Crossrail Review

Contents

From the Chairman

Crossrail - Investing in London's future

The concept of a new cross-London rail link was first mooted nearly half a century ago. Since then, Crossrail has, in one form or another, consistently been advanced as a strategic solution to London's transport needs.

Since the last attempt to promote Crossrail, in the early 1990s, pressures on the capital's transport infrastructure have continued to grow. Passengers are faced with increasing congestion on the central London passenger network. The Government's Airports White Paper, 'The Future of Air Transport' will result in additional strains at Liverpool Street if a new runway is built at Stansted. And the Government's ambitious regeneration initiatives have created potential new demand for transport, particularly in the key Thames Gateway area.

The Government provided substantial amounts of funding to Cross London Rail Links Limited (CLRL), a joint venture between the Strategic Rail Authority and Transport *for* London, to develop new proposals for a Crossrail link. This resulted in CLRL's submission of its Crossrail Business Case to the Secretary of State for Transport on 11 July 2003. In his response of 14 July, the Secretary of State announced the creation of the Review of CLRL's Business Case, which I have led.

The Report sets out the Review's findings, but in summary:

- The nature of the interface with the mainline railway gives rise to concerns about whether CLRL's proposals could be operated as intended, which should be substantially alleviated once Network Rail's plans for improved performance on its network show results
- CLRL's scheme appears to deliver acceptable value for money, and the scheme would provide an effective vehicle to support the Government's objectives for regeneration and the creation of sustainable communities, although there is scope for debate about the level of wider benefits that might be realised
- Some costs appear understated, but others are overstated and the two broadly cancel each other out. In addition, the Review considers that CLRL has understated the level of likely revenues, perhaps by as much as £1,200 million NPV. Crucially for such a large and complex project, we believe the cost provision for project management is significantly understated, but there is still a reasonable probability that the scheme could be achieved within the overall levels of provision projected by CLRL
- CLRL's present corporate structure, involving a deadlocked joint venture between the Strategic Rail Authority and Transport *for* London, would not offer effective project governance going forward. CLRL would also need to do some internal restructuring to take on the role of robust project client
- There is doubt as to the available market capacity in the construction and financial sectors to support a project of this size, financed in the way CLRL proposes, and in CLRL's procurement model the national taxpayer would be positioned as lender of last resort, assuming delivery and commissioning risk on the project
- CLRL's proposals would have a whole-life cost in excess of £11,200 million NPV
- London business interests appear ready to contribute significant amounts, in the range of £2,000 million to perhaps £3,000 million NPV, to the cost of the project by way of Alternative Funding Mechanisms

- In broad terms, the £11,200 million cost of the scheme would be offset by the revenue adjustment of £1,200 million and by £2,000 - 3,000 million raised from London businesses through Alternative Funding Mechanisms. Crossrail is a major new infrastructure project, developed outside the 10-Year Transport Plan, which set transport investment for 2000/01 - 2010/11 and made no account for Crossrail.

The Review's Terms of Reference require me to assess whether the CLRL Business Case is deliverable against the set of tests as shown on page 13 of the Report.

The Review's conclusion is that, while there are no pivotal problems, the aggregation of the concerns noted above and elsewhere in the Report creates significant uncertainty. Some of these concerns reflect the still preliminary development of the scheme, and could be expected to be resolved in time, but others are and will remain more enduring objections. As a result, the Review cannot be satisfied that CLRL's Business Case fully meets the tests in the Terms of Reference. Accordingly, as matters stand, the Review cannot confirm the deliverability of the CLRL Business Case.

That is not to say in any way that CLRL's work is deficient. On the contrary, it has approached its work with commendable professionalism and commitment. Indeed, in moving to the second part of the Terms of Reference - to explore whether there might be other means of delivering a Crossrail project that performed better against the key tests - the Review was able to start from the work that CLRL has done, using that as a stable and robust platform from which to proceed.

The Review has explored a number of alternative ways of proceeding with Crossrail so as to offer surer and less costly delivery, while securing as many as possible of the benefits of CLRL's scheme. We have considered a number of different configurations for CrossraiI. Some look better than others, especially those that link the central spine to Heathrow and the growth areas to the east of London.

We have also explored new ways of funding and financing Crossrail and have opened up promising avenues for the innovative use of Stakeholder Equity drawn from fares that could be used to give transport users, for the first time, a genuine stake in the delivery of a major project. The Report describes how Stakeholder Equity could work and the benefits it could bring in insulating the general taxpayer from a significant part of the downside risk.

The Review's Terms of Reference did not invite us to recommend whether CLRL's scheme should be taken forward, or whether any alternative scheme should be substituted. But the key finding that the Business Case is not fully deliverable as intended, the consequent exploration of possible alternative approaches, and the conclusion that some are genuinely promising, suggest that it would be helpful to outline what work needs to follow in order to establish a fully deliverable Crossrail project that could satisfactorily be presented to Parliament in a Hybrid Bill.

The Review considers that this work should include:

- further engineering and economic analysis to determine the optimal scheme design
- detailed scheme development in sufficient detail to populate a Hybrid Bill
- refinement of procurement and financing strategies
- full consultation on the preferred method of business rate etc. Alternative Funding Mechanisms
- market testing of the Stakeholder Equity approach
- formal agreement on the interface between Crossrail and the Heathrow Express
- securing comfort on appropriate regulatory issues (for example, in relation to state aid clearances)

This is a substantial body of work that would take some time to complete. It is important that the work is carried out properly, but the Review believes that the tasks involved are not so substantial as to render impracticable the deposit of a Hybrid Bill during the Parliamentary session beginning in November 2004. A prompt decision would, however, be required in order to meet this timetable.

The Review also considers that, if Ministers wished to proceed with a Crossrail scheme, a fresh look should be taken at project governance. The current arrangements, under which Transport *for* London and the Strategic Rail Authority jointly own CLRL, do not promote decisive, robust governance. This would be essential, both as the scheme approached Parliamentary scrutiny, and beyond. Previous Hybrid Bills have involved a project promoter resting in Government ownership. That is a model that the Review would recommend.

Crossrail has a long and somewhat chequered history. At different times, the project has involved different route configurations and different costs. This Review has tried to sort the wheat from the chaff. But this is not just about the dry bones of forensic analysis.

The issues of price and risk, costs and benefits, and funding and financing are key, of course, but the history of the project, the Government's expressed support for it in principle, and the perceived pressures on public transport in London have imbued Crossrail with an additional symbolic importance. In London's financial community and beyond, there is a widespread belief that the capital's pre-eminence as a major financial centre would be under threat without Crossrail. To that extent, this decision has broader ramifications than simply whether or not to commission a world scale transport infrastructure project. The assumption by many, both here and abroad, that Crossrail would be built means that any decision not to proceed in some form could be misinterpreted as a lack of confidence in the future of London. However, any decision on Crossrail must be taken in light of competing wider pressures and in particular transport on the public purse.

I believe this Report meets the Terms of Reference that were set for this Review, and identifies the key issues that would need to be addressed before a decision could be taken.

In concluding, however, I must record my sincere thanks to Norman Haste and his colleagues at CLRL who gave the Review a ready welcome and have afforded it their most willing assistance. I am also grateful to the Strategic Rail Authority and to Transport *for* London for their help and co-operation, and to all the various people and bodies who have given me their views, either in person or on paper. Without their co-operation and goodwill, my work would have been infinitely more difficult.

Adrian Montague

A. Introduction

CLRL's Business Case and the case for Crossrail

1. Proposals for the construction of a new East-West rail link across London were first mooted shortly after the Second World War. Since then the idea has resurfaced from time to time, though no significant steps were taken to turn aspirations into reality until the late 1980s, when the original Crossrail scheme was developed. Meanwhile, London continues to grow, economically and physically. The capital's global pre-eminence in financial and business services and its attraction as a place to live and as a tourist destination are placing ever-increasing demands on its infrastructure. A combination of market forces and Government policy means that growth, and the associated pressures on infrastructure, will continue for the foreseeable future.

2. Cross London Rail Links Limited (CLRL) was established in January 2002 as a joint venture between the Strategic Rail Authority and Transport for London to breathe new life into the Crossrail concept and to develop proposals that might prove more capable of delivery than those of its predecessor venture. The Government underscored its commitment to the project at a level of principle by providing £154 million of funding for carrying out feasibility work, including the preparation of a business plan, and acquiring the necessary Parliamentary powers. CLRL's Crossrail Business Case was presented to the Secretary of State for Transport on 11 July 2003.

3. The Review has concentrated on CLRL's July 2003 Business Case which defines the Crossrail Benchmark Scheme. We are aware that CLRL has continued to refine its work and has carried out further analysis. This is especially true of the preferred procurement methodology and the route to the west of Paddington, where CLRL has important new proposals for accessing Heathrow and operating a service to Maidenhead. The Review has not attempted to track all these revisions but has sought to take account of the most significant. None of the CLRL revisions materially affects the conclusions reached in this Report.

4. When the Crossrail scheme was first contemplated, it focussed on addressing the problems of central London. Now, the issues that it seeks to address go more widely. Not only has London itself expanded through regeneration in the east, but its enlarged job catchment area requires the provision of efficient and reliable travel across a wide geographical area, both for commuters and for international business travellers. Equally, if the Government's recent Sustainable Communities Plan is to be delivered properly in London and the South East, it will create significant demands on public transport which Crossrail would go some way towards meeting.

5. The CLRL Business Case is based on the proposition, with which the Review concurs, that current rail commuter services into London and on the London Underground network have high levels of overcrowding, both throughout central London and on the approaches to the London terminuses. Many parts of the London Underground network carry passenger flows in excess of their planned capacity. This congestion, which in turn leads to service unreliability, carries a real economic cost in addition to simple passenger discomfort, particularly given that the main wealth-generating sectors in London are heavily concentrated within the central area. The general belief in London's financial community and beyond is that the capital's status as a major financial centre would be under threat without Crossrail or other significant upgrades or new lines.

6. London Underground plans capacity increases over the next 20 years; the public-private partnership infrastructure contracts for the London Underground are designed to deliver a 15% increase overall on current capacity. But this increase will of itself be insufficient to remedy the problem of overcrowding. Indeed, based on the planned levels of employment and population growth within central London, according to CLRL's forecasts the overall rail network will be more crowded in 2016 than at present if Crossrail is not built.

7. CLRL's Business Case says that Crossrail would therefore make a significant and lasting contribution to improving services to London's travelling public by addressing existing and future overcrowding on both the main rail and London Underground networks, providing as it would about a 7% increase on current capacity across the central cordon. In addition, because Crossrail would substantially improve accessibility and travel times between key destinations, CLRL has suggested that it would bring wider benefits and help delivery of other Government initiatives, including contributing to the Government's transport and planning policies, helping to create new communities in the growth areas of the Thames Gateway and supporting the further development of London's financial and business services (FBS) sector.

8. In summary, CLRL believes that its Crossrail proposals have a significant role to play in addressing existing and future crowding on both the main rail and London Underground networks and in achieving the London Plan by facilitating economic development and promoting regeneration. It also believes that there is significant support from major stakeholders, not least the London business community.

Government response to the CLRL Business Case

9. At the highest level of principle, there can be no doubt that Crossrail has the potential to improve public transport significantly within and into London. Equally, there appears to be consensus that Crossrail would facilitate the achievement of planned growth targets for London, assist the economic development of London, and contribute to the delivery of regeneration policy, particularly in the Thames Gateway. Informal soundings suggest that a Crossrail project would receive widespread support from the travelling public, residents and business. However, these soundings have not been informed by precise knowledge of how much the project will cost them but many of those consulted have never the less been made aware that it would not be free of cost to them. In the light of the expansion of both Stansted and Heathrow foreshadowed in the recent Aviation White Paper, Crossrail would also make an important contribution to meeting the additional demand that would be placed on surface access to the airports.

10. But in any terms it is a massive project. Even on the basis of CLRL's projected costs of approximately £10,000 million (including contingency but excluding financing costs) it would probably be the largest infrastructure project ever undertaken in the United Kingdom. Given the United Kingdom's historic difficulties in delivering large transport infrastructure projects to time and to budget such as the West Coast Main Line upgrade, where projected costs increased from around £2,000 million to the current estimate of around £9,000 million, it would clearly be irresponsible for the Government to commit to the project without first ensuring that its projected benefits and costs are soundly based, that the prospects for its successful delivery were assured and that the taxpayer contribution was affordable against the background of the very significant pressures on the railway.

11. Accordingly, following receipt of CLRL's revised Crossrail Business Case, on 14 July 2003 the Secretary of State announced that he would establish an expert team to review CLRL's proposals. The Review was asked to consider the proposals for deliverability and value for money and to assess the extent of Government funding that might be justified, as well as the proportion of funding that should come from non-Government sources. At the same time, the Review was asked to consider whether there were any other means of delivering a Crossrail project that might offer better performance than CLRL's proposals.

12. The full terms of reference for the Review were:

    1. To establish the full cost of Cross London Rail Link's July 2003 Crossrail Business Case proposals, and to assess:

        (a) whether they are likely to deliver to time, scope and budget

        (b) whether the Business Case proposals will offer value for money

(c) the extent of Government money that can be justified

(d) the proportion of the funding required from non-Government sources

2. To identify any means of delivering a Crossrail project which offer better performance than the Business Case proposals against tests 1 (a) - (d) above

3. To report to the Secretary of State as soon as practicable.

Composition of the Review Team

13. On 9 September 2003, the Secretary of State announced that Adrian Montague had accepted his invitation to lead the Crossrail Review. On 24 September 2003, Adrian Montague announced the key members of his expert team, including Hugh Norie (MPG) and Stephen Dance (PUK). External advisers were subsequently appointed to provide specialist support on corporate finance, economic analysis, accountancy, property and legal issues arising out of the Review.

14. A complete list of the Review Team and external advisers is given at Annex A.

Approach to Review

15. Given the purpose of the Review and the timescale within which it had to report, it was neither possible nor desirable for it to replicate the work that had already been undertaken by CLRL. Accordingly, the fundamental methodology adopted was to evaluate and validate the data and assumptions used by CLRL in constructing its Business Case. This involved working closely with CLRL, and the Review wishes to record its gratitude for the helpful and professional way in which CLRL responded to requests for information and clarification. Without that assistance, it would not have been possible to complete the Review to the necessary deadline.

