilated air to be kept below 2 ppm). The Homefield and NESR shafts are identified as the most sensitive (requiring the emission concentration of naturally ventilated air to be kept below 0.1ppm).

If other potentially sensitive receptors such as public parks and commercial premises are considered (which would represent the most cautious approach from a potential impact perspective), the sensitivity increases considerably at all shaft locations apart from Charlton. The maximum permissible concentration of hydrogen sulphide at Abbey Mills and Beckton falls to 0.1 ppm. At NESR and Homefield, the maximum permissible concentration would is closer to 0.01 ppm.

The results of monitoring conducted on existing storm sewers in the Thames region indicates that the hydrogen sulphide concentration of air released could be as high as 2 ppm. The results of the modelling therefore indicate that some form of enhanced dispersion, or other form of odour control technique, will be required at all shaft locations if the risk of impact from the ventilation of the tunnel is to be minimised when the storm tunnel is in use. Both of these options will require the installation of a forced air extraction system, which could also be used to manage the air within the tunnel and direct

discharge of the air to the least sensitive shaft locations when necessary (e.g. Abbey Mills, Beckton, Heathwall or Charlton).

From the perspective of utilising dispersion to mitigate the impact of odorous emissions from the forced air ventilation system, the stack height is directly proportional to the release concentration of the air. If the concentration of the air from the tunnel conforms with the findings of odour monitoring conducted to date from existing London storm sewers, then the provision of 10m stacks for release of the extracted air at Abbey Mills, Beckton, Heathwall or Charlton should be sufficient to prevent any appreciable odour impact. The stack height requirements are however sensitive to variations in the emission concentration. Bearing in mind the uncertainties associated with predicting the concentration of air released from the tunnel at this time, reliance upon dispersion to mitigate the impact of the forced air extraction systems is likely to entail a significant amount of risk.

The installation of some form of odour treatment system capable of maintaining the release concentration of extracted air beneath critical levels irrespective of the condition of the tunnel is considered to represent a more prudent and cautious approach at this time. It is therefore recommended that the design include the provision of dedicated odour treatment systems at all of the proposed forced air system discharge shafts. On the basis that the odour releases from the tunnel are likely to be intermittent; some form of absorption or chemical scrubbing based system is likely to represent the most effective and economical solution from this perspective.

7.3 Odour Control of the Full Solutions

Air intake structures some 4-5m high would be located at the Homefield, NESR and Charlton shaft sites. These buildings house the intake fans that would be required to slightly pressurise the atmosphere of the tunnel to assist the expulsion of air at the exhaust points. The system is intended to promote one complete air change per day to ensure that odour will not build up in the tunnel. Blowing air into the tunnel at the intakes will not cause a local odour issue at these locations.

Similar exhaust structures would be required at the Heathwall, Abbey Mills and Beckton shaft sites. The ventilation building would accommodate twin fans (duty / standby as exhaust capability is more critical). In addition a vent stack (approx 1m diameter) would be located adjacent to buildings, approximately 5m higher than the buildings to assist dispersion of exhaust air. Odour control plant to treat the exhausted air, 15m x 5m by 3m high, may also be located alongside the buildings.

By venting the tunnel continuously between events the displaced air should be of very low odour. The only possibly substantive source of odour would emanate from the intercepted sewage flowing into the tunnel and will therefore be of short duration. Measurements taken from existing storm sewers so far suggest H_2S levels are unlikely to be greater than 1 - 2 parts per million (and then only for short periods).

7.4 Odour Control of the Partial Solutions

It is assumed that the partial solutions would employ similar odour control measures. Therefore an air intake structure would be located at Homefield and an exhaust structure at Heathwall for the Western tunnel. For the eastern tunnel the intake would be at Abbey Mills with the exhaust at Beckton.

8 WATER RESOURCES

8.1 SURFACE WATER

Improving the water quality of the Thames Tideway is one of the key objectives of the TTT solution. Along with the objectives set for Health day risk improvement and litter reduction, the third water quality objective is to meet the dissolved oxygen (DO) standards agreed during the TTS Studies in order to protect the aquatic ecology populations and overall ecological sustainability of the Tideway.

To test whether the proposed solutions would meet the DO standards, a modelling exercise has been undertaken to predict the future water quality conditions with each proposed solution in place. The model assessed the impact of 154 storm events over a 34-year period for each solution taking into account predicted water temperature increases as a result of climate change, as well as population increases up to 2021.

The standards state absolute levels for dissolved oxygen and stipulate for how long and how frequently the Tideway oxygen level can fall below this value and still be compliant thus:

Threshold 1 - the DO level in the Tideway must not fall below 4mg/l for longer than 29 consecutive tides on more than one occasion per year.
Threshold 2 - the DO level in the Tideway must not fall below 3mg/l for longer than 3 consecutive tides on more than one occasion every 3 years.
Threshold 3 - the DO level in the Tideway must not fall below 2mg/l for longer than 1 tide on more than one occasion every 5 years.
Threshold 4 - the DO level in the Tideway must not fall below 1mg/l for longer than 1 tide on more than one occasion every 10 years.

In order for the Tideway to be compliant with the overall DO objective, any proposed solution must ensure that the future Tideway water quality meets all three standards all of the time i.e. it is not acceptable for a solution to comply with thresholds 1 and 2, but fail on threshold 3. The allowable durations were included to reflect that fish populations can withstand moderately low DO levels (e.g. 4mg/l) for a period of time before this level becomes potential lethal, whereas much lower concentrations (e.g. 2mg/l) are likely to cause lethality within a much shorter time frame (i.e. 1 tide). The return period for each threshold was included to reflect the concept of sustainability i.e. that fish populations are more likely to be able to withstand moderately low DO levels more frequently without affecting the ability of a given fish species to maintain sustainable population levels.

The modelling results show that only complete tunnel Options 1a, 1b and 1c would be compliant with the DO objectives when the additional improvements resulting from the STW upgrades are also considered. All three West/East tunnel Options 2a, 2b and 2c fail the DO standards.

Although options 1a, 1b and 1c can meet the DO objectives, the frequency of spills where the solution is beaten is greater for 1b as a result of its smaller size. On average, it is predicted that options 1a and 1c will reduce the frequency of CSO spills from 70-105 spills a year without a solution in place to 3-4 times a year. Option 1b would result in 7-9 residual spills per year.

8.2 GROUND WATER

Broadly speaking, London sits upon five geological strata, each of which has distinctive hydrological properties. At the surface is a shallow layer of gravels, permeable to water. This in turn rests upon a broad layer of clay, of variable depth but typically extending downwards for 50m-60m. This London Clay is relatively impermeable to water and is the best tunnelling medium. Beneath the London Clay are sandier layers, the Reading and Woolwich Beds (the Lambeth Group), perhaps 25m deep, and the Thanet Beds, a further 10m deep. These two strata frequently hold groundwater. Below the Thanet Beds is a layer of Chalk, thoroughly permeable to water and a major aquifer.

There are a number of risks to water resources associated with the TTT. The key risks include:

- Contamination of groundwater
- Dewatering of aquifers
- Ongoing risk of contamination from the TTT itself

The potential for contamination during construction arises from two sources. Firstly the risk that shaft or CSO excavations may form a pathway for the transfer of any contamination to unpolluted groundwater in the lower strata. This impact is discussed in more detail in Section 11. Secondly the risk of groundwater contamination from the tunnel boring machine (TBM) itself. It is likely that the TBM will have to operate for some periods in ground that is permeated by water and the risk of contamination from such operations is an issue that will need further investigation.

Another risk is the possibility that tunnelling operations would create a preferential flow path for groundwater in the Reading and Woolwich Beds, the Thanet Beds, or the Chalk aquifers. Water is abstracted from these aquifers for a variety of uses and if the TTT were to cause their flows to be altered it is possible that supplies could be interrupted.

Dewatering will be necessary at some shaft sites during construction. Current regulations state that a temporary abstraction license from the Environment Agency will be required for this purpose.

Finally there is the ongoing risk of contamination from the TTT. As the tunnel is, in effect, carrying raw sewage through sources of potable water, any leakage to the surrounding groundwater would be serious. As discussed in Section 11, it is assumed that appropriate design and selection of materials will ensure that such a leak impossible.

8.3 Option Sensitivity

The likelihood of any groundwater effect arising as well as the extent of a worst-case effect will generally vary with the tunnel size.

9 BIODIVERSITY

9.1 INTRODUCTION

This section identifies the ecological receptors that may be affected by each of the TTT tunnel options and the associated infrastructure. At this stage potential receptors are limited to non-statutory designated sites and any known protected species. The presence of species controlled under Schedule 9 of the Wildlife and Countryside Act (1981) has also been considered, since it is an offence to 'plant or otherwise encourage the growth' of these plants. Relevant species in the context of this project include Japanese knotweed (*Fallopia japonica*) and giant hogweed (*Heracleum mantegazzianum*).