16. The Review Team also wished to give due attention to proposals from organisations other than CLRL. In this connection, it discussed with London Regional Metro its thinking on developing a cost-effective East-West rail route across central London and the means by which property development contributions might be optimised.

17. The Review was naturally concerned to hear the views of stakeholders affected by the Crossrail proposals, including those who might be prepared to contribute towards their costs. A series of meetings was held between members of the Review Team and a wide range of stakeholders in a variety of contexts, including events organised by London First. A full list of those contacted during the course of the Review is given at Annex B. The Review is grateful for the helpfulness of the stakeholders with whom it engaged and for their valuable contributions.

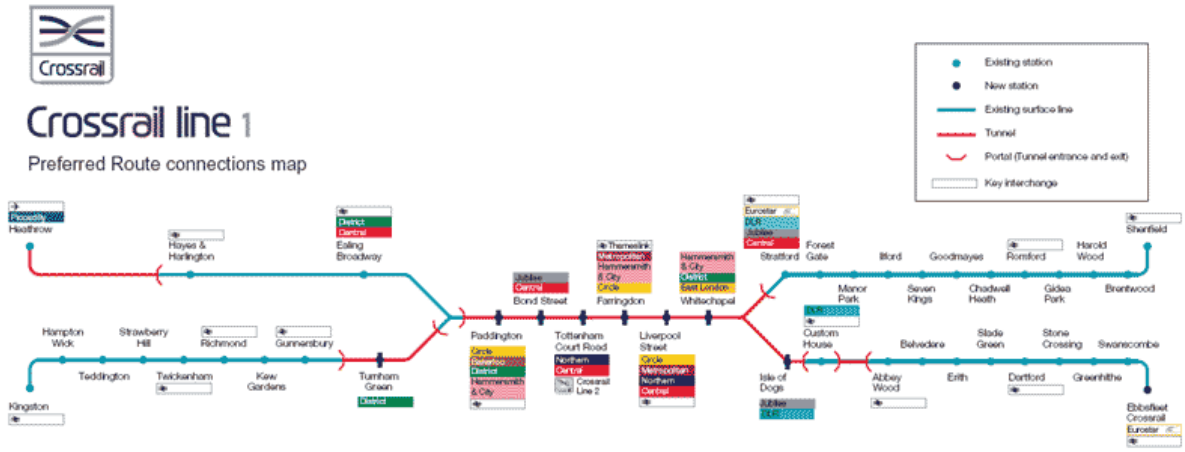
B. Evaluation of the CLRL benchmark scheme

Are Cross London Rail Link's July 2003 Crossrail Business Case proposals likely to deliver to time, scope and budget?

Deliverability

Introduction

18. CLRL's proposals (also referred to as the 'Benchmark Scheme') are described in detail in its Business Case. The scheme's essential characteristics are tunnels from Paddington to Whitechapel and the Isle of Dogs with branches, generally on the surface, westwards to Heathrow and Kingston and eastern branches to Shenfield and Ebbsfleet, as depicted below:



19. Since CLRL submitted its Business Case earlier in 2003, its detailed engineering and design proposals have continued to be developed and refined. The Review Team has had access to this emerging work and has taken it into account in its findings. In order to meet the deadline for completion of the Review, it was however necessary to adopt a cut-off point, beyond which further refinements to the CLRL Business Case could not be considered. For this reason, no developments beyond 30 November 2003 have been taken into account in the sections of this document that look at the Benchmark Scheme, i.e. Part B, and the benefits quoted in these sections are as identified by CLRL in its July 2003 Business Case. However, the Review has considered more recent work by CLRL when looking at alternatives to the Benchmark Scheme in Part C of this document.

20. It must be acknowledged at the outset that CLRL has done valuable work in defining the scope of its Benchmark Scheme and in considering how it might be procured and financed. CLRL has made significant progress in developing an East-West rail link, and identified a number of key issues, and proposed effective solutions to them. Its work has been carried out with professionalism and care and the CLRL Business Case provides a strong basis for wider consideration of the issues raised in constructing a major piece of transport infrastructure of this kind. For any major project, it is now customary to have a 'Gateway Review' to identify potential difficulties at an early stage, before project funding and other resources are committed. This Review effectively serves that purpose and is therefore concerned not with highlighting deficiencies, but with identifying facts that are material to the decision as to whether or not to proceed with a cross-London rail link.

21. In carrying out its work, the Review Team considered the engineering and design feasibility of the Benchmark Scheme, as well as the reliance that could be placed on estimates of both capital and operating, maintenance and renewal costs, together with revenues and other economic and regeneration benefits. It also reviewed the robustness of the proposed project management arrangements and their associated costs and environmental and heritage issues.

Scope

Engineering and technical

22. The engineering design for Crossrail is a mixture of pre-feasibility concepts and detailed plans, with the central section having been most closely specified. The majority of the railway systems, including rolling stock, are described at an outline level only. However, CLRL proposes throughout the use of established mainline or metro technologies, or technology that will have been tried and tested by the time the construction of Crossrail begins. Essentially, the objective would be to build a new railway based on proven technology, so that there would be no undue exposure to technological risk. Similarly, established tunnelling technology would be used to bore the central running tunnels, which would follow a route that has been safeguarded since the early 1990s.

23. Given the need to cope with trains of similar specification to the rest of the national network, CLRL has designed the central area underground stations to be large, which would have significant cost consequences. Since the Business Case was published, the station design has been refined and generally simplified, though work needs to be done to assess whether the station designs could be further optimised (for example by reducing platform tunnel lengths and reducing the number of ticket halls).

24. The main engineering hurdles to be overcome in constructing Crossrail would lie in the inherent difficulties of tunnelling and ticket hall construction under central London. Even using established technology, there would be ample scope for unexpected problems with their attendant consequences for cost and time. None of the other civil engineering work calls for particularly novel solutions, though as most of it would take place on operating sections of Network Rail's infrastructure, there would be a clear need for rigorous management and careful planning, and a collaborative approach.

25. While the Benchmark Scheme would utilise much existing proven technology, some more innovative solutions would be deployed. Most significant would be the proposed use of automatic train protection (ATP) and operation (ATO). No modern mainline ATP systems yet exist in proven form, though the ERTMS level 2 system that is stated to be the basis of the Benchmark Scheme is being trialled at present in the UK. No mainline ATO exists at present, though it is established technology on metro systems, and ATO based on the London Underground Central Line version might be an appropriate option. While the technology might well be proven by the time construction work began, it must be counted as a risk factor at this stage. The lack of modern, proven systems for ATP and ATO would represent technical risks for Crossrail, as would the operational impact of using ATO on a mainline railway, in particular the changeover from a manual system to ATO at Crossrail entry points. CLRL has stated that if ERTMS is not proved and available in time, it will not take this technical risk.

26. In relation to rolling stock, the key concern would be the impact on dwell time of the proposed two doors per side design. This configuration could impair the intended service frequency in the central section because it would not support rapid movement on and off trains. In addition, the chosen signalling systems and performance of the ATO package might place challenging requirements on the rolling stock design.

27. The Review considers that the engineering scope control within the CLRL proposals requires further refinement, in particular in relation to the core document control system and its search facilities. Without improvements to the project information systems, the Review considers that it would be difficult to avoid engineering scope creep, with consequential impacts on cost and programme.

Operability

28. The CLRL Benchmark Scheme assumes a 24 trains per hour service in the peak between Paddington and Whitechapel. The Review considers that there might be problems in achieving this level of service and is not yet satisfied that the proposed 24 trains per hour peak service would be deliverable in practice.

29. Interactions with the mainline railway would represent the most significant obstacle to achieving the proposed level of service. For the Benchmark Scheme there are six rail interfaces with the existing Network Rail system, with both radial and orbital routes in the London area. Four of these are key radial routes that are already operating at or near capacity during peak hours. There are already passenger services over the other two that operate at metro frequencies, as well as a large number of freight services. Perturbations in service levels on the routes with which Crossrail would interface, such as those indicated by current punctuality and reliability on those lines, would inevitably have an impact on the ability to deliver a 24 trains per hour peak service.

30. The other principal interface relates to the operation and maintenance of sub-surface London Underground stations on the core Crossrail section between Paddington and Whitechapel. Further consideration would need to be given to the practicality of current proposals, when set against the prime need for an integrated approach to station and operations management throughout the Crossrail system. This would include considerations of safety, security, maintenance and standards, as well as consistency in service delivery.

31. The Review has identified a number of other factors relating to operability where it believes the assumptions in the CLRL Business Case should be reconsidered, viz.;

- the proposed use of two traction power supply systems so that Crossrail could operate over two relatively short non-core third rail DC-equipped route sections (Ebbsfleet-Abbey Wood, Connaught Tunnel, and Kingston-Richmond/Gunnersbury). It is unclear whether or not the proposed service levels would justify the costs of installation and additional complexity that would be incurred

- the proposals in the Business Case to use guards, in the light of the availability of modern on-train security systems (it should be noted that South West Trains continues to use guards along its routes, in contrast to general practice on London commuter services). We understand that CLRL has since revised its intentions, and no longer proposes to use guards

- whether the utilisation of all existing facilities for maintenance and outstabling locations should be reassessed (even if some adaption is necessary) in preference to developing brownfield and greenfield sites. CLRL has subsequently decided to use Romford Railway Goods Yard as the main Crossrail Depot

- the probable need for an additional turnback facility at Old Oak Common, given that the proposed facility at Westbourne Park might be insufficient

- the number and positioning of emergency turnback facilities, both within and on the approach to the central section, which appear to be insufficient to cope with service perturbations.

32. While a draft timetable has been developed to support the Business Case, it has not been verified by Network Rail or by the relevant train operators. Comparison of the draft Crossrail timetable with existing timetables for the Network Rail routes has highlighted a number of potential conflicts with train paths that are already allocated to services for which there would be no proposed Crossrail substitution. While procedures exist to flex the allocation of train paths, it is unlikely that this could be done without significantly affecting operations at the relevant London terminuses and the network access rights of both Franchised and Open Access Train Operators.

33. Some of the integration difficulties might be addressed by planned improvements to Network Rail as set out in its current Network Plan.

34. In the light of these considerations, the Review considers that the proposed Crossrail peak service level of 24 trains per hour in the central section might not be achievable. In order to achieve delivery of a 24 trains per hour peak service through the core section, the punctuality of presentation at all interfaces with Network Rail would need to be for at least 95% of trains to arrive within 5 minutes of timetabled time. Equally, the ability of trains to leave Crossrail at Network Rail interfaces to an equivalent level of punctuality so as to minimise undue peturbation to the network would need to be established. Some of the current interface difficulties for Crossrail services might be reduced by potential improvements to the Network Rail infrastructure, as set out in its current Network Plan. However, the impact of these improvements would not be uniform, in terms of service delivery. On the basis of current performance of the route sections making up the Benchmark Scheme, the following peak throughputs could be anticipated:

- Paddington to Shenfield and Abbey Wood - **22/23 trains per hour**. This would improve to 23/24 trains per hour in the event that Network Rail and the Train Operating Companies improved punctuality performance on the Liverpool Street - Shenfield line by 6% on that currently achieved

- Heathrow to Paddington, Shenfield and Abbey Wood - **21/22 trains per hour**. This would improve to 22/23 trains per hour in the event that Network Rail and the Train Operating Companies improved punctuality performance on the Great Western lines by 15% on that currently achieved

- Heathrow & Richmond to Paddington, Shenfield and Abbey Wood - **20 trains per hour**. This would improve to **21/22 trains per hour** if the North London Line service were to be discontinued between Gunnersbury and Richmond. Both figures assume that London Underground District Line services between Turnham Green and Richmond would be discontinued

- Heathrow & Kingston/Richmond to Paddington, Shenfield and Abbey Wood -

- **17-19 trains per hour**. Assumptions on service discontinuance as above

- Heathrow & Kingston/Richmond to Paddington, Shenfield, Abbey Wood and Ebbsfleet - **16-18 trains per hour**. Assumptions on service discontinuance as above.

- It can therefore be seen that the addition of the several branches to the core reduces the throughput, progressively, if no further measures to improve reliability are put in place.

35. CLRL is currently completing its study on the impact of 'dwell times' at stations in the central section, between Paddington and Whitechapel. However, from output received so far, it is apparent that a decision to use 10-car trains, each having two doors per side, would probably reduce the core throughput to the lower of the figures given above, in each case.

36. In order to obtain 24 trains per hour through the central tunnel it would be necessary:

- to have both Network Rail and the Train Operating Companies improve their delivery of punctuality at the relevant interfaces, and/or

- to segregate Crossrail services from those of other train Operating Companies and Network Rail interfaces, and/or
- to cut back Crossrail services from some of the outer branches of the Benchmark Scheme, giving greater segregation of the Crossrail system.

37. A detailed operations feasibility study would be essential to establish clearly the impacts of the proposed Crossrail train service on the affected Network Rail routes, and to quantify the reliability and robustness of a 24 trains per hour (or reduced) service. This study would also be required to determine the modifications necessary to the network to allow Crossrail, and the network, to operate as planned.

Freight

38. There are three main areas where Crossrail could affect rail freight traffic interests. These are (a) the use of the Crossrail tunnels by freight; (b) the effect on freight of Crossrail services using the existing network; and (c) the use by Crossrail of lands currently used or affected by freight interests.

a) Use of Crossrail tunnels for freight.

39. The running tunnels presently planned are large enough to accommodate UK freight trains. Due to the high frequency of passenger trains throughout the day, freight operations would almost certainly have to be restricted to night-time, and might well conflict irreconcilably with normal night-time maintenance. Freight trains would have to be compatible with the more stringent safety standards involved with operations in long tunnels, especially tunnels under one of the largest cities in Europe. It is therefore unlikely that any freight other than specialised enclosed lightweight trains would be suitable, and even then would have to be operable within the Crossrail operation and maintenance timetables.

40. With the present proposals for the alignment of Crossrail eastwards from Custom House, through the Connaught Tunnel and beneath the Thames, and for its linkage with the North London Line at Custom House, it is very unlikely that any significant use could be made of Crossrail between Custom House and Abbey Wood by freight other than specialised trains. In particular, gradients of up to 1 in 30, and signalling and power restraints, would create serious difficulties.

b) Effect on existing freight services using the Network.

41. Freight services would be affected in particular on the Great Western Relief Lines west of Paddington, particularly if Crossrail Maidenhead services were introduced. Subject to further study and consultation it is expected that freight services could continue to run outside the peak, but would need to be able to comply with reliability criteria in the use and timing of paths to enable the railway to be operated efficiently. A grade-separated crossing is proposed by CLRL at Acton, where slow entry and egress of freight trains at Acton Yard would otherwise reduce line capacity unduly.

42. Freight services using the Great Eastern lines east of Stratford would also be affected. In particular, this would apply to services from North Thamesside joining the GE lines at Forest Gate and crossing to the North London Line, and these would need to be carefully timetabled and regulated, and restricted to non-peak times. It is not yet clear that grade separation at Forest Gate would be practicable. The alternative of using the Tottenham and Hampstead line may also prove impracticable without significant investment in its infrastructure due to gauging, loading and traction constraints.

c) Lands used by freight interests.

- *Ladbroke Grove Batching Facilities* - the existing batching facilities would have to be relocated. Discussions are continuing on this issue. This site has been safeguarded for the Crossrail tunnel portals since the mid-1990s

- *Acton Yard* - a grade-separated access is planned. It is expected that this would not adversely affect operation of the yard
- *Old Oak Common* - Crossrail may need some stabling facilities at this site. This could, depending on the scale of its requirements, affect EWS interests there
- *Slade Green* - Crossrail would need this site for stabling if the route is extended from Abbey Wood to Ebbsfleet. The site has been earmarked for a future freight facility, and this use would be affected by Crossrail. However, it is not yet clear that the proposed freight facility would be feasible to operate; the land is in any event designated as Green Belt
- *Romford* - this site is at present CLRL's preferred site for the Crossrail train maintenance depot. The site is occupied by Balfour Beatty Rail Maintenance Ltd and, although it is currently under-used, may become more important in the future for main line rail maintenance following the closure of Temple Mills.

43. CLRL is continuing to hold discussions with Network Rail and freight operators on the issues raised by Crossrail, and these discussions will continue to bear on the proposals being prepared. Measures are being considered to mitigate effects on freight, and indeed on other railway operations, where practicable.

44. Finally, it should be noted that in preparing its Benchmark Scheme, CLRL has considered the possibility of a staged opening. This would, however, be intended primarily to address possible resource difficulties: that is, the whole scheme would be built sequentially over the course of the programme, rather than some elements being left for later construction.

Conclusion 1: Scope

The Review considers that the proposed 24 trains per hour peak service in the central section might not be achievable without further investment in the adjoining network or curtailment of some of the outer branches. Work is currently underway to establish what level of service might be possible, although this is difficult to predict given the uncertainty over other improvements which are forecast in the Network Rail Plan: preliminary indications are that without improvements it could be as low as 16-18 trains per hour at peak times. Further work would be necessary by CLRL to assess what levels of additional investment would be required and how operation of the Benchmark Scheme could be simplified to achieve a reliable service level of 24 trains per hour at peak.

Costs and revenues

Capital costs

45. Capital costs in the CLRL Business Case, net of general contingencies, include:

	£ million
Land and property	695
Tunnels	1,680
Surface route infrastructure	314
Trackwork	298
Stations	2,201
Railway systems	919

Stabling, depots and maintenance	283
Project team and commissioning	496
Total	6,886

The CLRL base estimate is stated in prices current at Q1 2002 and does not include any financing costs. No allowance is made in these figures for general inflation or any differential between construction costs inflation and RPI, which are considered separately. The Review has retained this approach and all numbers referred to in this section, including contingencies and adjustments, are stated on this basis.

46. The Review has sought to validate the various categories of cost that would be incurred in constructing Crossrail. Generally, the robustness of the CLRL estimates varies considerably and reflects elements of the design that are at different stages of development (e.g. while the central stations have been designed in some detail, plans for depots and stabling are less well defined).

47. The CLRL base estimate of £6,886 million assumes advance construction work would begin in July 2005, with the main works beginning in July 2007 and completing in April 2012. Services would begin on all route sections in 2013 and a new rolling stock fleet would be provided under a leasing arrangement: these lease costs are included as operating rather than capital costs.

48. In addition, CLRL has added a general contingency of £2,854 million. This is CLRL's assessment of a 'prudent and sensible outer range' for the estimated capital costs for the purposes of economic appraisal. CLRL's total capital cost estimate is therefore £9,740 million. It is on the basis of this estimate that Crossrail is commonly referred to as a £10 billion scheme.

49. Since the Business Case was submitted to the Department for Transport in July, CLRL has made a number of changes to its Benchmark Scheme, bringing the total estimated capital cost to £10,347 million by the Review's cut off in November 2003.

50. Though the base estimate does not take any account of opportunities for cost savings, CLRL is currently reviewing the design of stations in the central section and believes that savings in the region of 10-15% might be obtainable for these stations.

51. The Review considers that CLRL's estimate represents an appropriate feasibility estimate for a railway scheme that has not yet crystallised into a firmly defined project. This is evidenced by the significant number of scheme variations that were still being considered as the Review completed its work and by the high level of contingency in the estimate.

52. Generally the Review supports this prudent approach to a feasibility estimate. In this context, CLRL's estimates are reasonable, have been professionally prepared and are suitable for their purpose, i.e. consideration of route and scope options and preliminary financial appraisal.

53. However, a number of costs have been identified as not having been included or fully covered in the base estimate, i.e. in relation to:

- staging (where a proposed commissioning strategy and sequence that envisages partial services from Farringdon to the Isle of Dogs some 18 months before services from some of the outer routes might affect escalation costs, financing costs and the timing of benefits)
- the costs of the project management team (where the proposed cost of £496 million is considered to be substantially underestimated, possibly by as much as £1,000 million)
- costs for work on Network Rail (which might become necessary to improve the operating performance of elements of the network adjoining Crossrail)
- other third party costs falling to Government (for example in relation to Her Majesty's Railway Inspectorate and Docklands Light Railways)

- the costs of acquiring property currently owned by Network Rail or London Underground
- negotiations with BAA in respect of services to Heathrow
- substituting London Underground services or any compensation payable to the private sector infrastructure companies under the change mechanisms contained in the London Underground PPP and PFI contracts and compensation to train operating companies under their franchise agreements with the SRA.

54. The Review has considered the individual elements of CLRL's proposed Benchmark Scheme to identify any areas of concern and to identify potential scope for cost savings. The most important of these items are considered below.

Central section

55. CLRL's base estimate for the construction of this section, which includes the tunnels and stations from Royal Oak to Bow Triangle with the branch to the Isle of Dogs, is £3,993 million. CLRL's estimate of the additional general contingency required is £1,266 million.

56. The Review has identified a number of concerns in relation to this estimate. Weekly labour rates for preliminary costs for tunnelling were found to be substantially too high. The duration of the tunnelling-related work items is also based on a conservative rate of drive. Some inaccuracies were also found in the prime cost estimate for the main section and in the tunnel construction cost.

57. Further savings would be likely to be possible in relation to the central stations, as the preliminary designs were developed. It appears that high labour rates have been assumed here also. Taken together, the Review believes that the correction of these anomalies might result in savings in the central section in the region of £400 million.

Branches

58. CLRL's capital cost estimate for the four Crossrail branches of £2,130 million is not as detailed as for the central section, though it is generally appropriate for a scheme at this stage of development. However, while the estimate is adequate as a basis for considering the overall cost and relative order of magnitude between various elements of the project, the Review does not consider that it could be used as a basis for decision-making without further detailed work being undertaken. CLRL has estimated an additional general contingency of £1,310 million, which reflects, among other things, the uncertainty in the capital cost estimates for the branches.

Signalling

59. The signalling scheme cost of £506 million is based on a technical scope that is not yet sufficiently defined to support a robust estimate. The Review considers that this estimate is at the upper end of the range and exceeds target cost for the emerging technology. A more realistic figure, based on West Coast Main Line route modernisation pilot schemes and cost estimates from the National ERTMS programme, suggests that costs are likely to be around £360 million. Additionally CLRL has allowed a further £150 million for a control centre, which is not unreasonable at this stage.

Depot costs

60. The precise depot locations are not known at this stage, but the total capital cost estimate figure of £283 million (covering depots, stabling and maintenance vehicles) is based on a minor servicing style depot, with heavy overhaul being undertaken by the train providers at their own facilities. In general, the adopted methodology for estimating this cost is reasonable and the figure provides an acceptable assessment for the present level of scope definition and project development. CLRL has subsequently chosen Romford Railway Goods Yard as the main Crossrail depot. The effect of this choice on CLRL's depot cost estimate is being established.

Rolling stock costs

61. CLRL's Benchmark Scheme does not recognise rolling stock as a capital cost item but assumes a leasing procurement strategy. The costs are therefore accounted for within operating, maintenance and renewal costs, though the rolling stock calculations are set out as capital costs. A budget unit cost of £900,000 per vehicle has been adopted, on the assumption that this figure will be reviewed in line with project development and scope definition. This would give a total fleet cost of £650 million.

62. The treatment of this unit cost as a lease charge would require further analysis in the context of the overall procurement strategy and other client/owner/operator costs. The technology and integration risks associated with the introduction and inter-running of a new vehicle must also be provided for. In this regard, it is recommended that a contingency of at least 20% be applied to rolling stock costs at this level of project development and scope definition.

63. The option of using existing rather than bespoke rolling stock has also been considered. Here there would be important safety concerns to address, notably the need for any existing stock to have an appropriate fire certification for use in tunnels. The costs of modification of existing rolling stock to be compliant with such safety regulations would be prohibitive, although there maybe more scope for making use of the new rolling stock that is due to come onto the network between now and the date when Crossrail would come into operation. Cars with only two doors per side could also impair the intended service frequency in the central section because they would not support rapid movement on and off trains. Further, to the extent that trains would need to be moved from elsewhere on the network to service Crossrail, this would give rise to replacement cost and reliability issues for other Train Operating Companies and rolling stock leasing companies. The Review has concluded that using existing rolling stock may have the potential to reduce the cost of Crossrail, but that it would also be likely to impact on the quality of the service provided by Crossrail and, possibly, elsewhere. Therefore, while there is a case for investigating further the potential for using existing rolling stock, this investigation would need to take into account all the consequences of doing so, not just cost.

Project management costs

64. Though the procurement and execution strategy for Crossrail has not been determined, it is nonetheless possible to estimate an aggregate figure for the costs of managing the project, regardless of how this would be split up between individual parties. In its Business Case, CLRL has effectively assumed costs of £496 million.

65. The Review has benchmarked these costs against those incurred for the construction of CTRL and believes that they are significantly understated. This comparison suggests that on the basis of a scheme the size of that proposed in the CLRL Business Case, the management cost could be up to £1,000 million higher, making the total project management cost £1,500 million.

Heathrow Express

66. If a western limb of Crossrail were to serve Heathrow airport, appropriate arrangements would need to be made with BAA in relation to the Heathrow Express, including additional infrastructure costs. CLRL's Business Case assumes that any such arrangements would be price-neutral, but accepts that this assumption has yet to be tested in a commercial negotiation.

Property acquisition costs

67. CLRL has engaged Transport for London Property to estimate the likely costs associated with acquiring land and property. The CLRL Business Case indicates that some 3,500 properties are identified for temporary or permanent acquisition. The vast majority of these are underground and would involve acquisition only of the 'sleeve of land' to accommodate the tunnel. There is an established basis for such acquisitions arising out of previous underground schemes, including CTRL and the Jubilee Line Extension and, because there is no disturbance of the surface, the compensation payment to owners is generally only minimal.

68. There are currently over 300 properties (some of which comprise several legal interests) above ground, where construction of Crossrail would require the acquisition of surface land and buildings, to enable the construction of stations, entrances, vent shafts and, potentially, depots and stabling. Some of the land would be required temporarily for use as worksites during the period of construction only and could be returned at the end of the process to its owners. However, for station development, ventilation buildings and in certain cases where the lines encroach on building foundations, there would be a need for permanent acquisition of land and buildings, which would then need to be demolished or substantially altered to accommodate Crossrail. Subsequently, these areas might be suitable for new development, for example by building over stations. The process of developing Crossrail would cause disruption to property and to business activity in central London. The direct costs are allowed for within the estimates for compensation. There might also be indirect effects by way of temporary reduction in economic activity and reduction in business rates for affected properties.

69. The majority of permanent acquisitions, accounting for over 75% of costs, are located in the central section of Crossrail. The requirement for property acquisitions on the branches is less because Crossrail would use mostly existing routes (although costs of acquiring rights over existing railways are dealt with by means of access charges). CLRL has estimated land and property acquisition costs on the assumption that acquisition is by, or under threat of, compulsory purchase using specific powers granted through a Hybrid Bill procedure. It has further assumed that the statutory compensation code would apply in respect of the payment for land taken and compensation for disturbance. Costs have been assessed on a gross basis, without any allowance for temporary income or capital receipts from any subsequent development (the potential benefits of which are considered within the revenue and funding sections). The majority of this expenditure would be incurred prior to or at the same time as construction of Crossrail. The Review considers this to be a sound approach.

70. In the CLRL Business Case, the base land and property costs for the Benchmark Scheme were assessed at £695 million. In addition there is a contingency allowance of £229 million (which is a specific allocation within the overall contingency of £2,854 million). The base figure for property has subsequently been adjusted upwards to £883 million, partly as a result of changes to the details of the Benchmark Scheme requiring additional properties to be acquired and partly as a result of better information becoming available concerning the property interests to be acquired. Within this figure CLRL has included a specific contingency of 15% to account for anticipated change of law in relation to compensation contained in the Planning and Compensation Bill. CLRL contends that this contingency, together with increased certainty about the engineering solutions, should enable the general contingency allowance to be reduced.

71. The Review has assessed the assumptions and approach adopted by Transport for London Property/CLRL and has independently appraised a sample of major properties in the central area, together representing about 30% of the total costs by value. The Review considers that the general approach adopted by CLRL is realistic and appropriate, given the status of scheme design and the lack of detailed data on property interests at this stage. Likewise the majorities of assumptions are soundly based and provide a valid basis for estimating cost. The Review considers, however, that the following assumptions should be tested further:

- the assumption that property (including operational and commercial property) could be acquired from London Underground and/or Network Rail at no cost
- the assumption that CLRL's internal costs are not allowed for under this heading (particularly given the Review's concerns about the inadequacy of overall project management allowances)
- the assumption of an additional 15% contingency on account of the potential changes to the compensation code contained in the Planning and Compensation Bill, which allowance the Review considers to be excessive.