9.2 NON-STATUTORY DESIGNATIONS AND NATURE CONSERVATION POLICY

Non-statutory sites in London are divided into a hierarchy according to their ecological value. Sites of Metropolitan Importance for Nature Conservation (SMINC's) are important at a regional and sub-regional level and contain the best examples of London's habitats. They may also support rare species, populations, or assemblages of species.

Sites of Borough Importance are important from a borough perspective in the same way that the Metropolitan sites are important to the whole of London. There tends to be a significant variation in the ecological quality of these sites, since they are considered in a Borough context. Sites in Boroughs that are deficient in open space tend to be of lesser intrinsic value than those in Boroughs with a larger proportion of open space. Sites of Local Importance tend to be of particular value to people nearby, such as schools and residents.

All three categories of site are identified by the Greater London Authority (GLA) and adopted by the London Borough(s) in which the site lies. Once adopted, sites are generally referred to in the context of a Local Development Plan or Framework as Sites of Importance for Nature Conservation (SINC's). In some cases, where the nature conservation designation conflicts with a different proposed use, the Borough will not adopt SBI's and SLI's. SMI's are adopted in all cases.

9.3 APPROACH TO ASSESSMENT

Each of the SINC's which may be affected by the temporary or permanent elements of the TTT development have been identified on the Constraints Mapping (Appendix 4). The presence of any semi-natural habitats at each of the sites was noted during visits undertaken during October 2006. In combination, this information has been used to appraise in broad terms the relative ecological impacts of the tunnel options.

9.4 IMPACTS ON DESIGNATED SITES

9.4.1 River Thames and Tidal Tributaries SINC (M031)

Impacts on the Tideway Fisheries

The River Thames and Tidal Tributaries SINC (Site of Metropolitan Importance) supports a mixed population of marine, estuarine and freshwater and migratory fish. Key elements when assessing risk are those species, which have a high dependency on estuarine habitat quality during one or more life-stage. These include the following groups:

A - Estuarine resident species such as flounder, sand-smelt, smelt and goby;
B - Species that depend on the estuary as a nursery ground, e.g. bass

C - Migratory species that depend on good estuarine quality when moving between fresh and salt water, e.g. salmonids, eels.

Other groups of species are equally important but their sustainability is less dependent on the Tideway because their populations are spread over a much larger mosaic of habitats.

Fisheries work undertaken as part of the Thames Tideway Strategy (Turnpenny et al., 2004) investigated the lethality of acutely low DO levels associated with storm CSO discharges on species of groups A, B & C above. The aim was to identify risk to sustainability caused by short-term pulses of hypoxia (as opposed to chronic hypoxia caused by continuous discharges – known as 'oxygen sag'). The Tideway Fish Risk Model (TFRM) was developed as a tool for assessing the likely level of mortalities associated with CSO events. Within this context, it was proposed that a 10% annual mortality rate can be sustainable for the species in question, rising to >20% in some multiple-year-class species such as flounder or bass. It is important to understand this in order to fully appreciate the significance of the numbers of standards breaches reported in the table above.

Although the results shown above have not been put through the TFRM, the number of breaches in all cases will be lower than the present baseline condition, for which sustainability is indicated in most cases (see table below); salmon and smelt are, in particular, considered marginal at present. However, some fish kills can still be expected under these conditions.

Options 1a, 1b and 1c meet all the standards and are expected to achieve sustainability as well as the absence of significant fish kills and the absence of significant sub-lethal effects are not expected (sub-lethal effects described as – effects on fish behaviour, which may cause temporary disruption of populations and loss of habitat).

Option 2a, fails on the 4 mg/l standard but meets others. This indicates that under this regime, sustainability for most species is expected although this is marginal as the 3mg/l standard is borderline compliant, therefore a significant fish kill occurring infrequently is still likely: additionally, sub-lethal effects are expected for option 2a and there remains some risk of kills of sensitive species such as salmon, should events coincide with runs.

Options 2b and 2c fail on the 4mg/l standard as well as the 3mg/l standard hence sustainability is unlikely for these options as fish kills are likely to occur more frequently than the other options. As with option 2a, sub-lethal effects are expected for and there remains some risk of kills of sensitive species such as salmon.

Other Impacts on the SINC

Five of the 32 CSO/shaft sites will require land take from the River Thames and Tidal Tributaries SINC (Site of Metropolitan Importance). These are:

- Putney Bridge - 686m^2
- Jews Row and Falcon Bridge - 374m^2
- Heathwall Pumping Station - 4335m^2
- Fleet Main - 1053m^2
- Deptford Storm Discharge – Greenwich pumping station - 446m^2

The SINC is designated for supporting an assemblage of habitats unique in a London context. They include mud flats, shingle beach and inter-tidal vegetation. These habitats are particularly important for wildfowl and wading birds. The river supports over 100 species of fish and a number of nationally rare invertebrate species.

Effects on ecological effects on these sites include permanent loss of and temporary disturbance of inter-tidal mud flat. Depending on the time of year in which the works are undertaken, there is also potential for disturbance to wintering or breeding waterfowl.

Options 1a and 1b will utilise all five of the CSO shaft sites listed above (cumulative construction land take 6894m^2); whilst options 2a, b and c will utilise 3 of the 5 (Putney Bridge, Jews Row and Falcon Bridge and Heathwall Pumping Station (cumulative construction land take 5395m^2).

In addition to the likely losses as a result of CSO and shaft related works, there will also be additional losses from the construction of temporary jetties within the SMINC. Temporary jetties will be constructed at shaft locations at two sites on the River Thames; Heathwall, NESR. Both of these sites would be utilised for options 1 and 2.

At Heathwall a pontoon approximately 50m from, and parallel with, the shoreline will be constructed to allow materials to be delivered by barge. The pontoon will be connected to the shore by a jetty. An additional area between the pontoon and the shore will be used for a grout/bentonite plant (can this be correct? – drawing 50590/P/132. The total loss of inter-tidal habitat in this location will be 4,900m^2.

At NESR two platforms will be constructed perpendicular to the shoreline. The platforms will be approximately 30m in length and will be spaced 20m apart. Barges will land in the space between the two platforms. The platforms will be used as working and storage areas and will house grout and bentonite plants.

The total land take arising from inter-tidal habitats considered to be of Metropolitan importance will be approximately 6,400m^2. There is also likely to additional scour in the proximity of the structures and erosion caused by the movement of barges.

In the context of the overall SMINC this is a negligible area of inter-tidal habitat, and the impacts will be temporary. However, in order to meet the requirements of the Thames Tideway Encroachment Policy the EA are likely to require detailed reinstatement plans and there may be a requirement for additional enhancement measures once reinstatement is complete.

The location of the grout and bentonite plant above inter-tidal habitat, coupled with the movement of materials on and off barges presents a risk of pollution. Pollution may result in fish and invertebrate mortality and cause negative effects on waterfowl, all of which are protected through the SMINC designation. As a result, any pollution risk is likely to be considered significant in the context of the Thames Tideway. The risk will be controlled through a Construction Environmental Management Plan.

9.4.2 Beckton Ditches and Grassland SBI

For each of the options the TTT pump-out shaft and related STW extension at Beckton will be located within the Beckton Rectangle, which forms part of the Beckton Ditches and Grassland SBI (A GLA-designated site, not adopted within the LBN UDP). The site comprises rough grassland and ruderal vegetation communities characteristic of 'brownfield', or formerly used land. There is also a reed bed that has developed within a former sludge lagoon. The reed bed is known to support a number of breeding bird species including reed warbler (*Acrocephalus scirpaceus*) and reed bunting (*Emberiza schoeniclus*), and amphibians (smooth newt) and reptiles (grass snake). A small area at the southern end of the Beckton rectangle has been designated by LB Newham as a Site of Importance for Nature Conservation.

Construction of the pump-out shaft and related STW extension (using indicative layouts of October 2006) would result in land take from the Beckton Ditches and Grassland SBI and from the SINC described above

Option	Land Take (m^2)	Other Impacts
1a, 1b, 1c	2,692	Pontoons and jetties at Heathwall and NESR
2a, 2b, 2c	1,086	Pontoons and jetties at Heathwall

Complete reinstatement of the temporary jetty sites at Heathwall and NESR will be required following completion of construction. Enhancement of the shoreline, either here or in an alternative location may also be required to meet the requirements of the Thames Tideway encroachment policy. Mitigation for impacts on protected species and habitats during the construction stage of the project may include trapping and translocation of reptiles. Vegetation clearance would be undertaken during the winter period to minimise impacts on breeding birds and this clearance would also encourage reptiles to vacate areas and move to adjacent retained areas in advance of any translocation.