72. In terms of the estimate of compensation amounts, the Review considers that CLRL's approach has tended to lead to an overstatement of the likely levels of value and market based compensation payable (based on Q1 2002 prices). However, the estimates are necessarily based on incomplete information and it is likely that the actual costs associated with individual properties would vary, sometimes significantly, from the estimates. There is no evidence of a systematic bias, however, and it is reasonable to expect that variations up and down would broadly equalise across the portfolio.

73. The most important factors determining the actual costs within the range include:

- the state of the property market at the date of acquisition. (The property market is cyclical and does not generally track inflation. The Investment Property Database index for Central London offices shows a decline of about 9% since Q1 2002 when the valuations were done, close to the top of the current cycle. However, previous property cycles have had a greater amplitude and there is scope for more significant variation, up and down, in the future.)
- the accuracy of the data on floor areas and activities within buildings. (The estimates have been compiled on the basis of publicly available data and inspection of properties from public land. Experience on other schemes indicates that this can lead to significant error for individual sites.)
- the route and engineering solutions adopted. (Even within the Benchmark Scheme, there have been certain changes to engineering solutions that result in individual properties being brought into or taken out of the scheme. Any significant change to the scheme, for example the omission/addition of a station, or changes to routes, would affect the property costs, but they are particularly sensitive to scheme changes in the central section and to Canary Wharf.).

74. The property acquisition and compensation costs might also be affected by changes in law, for example amendments to the Crichel Down Rules or changes to the compensation code, or by the extent and nature of the powers contained in the Hybrid Bill.

75. It would also be necessary for Crossrail to develop collaborative arrangements with Network Rail and London Underground to ensure the most effective delivery of the project and most efficient structuring of financial arrangements between the parties. Both these organisations have a vital role to play in delivering Crossrail, and it is essential that they should be brought into the project as active contributors at an early stage.

76. On this basis the Review has concluded that, for the Benchmark Scheme, gross land and property costs are likely to be in excess of the original base estimate of £695 million contained in the CLRL Business Case, probably by some £150 million. It is reasonable to argue that, on the basis of this revised base cost, the general property contingency could be reduced from 33%, but the Review has no specific risk analysis to support any new figure and the change would not be material to the Business Case.

Overall capital costs

77. In summary, the Review has concluded that CLRL's July Business Case has understated the likely capital costs by £1,000 to £1,500 million. Against this must be set potential savings of approximately £620 million, suggesting that a total adjustment of approaching £1,000 million i.e. £10,720 million less £9,740 million should be made to the capital costs. However, any such estimates are extremely tentative when so much of the scope and project definition remains open.

78. In the light of the increased project management resource that the Review has recommended, it might be appropriate to reconsider the level of contingency allowed for by CLRL. However, for reasons of consistency, the Review has not done so at this stage. The table below shows the contingency calculated on the same basis as CLRL, but adjusted on a pro-rata basis to reflect the changes made to the underlying cost estimates.

Table 1: Capital cost adjustments	
Q1 2002 prices	**£ million**
Benchmark Scheme (Business Case estimate)	6,886
CLRL changes (post-Business Case to November)	
capital costs (excl. land & property)	291
additional land & property costs	138
Subtotal	7,315
Potential savings:	
Central section	(400)
Branches	(80)
Systemwide	(140)
Additional management costs (say)	1,000
Subtotal	7,695
Contingency	
Business Case estimate	2,854
Pro-rata increase in contingency	171
Total	10,720

Risk-adjusted cost profile

79. It will be apparent from the foregoing that, given the current project scope and definition, the quantum of outturn costs might differ significantly from the current estimates. For that reason, the Review has prepared a preliminary analysis of the potential impact on CLRL's capital cost estimate of the risks that would be likely to be encountered. This analysis indicates that:

- the most likely cost of CLRL's Benchmark Scheme, including general contingency, is in a narrower range between £8,500 million and £9,500 million; the eventual outturn figure would depend on, inter alia, how well the project and its associated risks were managed
- there is a high probability that the Benchmark Scheme could be constructed within CLRL's July Business Case capital cost estimate, including contingency, i.e. £9,740 million
- there is a low probability at this stage that construction costs would be below £7,000 million, including contingency
- however, there is also a low probability that construction costs would reach or possibly exceed £11,000 million due to uncertainty and potential risks.

80. The analysis carried out by the Review necessitated the use of many simplifying assumptions, and the results should be regarded as indicative only. The results underline the need to firm up the scope and definition of the project to improve the reliability of the estimate, and to capture the potential benefits of good management by effectively managing risk.

OMR costs

81. The operating, maintenance and renewal (OMR) costs include the cost of operating the trains on both the main line rail network and the central section. It is assumed that track access charges would be paid to Network Rail for the use of the mainline rail network, but that there would be no payment for access to infrastructure on the central section. The operating costs include the cost of operating stations in the central area, but it is assumed there would be no additional cost for access to Network Rail stations for services that are being substituted. It is also assumed that Crossrail would only be responsible for maintenance and renewals on the central section, with those on the main network being paid through track access charges.

82. On OMR costs, CLRL has estimated a total cost of £4,168 million NPV over 60 years, allowing for displaced rail services, rising to £5,000 million NPV when an allowance for contingency is made. Against this, CLRL has identified potential benefits of some £900 million from removing bus services that should no longer be required once Crossrail were in operation - reducing the total to some £4,000 million NPV.

83. Table 2 shows the overall costs of operating, maintaining and renewing the Crossrail project set out in the Benchmark Scheme.

Table 2: Operating, maintenance & renewals costs	
CLRL Business Case	**£ million NPV**
Rolling stock	1,099
Operations	1,351
Maintenance & renewals	2,374
Subtotal	4,824
Displaced Rail/London Underground services	(656)
Subtotal	4,168
20% contingency	832
Subtotal	5,000
Displaced bus services	(915)
Total	4,085

Since the start of the Review, CLRL has reconsidered parameters on which the OMR costs were based and has reduced maintenance and renewals costs substantially. This represents a reduction of £830 million NPV, primarily due to a large reduction in the replacement costs CLRL had assumed for

the central station structural works. The review considers such a reduction to be appropriate. It would take total expected OMR costs down to around £3,330 million NPV.

Revenues

Methodology

84. The Business Case underpinning the CLRL Benchmark Scheme uses two transport models (Railplan and LTS, both owned by Transport for London) to estimate the user and non-user benefits of the scheme. Together these models also enable revenue forecasts to be calculated. A further specialist model is also used for quantifying the impact of rail links to Heathrow airport.

85. The LTS model has been used to predict changes in mode split between public and private trips, as well as changes in their distribution, as a result of changes in transport networks and demographics. This has enabled a picture of London's likely transport activities in 2016 to be constructed, assuming that Crossrail were not built but that all other expected changes took place. The data from LTS has then been fed into Railplan, which is then used to calculate the benefits of Crossrail in terms of crowding relief, in-vehicle saving times, wait time benefits and other benefits such as time saved walking through interchanges.

Likely revenues

86. The user and non-user benefits these models suggest would be likely to be generated by Crossrail are taken into account in the value for money assessment. But Railplan can also indirectly calculate revenue benefits by measuring the extra trips on the network that would be created. CLRL believes that about a third of the traffic carried on Crossrail would represent new public transport trips, with two-thirds being diverted from the existing public transport network. According to CLRL's work, gross revenues are accordingly projected at £7,656 million NPV, with £2,244 million NPV net of transfers between public transport modes. This assumes that public transport fares would generally rise in line with inflation and that Crossrail fares would be set in line with the general fares level. CLRL's forecast of revenues is already taken into account in the overall net cost of the project reported i.e. £11,273 million NPV in the case of the Benchmark Scheme.

Evaluation

87. The reliance that can be placed on these figures is, of course, dependent on the robustness of the models that have been used to generate them and their underlying assumptions. Generally, the models used are considered to be appropriate, while the adopted methodology takes sufficient account of their key strengths and weaknesses. There are, however, some areas where the assumptions are subject to risk, particularly in relation to population and employment projections and future network assumptions, and there are also areas where CLRL's assumptions are unpersuasive, principally on the relationship between passenger demand and journey times.

88. As far as the revenue projections are concerned, the most significant single issue arises in relation to the chosen elasticity of demand (-0.6). This parameter appears to have been based on limited empirical evidence. The Review considers that this is a conservative assumption, having carried out an analysis of the markets served by Crossrail. This analysis applied known London fares elasticities to modelled journey times to derive an estimate of the appropriate journey time elasticity. The Review's conclusion is that an elasticity of 1.1 would be a more robust assumption. This would increase revenues by over 50% (i.e. an increase in revenues of up to £1,200 million NPV, taking the forecast total net revenue level to some £3,500 million NPV). An alternative demand function, making the elasticity for each origin and destination pair proportional to journey time, may also be more appropriate than the current fixed elasticity model. Making this further change to give an elasticity proportional to journey time would add a further £1,000 million NPV, i.e. taking total net revenues to a potential £4,500 million NPV.

89. The Review's analysis suggests that other factors on revenues broadly cancel out. For example, the Review has considered whether suppressed demand could lead to higher revenues. The CLRL Business Case compares the Benchmark Scheme against a base case assuming demand and revenue levels that are unconstrained by capacity. Of course, in practice, demand could be constrained: CLRL's forecasts do appear to show congestion levels that are higher than could be supported in reality on certain, limited areas of the network. The Review therefore thinks that this effect could result in Crossrail generating higher revenues than CLRL's analysis shows, but probably only of the order of £100 million NPV. CLRL should look at this area in more detail to see if a higher figure could be justified. When doing so, CLRL would need to bear in mind the effect on benefits: while suppressed demand is likely to serve to increase revenues, it could have the opposite effect on forecast benefits.

90. Also, probably on the upside for revenues, CLRL's evaluation assumes that other significant enhancements to London's transport network will be in place by 2016, notably completion of the upgrading of the London Underground network under the PPP arrangements and Thameslink 2000. If this is not the case, the benefits from Crossrail would be likely to increase, with a consequent increase in revenues. CLRL's estimate of non-fares income, principally advertising revenues, also appears to be conservative.

91. On the downside, CLRL's method of using single morning peak traffic figures to generate annual revenue values has possible revenue implications, since it assumes that peak demand generated by Crossrail owing to reduced congestion would also be generated in the off peak. If this were not so, revenues might be over-estimated by as much as 10-15%.

92. Overall, leaving aside the question of the appropriate demand elasticity, which would have a major impact on expected revenues, the issues the Review has identified with CLRL's revenue forecasts broadly cancel out.

93. Table 3 below shows the overall effect of the positive and negative adjustments made by the Review to the revenue figures set out in CLRL's Business Case. The net impact is to increase the projected revenue by £1,200 million NPV.

Table 3: Net revenue adjustments	
Net Benchmark Scheme revenues	£ million NPV
(Business Case estimate)	2,244
Less conservative elasticity	(1,200+)
Other factors	
Suppressed demand	100+
Annualisation - off-peak congestion	(200)
Other (including non-fares revenue)	100
Total	3,444

Whole-life net costs

94. On a whole-life net cost basis, CLRL's analysis in its July Business Case suggested a total cost of £11,273 million NPV, allowing for all costs and revenues, except any additional costs that might be associated with private sector financing. This total breaks down as in the table below.

95. The Review's consideration of CLRL's Business Case, together with changes made by CLRL itself, suggests that CLRL may have understated capital costs, but that this would be largely offset by a similarly sized overstatement on OMR costs. In addition, the Review considers CLRL to have underestimated forecast revenues from Crossrail, by as much as £1,200 million NPV and, possibly, more.

Table 4: Whole life net costs	
CLRL Business Case	£ million NPV
Costs	
Capital costs	8,869
Tax loss and other costs	560
Crossrail OMR costs	5,789
Cost savings from bus/Network Rail/London Underground	(1,701)
Total costs	13,517
Revenue	
Crossrail gross revenues	7,656
Revenue transfers from bus/ Network Rail/London Underground	(5,412)
Total revenues	2,244
Total net costs	11,273

Conclusion 2: Costs and revenue

In conclusion, the Review considers that while significant elements of the project scope and definition remain to be decided, cost estimates must be treated with some caution.

CLRL's analysis suggests that the net present cost of its Benchmark Scheme would be £11,273 million NPV, allowing for all costs except for financing costs, and less net revenues generated by the project. However, within CLRL's Business Case analysis there are both understatements and overstatements. These might necessitate a net upward cost adjustment approaching £1,000 million NPV to CLRL's July 2003 assessment of capital costs, but this would be largely offset by reduced OMR costs. There is also a potential positive variance in net revenue that could see this increase by up to £1,200 million from CLRL's own estimate.

The Review has concluded that further work is necessary by CLRL to firm up the scope and definition of the project before more reliable cost estimates could be established.

Project governance arrangements

96. Both CLRL and the Review agree on the need to ensure that robust project management arrangements are put in place. In practice, this would mean appointing a strong project manager with the right incentives who would be able to manage contractors and sub-contractors to deliver the project on time and to budget.

97. The more difficult question relates to the issue of the project client. CLRL naturally assumes that it would adopt this role, with appropriate project management and execution arrangements underneath it.

98. Given the nature of CLRL's constitution, there must however be some doubt as to whether this would be the most appropriate arrangement. As currently constituted, CLRL is a 50/50 joint venture between the Strategic Rail Authority and Transport for London, with neither party (or any third party) having a controlling interest. The decision-making process therefore necessarily involves an element of compromise as CLRL is unable to function unless both of its shareholders are in agreement.

99. This arrangement has served CLRL well during this early feasibility stage and ensured that the two main stakeholders in the scheme retain the necessary degree of control and ownership over the project. It is, however, clear to the Review that these arrangements would be unsustainable if the project moved forward, particularly once construction work began.