9.5 INVASIVE PLANTS

Two of the CSO/shaft sites, West Putney and Abbey Mills, were found to support stands of Japanese knotweed. The plant is also widespread within the Beckton Rectangle in the likely location of the TTT pump-out shaft and the related STW extension. All of these sites will be affected by each of the tunnel options.

Japanese knotweed may be treated either by direct removal of any arisings contaminated with shoots or rhizomes of the plant, or by in-situ treatment. Removal of arisings is expensive and often impractical, since the root system can penetrate to a depth of 3m and to a distance of 7m from the base of the plant. In situ treatment entails the use of a systemic herbicide, which is sprayed on to the foliage and transferred to the root system, thus killing the plant. In situ treatment may take over 2 years to complete.

9.6 CONSTRUCTION EFFECTS

	Significance without mitigation	Likely Mitigation Measures	Residual Significance
Full Options 1a, 1b, 1c	Moderate	Realign construction compounds so avoid SMINCs timing of works to avoid wintering birds?	Low
Partial Options 2a, 2b,2c	Moderate	Realign construction compounds so avoid SMINCs timing of works to avoid wintering birds	Low

9.7 OPERATIONAL EFFECTS

Detrimental Effects

	Significance without mitigation	Likely Mitigation Measures	Residual Significance
Full Options 1a, 1b, 1c	None	Not Applicable	None
Partial Options 2a, 2b,2c	None	Not Applicable	None

Beneficial Effects

	Significance
Full Options 1a, 1b, 1c	Aquatic ecology - Major positive – meets all standards in relation to dissolved oxygen levels. Terrestrial ecology - Neutral

	Significance
Partial Options 2a, 2b,2c	Aquatic ecology - Minor positive – improvement on existing situation, but fails 4mg/l dissolved oxygen standard and sub-lethal effects anticipated on some fish species. Terrestrial ecology - Neutral

9.8 Option Sensitivity

In all cases and in the absence of mitigation, the construction impacts (cumulative loss of foreshore habitats) are judged to be of moderate significance. Mitigation measures such as realignment of construction site boundaries should reduce the level of significance to a low level although some residual effects are probably inevitable, particularly in the vicinity of new jetty sites.

Given the relatively modest difference in temporary land take of designated habitats associated with the construction of the full and partial options, construction effects on biodiversity do not provide a strong discriminating variable between the options.

Any of the three full options are clearly more beneficial than the partial options in terms of aquatic ecology.

10 WASTES

10.1 CONSTRUCTION EFFECTS (ARISINGS)

As has already been stated in Section 6, the bulk of the arisings (from the tunnel and shaft sites) will be removed by barge. Where possible arisings from most of the CSO sites would be transferred to the temporary jetties and also removed by barge. It is however recognised that in some cases this may not be possible or desirable and that it may be more sustainable for arisings taken from CSO sites to be driven directly by HGV to the site(s) where it will be re-used. Wherever possible the arisings will be reused in new construction, although in a limited number of cases, where contamination is present, landfill disposal may be the only appropriate waste management option.

The arisings generated by each option is given in the table below.

Option	Tunnel	CSOs	Total
1a	2,314,264m^3	192,868m^3	2,507,132m^3
1b	1,732,265m^3	192,868m^3	1,925,133m^3
1c	2,357,772m^3	192,868m^3	2,550,640m^3
2a	1,802,385m^3	134,956m^3	1,937,341m^3
2b	1,382,285m^3	134,956m^3	1,517,241m^3
2c	1,338,203m^3	141,213m^3	1,479,416m^3

For each option, the volumes of arisings and the environmental impacts associated with its management and disposal are highly significant.

Mitigation can however be applied in respect of re-use of the arisings. Although it is difficult to predict aggregates markets years in advance of construction, there are strong current local markets for gravels, chalk and clays such that it is envisaged that the great majority of tunnel arisings will find a useful function within the London area.

In the case of any Abbey Mills-Beckton direct link (various options), at least half of any spoil generated from this link (assuming a 7.2m diameter) and which would arise at the Beckton construction shaft, would be required at the Beckton Rectangle to prepare the site for the construction of the STW extension.

The Environment Agency has indicated that, whilst timescales are uncertain, there may be an opportunity for using TTT construction arisings within new flood defences which are planned within the Thames Estuary over the coming decades within the Agency's own "T2100" flood defence programme.

Irrespective of the mitigation applied, given the volumes of arisings that require management / transport, it is unlikely that the scale of the residual effects can be reduced substantially and at this stage the residual effects are best regarded as of high significance for all options.

10.2 OPERATIONAL EFFECTS (SEWAGE SLUDGE)

An increase in the volume of sludge generated at Beckton STW (and Crossness STW in the case of the partial options) will be the main operational waste impact of the TTT. The volume of TTT derived sludge will vary from day to day but TWUL has calculated that the long-term daily average values

would be in the range of eight to twelve tonnes of total dried solids (TDS). This range is applicable to all the tunnel options.

The volume and mass of waste removed from the site on a daily basis would depend on the occurrence of storm events and on the treatment option adopted: incineration, liming or digestion. While the average daily volume attributable to the TTT would represent only a very small increase over the average of 344 tonnes TDS currently being produced at Beckton STW, it is nevertheless subject to peaks and troughs corresponding to the need for pump out of the tunnel.

Mitigation can be applied in respect of the operational wastes. The most effective mitigation, and TWUL's preferred solution, is to use energy recovery with the subsequent grate ash being re-used within construction materials. Other treatment options include digestion, which does generate modest volume & mass reduction and enables generation of biogas for energy use, and liming, which actually increases volume / mass (by use of imported lime) but enables subsequent use for land-spreading rather than landfill disposal.

If energy recovery is used as the sludge treatment option, given the substantial reductions in volume that can be achieved, the residual effects of the operational wastes arising are judged to reduce from moderate to low. For other sludge treatment solutions, given the modest volume reductions (or increase for liming), the effects of the waste are judged to remain at moderate significance.

10.3 Option Sensitivity

As would be expected, the full options generate somewhat greater construction wastes on average than the partial options (2m-2.6m m^3 for full solutions, 1.6-2.1m m^3 for partial options). However they are of similar scale and construction waste volumes do not appear to offer a useful mechanism for distinguishing between the options. Phasing would extend the total construction period but since the total volumes would remain the same for any option, the arisings during a given time period (e.g. monthly, yearly) would be lower than for a non-phased solution.

Each of the options result in similar sludge arisings and assuming any particular treatment options are valid for each TTT option, for any given treatment solution, the residual volumes would be similar. As for construction wastes, operational wastes are unlikely to offer a useful mechanism for distinguishing between the options.

11 CONTAMINATION

11.1 BACKGROUND

All of the TTT options will require substantial excavation of arisings (see 9.1 above) although the majority of this will be tunnel bored from deep strata and therefore unlikely to be grossly contaminated. However the subsurface works for CSOs and shafts have perhaps a greater risk of encountering contamination. In addition, the STW extension for the TTT is likely to be located on the Beckton Rectangle, an area with variable contamination including some hot spots of gross pollution.

11.2 APPROACH TO ASSESSMENT

With the exception of the Beckton Rectangle, no technical investigations have been undertaken into the extent of likely contamination at any of the shaft or CSO locations. However the opportunity to review the *potential* for contamination at each shaft location has been taken by reviewing historic mapping and records of known pollution incidents from the Environment Agency databases.

It is assumed that any impacts from existing contamination will arise, or at least be triggered during the construction phase of the project. It is assumed that operational effects, such as potential for the TTT itself causing pollution through leaks or catastrophic failure, will not arise with the use of modern engineered techniques and materials.

11.3 CONSTRUCTION EFFECTS

The following potential for contamination were noted at the shaft sites.

Shaft	Specific Issues	Summary of Contamination Risk
Homefield	Brewery, active, within 250m	Low
Heathwall	Paint Works within 140m, Coke Plant, Sludge Pit, Tanks within 250m Pumping Station on site	High because of major industrial use with possible polluting sources
NESR	Historic Iron Foundry 250m NE Sewer Pumping station on-site	Moderate
Abbey Mills	Historic chemical works & oil storage nearby ((140m, 220m) Sewage Pumping Station	High because of major industrial use with possible polluting sources
Charlton	Historic Paint works, Iron Foundries all within 50-200m	High because of major industrial use with possible polluting sources
Beckton STW	Historic Gas works Extensive STW Industrial Areas to East	High/ Certain: because of known contamination arising from adjacent gas works and other sources

The risk of encountering existing contamination at the construction shafts thus appears high in the majority of cases and clearly a proportion of excavated material in some of these locations will be contaminated although this cannot be quantified without further investigation.

Whilst no similar review has been undertaken of the 36 CSOs, it is clearly likely that given their proximity to the river, and the many previous industrial uses of the riverfront, an unknown proportion will be contaminated. The principal risk of contamination results from the construction of links between CSOs and the TTT. This could create a pathway for pollution across strata from the (potentially)

polluted surface layers to the lower layers of clay and chalk that can be assumed to be free of contamination.
However it is very unlikely that a new pathway will be created as the construction method for the CSO shafts includes pressure grouting to the outside of the shaft segments, sealing any gaps/cracks/pathways. The diaphragm wall method of construction for the main shafts entails placing the concrete of the walls in direct contact with the excavated faces. Further more the shafts are very deep, therefore there is a very low likelihood of a pathway being created.

Based on the above review, the construction effects in relation to contamination are judged to be highly significant for all options. Mitigation can however be applied by removal or in situ treatment of contamination encountered or by using appropriate working methods to minimise the risk of mobilising contamination. Once appropriate studies have been undertaken, the true extent of contamination defined and with appropriate mitigation measures in place, it is possible that the residual effects (of all options) will be of moderate significance.

11.4 Option Sensitivity

The one shaft that is included within the full options, but excluded from all of the partial options, is NESR and this seems to be at only moderate risk of contamination. Options 2a and 2b, which exclude the Charlton Shaft, would avoid the high risk of contamination at that location. However, in general since the effects of contamination can be mitigated, the relatively modest differences in risk between the options do not assist greatly in distinguishing between the acceptability of the TTT options.

12 NOISE AND VIBRATION

12.1 Construction Effects

All of the TTT options would represent major construction projects, much of which will be carried out within the urban environment in relatively close proximity to a large number of noise and vibration sensitive receptors. Whilst the tunnel boring would be at depth and noise is likely to be mitigated by this, noise impacts at shaft locations may be much more substantial, since they represent construction sites, which will be active for extended durations and in some cases in relatively close proximity to residential areas. CSO works might also generate significant noise effects but the more limited duration of these works would ensure their overall significance would be less.

Partial TTT options would generate fewer noise impacts than the full solution, given that there is one-two fewer shaft sites and 16-17 fewer CSOs. However all of the TTT options are considered likely to generate highly significant noise effects during the construction period.

Mitigation of effects at individual sites should be possible using appropriate noise control techniques. This would include maximising source-receptor distances where feasible (particularly for any static noise sources e.g. compressors, generators) and by work-site enclosure using acoustic barriers. Given the potential for mitigation at individual sites, it is likely that the overall significance of residual noise effects for all TTT options can be reduced to moderate significance.

It is important to note that no predictive noise or vibration calculations have yet been made although this would be an important part of the Environmental Impact Assessment of any preferred option that was progressed.

12.2 Operational Effects

Operational noise and vibration impacts are unlikely to be significant since the main new pump out at Beckton STW would be remote from sensitive receptors. Although full details of mechanical ventilation systems for the tunnel are not available, any noise and vibration effects are thought unlikely to be significant. Further consideration will be given to such effects if any plant data becomes available.

12.3 Option Sensitivity

All of the TTT options are, likely to generate highly significant noise effects during construction which with appropriate mitigation at each shaft and CSO site might be reduced to moderate or low significance. The cumulative effect of construction noise effects of any TTT option are likely to be of the same order of magnitude since the effects at the shaft sites are likely to be much greater than at CSOs and the partial options include just one or two less shaft sites (although 16-17 fewer CSOs).

Construction noise effects are not judged to represent a robust mechanism for distinguishing between the acceptability of the TTT options.

13 TRAFFIC AND TRANSPORTATION

13.1 INTRODUCTION

Works associated with the excavation of the tunnel and connecting the CSOs to it will lead to some traffic disruption. TWUL uses a model to make estimates of the costs of traffic disruption generated by street works, principally mains replacements or leakage repairs.

13.2 LONDON TRAFFIC DISRUPTION MODEL

The model requires the following inputs:

- Type of road: designed to take account of variations between A roads, B roads and residential roads
- Traffic profile: hourly variation of traffic flows throughout the day, standard assumptions made for each type of road
- Type of event: mains replacement or leakage repair
- Restriction type: width restriction, shuttle working or road closure
- Duration of works
- Travel costs: the value of “travellers” time and vehicle operating costs

13.3 CONSTRUCTION IMPACTS - IN-CARRIAGEWAY WORKS

A judgement of the likely effect of in-carriageway construction in relation to CSOs can be given by considering the types and importance of the roads where in-carriageway works will be required. The more important the road and the greater the duration of works within the carriageway, the greater the likely effect. The CBA project team is estimating the social costs associated with these effects. The effects are summarised below:

Option	Construction Effects		
	Road Closure	Road Narrowing	Shuttle Working
1A	UAP1: 0 UAP2: 1 UAP3: 1 UAP4a: 2 UAP4b: 4	UAP1: 2 UAP2: 1 UAP3: 1 UAP4a: 0 UAP4b: 1	UAP1: 4 UAP2: 1 UAP3: 0 UAP4a: 0 UAP4b: 0
1B	UAP1: 0 UAP2: 1 UAP3: 1 UAP4a: 2 UAP4b: 4	UAP1: 2 UAP2: 1 UAP3: 1 UAP4a: 0 UAP4b: 1	UAP1: 4 UAP2: 1 UAP3: 0 UAP4a: 0 UAP4b: 0
1C	UAP1: 0 UAP2: 1 UAP3: 1 UAP4a: 2 UAP4b: 4	UAP1: 2 UAP2: 1 UAP3: 1 UAP4a: 0 UAP4b: 1	UAP1: 4 UAP2: 1 UAP3: 0 UAP4a: 0 UAP4b: 0
2A	UAP1: 0 UAP2: 1 UAP3: 1 UAP4a: 0 UAP4b: 2	UAP1: 1 UAP2: 1 UAP3: 1 UAP4a: 0 UAP4b: 0	UAP1: 0 UAP2: 0 UAP3: 0 UAP4a: 0 UAP4b: 0

Option	Construction Effects		
	Road Closure	Road Narrowing	Shuttle Working
2B	UAP1: 4 UAP2: 1 UAP3: 0 UAP4a: 0 UAP4b: 0	UAP1: 1 UAP2: 1 UAP3: 1 UAP4a: 0 UAP4b: 0	UAP1: 0 UAP2: 0 UAP3: 0 UAP4a: 0 UAP4b: 0
2C	UAP1: 4 UAP2: 1 UAP3: 0 UAP4a: 0 UAP4b: 0	UAP1: 1 UAP2: 1 UAP3: 1 UAP4a: 0 UAP4b: 1	UAP1: 0 UAP2: 0 UAP3: 0 UAP4a: 0 UAP4b: 0

UAP1: High standard single/dual carriageway road carrying predominantly through traffic where Transport for London is the highway authority (all "A" category roads);
UAP2: Good standard single/dual carriageway road carrying predominantly through traffic where London Boroughs are the Highway Authority (predominantly "A" category roads);
UAP3: Variable standard road carrying predominantly local traffic with frontage activity including loading and unloading (predominantly "B" category roads);
UAP4A: Predominantly residential roads with some through traffic observed
UAP4B: Residential roads used for local access (little or no through traffic)

The table above demonstrates that the combined CSO works for the full solutions (1a, 1b, 1c) will impact a greater number of "high standard" single/dual carriageway roads where Transport for London is the highway authority (six for the full solutions compared with just one for the partial solutions). The majority of these CSOs works within "high standard" single/dual carriageway roads are on the Embankment in Central London for the full options, 1a, 1b and 1c.

	Significance without mitigation	Likely Mitigation Measures	Residual Significanc
Full Options 1a,1b,.1c	High	Advance warning and signage Traffic Management Measures	High/Moderate
Partial Options 2a, 2b,2c	High	Advance warning and signage Traffic Management Measures	High/Moderate

Mitigating the effects of lane closures and other in-carriageway works in the urban environment with high traffic volumes is problematic. It may be achievable in part by a combination of advanced notice and warning signs to drivers and well-designed and adaptable traffic management measures. In some critical areas, perhaps only nighttime or weekend working may be acceptable.

13.4 Construction Impacts - HGV Movements

At the present time it is unclear what the construction impacts are likely to be. Clearly the main long-term effects will be experienced at the shaft sites through the delivery of construction material by HGV, although there is likely to be some short-term disruption at the CSO sites.