100. The Review has not come to a fixed view on what ownership structure for CLRL would be most appropriate, though it considers that the current 50/50 split would not be effective in delivering the Parliamentary process. Options would include: giving one of the current shareholders a controlling interest; introducing a new shareholder (or shareholders) to provide an element of balance; or taking the company into direct Government ownership (i.e. creating a Government-owned company or 'GoCo'), recognising the Government's role as promoter of the required legislation.

101. This latter route has always been used in the past whenever a Hybrid Bill has been mounted. The advantage of having such a company is that it would provide the Government with more direct control during the crucial Parliamentary scrutiny phase of the project. By this means, the Government could assure itself that risks were being properly allocated and that CLRL was properly organised to respond to petitions while defending against proposals that would unduly increase costs or depress revenues. It would also give the Government the opportunity to restructure CLRL into a more effective project client organisation capable of acting robustly and decisively. Whatever solution were adopted, the Review believes it would be essential that CLRL had an appropriate board and management structure to ensure that decisions could be taken in good time and that proper control could be exercised over the management of the project.

Conclusion 3: Project governance arrangements

If Crossrail were to proceed, robust project governance arrangements would need to be in place. The Review does not consider that CLRL's current constitution would be appropriate and believes it would need to be restructured in anticipation of any legislation. A 'GoCo' has shown itself to be a suitable structure in the past.

Procurement

Procurement structure

102. Since submitting its Business Case, CLRL has continued to develop its thinking on procurement. A number of options are set out in its Procurement Strategy of 24 November 2003, and these have provided a substantial basis for the Review's work, although CLRL's work is continuing.

103. CLRL has undertaken a detailed assessment of the merits of procuring Crossrail using a concession structure against alternatives where CLRL, or another party such as Network Rail or London Underground, would retain ownership. Although CLRL's Procurement Strategy paper does not explicitly state a preference for either model, it is the concession option that was initially recommended by CLRL and the one that appears most developed.

104. CLRL considers that the size of the transaction would render a single fixed price lump sum construction contract unviable and would be likely to provide poor value for money, particularly given the railway and tunnelling risks. However, a multiple concession structure would also be unwieldy and sub-optimal: project upon project dependency would be introduced and there would be no single point of contact.

105. CLRL has therefore considered four potential procurement structures for the off-network works:

- CLRL lets a single concession contract for all off-network works on a target price basis. The concessionaire would be the owner and responsible for operations and maintenance (though these roles would be sub-contracted to other parties)
- CLRL retains ownership. It lets a contract for a project manager who would assist it in the negotiation of the various works packages for the off-network works. CLRL could retain the responsibility for operations and maintenance or pass it to Network Rail
- Network Rail becomes the owner and is made responsible for carrying out the project
- London Underground becomes the owner and is made responsible for carrying out the project.

The first two options are discussed in most detail, but as CLRL seems to consider that the ownership structure can be considered separately from contracting strategy, the contractual structures proposed are still somewhat unclear.

106. Under the concessionaire model, CLRL assumes that prior to any formal invitation to negotiate (ITN) there would be a process of 'convergence', i.e. soft testing of the market to ensure that the proposed ITN documents were likely to be broadly acceptable to both the financing and contracting markets. A number of papers on key areas would be published for market feedback, including proposed risk matrix and allocation, protocols and procedures with Network Rail and London Underground, and the financial structure of any Government support and termination compensation.

107. As CLRL acknowledges, this convergence process would provide an opportunity to consider fresh perspectives and political solutions to potentially difficult areas outside the context of a formal negotiation and hence reduce the overall amount of time and cost expended. The Review agrees that this approach would have some merit, but notes that the process would need to be carefully managed to ensure that valuable competitive tension, and consequent potential for enhanced value for money, were not lost. It would also be necessary to ensure that any procedures were properly validated so that the public procurement regime of the European Union was not breached.

108. Under CLRL's vision of the concessionaire model, the concessionaire would assume only limited construction risk, with substantial committed cost overrun support provided from Government. A key objective would be to incentivise the concessionaire to manage the substantial risks retained by the public sector. The concessionaire would manage the individual subcontracts, which would be procured on an open book basis using a variety of contracting methods. The concessionaire would be remunerated through incentive payments linked to construction cost overrun and through availability payments linked to debt repayment and operation and maintenance costs. This availability charge would flex depending on outturn cost and private sector funding drawn down at construction and systems completion, with Government retaining ridership risk. Substantial termination compensation, of between 90-100% of outstanding project debt, would be payable by Government on contractor default.

109. Under the concessionaire model, construction cost overruns would be funded by public and private finance, with the public sector contribution increasing as cost overruns increase. Availability fees would be adjusted to protect debt coverage ratios, with concession default being triggered when a pre-determined cap on Government support were reached. The proposed funding arrangements envisage private sector equity and debt being raised by the concessionaire. The market capacity for such funding is considered to be in the region of approximately £4,000 million for limited recourse project debt and around £350 million for equity provided by the project manager or other possible investors. In the event of alternative, less expensive, funding being available for Crossrail, for example in the form of further Government funding, CLRL have indicated that their financing plan would reflect a lower amount of project debt. CLRL suggests that a debt level of around £1,000 million would ensure that Crossrail benefits from disciplines brought by project lenders and would allow genuine competition between alternative debt providers. Government capital grants would provide the remainder of the funding requirement. Depending upon the amount of project debt raised, Government grant funding would total around £4,500 million to £7,500 million. The costs associated with financing the project debt do not appear to have been allowed for in the transport appraisal included in the Business Case.

110. The presence of a reasonable amount of private capital is seen as an important element of the concession model. Although private sector equity and debt would carry a funding cost above that of Government provided or guaranteed finance, it is believed that this cost would be outweighed by the benefits brought to the project. These include due diligence, project monitoring and increased focus on whole life costing.

111. CLRL has continued to explore other models, notably with CLRL as owner of the works for the central section. In this case, CLRL would retain a project manager with the same incentives as the concession option, but CLRL would have direct ownership of all the assets during and after construction. The off-network construction works would be carried out under direct contracts between CLRL and contractors on a fixed price, target price or other appropriate basis. The main advantage of this option is that the procurement process would not be as intensive as in the concession option. Further variants to this model would envisage the possibility of either Network Rail or London Underground being the owner of Crossrail.

112. The issue that lies at the heart of CLRL's decision initially to promote a concessionaire solution but also to explore other options is the difficulty of establishing the most appropriate procurement route for a project of unprecedented size and scope. In considering the suitability of a concessionaire model as against other alternatives, the Review is mindful that there are relatively few examples of successful large transport infrastructure projects undertaken in the public sector on which to draw for guidance. Some of the positive and less positive outcomes can be seen in the Jubilee Line Extension. The construction of the Channel Tunnel Rail Link provides a current example of good practice.

113. As far as the concessionaire route is concerned, while the Review considers that there is nothing inherently wrong with this model, the particular variant proposed by CLRL would not provide value for money. The level of risk transferred to the private sector would be relatively low. The public sector would be expected to retain ridership risk and a large part of the construction cost risk, with a high level of cost overrun support. Much of this risk would be retained by Government to allow the raising of private sector equity and debt. Although the Review acknowledges the benefits that would be brought by the presence of private sector capital, it believes that it is unlikely that the pricing of this capital would reflect the limited risk transfer and will therefore offer poor value. This is particularly the case here, where CLRL believe the Government would need to be asked to guarantee the project debt very substantially in the event of a default. The Review estimates that this debt will cost around 1.00-1.50% over the cost of gilts.

114. Under the model where CLRL retains ownership, CLRL has considered using a target price contract to incentivise the project manager. The Review agrees that, in principle, this could provide an appropriate incentive mechanism, but the accuracy with which a target price could be determined would be central to its success. To negotiate a robust overarching target price contract would mean having proper means of introducing competition, and understanding the full scope of the project and all the underlying sub-contracts that would support it. There would also be difficulties in dealing with future changes in scope. The Review considers that further work would be necessary to determine more precisely how a proper target price could be negotiated, before it could take a definitive view on the robustness of the mechanism.

115. The option where Network Rail becomes owner has only been discussed very briefly, and is not viewed favourably by CLRL. The Review does not consider that this option should be pursued as handing the project to Network Rail, a private sector entity, in the absence of a competitive tender, would be inconsistent with public procurement rules.

116. The option where London Underground becomes owner is also only very briefly discussed by CLRL. As London Underground is a public body, it would probably be possible to hand responsibility for the carrying out of the project to it without offending public procurement rules, although the Review would question whether this is the best approach. The problems would also be more the practical ones of whether London Underground has or could obtain the necessary skills to handle a project of this size and complexity.

Hybrid Bill

117. CLRL has proposed that it should seek the necessary powers to acquire land to build Crossrail by means of a Hybrid Bill. It has effectively already begun that process by undertaking public consultations on the proposed route. It is also preparing to embark upon the Environmental Statement that would need to be deposited with the Hybrid Bill.

118. In announcing his Review, the Secretary of State has already indicated that the Government believes that, should Crossrail go ahead, a Hybrid Bill would be the most appropriate route. The Review notes that the process is unlikely to be straightforward, particularly since on even optimistic assumptions any Hybrid Bill would be unlikely to receive Royal Assent before the latest date for the calling of a General Election (June 2006).

119. The main areas that would need close consideration are:

- the extent and nature of powers contained in the Hybrid Bill, particularly relating to the extent of powers to acquire land (i.e. it would be necessary to identify all the land required for the construction of Crossrail before the Hybrid Bill were deposited)
- the means of vesting or otherwise transferring land and property ownership to Crossrail
- the extent of any requirement to specify the form of new development subsequent to the construction of the railway (which would be particularly important for Conservation Areas)

- the ability to retain ownership to land over stations once acquired (where owners might challenge the need for Crossrail to retain the development platform and air rights once the station were built)
- the interaction with other general legislation proposed and in the programme, including the Planning and Compensation Bill and Crichel Down Rules
- methods and structures for financing the project.

120. The Hybrid Bill would usually provide outline permission for the acquisition of land necessary to build Crossrail. More detailed permissions would need to be sought from Local Authorities in due course, which could have implications for the timescale for delivery of the project.

121. The successful negotiation through Parliament of a Hybrid Bill requires teams of several disciplines to work closely together, so as to provide information and evidence which is clear, comprehensive, objective and defensible. A close relationship between the sponsor of the Hybrid Bill (the Department) and the project promoter (CLRL) would be essential. It is for this reason that the 'GoCo' route is normally followed.

122. CLRL is making progress with preparations for a Hybrid Bill, but there would be a significant amount of work to be completed if CLRL's planning assumption of a November 2004 deposit date were to be met, although it would be possible to introduce the Hybrid Bill later in the session with the approval of Parliament. In this regard, there would need to be a close interface between the environment and engineering teams and those managing the public consultation as the deadline for deposit of a Hybrid Bill approached. In particular, the iterative approach that CLRL has currently adopted would need to be replaced by a more integrated process.

123. CLRL has assumed a 24-month period for enactment of a Hybrid Bill. The Review believes that would probably be achievable, if the process were well-managed, although the numbers of petitions during Parliamentary scrutiny might be very high. There would be some obvious handling issues that would arise, notably the virtual certainty of a General Election being called before the Hybrid Bill could complete its passage through Parliament. A Hybrid Bill may be resurrected with Parliament's approval, but there would be obvious merits to ensuring that Parliamentary time and other resources were not wasted (i.e. by moving onto a new Parliamentary stage - particularly going beyond Second Reading - unless on a reasonable view it were clear that stage could be completed before Parliament were dissolved). Meeting CLRL's planning assumption of November 2004 for the deposit of the Hybrid Bill is not critical.

Conclusion 4: Procurement

The Review is not convinced that a concessionaire solution along the lines initially proposed by CLRL would provide satisfactory risk transfer for the additional costs incurred and considers that further work would be necessary before the other alternatives now put forward by CLRL could be properly evaluated. It does, however, believe that target price contracts, supported by robust project client and project management arrangements, would be the appropriate way to deliver a project of this complexity, though further work would be necessary to determine an appropriate structure and target price. While the Review supports the choice of the Hybrid Bill route, it notes the significant amount of work that would be necessary if CLRL's proposed timetable were to be met and the ramifications of a General Election being called while the Bill were in Parliament.

The Review also concludes that the current governance structure of CLRL would not be likely to meet the rigorous demand of a Hybrid Bill process. A better relationship would be significantly closer and more direct - i.e. with CLRL formed as a 'GoCo'.

Construction market capacity

124. The size of the Crossrail Benchmark Scheme raises the obvious question of whether there would be sufficient capacity in the construction market for it to be delivered within the envisaged timescale and/or without significant escalation in labour costs that would affect its costs. The number of other potential projects that might coincide with Crossrail, such as Thameslink 2000, regeneration work in the Thames Gateway and a successful Olympic bid, would increase the pressure on market capacity.

125. In this respect, the Review recommends that two surveys should be carried out before any decision is taken finally over whether or not to proceed with any scheme. The first of these should survey the demand and supply of industry resources available to the project in the light of the large number of other potential projects in the London area and United Kingdom more generally in the same period. In the case of labour, this survey would need to address the likely effect on labour productivity as the result of less skilled labour and management being drawn into the industry given the predicted high level of construction and railway activity.

126. The second survey should focus on current and likely industry future prices, bearing in mind the results of the first survey in relation to industry capacity and demand.

127. The Office of Government Commerce, OGC, has responsibility for understanding market capacity issues in relation to public procurement and should be consulted over these market capacity issues.

Conclusion 5: Construction market capacity

Crossrail would make considerable demands on the construction market and it is not yet clear whether the necessary capacity exists. The Review therefore recommends that two surveys should be carried out: one on construction industry capacity per se, the other on likely industry pricing. This work should be carried out in discussion with OGC.

Financial market capacity

128. Similar capacity concerns affect the financial market. Here the issue is closely bound up with any decision on procurement route, funding and financing strategy, so the quantum and timing of funds to be raised in the market might vary quite considerably, even for a project of a fixed scale, scope and cost.

129. Two essential points can be made. First, the availability of significant equity funding for a project of this size would be likely to be relatively small. For Crossrail, even an equity contribution from the construction companies of just 5% would require raising substantially more than £500 million, an amount that would be exceptional by comparison with earlier transactions and practically untenable in terms of the balance sheet risk it would present to the companies concerned. While the growing number of infrastructure funds might provide an additional source of equity funding, private equity houses are not in the project evaluation business and they might require higher returns.