In general the bulk of the construction materials will be delivered by barge, although some road deliveries will be necessary particularly during the opening phases of construction. Similarly the waste arisings will be removed by barge, avoiding the use of roads wherever possible.

13.5 Option Sensitivity

In all cases and in the absence of mitigation, the traffic related construction effects are judged to be of high significance. Disruption has the potential to be extensive. Mitigation measures such as advanced warning and signage and carefully determined responsive traffic management measures will help reduce the level of significance but some residual effects are inevitable.

14 ARCHAEOLOGY AND CULTURAL HERITAGE

14.1 BACKGROUND

Unknown archaeological resources are, by their very nature, impossible to quantify. However any preliminary appraisal is undertaken on the basis of risk assessment to understand the likely scale and significance of impact on buried archaeology. Much of the construction work related to the TTT would occur in the Archaeological Priority Area around the Thames and this area is known to be of archaeological importance because of past finds, excavations and historical interest.

Features of above ground cultural heritage, notably Listed Buildings are well distributed along the route of the TTT with some Listed Buildings in close proximity to the alignment (see Mapping).

14.2 CONSTRUCTION EFFECTS

Most of the tunnel will be constructed at depth within rock (chalk) strata and this will not contain archaeological resources. However in surface layers and particularly where sites have been undeveloped the chance of archaeological finds is relatively high. Since the excavations in surface layers is a relatively small part of the total excavation for each option, the significance of the effect on unknown resources is here judged to be moderate.

Appropriate archaeological watching briefs at each location where excavation is undertaken will mitigate detrimental impacts on resources. In most cases a process of recording and preserving finds ex-situ should provide an acceptable approach. With appropriate mitigation measures in place, which have been agreed with the Greater London Archaeological Advice Service (GLAAS), the residual effects on archaeological resources are likely to reduce to low significance for all options.

Any potential for impacts on listed buildings will need to minimised on a case-by-case basis. Whilst none of the options should lead to direct impact upon listed buildings, vibration assessments may need to be carried out in some cases (see also 11) and other measures may be required when worksites for CSOs are nearby. There may for example need to be particularly rigorous controls on materials storage and dust in the vicinity. The potential effects on Listed Buildings are judged to be of moderate significance but once mitigated by appropriate site-specific measures, the residual effects on listed buildings are likely to reduce to low significance for all options.

14.3 OPTION SENSITIVITY

While it is arguable the importance of cultural heritage receptors in central London outweighs those elsewhere on the TTT route, in practice the significance of effects on both archaeological resources and listed buildings is unlikely to vary between the options. Site-specific mitigation should enable problematic impacts to be reduced to acceptable levels at any given site. Archaeology and cultural heritage is therefore not considered to be a useful mechanism for distinguishing between the acceptability of the various TTT options.

15 FLOOD RISK & CLIMATE CHANGE RESPONSE

15.1 FLOOD RISK

Given the nature and objectives of the project all development will be either close or under the Thames Tideway and therefore the issues of flooding and flood risk must be considered. In this regard there are number of sub-issues relating to flooding and inundation of the tunnel itself and impact on existing flood defences.

The basic principles of flood risk require development to seek to prevent an increased risk to life and/or flooding to third party land and property as well as the development itself, and wherever possible it should reduce flood risk. Accordingly the preferred position is that development should reduce the existing flood risk situation, whilst the absolute minimum is that development should not add to this risk.

All of the sites of the shafts and sewage treatment works (STW) are presently protected by flood defences (tidal and fluvial) of an appropriate standard. Therefore In order to prevent any increased flood risk to the development itself and the wider area benefiting from the presence of the defence, it is essential that the development in no way compromises the existing flood defences due to either the location, design or construction of the development. It will be necessary for access to be provided to the defences for the maintenance or modification. To facilitate this a minimum of 10 metres clearance from the defences should be provided.

Further mitigation against flood risk may be via the design specification of the surface works. This could require that the shaft sites are elevated to further reduce the risk of inundation should the existing defences be breached. Alternatively, the shaft sites and CSO covers may need to be water tight to prevent any flood water entering the tunnel via either the shafts or CSOs. The latter would minimise the visual impact of the shafts and may be preferable to raising the shaft sides, particularly in the areas of public open space, where a raised platform would have no obvious open space related function.

It should also be noted that the CSOs will continue to be connected to existing outfalls. Therefore should the capacity of the interceptor be exceeded the CSO would revert to discharging directly into the river and therefore local flood risk is not increased. In some cases the new works at CSO sites will improve existing drainage and reduce current flood risk.

15.2 CLIMATE CHANGE

It is widely accepted that accelerated climate change is occurring. We will experience hotter drier summers with more intense rainstorm events, warmer wetter winters, rising sea levels and more frequent storm surges. Whilst measures to address the causes of climate change are being taken, it will be necessary to respond to the changing climate. This will include the increased risk of flooding from tidal, fluvial sources as well as surface water run-off.

The Tideway project has been conceived for the purposes of reducing the frequency of untreated discharges of sewage from the combined sewer into the Thames Tideway. This should deliver significant water quality, amenity, recreation and ecological benefits as summarised at 8.1. In order to ensure that this is properly achieved, the increase in flows likely to be experienced in the combined sewer system as a result of the changing climate - both wetter winter and intense summer storms - must be fully factored into the feasibility and assessment of the various options. The partial tunnel options will deliver less capacity for the storage of increased flows resulting from climate change and may result in more frequent discharges of untreated sewage (than other options), as may the decision to limit treatment capacity at the STW. The full tunnel solutions are therefore more resilient as they have greater storage capacity and are therefore more capable of responding to storm surges without having to discharge into the river.

The increased risk of tidal flooding is likely to be managed in the Tideway with flood defences being maintained in the future. The development must not compromise the ability for these defences to be maintained, upgraded or realigned, for land to be designated for the purpose of surface water, fluvial and tidal flood storage, and for land to be raised as part of a flood risk management strategy.

In the upper reaches of the Thames Tideway in the next 30 years, due to the impacts of climate change it may no longer be possible to use the Thames Barrier to prevent fluvial flooding (through preventing the inflow of tidal waters and thereby increasing capacity for fluvial flood storage in the Thames).

The increased frequency of intense summer storms is likely to result in increased surface water run off and sewer flooding. In response to this increased risk of flooding, it will be necessary for buildings, utilities and facilities to be constructed to be flood resilient and for them to remain operational during flood events. These impacts have been considered in the modelling.

In order to respond to the impacts of climate change, sustainable construction methods should be employed as part of the development to cool and shade facilities and minimise further adverse impacts such as odour. Such methods may include green roofs, shading from planting, orientation of buildings, less glass.

16 SUSTAINABILITY

16.1 BACKGROUND

The Mayor of London recently released a SPD on Sustainable Construction to support the implementation of the London Plan and, in particular, Policy 4B.6 on Sustainable Design and Construction. Policy 4B.6 states that:

> *The Mayor will, and boroughs should, ensure future developments meet the highest standards of sustainable design and construction and reflect this principle in UDP policies. These will include measures to:*
>
> - *Re-use land and buildings*
> - *Conserve energy, materials, water and other resources*
> - *Ensure designs make the most of natural systems both within and around the building*
> - *Reduce the impacts of noise, pollution, flooding and micro-climatic effects*
> - *Ensure developments are comfortable and secure for users*
> - *Conserve and enhance the natural environment, particularly in relation to biodiversity*
> - *Promote sustainable waste behaviour in new and existing developments, including support for local integrated recycling schemes, CHP schemes and other treatment options (subject to Policy 4A.1 and 4A.2).*
> - *Applications for strategic developments should include a statement showing how sustainability principles will be met in terms of demolition, construction and long-term management.*
> - *Boroughs should ensure that, where appropriate, the same sustainability principles are used to assess planning applications.*

The SPG provides guidance on the way that measures identified in the policy can be implemented to meet the London Plan objectives. The SPG itself is structured around seven objectives. The intention is that it will give both Local Planning Authorities and developers clear guidance on how sustainable development can be achieved.

The SPG applies to all 'major' developments, which are referable to the Mayor. It includes a series of 'Essential Standards', which apply to all major developments in London, and a second tier of 'Mayor's Preferred Standards', which indicate exemplary benchmarks that are not yet policy requirements.

Although the SPG provides some guidance on how the Standards might be achieved, it is not prescriptive. Likewise, it identifies the various methods and tools by which performance against the Standards might be measured, but again it is not prescriptive. It is, therefore, the responsibility of the applicant to ensure that performance is appropriately assessed and demonstrated.

TWUL notes that many of the standards set out in the SPG are specifically related to residential development, or buildings that will be occupied for some period of time. The TTQI works differ greatly from a residential development and a large number of the Standards are not directly relevant. The corollary to this is that there are also Standards which are relevant to STW and related development, but which are not included in the SPG. It has, therefore, been necessary to develop additional

sustainability principles and standards to supplement those contained within the SPG. The resultant Sustainability Appraisal is included as Appendix 2.

A workshop held by TWUL specifically to review the objectives in relation to STWs concluded that the following 13 Objectives were appropriate (the first seven are from the SPG):

1. Maximise re-use of land and buildings;
2. Maximise use of natural systems both within and around the development;
3. Conserve energy, materials, water and other resources;
4. Reduce the impacts of noise, pollution, odour*, waste*, flooding and micro-climatic effects upon the local community and environment;
5. Ensure developments are comfortable and secure for users;
6. Conserve and enhance the natural environment and biodiversity;
7. Promote sustainable waste behaviour in new and existing developments;
8. Contribute to London's self-sufficiency with regard to wastewater treatment for the long-term. (growth & social function of providing wastewater treatment for London);
9. Ensure the development is value for money for customers, job creation (especially construction phase - using local labour and sourcing supplies locally);
10. Minimise the impact of the development on the road network;
11. Conserve the built environment (e.g. quality of design) and cultural resources;
12. Conserve and enhance community involvement and facilities; and
13. Sustainable Construction.

16.2 Application to the TTT Options

The Sustainability Framework identified above was applied to the TTT options during a workshop held in October 2006 between relevant TWUL staff, including planners, engineers and environmental specialists as well as the appointed consultants.

Whilst there was clearly no opportunity to include detailed sustainable design measures on design drawings within the workshop, the potential for including many measures was explored in a more generic sense. Particular consideration was given to any likely differences between the Options and whether these might be a material consideration in any decision making process.

16.3 Workshop Conclusions

In general very few substantive differences between the options were identified and this accords with the results of the environmental appraisal work summarised in Sections 5 to 15 of this report. The following points were noted:

16.3.1 Maximise re-use of land and buildings

In most cases above ground works for both the CSOs and the shafts will be on previously developed land, which in some cases will be contaminated, thus affording the possibility of local remediation (by arisings removal) in some cases. In a few cases, i.e. shaft sites at Homefield and NESR (Option 1) only, new permanent structures will be required in areas that are currently open land. There are relatively few differences between the Options except in respect of Open Land at NESR.

16.3.2 Maximise use of natural systems both within and around the development

The potential for use of natural systems is limited for all options although the horizontal transport of sewage along the TTT is a gravity system (with mechanical pump-out at Beckton STW (or Heathwall PS in the case of the Partial Options - West Tunnel. Due to tunnel length mechanical ventilation will be required for all TTT options. In general the use of natural systems is likely to be limited to the few above ground structures where there is potential for green roofs and some landscape planting.

16.3.3 Conserve energy, materials, water and other resources

The operational development will require energy, primarily for pumping at Beckton but also for mechanical ventilation at shaft sites. TWUL will meet or exceed the relevant GLA policy requirement in respect of Renewable Energy contribution at the appropriate time. A preferred solution may include energy recovery from sludge, bio-diesel generators or on-site wind turbines at Beckton STW.

As a major infrastructure project, the construction of the TTT will undoubtedly use substantial resources, notably concrete and steel. The embodied energy of materials is also likely to be high. Resource use will be minimised wherever possible with recycled, locally sourced products used in preference to virgin products, which require transport over long distances. Subject to structural requirements, Portland cement substitutes such as fly ash and slag will be used in concrete where appropriate and this should be the greatest opportunity for achieving the Mayor's 10% target for recycled & reused content.

The large volumes of arisings produced (up to 2,360,000m^3 for Option 1c for the tunnel excavation, excluding the CSOs) will be re-used wherever possible and the Demolition Protocol will be used to quantify materials and identify markets for materials.

16.3.4 Reduce the impacts of noise, pollution, odour*, waste*, flooding and micro-climatic effects upon the local community and environment

During construction, noise impacts will arise at all shaft sites and also at CSOs although the latter will be of much shorter duration. The Considerate Constructors Scheme would be adopted in addition to any noise controls that are imposed as planning conditions or through other control procedures. Noise impacts during operation should be minimal.

Odour is likely to remain the main potential for impact during the operational phase although an engineering solution including odour control units should ensure there are no significant operational effects in the vicinity of the vent sites. At Beckton STW, the TTT extension should be odour neutral.

There will be modest opportunities for inclusion of Sustainable Urban Drainage Systems (SUDS), including permeable paving, green and brown roofs within the operational development as there are so few above ground structures but all opportunities for inclusion will be explored during the design stage. Microclimate considerations are not considered likely to be problematic or impose constraints upon design.

16.3.5 Ensure developments are comfortable and secure for users

The objective is not directly relevant to the main TTT development. The TTT including above ground infrastructure will not have any public access and all operational access points (e.g. the vent shafts) will be secure to exclude the potential for unauthorised access. Secured by design principles will be adopted and these will be implemented in accordance with the recommendations of a Crime Reduction Design Adviser.

16.3.6 Conserve and enhance the natural environment and biodiversity

Some open space will be lost during construction at some the shaft sites and several CSOs. Such space will be largely reinstated to the former use once the development is operational except for the immediate landtake requirements for the vent shaft footprints and any supporting infrastructure (odour control plant, access points, fencing). In such cases (Homefield, all options and NESR, full options only), community features such as a Mixed Use Games Area (MUGA) may need to be provided to compensate for loss of any open space and in particular the recreational function of that space.

Some habitats will be lost or damaged during construction (e.g. shaft sites, temporary jetty locations) but in almost all cases, reinstatement of habitats (and probably their enhancement) will be possible

once TTT construction is complete. Permanent habitat loss at Beckton STW for the TTT related treatment plant will need to be offset by on-site habitat enhancement, probably on the Creekside SNCI or in the area to the north-west of Beckton Rectangle. The use of green and brown roofs on the few relevant buildings and structures will provide modest opportunity for additional habitat gains.
The TTT development primary function is to improve the water quality and thereby the ecological status of the Thames Tideway. Once operational the TTT should deliver substantial benefits in respect of biodiversity gains, notably in respect of fish populations since the river will suffer fewer pollution events. The benefits are greater with the full solutions than with the partial solutions (see Section 9).

16.3.7 Promote sustainable waste behaviour in new and existing developments

All options will generate considerable volumes of arisings. As stated above (at 16.3.6), the use of the Demolition Protocol will assist in identifying local markets for the materials produced. The successful local waste management and transport of these materials will be key to the sustainability of the project during construction.

The operational development will generate sewage sludge and at present it is anticipated that the calorific value of the sludge will be utilized through energy recovery.

16.3.8 Contribute to London's self-sufficiency with regard to wastewater treatment for the long-term

All TTT options would play a fundamental role in the capture and short-term storage of CSO spills, which would have otherwise been released untreated to the Tideway, enabling the captured material to be treated before it is released through the STW effluent channel. The design life of the TTT itself is defined as 100+ years. Given its function and the design life, the TTT will have a long–term role as a key element of London's wastewater collection and treatment infrastructure. The additional benefits of the full solutions compared with the partial solutions are covered elsewhere within this report, most notably at Section 8: Water Resources, Section 9: Biodiversity and Section 15: Flood Risk and Climate Change Response.

16.3.9 Ensure the development is value for money for customers, job creation

Cost Benefit Analysis is being carried out by TWUL to ascertain the sector benefits associated with improving the water quality of the Tideway. It is anticipated that it will assist in growth and regeneration and benefit local fisheries. Whether this will represents value for money for customers is being determined by the funding PWG (and other Project Working Groups) and in particular by key stakeholders such as Ofwat and the Consumer Council for Water (CCWater).

Job Creation will be substantial during the construction phase and for most of the construction period about 1000 construction workers and support staff are likely to be employed at any given time. There will be few jobs associated with the operational development.

16.3.10 Minimise the impact of the development on the road network

The construction of the TTT is likely to generate significant effects on the road network in respect of both HGV generation (construction materials import and some arisings movements) and in-carriageway works to link the CSOs to the TTT. The impact will be minimised by using river transport as much as possible, notably for tunnel arisings. The full options, which include in-carriageway CSO works within important roads in central London, seem likely to generate more disruption than the partial options which avoid this area.

Extensive further traffic assessment will be required for any option, but for any option a comprehensive Green Travel Plan, combined with a well designed waste management strategy and responsive traffic management measures should reduce disruption to acceptable levels.