130. It is not clear, therefore, that the traditional PFI approach of private sector equity provided by consortium members and financial investors supported by non-recourse bank debt could be readily applied to a project on the scale of Crossrail. CLRL's financing plan acknowledges this and assumes around £350 million of equity. This figure represents a far lower percentage of total project cost than would normally be required to form the primary layer of risk capital and to support project debt, but one that the Review believes is a fair estimate of likely market capacity. One consequence of this, depending on how the risk were shared, is that project risk would become over-concentrated on the small layer of equity capital. Unless the risk transfer arrangements therefore limit the risks to which equity would be exposed, in effect through further Government risk assumption, it is unlikely that the private sector would be able to accept the equity terms. But an absence of private sector equity altogether would be regrettable. Its existence would offer important benefits: first, equity providers would be incentivised to ensure that the project is effectively delivered; and, second, the presence of some equity would facilitate the introduction of project debt which would in turn mean the introduction of bank due diligence and lenders' oversight, both of which could be expected to improve the governance of the project.

131. In relation to private sector debt, the overall capacity of the market, the availability of funds, and the terms on which they may be offered, would necessarily be bound up with market conditions at the time they were sought and the level of expected returns when compared to comparable projects (i.e. other large transport infrastructure projects).

132. The size of the CLRL Crossrail project is such that in whichever form the project were procured, funding of up to £15,000 million, including net financing costs, would be required over the period of construction. Only AAA rated securities, such as gilts, have access to markets sufficiently deep so as to allow this amount of funding to be raised from a single source. Project finance debt, which would be of a lower, but at least investment grade credit rating, would therefore need to be procured alongside either of these two funding sources in order to meet the project cost. CLRL is proposing that Government grants (i.e. gilt funds) should provide the balance.

133. Project debt for Crossrail could take many forms, including bank debt, bonds and loans from development banks such as the European Investment Bank. CLRL has assumed that, in aggregate, the amount of debt that could be raised from such sources for a project with a risk profile such as Crossrail would be around £4,000 million. The Review broadly agrees with this assessment.

134. In the section discussing Concession Structure, the Review raises concerns that the pricing of debt in the concession structure proposed by CLRL would offer poor value for money given the limited risk transfer to the private sector. It is the Review's view therefore, that if the structure proposed by CLRL were to be adopted - which it does not recommend - the amount of project debt should be minimised relative to grant funding so as to improve value to the taxpayer. This project debt should nevertheless be of sufficient size to ensure that the project benefits of lenders due diligence are obtained.

Conclusion 6: Financial market capacity

The Review has concerns about the capacity of both financial and construction markets to take on a project of the size of CLRL's proposals without significant levels of Government financial support. Given the size of the transaction and its projected internal rate of return, it is unlikely that it would prove possible for a significant proportion of equity funding to be raised. While market capacity for project debt would fall well short of the funding required for Crossrail, value for money concerns lead the Review to conclude that such funding should be limited relative to gilts.

Environmental and heritage considerations

135. The CLRL Business Case contains an Appraisal Summary Table of the potential effects of its scheme on the environment and historic resources. The Review Team's assessment of Crossrail's environmental impact is based on CLRL's work to prepare this appraisal and further work that has been started by CLRL to prepare an Environmental Statement in support of a potential Hybrid Bill. CLRL has much work to do to prepare the appraisal and the Environmental Statement, as the scheme is not yet firm in all respects. This might result in an under-assessment of the environmental impact of construction at the present time.

136. CLRL has developed a management system for project and implementation risks. While the risk management system appears to be in accordance with best practice, there are shortfalls in its application, and inconsistencies between the registers of design, construction and environmental risk. Further examination and rationalisation of risk management is recommended, focusing on ensuring controls would be in place to mitigate known major environmental risks.

137. The most significant environmental risk would be spoil disposal. CLRL recognises this, but relevant cost estimates are not based on detailed information and actual costs could be higher. Although the volume of excavated material would be considerable, robust information on the proposed management and disposal of spoil is not currently available. Further work on this would be needed, as delay in resolving this issue could jeopardise the proposed programme.

138. Work on the Environmental Statement is in its early stages. Not all required information is yet available, notably engineering and construction detail and baseline environmental data. The Environmental Statement, and its interface with the risk management process, would be a key element in the preparation for Parliamentary proceedings and response during Select Committee. CLRL's environmental team would need to be strengthened to deliver the required information and to manage this process if the current programme were to be met. CLRL has subsequently strengthened its environmental team by bringing in independent town planning and environmental consultants.

139. CLRL would need to enhance its identification of risks and the mitigation measures that it would deploy to manage them in order to prepare effectively for Parliamentary scrutiny. It would need to carry out full consultation with non statutory environmental bodies. CLRL would also need to ensure full integration of its workstreams.

140. Risks to heritage have been identified and include disturbance of or unexpected discovery of archaeological remains, demolition of buildings and loss of setting. CLRL is carrying out surveys to evaluate the extent and importance of archaeological remains. CLRL has in place a management strategy for archaeological finds, but this issue would remain a risk to the project in terms of cost and programme.

Conclusion 7: Environmental and heritage considerations

The timetable for completing the Environmental Statement within the current programme would be challenging, especially if there were delays in obtaining necessary information. Work would need to be prioritised to resolve inconsistencies in appraising and managing environmental risks. A robust strategy would need to be developed for disposal of spoil as a delay could jeopardise the proposed programme.

Timetable

141. CLRL's programme assumes deposit of the Hybrid Bill in November 2004, with advance work beginning in June 2005 and work on the central section commencing in June 2007. On this basis, revenue service would begin on the central section in March 2013, with the whole scheme fully operational by January 2016.

142. To achieve this timetable, it would firstly be necessary for the Hybrid Bill to have received Royal Assent by November 2006. Assuming that a Bill could be deposited and pass Second Reading before the next General Election is called and depending on when that General Election is called, that seems a reasonable assumption, though if the deadline were missed it is unlikely that time could be made up. But any delay would not be great in comparison to the timetable for completing the project.

143. For the central section to be opened in 2013, it would be necessary for the central stations to be built in parallel. Construction of these underground stations would be on the critical path of the project, and therefore would dictate the overall duration of the construction programme. While there would be issues around construction market capacity, and an ever-present threat of unforeseen problems that are inherent in excavation under a major city, CLRL has allowed sufficient contingency at this stage for the duration of works.

144. The construction of the central tunnels assumes a degree of float that might well be optimised by adopting a modified construction strategy. To mitigate any potential delay risk to underground work, a more detailed survey would be necessary to identify any currently unforeseen obstacles such as building foundations and underground utilities, and to determine soil conditions and ground settlement behaviour.

145. Overall, the Review considers that even though the durations used for the tunnelling work are too conservative, CLRL's programme is nonetheless robust. With the right management structure and co-operative and experienced contractors, CLRL's envisaged programme could be the basis for a successful project programme.

146. As far as the 'on network' work is concerned (i.e. essentially the four branches off the main central section running on Network Rail lines), CLRL has proposed that Network Rail should carry out the work. There are, however, insufficient detailed engineering designs for the development of a valid programme for this work, though a generous amount of time has been allocated to it, and no funding is provided for this work in Network Rail's present regulatory review. If this work were undertaken in parallel with construction of the critical central section, then it should be possible to complete it within the time available. For the 'on network' works to proceed to plan, it would also clearly be necessary to ensure that both Network Rail and London Underground were tightly bound into the process, both before the Hybrid Bill were deposited and thereafter through the Parliamentary process and subsequent construction and operation.

147. Generally, the main risks to achieving the timetable envisaged by CLRL would be:

- unforeseen underground obstruction
- consents and interfaces (e.g. with local authorities, Network Rail and London Underground)
- delays due to design changes
- insufficient land acquisition process and procurement policy
- delays due to the procurement process(es) for construction work
- delays due to late access to land
- insufficient construction and management resources.

148. If these issues could be addressed positively, the Review believes that CLRL's envisaged programme would have a reasonable possibility of being achieved.

Conclusion 8: Timetable

CLRL's proposed construction timetable includes adequate and reasonable contingency provisions though there are a number of risks which, were they to materialise, might have a significant impact on its achievability. More work, however, would be needed to make the

programme more robust, such as binding in key third parties like Network Rail and London Underground.

Value for money

Will Cross London Rail Link's July 2003 Crossrail Business Case proposals offer value for money?

Assessment of value for money

149. CLRL's Business Case has been prepared in accordance with the Government's guidance on appraisal of major transport projects. It assesses the project against five objectives, viz.: economy (cost: benefit), environment, safety, accessibility, and integration.

150. However, existing guidance is not designed to cope with the relatively few number of mega-projects of Crossrail's size. The CLRL proposal therefore needs special consideration to assess the impact of Crossrail on overall economic growth accurately, particularly in London, or on wider Government policies, such as the proposed development of the Thames Gateway, given the number of other factors which will affect these bigger outcomes.

151. In summary, Crossrail's main transport benefits are considered to be:

- time savings experienced by users of Crossrail
- crowding relief for passengers using Crossrail and other services
- increased fare revenue; and reduction in highway use arising from a shift to public transport.

  By applying a standard methodology developed by the Department for Transport, it is possible to determine whether these benefits are likely to represent value for money by assigning them monetary values and comparing them with the net costs and subsidy requirements of Crossrail.

152. CLRL have derived benefits and demand forecasts for Crossrail using the established LTS and Railplan models. These forecasts are in turn based upon projections of population and employment in the draft London Plan for the year 2016. A base case that assumes Crossrail is not built has been used as a yardstick to assess the effects of the proposed scheme. This base case assumes a number of other changes to the transport network, such as enhancements to the national rail network and improvements to London Underground consequent to implementation of the PPP contracts.

153. On the basis of CLRL's assessment, the Benchmark Scheme has a benefit-cost ratio of 1.99:1. CLRL also believes it delivers significant benefits in relation to the other four objectives of environment, safety, accessibility and integration.

154. CLRL's use of the modelling tools is generally appropriate, and the methodology takes account of the models' key strengths and weakness. Overall, there are many simplifications within the process, but these are unlikely to lead to major errors. The Railplan and LTS models have been calibrated against actual public transport usage and have been shown to contain some sizeable variations from known flows. The results therefore need to be viewed with some caution.

155. The validity of the key assumptions behind CLRL's analysis is critical to the robustness of its overall findings. Most significant is the assumed growth in London's population and employment, as derived from the draft London Plan for 2016, which is used to generate the peak demand scenario. While these forecasts are broadly adopted, there is some inevitable circularity as they will only be achieved if there is significant investment in supporting infrastructure, including other transport projects. Crossrail is not seen as essential to achieving the planned growth, but is expected to facilitate it greatly.

156. The draft London Plan has been the subject of detailed scrutiny in Government and the assumptions made about population and employment were fully debated at its Examination in Public. The broad level of growth in population put forward in the London Plan is being adopted by Government for planning purposes and will form the basis for housing policies in more detailed plans at the borough level. Sensitivity tests have been run on the benefit-cost ratio against a range of other scenarios, including lower population and employment growth in London, lower outturn demand and higher off-peak growth rates. Even if the assumed growth were to fail to materialise at all, the benefit-cost ratio would still be positive at 1.01:1.

157. Of the other key assumptions in the CLRL Business Case, the Review has also identified some other concerns including:

- the network and service package assumed in the base case against which Crossrail is evaluated. This assumes a large number of network improvements that are in practice likely to be constrained by funding; and no allowance has been made for performance improvements which are expected to improve reliability
- the journey time elasticity that determines the level of demand generated by Crossrail (discussed further under 'Revenues'). A more appropriate elasticity might raise the benefit-cost ratio marginally from 1.99:1 to 2.1:1, while an alternative demand function could raise it further to 2.4:1
- the methodology for annualising morning peak benefits and revenues. This incorrectly reflects journey lengths and makes no adjustment to reflect seasonality. This is likely to be neutral for revenues but reduce benefits by 11%
- the benefits attributed to improved step-free access and quality benefits appear to take no account of planned London Underground improvements in the base case and are hence overstated
- the effect of trip suppression on revenues and benefits in the base case as networks become crowded has not been fully taken into account, while the revenues arising from reduced congestion are incorrectly assumed to accrue off-peak. These two factors are, however, likely to balance each other out and have an overall neutral effect
- the calculation of tax losses due to the switching of consumer spending to zero rated public transport fares from other goods and services is included in the estimate of total costs, following Green Book guidance. However there is an error in the calculation such that losses are overestimated by about £100 million reducing the net costs by this amount.

158. The impact of Crossrail on Heathrow services requires further detailed investigation, including the assumptions used for the calculation of economic benefits and revenues. The current Heathrow Express provides a high quality, four trains per hour direct service between Paddington and Heathrow airport and a further two trains per hour stopping service is assumed in the base case. The Benchmark Scheme provides six Crossrail trains per hour and replaces the Heathrow Express (the 4 direct and the planned 2 stopping services), thus representing a similar level of service. Current proposals (January 2004) are for four Crossrail and four Heathrow Express trains per hour which would be expected to provide greater benefits than the base case.

159. But there are two particular factors to be taken into account. First, by nature of the rolling stock to be deployed, the Crossrail service would not be of the same premium quality as the Heathrow Express. Second, the introduction of additional trains onto a section of track that is already heavily used could have consequences for traffic on the Great Western main line into Paddington. CLRL is currently examining layouts which would avoid this problem. Further work is necessary to assess the impact of both of these issues.

Conclusion 9: Value for money

Overall, the Review has concluded that the Business Case for the Benchmark Scheme is robust and could provide good value for money. It is, however, critically dependent upon the extent to which the expected population and employment growth in London materialises.

Wider benefits

160. CLRL believes Crossrail would produce demonstrable and quantifiable direct transport improvements, which would support economic growth in London and in turn, national economic prosperity. CLRL believes that Crossrail would also deliver wider benefits in three main areas:

- support for London's position as a pre-eminent FBS centre
- support for the planning and transport policies of the Government, the London Mayor and the transport authorities
- regeneration effects, particularly in the Thames Gateway.

161. CLRL believes that Crossrail would make a significant contribution to the Government's overall transport objectives. It would also support the development strategy outlined in the draft London Plan, in particular in sustaining FBS clusters by linking the City to the Isle of Dogs. Crossrail would also serve many of the centres and areas identified as Opportunity Areas and Areas for Intensification, including the Isle of Dogs, Royal Docks, Paddington and Hayes.