16.3.11 Conserve the built environment (e.g. quality of design) and cultural resources

All of the TTT options traverse London and it is inevitable that the route passes a large number of Listed Buildings, which could be impacted by vibration or surface works at CSO or shaft sites. Any possible impacts to cultural assets from vibration are likely to be largely mitigated by the depth of the tunnel. Nevertheless further site-by-site evaluation would be needed, notably in respect of the most important buildings including World heritage Sites in Central London in respect of the full TTT solutions.
The potential for archaeological finds is high in many areas although the impacts can generally be mitigated by implementation of an effective watching brief and the recording and preservation of all noteworthy artefacts.

There are few above ground structures associated with the TTT itself although there will be a clear need to ensure high quality design that, where possible, is in keeping with the local vernacular in respect of above ground works for both the main vent shafts and the CSOs.

16.3.12 Conserve and enhance community involvement and facilities

The TTT and the improvements to the Tideway that will result (in respect most notably of improved microbial standards and the reduction in sewage-derived-litter) will generate community benefits and these benefits are being addressed by the CBA team. In general the greatest benefits to the3 Tideway and thus its recreational and amenity value can be expected with the full solution.

There will be disruption during construction to recreational facilities within open spaces at Homefield (and the NESR for the full solutions, as well as a few CSOs) and minor permanent landtake at these sites to provide vent shafts. These largely temporary effects have to be offset against the long-term benefits associated with the Tideway improvements

Community involvement has been facilitated to date far by the Stakeholder event in November 2006 to which a total of 46 organizations, all with local interests, were invited (see Section 17 for full details). Once an option is selected further involvement is likely to be possible through the EIA scoping process, appropriate representations during the planning process and any further stakeholder events and exhibitions that may be arranged.

16.3.13 Sustainable Construction

Appropriate policy guidance will be adhered to in respect of controls on construction whilst to reduce the construction impacts on local residents further in the vicinity of shaft and CSO sites, the Considerate Constructer's Scheme will be adopted by the project. A target of 32 out of 40 will be set for all sites through specification in the contractor's preliminaries and identified in the Environmental Management Plan.

Close attention will be paid during construction to material use, the potential for re-use and use of recycled materials and local sourcing. Further consideration in respect of waste management and material use is provided above.

17 STAKEHOLDER ENGAGEMENT

17.1 INTRODUCTION

The promotion of any TTT options will require extensive stakeholder engagement both prior to and throughout any planning application and other consenting procedures. This engagement would be undertaken via a series of requirements some of which are statutory and some of which are discretionary. In terms of the key stakeholder engagement requirements these are summarised below. Previous consultation is respect of the earlier TTSS is discussed in the Introduction to this report.

17.2 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Any TTT option taken forward through the planning process would be subject to EIA. TWUL's approach for any major development, which accords with EIA best practice, is to submit an EIA scoping report to the relevant planning authority for comment. The authority then has five weeks to solicit comments from consultees (typically statutory bodies) before returning a Scoping Opinion to the applicant. The scoping process thus provides a mechanism for ensuring that the scope of EIA studies undertaken is appropriate, that all key issues are addressed and that the statutory bodies are aware of the proposals and the potential for environmental effects.

17.3 STATEMENTS OF COMMUNITY INVOLVEMENT (SCIS)

Government has recognised the importance of active stakeholder engagement in all stages of the planning process, from policy formulation through to the determination of individual planning applications. This focus is now enshrined in legislation in the form of Statements of Community Involvement (SCIs) as required by Section 18 of the Act.

All LPAs are required to produce SCIs and these are produced early on in the plan making process so the requirements included within each SCI can be applied to subsequent planning policy documents and certain planning applications.

In the case of TTT there are 12 London Boroughs who will need to give consideration to individual planning applications. Each of these Boroughs will have either produced an SCI or be in the process of producing one. Whilst there is guidance on the production of SCIs there is a good degree of flexibility in terms of their individual requirements. Accordingly, no two SCIs will be identical and therefore each will adopt slightly different approaches to stakeholder engagement. In addition all SCIs need to be deliverable and therefore resourcing plays a key role in defining the scope of SCIs and often the aspirations for stakeholder engagement are restricted by the resources available to implement them.

Notwithstanding this resource-based issue, in the case of planning applications the onus for stakeholder engagement is placed firmly with the developers. LPAs are responsible for defining the terms of any engagement, whilst developers will generally undertake it and report the results. The LPA will then assess the exercise in light of the results reported to them by the developer.

17.4 PLANNING APPLICATIONS

Once SCIs are adopted they will set out the consultation requirements for all planning applications. The most onerous requirements will be applied to major planning applications where the impacts of any development are greatest.

In the case of TTT it is likely that a series of pre-application community based events will need to be undertaken as a minimum. Any subsequent planning application will need to include a statement setting out the extent of stakeholder engagement and how the scheme has been able to respond positively to any comments or concerns raised. The SCI process is therefore designed to encourage

greater participation in the planning process and genuine community influence on schemes and local decision-making.

By the time formal planning applications are submitted for the TTT it is likely that all constituent boroughs will have approved SCIs and therefore there will be a formal requirement to undertake stakeholder engagement exercises in accordance with each of them. In addition, where SCIs have been published but not yet approved the Boroughs will treat them as material considerations in the determination of individual planning applications and therefore general compliance with draft SCIs may well be required although absolute compliance would be more difficult for individual Boroughs to insist on whilst their SCI remains in draft form.

17.5 Voluntary Procedures

The existing planning applications consultation procedures are limited. Potentially these could be relied upon if a planning application was submitted prior to the approval of a SCI. Essentially they comprise a combination of consultation and notification once the application is submitted and nothing beforehand, other than that volunteered by TWUL through seeking a Scoping Opinion within the EIA Process (see 17.2.1 above).

In practice a scheme such as TTT would recognise the importance Government is now placing on Stakeholder Engagement and would not seek to rely on existing basic consultation requirements irrespective of the status of any SCI. Accordingly, TWUL would initiate or encourage project partners to initiate, their own comprehensive stakeholder programme. This has been undertaken on numerous major infrastructure projects and would be tailored to the project, the issues and the community interface.

17.6 TTT Optioneering

All of the above applies in the case of a known scheme which is either ready to be submitted as a planning application or is in the process of doing so. In the case of this optioneering exercise the stakeholder engagement options are more limited as there are a range of schemes under consideration and the details of each of them are not at a detailed design stage.

Given these constraints and the challenging time frame imposed on this project an abridged stakeholder exercise has been undertaken. This has been directed towards the key technical stakeholders and has therefore excluded the general public.

As already noted in Section 1, a Planning and Environment Project Working Group (PEPWG) was set up early in the assessment stage. This comprises the project partners plus some key stakeholders. The PEPWG is as follows:

- Association of London Governance (ALG)- representing the London Boroughs
- Environment Agency (EA)
- Government Office for London (GOL)
- Greater London Authority (GLA)
- London Borough of Newham (LBN)
- London Thames Gateway Development Corporation (LTGDC)
- Port of London Authority (PLA)
- TWUL (TW)

The inclusion of the last two reflects the works that are anticipated at Beckton STWs, which will be the largest permanent above ground works associated with the tunnel irrespective of which option is pursued.

The PEPWG has made an important contribution to the content of this report and the way in which the assessment has progressed. To this end the key inputs and areas of agreement from the PEPWG include the following:

- Identification of Issues
- Terms of Reference
- Report Structure and Contents
- Report Review arrangements
- Stakeholder Engagement

The role and input of the PEPWG is detailed in Section 1 of this report.

In terms of Stakeholder Engagement the PEPWG was keen to seek the views of other organisations and authorities that may be interested in the TTT as it moves towards a preferred option. To this end a Planning and Environment Stakeholder Consultation Event day was arranged. This was held on 17th November 2006 and involved all the relevant London Boroughs along with other statutory and non-statutory organisations. The list of invitees and attendees is included as Appendix 7 and a summary of the representations received from the event is included as Appendix 8.

A summary of the main stakeholder issues and concerns raised at the Stakeholder Event is included in the following section.

17.7 Stakeholder Event

The Thames Tideway Tunnel Planning and Environment Consultation event was held on Friday 17th November 2006 at City Hall, London. The event centred around three introductory presentations held throughout the day. The Project Manager, Andrew Gosling, who explained the purpose of the day and introduced the people attending on behalf of Thames Water, introduced each session. He then handed over to the Lead Design Engineer, John Greenwood, who gave a short presentation about the need for a Tideway Tunnel and the various options available. The rest of the sessions were then used for those attending to gain further information and ask any questions they had. A wealth of information was displayed around the room and on tables for the attendees to use to further their knowledge of the project and speak to representatives from specific areas, such as Engineering and Construction, Planning and Environment, and Modelling and Water Quality. Each attendee was then asked to complete a response form for any representations they had.

A total of 17 of 46 organisations invited attended the event and completed response forms. Organisations invited included all of the London Boroughs affected by the proposed development as well as all relevant major agencies. The main issues raised included the following:

- LB Bexley – Questioned how RE targets will be met and wanted clarification on impact on biodiversity.
- LB Barking and Dagenham – Concerned about the level of odour and questioned the viability of the two tunnel option.
- LB Greenwich – Questioned the impact of the main tunnel on Greenwich and Woolwich Foot Tunnel, and the size of the construction site at Charlton.
- LB Hounslow – Questioned whether funding can be obtained from the ECC. In favour of full storage and transfer solution to comprehensively deal with storm water overflow.
- LB Richmond – Concerned about impact on local residents and noted that work at Putney West will require careful coordination of planning and construction issues etc.
- LB Tower Hamlets – Supportive of the project. However, concerned about the loss of open space at King Edward Memorial Park, and questioned the shaft location. Suggested optimising the design so that above ground structure is as close to the edge of the park as possible. Also suggested that green space lost should be replaced elsewhere in the borough.

- London Chamber of Commerce and Industry – Supportive of the project. However, concerned about any impact on the 2012 Olympic Games.
- London Port Health Authority - Strongly supports option 1, preferably 1 (a) as this is the only scheme that provides full public and environmental health protection.
- Natural England - Believe that there should be complementary programmes to minimise and reduce the amount of storm water entering the system. Furthermore, they are concerned about the proposed expansion of Beckton STW and any on sites of nature conservation importance.
- Olympic Delivery Authority – Demanded that Wick Lane CSO must be sealed up.
- Thames Estuary Partnership - Preferred Full Tunnel option as central river will suffer from untreated CSOs not included. Want to be involved in 'Comprehensive stakeholder Involvement' as they pointed out that they have very good communication networks.
- Thames Gateway London Partnership – Believe it is essential to give priority to Beckton/ Abbey Mills/ Lower Lee area.

17.8 CONCLUSION

The assessment presented within this report has been able to draw upon a wide range of views and issues raised as a result of the consultation exercise. Whilst many of the issues raised are common to all options there are issues, which are of a site- or option-specific nature, and therefore, where there are concerns or potential objections they do serve to identify possible planning risk.

In addition, there should be no confusion as to the status of the consultation work undertaken to date, which is preliminary and informal, and does not replace or reduce the need to consult widely once a preferred option is selected. That said, it does serve to illustrate a number of likely issues and identifies the key stakeholders. However, the risk of new issues and additional stakeholders arising once a preferred option is pursued remains.

18 CONCLUSIONS

18.1 PLANNING STRATEGY

Once a preferred option for the TTT is selected there are range of procedural issues which will need to be addressed. All options considered in this report will require EIA and therefore no part of the proposals could be promoted as Permitted Development (i.e. exempt from the need for Planning Permission). Specific planning permission will therefore need to be sought for all works.

Counsel advice suggests that planning applications will need to be submitted to all, the Boroughs on the tunnel route, even if there are no above ground works in a given Borough. In the case of all TTT options this will involve the submission of planning applications to the constituent Boroughs. This introduces the following risks:

1. Refusal of all or part of the tunnel that could potentially stop or delay the whole scheme.
2. Delays as individual applications are determined to different LPA timetables
3. Unacceptable and inconsistent planning conditions imposed by different Boroughs.

These risks increase with the number of Boroughs involved and therefore are less for the two tunnel solutions. In the case of Abbey Mills to Beckton link the risks are further reduced as any planning decision could potentially be made by a combination of the Borough (Newham) and the LTGDC. In timescale terms, local approval is attractive in all options though unlikely to be realistic in all but the Abbey Mills to Beckton link. In all cases extensive and early stakeholder engagement reduces the planning risk and should speed up the determination process.

The alternative to local determination is Secretary of State Call–in and the determination of a series of individual planning applications by Public Inquiry in accordance with relatively new, and largely untested, procedures for Major Infrastructure projects. This process is intended to streamline procedures to fast track projects such as TTT. In light of the relative infancy of these procedures the extent to which applications are fast tracked in comparison with previous procedures is unknown. A possible timetable for determination is provided in Section 3.7 of this report.

It is understood that local determination may be achievable for an Abbey Mills to Beckton link subject to all works at Beckton being within the confines of the existing STW and therefore outside the Beckton Rectangle. This raises this possibility of a more rapid planning approval obtained locally. The environmental issues associated with this short tunnel section are also relatively limited and much of the baseline data is already well established. A genuinely fast-tracked permission may therefore be possible for this link. Given that Abbey Mills accounts for 50% of all CSO spills this option potentially offers significant environmental gains and a relatively rapid consenting timeframe.

18.2 ENVIRONMENTAL EFFECTS

The review of planning and environmental issues within Sections 5-16 of this report identifies a number of effects that are likely to be of high significance for all TTT options. In most cases it is likely to be possible to reduce the significance of the effects, notably during construction, through appropriate controls at each construction site. The following tables summarise very briefly the likely significance of effects of all options using the criteria outlined in 4.2.4.

Construction Effects

Issue	Significance of Effects	
	Without Mitigation	With Mitigation
MOL & Open Space	High. Large area of valuable public open space to be lost	High. Limited opportunities for mitigation.
Energy Use and Carbon Dioxide	High. Large consumption through boring and spoil removal.	High. Limited opportunities for mitigation.
Odour	Low.	Low.
Biodiversity	Low. Limited foreshore works and other sensitive sites	Low. Avoidance of most valuable areas.
Wastes	High. Large volumes of arising for disposal and or re-use.	Moderate.
Contamination	Moderate. Limited number of potentially contaminated sites	Low. Implementation of remediation strategy.
Noise & Vibration	High. Major excavation and vibration	Moderate. Controlled hours and construction management
Traffic	High. Large volumes of materials to be transported. Central London street works	Moderate. Extensive use of river barges and traffic management.
Archaeology & Cultural Heritage	High. Riverside has generally high archaeological potential	Moderate. Watching brief and recording of finds.

Operational Effects

Issue	Significance of Effects	
	Without Mitigation	With Mitigation
MOL & Open Space	Moderate. Limited land take	Low. Careful design and surface treatments
Energy Use and Carbon Dioxide	Moderate	On site renewable energy provision of 10-20%
Odour	Moderate	Low. Engineered solution involving extraction at most sensitive sites
Biodiversity	Low	Low
Wastes	Moderate	Low. Waste disposal via STW waste streams
Contamination	Low	Low
Noise & Vibration	Low	Low
Traffic	Low	Low
Archaeology & Cultural Heritage	Low	Low

18.3 Option Sensitivity

One key issue which strongly favour one options over another other is:

- Water Resource and Aquatic Ecology benefits to the Tideway (the rationale behind the development) with the operational scheme in place - the benefits are greatest with the full solutions,

A second is:

- Traffic where the partial solution has significantly lower impacts during construction .

Most other variables and effects are of a similar magnitude for each of the options although there are modest variations in the size of effect, which generally vary as a function of tunnel length and size or the volume of tunnel-pump-out.

18.4 Risks and Issues

Given the scale of complexity of the proposed TTT the number of key and substantial issues which have the potential to either prevent or delay the project appear limited. Essentially these relate to traffic issues particularly in relation to CSO work in Central London, Loss of public open space (public parks) and regeneration objectives in and around Beckton. Construction waste is a significant issue, but ultimately one that can be addressed through a comprehensive waste management strategy.

The delivery of any option raises important challenges. These are particularly pertinent in relation to early delivery of a possible Abbey Mills to Beckton link. This option may be promotable as a separate project and would deliver substantial water quality gains, yet incur relatively modest and self-contained environmental and planning impacts.

Land acquisition is also an important issue and may be highly sensitive in the case of the Council owned public open space sites. These sensitivities enhance the possibility of CPO powers being invoked. This in turn introduces risks in terms of delay and compensation.

Overall the risks across the project for a full tunnel solution (single or two tunnel solution) are considered moderate, although significant enough not to be discounted. Conversely, the planning and environmental risks associated with an Abbey Mills to Beckton link are considered small. The regeneration objectives of the LTGDC and, to a lesser extent LB Newham, need to be addressed. However, the existing planning policy framework would not appear to make these issues insurmountable.

19 APPENDICES

A1 PEWEG Terms of Reference

A2 Sustainability Appraisal

A3 Data Spreadsheets

A4 Environmental Constraints Maps

A5 Site Visit Proformas

A6 List of Invitees and Attendees

A7 Stakeholder Responses

Thames Water Utilities Limited
Clearwater Court, Vastern Road, Reading RG1 8DB

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