162. Within the FBS sector, CLRL believes any wider benefits - over and above those quantified in the main transport appraisal - would primarily be realised by 'agglomeration', i.e. the clustering of both new and existing companies delivering growth in high value jobs within the existing high density areas, namely the West End, the City and the Isle of Dogs. CLRL argues that agglomeration delivers significant advantages to business in the FBS sector and that this would be reflected in the higher rents that might be commanded within central London and result in higher tax revenues being made available for redistribution. By serving the three main areas where agglomeration benefits are likely to be realised, CLRL believes Crossrail has the potential to enhance them even further.

163. CLRL's Business Case for the Benchmark Scheme estimated that employment growth resulting from Crossrail might add between £8,000 million NPV and £9,000 million NPV to UK GDP. As CLRL acknowledged then, neither the accuracy of this figure nor how it should be treated had been agreed with Government at that stage.

164. One key issue was the extent to which this figure could be treated as additional to the benefits assessed in the main transport appraisal. Since producing its Business Case, CLRL has developed its thinking. The Review understands that CLRL now considers broadly £4,500 million NPV in agglomeration benefits to be additional to the benefits already identified elsewhere. (For the avoidance of doubt this does not represent CLRL's analysis of the effect of Crossrail on GDP. That would need to take into account other factors, such as, for example, time savings for business passengers that are included in the main transport appraisal.)

165. CLRL believes that Crossrail would also have the potential to contribute significantly to the Government's wider regeneration objectives, in particular in the Thames Gateway, where a range of initiatives is planned in relation to housing, education and health. Combined with local projects it would increase public transport accessibility, improve accessibility to additional jobs, education opportunities and cultural facilities outside regeneration areas and generally improve the image and perception of regeneration areas. CLRL has valued these regeneration benefits and estimates that Crossrail would enable or attract between 56,000 and 110,000 jobs.

166. The Review agrees that wider benefits will accrue in the areas identified by CLRL. In addition, it considers that Crossrail offers the potential to improve access to proposed airport developments, as set out in the recent Aviation White Paper, by improving access between central London and Heathrow and by significantly relieving congestion at Liverpool Street, which in turn would enable improved links to Stansted. However, the Review also considers that the impact of Crossrail would prevail far beyond the horizons of current economic plans and, therefore, that quantification of such benefits represents a significant challenge.

167. Particularly in relation to agglomeration benefits and regeneration benefits, the Review recognises the difficulty in forecasting such complex and interrelated effects over a substantial time period. It has assessed the CLRL approach and methodology and compared it to other available material within the Office of the Deputy Prime Minister and Department for Transport. Certain of the CLRL base assumptions and elements of its approach to the analysis are open to debate and, by using different analysis, it is possible to support a range of potential outcomes. Department for Transport economists' analysis suggests a somewhat lower but still significant number. The key factors affecting outcomes include:

- the location, nature and extent of future employment growth in London
- the relative productivity of Central London workers compared to outer London and elsewhere
- the impact of Crossrail on housing and economic growth in affected areas of London and the extent to which assumed growth is net additional or redistributed from elsewhere.

Wider benefits will also be sensitive to any changes in route from the Benchmark Scheme.

168. The Review has not undertaken its own analysis of the potential wider benefits.

It believes that further work would be required to identify them more clearly and to assess the extent to which they can genuinely be attributed to Crossrail. However, given the large number of variable factors involved and the substantial uncertainties about such long-term forecasts, it is likely that many of the potential benefits that are supported instinctively by consensus will defy empirical analysis.

Conclusion 10: Wider benefits

The Review has not sought to replicate CLRL's work in assessing the wider benefits of Crossrail, but it agrees that such benefits will accrue, contributing to the Government's transport and planning policies, helping to develop new communities in the Thames Gateway and supporting the FBS sector in London. However, it believes CLRL's methodology is open to debate and that ultimately it may not be possible to predict the empirical valuation of these benefits over the long term accurately.

Funding and financing

What is the extent of Government funding that can be justified? What proportion of funding would be required from non-Government sources?

Identification of funding sources

169. A decision on the level of Government funding that could be justified would need to be taken in the light of other revenue sources that might be available. Five main potential sources may be identified for funding the construction of Crossrail:

- net travel-generated revenues (i.e. farebox), potentially including revenues from other travellers in London and the South East who might benefit from the reduced congestion delivered by Crossrail
- any appropriate European Union subventions
- contributions from London (whether businesses or individuals), which might be voluntary or mandatory
- property revenues (e.g. direct contributions from property development over stations and elsewhere along the route)
- direct Exchequer support (i.e. in the form of grant or subsidies paid to Train Operating Companies).

170. The quantum and timing of the amounts that might be raised from each of these sources is discussed below.

Travel-generated forecasts

171. As far as the funding of Crossrail is concerned, two main issues arise in relation to farebox revenue. First, what proportion might reasonably be applied to the construction and operating costs of the scheme; and second, what would be the prospects for increasing revenues by raising the level of fares?

Use of fare revenue to fund Crossrail

172. The extent to which farebox revenue might contribute directly to Crossrail costs is inextricably bound up with wider issues of fares policy in Greater London. Assuming that Crossrail were integrated with other transport systems under the control of the Mayor, the revenues it would generate would form part of the same body of income as that taken into account for the purposes of setting the level of Greater London Authority (GLA) transport grant. For the purposes of its Business Case, CLRL has incorporated figures reflecting the net increases in rail revenues that would be due to Crossrail and has assumed that lower bus revenues (down by £467 million NPV) would be more than offset by the lower costs of running a reduced bus network once Crossrail were in operation (down by £915 million).

173. The net cost figures for both the Benchmark Scheme and the alternatives that are referred to elsewhere in this report (i.e. £11,273 million NPV for the Benchmark Scheme) encompass CLRL's overall forecast of costs for Crossrail, including capital, operating, maintenance and renewal costs, and any impact on costs elsewhere, such as those set out for the bus network in the previous paragraph, but exclude financing costs (over and above the cost of public sector financing that is implicit in the NPV calculation). They also take into account CLRL's forecast net revenues.

174. While this appears a reasonable basis on which to construct a business case for Crossrail, further work is necessary to validate some of the underlying assumptions. As set out earlier, the Review's view is that CLRL's analysis is based on too conservative a view of the impact that reduced journey times in London would have on passenger demand and therefore revenues. The Review's analysis suggests that CLRL understate the potential for Crossrail to generate revenues by £1,200 million NPV and, possibly, by as much as £2,200 million NPV. For the purposes of this report, the Review's central assumption is that Crossrail would generate £1,200 million NPV in revenues over and above those estimated by CLRL, even allowing for the assumption that fare increases would be held in line with inflation.

Fare levels

175. Under the Greater London Authority Act 1999, responsibility for fares policy in Greater London rests with the Mayor. While, theoretically, it would therefore be possible to increase revenues from Crossrail by raising fares, in practice any such move could only take place within the general context of the Mayor's fares policy and through agreement with him.

176. At present, the Mayor's stated fares policy is to cap the level of fare increases at RPI, at least for the next four years. Taking this as a starting point, CLRL's Business Case assumes no real-term fare rises during the next 60 years. However, higher fares would have the potential to generate significant additional revenues, and so the Review has considered this area further.

177. One possibility would be to introduce a Crossrail premium fare. There are difficulties with this - it is not clear at this stage, for example, how it could be made compatible with a Travelcard system.

178. Alternatively, fares could be raised more widely across London to fund Crossrail. In the past, there have been periods when fares have been increased at a rate above inflation. Such a policy - if introduced across the London Underground, London Buses and London mainline rail services -- might generate significant sums to assist the funding of the project.

European Union funding

179. The CLRL Business Case makes no assumptions about the possible availability of funding from the European Union. While it is difficult to see how Crossrail could qualify for Trans-European Network funding, it is possible that it might qualify under the Community's Growth Area Initiative.

180. This possibility is currently being explored, but it would seem prudent to assume that European Union funding is unlikely to be available and, even if it were, not in significant amounts.

London contribution (Alternative Funding Mechanisms)

181. Construction of a large new transport infrastructure such as Crossrail should unlock opportunities for attracting revenue other than through the farebox. Essentially, these contributions should reflect the general benefit that Crossrail would bring to London in terms of enhanced access, better services and business facilitation. Some of the benefit would show up in property values and might provide a basis for collection of contributions. This relationship has given rise to the current discussion of using property gains for Alternative Funding Mechanisms for Crossrail. The area over which such effects would be felt is clearly debatable, but a reasonable working assumption is that localities within one kilometre of stations should be likely to benefit and might therefore be expected to contribute to the costs of Crossrail. The potential for raising revenue from these localities is discussed further below.

182. Investment in new infrastructure provides benefits to a wider constituency than merely that of travellers and developers of property along the route. In particular, history shows that occupiers and owners of properties in the vicinity of stations on the route would be expected to benefit through enhanced access, which would in turn deliver business gains. Benefits would be reflected by increases in the rental and capital values attributable to residential and commercial properties.

183. Preliminary work by CLRL's property advisers suggests that the uplift in the value of commercial property in the Crossrail zone (defined as being within one kilometre of Crossrail stations) is likely to be in the order of 6% overall (with considerable variations across the zone). While such a forecast is inherently uncertain, the Review understands that this order of magnitude is not inconsistent with the available evidence from other major transport infrastructure investments.

184. Generally, there is little dispute with the analysis that property values might be enhanced through the development of transport infrastructure and that these increases could give rise to localised windfall gains. With the discussion of Alternative Funding Mechanisms has come some acceptance from those most likely to benefit from Crossrail that they must make some contribution to the cost of construction. A wide range of London business interests (e.g. London First, Chamber of Commerce, the Corporation of London etc) has already indicated that it will be willing to see such gains used to support the funding of the project. Initial indications from business interests have assumed a contribution of £2,000 million. Further consultation would be needed to settle the final level of contribution in the light of any scheme it is decided to build and the additional value it would create for London business, but the Review does not believe it unreasonable to postulate a stronger contribution from business for a substantial scheme than that advanced at the present stage of preliminary consultation. For the purposes of the Review, we have assumed business contributions in a range from £2,000 million to £3,000 million.

185. The Review has not itself carried out a thorough analysis of the potential for different Alternative Funding Mechanisms to raise revenues from such sources, but one option could be to include a provision in a Crossrail Hybrid Bill to enable a direct levy to be raised on developers in respect of Crossrail. This is dealt with in the subsequent section of this report, along with property revenues more generally.

186. Another possible Alternative Funding Mechanism would utilise the mechanism for collecting National Non-Domestic Rate (NNDR, i.e. business rates). Transport for London has undertaken a considerable amount of work in this area, concentrating on tax increment financing. This method would reflect the extent to which property values in the Crossrail zone outperformed the rest of the country. Transport for London has also considered a straightforward levy imposed within the Crossrail zone.

187. Transport for London has made some calculations on the sums that might be raised through business rate-based Alternative Funding Mechanisms. Their estimates cannot be treated as robust at this stage, but they appear to have followed a reasonable approach.

188. Transport for London's analysis focuses on the impact of tax changes rather than the additional value that may be created without any changes to the business rate system. Nevertheless, its modelling can be used to estimate the extent to which business rate payments might increase simply as a result of new developments attracted by Crossrail - Transport for London's analysis suggests additional revenues of £2,700 million NPV.

189. Transport for London's model does not provide any sensitivity tests around this central number. In addition, it does not provide an estimate of how much of this money would be a net rather than gross addition to business rates.

190. One key assumption is that Crossrail would facilitate the creation of 47,500 jobs in central London by 2027 and that these jobs would otherwise not be created. Clearly, there is risk around this forecast in both directions, and there are significantly different forecasts of the jobs that would be facilitated by Crossrail, both upwards and downwards. On the upside, the Centre for Economics and Business Research (cebr) has produced figures for Canary Wharf suggesting that the construction of Crossrail could result in an additional 208,000 jobs in London by 2023. However, most forecasts the Review has seen are significantly lower than this. On the downside, Oxford Economic Forecasting has suggested that Crossrail would support only an additional 18,000 jobs in central London by 2027. If Transport for London's analysis were adjusted to allow for only 18,000 new jobs, then the resulting increase in amounts raised through business rates would drop to around £1,000 million NPV.

191. Another key assumption is that any new jobs in London are truly new jobs and not just diverted from elsewhere in the country. If, in reality, they were to result from diversion, then the additional amount raised through business rates in London would be counterbalanced by a reduction in the amount raised through business rates elsewhere. However, the higher value of properties in London would mean that some effect persisted overall. This is an area that would merit further investigation, before such revenues were ascribed to the scheme.

192. The amount available on top of this through tax changes - specifically amending the business rate regime - would clearly depend upon when the new system was introduced and which system were chosen.

193. Tax increment financing is an established technique for raising finance in the USA that Transport for London has adapted for possible use in this country. Since the first Tax Increment Financing (TIF) law was passed in California in 1952, it has been widely used in the USA as an effective tool for local governments to finance capital projects in support of economic development. In essence, TIF allows development projects to be financed with incremental property tax revenues generated by the increased property values expected to result from the new development. Proceeds from the sale of TIF bonds sold in the municipal securities market are used to finance the project development costs. The TIF bonds are secured on the incremental tax revenues.

194. Transport for London's version of TIF would involve the Crossrail zone being removed from the 5-yearly business rate resetting exercise for National Non-Domestic Rates (NNDR). Assuming that commercial property values had risen by more in that area than elsewhere - either because of Crossrail or otherwise - then the effect of this would be to raise the business rate marginally over and above what it would otherwise have been, not just in the Crossrail zone but across England and Wales as a whole. According to Transport for London's analysis, introducing such a reform in 2005 - the next time business rates are due to be reset - would raise significantly more than doing it at a later date as it would take advantage of existing property movements since the last revaluation exercise. The Review understands that this conclusion is derived from commercial information on property movements. Any final conclusions remain subject to the results of the revaluation exercise currently being carried out by the Valuation Office.

195. Transport for London's analysis suggests that tax increment financing could raise in the region of £3,200 million NPV if it were to be introduced in 2005, and some £1,100 million NPV if it were introduced at the subsequent revaluation in 2010. In both cases, Transport for London's analysis effectively assumes that tax increment financing is in operation to 2039, rather than over the entire 60-year appraisal period. Increasing the period over which proceeds are collected and accounted for would increase the overall collections, potentially by more than £1,000 million NPV.

196. Tax increment financing has some downsides. First, any income from tax increment financing is dependent on the relative movement in property values between the Crossrail zone and elsewhere. It would be at risk if property values in the Crossrail zone failed to rise by more than elsewhere. Second, tax increment financing might also be presentationally troublesome - it would see increased business rates due to higher property values in the Crossrail zone retained within overall collections, rather than redistributed to other regions as would be the case under the current system. Regional lobbies might well represent this as their ratepayers paying for London's Crossrail.

197. An alternative approach would be to introduce a supplement on the business rate in the area that benefits from Crossrail. Transport for London's analysis suggests that a 2% supplementary rate in the area one kilometre around Crossrail stations could raise some £2,000 million NPV if introduced in 2005 and £1,700 million NPV if introduced in 2010. In both cases, this is on the assumption that the policy is maintained to 2039. As with tax increment financing, increasing the period over which the proceeds are collected would increase the overall collections, potentially by more than £1,000 million NPV. The amount of money raised could also be increased by raising the supplementary rate or widening the boundary within which it is collected.

198. Introducing such as boundary, with higher business rates inside than out, may have some downsides when compared to tax increment financing, which would see a flat business rate retained across England and Wales. There would necessarily be an element of arbitrariness to the final position of the boundary, which would raise questions of equity with, potentially, some businesses paying the supplement even though they did not benefit from Crossrail in any meaningful way. However, a supplementary rate would also have the great advantages of transparency (i.e. it is clear that those within the Crossrail zone are paying) and relative simplicity. It should also generate a more certain revenue stream than tax increment financing.

199. It would, of course, be possible to combine both systems so that some revenue was raised through adjusting the NNDR mechanism and some from a supplementary rate.

200. While CLRL's analysis and the Review have focussed on business as being the main contributor and the NNDR as the most effective means of measurement/collection, it is likely that residential property would also derive similar types of benefit from increased accessibility. This would be reflected in higher values for residential properties that benefit from being located close to Crossrail stations. In principle, an element of this increase should be captured through the Council Tax regime. However, in reality, this is unlikely to be an effective mechanism, as the 'banding' that takes place for the purposes of calculating the tax will see much of the increase lost. While there is an argument for looking at the Council Tax regime to see if more of the increase in residential property values could be captured more effectively, this is not something the Review has considered.

London contribution - Conclusion

201. Any decision on changes to business rates would require further work by HM Treasury, the Office of the Deputy Prime Minister and the Inland Revenue. No informed decisions can be made without their analysis of the likely impact of changes and the sums that might be realised. However, on the face of Transport *for* London's as yet unvalidated calculations, business rates might be a suitable mechanism for garnering the contribution that representatives of London's business community have indicated could be available from that source, i.e. £2,000 million and possibly significantly more. Either tax increment financing or a straight levy are possible routes. But, of the two, the latter looks to have the edge in terms of transparency, reliability of income and of public presentation.

Property revenues

202. In addition to the above there are some more specifically property development-based revenue opportunities that might be exploited, including:

- from development on land which would be acquired by Crossrail, for example over newly-built stations
- from the development/redevelopment of land and property close to the Crossrail route, but which would not be owned by Crossrail.

203. The CLRL Business Case acknowledges the potential of such opportunities but makes no specific allowance for any revenue resulting. It contends that the amount of funding that might be generated is not significant for the Business Case.

204. There is a popular view that property development can be used to create sufficient value to fund (or make very significant contribution to) the costs of transport infrastructure. In the Far East, for example, property development and transport planning have gone hand-in-hand to such good effect that the public sector contribution to some major projects has been very substantially mitigated. The Review has, therefore, undertaken (in collaboration with CLRL) an assessment of the development potential that might arise as a result of Crossrail and considered the extent to which there would be opportunities to improve the potential contribution to Crossrail from property development.

Over station development

205. Most of the opportunities for development on land acquired by Crossrail arise over the stations within the central section from Paddington to Canary Wharf. Outside this section, Crossrail would largely use existing stations or would acquire only relatively small areas of surface land on which the prospects of valuable development would be small.

206. Even within the central section, the ability to unlock significant value from development over newly built stations would be limited. It is reasonable to assume that Crossrail would only be empowered to acquire such land as it would require for construction of the railway and that it would not be able to acquire additional land for development purposes. This means that the sites acquired by Crossrail would generally be shaped for railway construction but not for subsequent development. In most instances, optimum value from over-station development would only be achieved by bringing in adjoining land interests and reconfiguring larger sites. In the absence of compulsion in relation to adjoining interests, Crossrail would be dependant on securing partnerships or collaboration agreements to secure optimum development. While such arrangements would be feasible within the context of the overall procurement, there could be no guarantee that landowners would co-operate and there would only be a limited extent to which Crossrail could use leverage to secure a substantial share in the wider development value.

207. Nonetheless, the Review considers that over-station development might raise between £100 million and £300 million. The critical factors which would determine the actual amounts and timing of receipts include:

- the cyclical nature of the property market, which would render receipts uncertain as to both quantum and timing (which in turn would limit prospects for securitisation of, or borrowing against, prospective receipts and limits the extent to which property receipts could be relied upon as part of the financial package for Crossrail). It is reasonable to assume that Crossrail would seek to optimise its returns through timing of the release of development, but this would also be dictated by the timetable for construction of the railway and its stations
- the nature and extent of planning consents that might be achieved for new development. The wide range of value potential is largely driven by different assumptions about the density of replacement development, linked to the height and massing of the new buildings
- the nature and extent of valuable development that could be achieved by Crossrail at Canary Wharf station, which is particularly sensitive to the nature of planning consent that might be achieved for development within the dock, associated development costs and property market movement.

208. The Review has considered the site value that might accrue to Crossrail on land acquired. It is acknowledged that additional returns might be achieved if Crossrail were itself to participate in the development. However, such profits would be earned in return for additional, development-related, risks and, while it could be feasible (even desirable) for Crossrail to share in this process, it is not appropriate to include the prospect of such receipts in the Business Case.

Development on other sites along the route

209. It is likely that the development potential of land and property in proximity to stations (but not acquired by Crossrail) would be enhanced, in some cases significantly. The CLRL Business Case refers specifically to the support that would be given by Crossrail to the continued development of Canary Wharf and there are other examples where Crossrail would either enable the release of property for economic development that would otherwise not be capable of development or would improve the capacity of land to accommodate increased density of development.

210. However, while such gains could be expected in principle, the extent of the potential benefits and the means by which they might be captured and applied as contribution to the costs of Crossrail are more difficult to assess. There are different effects between the central area, where markets are mature, public transport access is already very good, and the impact of Crossrail on development value (although potentially large) could not easily be separated from other factors, and the outer areas, where Crossrail could be expected to have a more readily identifiable impact on development values (although to some extent this would be at the expense of other areas and may also be reliant on other linked transport infrastructure packages in addition to Crossrail).

211. There is currently no statutory or fiscal mechanism by which development gains could be collected directly by Crossrail. In the absence of any development-based Alternative Funding Mechanism, Crossrail would need to rely upon contractual obligations entered into voluntarily by developers or, potentially, agreement of the Local Planning Authorities to hypothecate discrete payments received by them as a result of Agreements entered into under Section 106 of the Town and Country Planning Act 1990. All such amounts would have to be agreed by negotiation and are to that extent unreliable.

212. The Review considers that Crossrail would have sufficient commercial leverage to secure equitable contributions from major identified developers along the route (including Canary Wharf). Further work is required to formulate the amounts that could accrue from such contributions and how they might vary between route options and station locations. It is unlikely that the amounts involved would materially improve the funding problem of the Crossrail project and the uncertainty of timing of collection means that firm numbers could not be included in the Business Case at this stage.

213. This approach would be likely to capture only a proportion of the sites that would benefit and there would be potential for considerable "freeriding" by developers that did not enter into discussions. A means of mitigating this would be to introduce some form of Alternative Funding Mechanism, for example, by way of a levy on new development.

214. The use of a development tax, unlike changes to business rates, would not be new. Such a tax has been tried on a national basis and withdrawn on a number of occasions in the past because of problems with market reaction - primarily developers delaying the bringing forward of developments in order to avoid paying the tax.

215. Given the wide geographical scope of Crossrail and the particular characteristics of the various locations it would serve, it has been assumed that any property development opportunities directly facilitated by the project would be tendered on an individual basis as they became available. It is, however, possible that higher or more secure receipts might be secured by entering into exclusive property partnering arrangements with one or more developers in advance. The quantum of any additional funding received through such a property partnership cannot be assessed in advance of determining the precise nature of the arrangements, which would need to be competed, but it is unlikely to be material when set against the costs of the scheme.

Property conclusions

216. Overall, CLRL believes that while contributions from property development would be politically and presentationally important, the sums raised would in practice be likely to be relatively small in the context of Crossrail costs as a whole. While the Review would broadly agree with this view, it nonetheless stresses the benefit of maximising property receipts, not least so that the taxpayer would achieve full value for the investment in Crossrail. Should it be felt appropriate to impose a general tax on new property development, and the problems associated with such initiatives in the past overcome, then the sum raised could make a significant contribution to Crossrail costs.

Direct Exchequer support

217. Large transport infrastructure projects in the United Kingdom have usually been funded primarily through substantial direct Exchequer support (i.e. transport grant to the appropriate procuring body, often a Non-Departmental Public Body, or payment of track access charges). More recently, the use of private finance has been deployed in order to secure a more appropriate degree of risk transfer and better project and programme management discipline, in particular during the construction phase.

218. Crossrail is a major new infrastructure project, developed outside the 10-Year Transport Plan, which set transport investment for 2000/01 - 2010/11. Not only is this a new project outside existing funding plans, it is also a very substantial addition to existing programmes. Key challenges therefore exist in agreeing new and additional financing, while ensuring that the Government meets its fiscal rules.

219. The size of the CLRL Benchmark Scheme and its likely cost make direct Exchequer funding of the whole cost unrealistic. However, given the transport and regeneration benefits of the scheme not just to London but to the wider United Kingdom, a direct contribution from the Exchequer would seem to be appropriate. Regional considerations are important too, when deciding the amount of the Exchequer contribution, particularly in the case of Crossrail given the large scale of its projected cost, and it is legitimate to debate the balance between national, regional and local contributions.

220. In summary, when determining the level of the Exchequer contribution, a number of factors might be borne in mind, e.g.:

- the net level of expected benefits provided by the scheme
- the importance of both public and private sectors making a fair contribution, reflecting the benefits to each party
- the amount of funding that might be raised from other sources
- the extent to which the availability of direct Exchequer funding might serve to lever in and maximise the value of private sector contributions
- competing demands on the public purse, including regional considerations and current spending plans, particularly in the light of current rail funding pressures and the overall profile of spend on public services during the construction of Crossrail.

221. CLRL's analysis of its Benchmark Scheme suggests that the present value of costs less any revenues generated would total £11,273 million NPV, including all contingencies but not including any costs of financing the scheme, over and above the public sector cost of capital that is implicit within the discount rate used in calculating the net present value.

222. Our review suggests that CLRL's analysis has underplayed the potential for Crossrail to generate net revenues by some £1,200 million and possibly more.

223. The Review has considered Alternative Funding Mechanisms as put forward by Transport for London, in particular incremental business rate revenues from additional development in the Crossrail area, and reforming the business rate regime to fund Crossrail. More work is required here to assess the potential for Alternative Funding Mechanisms to support Crossrail: in particular the impact of Crossrail on property values, and the effect Alternative Funding Mechanisms might have on the viability of London businesses.

224. Nevertheless, it is clear that significant sums could be raised through business rates. Indeed, even without any reform, Transport for London's analysis of Alternative Funding Mechanisms suggests that new property developments could generate additional business rate payments valued at £2,700 million NPV. The Review would recommend further investigation before ascribing this particular revenue to the scheme - more conservative assumptions about job generation would push the total down to £1,000 million NPV and this would be reduced again if these jobs are simply diverted from elsewhere in the UK.

225. However, even leaving this to one side, there is no doubt that reforming the business rate system could provide a useful source of revenue. Representatives of London's business interests have indicated that they may be willing to contribute some £2,000 million and possibly significantly more towards the cost of Crossrail. A supplement on the business rate would be one possible way of collecting this contribution, with a supplement probably of the order of 2% to 3% within the Crossrail zone, if Transport for London's analysis is accurate.

226. Overall, this suggests that if the Benchmark Scheme were constructed and a business rate-based Alternative Funding Mechanism were employed to raise £2,000 million NPV, then the Exchequer would be left to pick up some £8,000 million NPV (plus any financing costs over and above the public sector finance costs already implicit in the NPV calculation). This assumes that there were:

- no premium fare
- no revenue raised through property developments linked directly to the scheme
- no increase in business rates, simply as a result of new developments along the route
- no wider development tax on new developments along the Crossrail route.

227. While, in practice, some or all of these factors would be likely to result in revenues offsetting the cost of the scheme, a significant funding challenge would remain. This is particularly so since any project that left the Government as the bearer of risk and lender of last resort would also leave the Exchequer to pick up any variations against the expected level of costs and revenues, both those generated by Crossrail itself and any Alternative Funding Mechanism.

228. In order to ensure balanced public expenditure between all the UK's regions, one approach might be to limit central Government's contribution. Further work would be needed to confirm the impact of Crossrail on GDP and the tax take from that. While this raises issues beyond the scope of this Review, it needs to be recognised that both the size and timing of a Government contribution must also depend on its affordability within the Government's fiscal rules, particularly against the background of the very significant cost pressures the Department for Transport faces on the railways.

Funding gap

229. As shown below, the funding gap in the absence of a central Government contribution would be of the order £7,000 million NPV to £8,000 million NPV. This gap presents a clear challenge to the fundability of the scheme.

	NPV (£ million)
Estimated Net Cost of Benchmark Scheme	11,273
Revenue Adjustment	1,200
Alternative Funding Mechanisms	2,000 - 3,000
Funding Gap	7,000-8,000

Conclusion 11: Funding and financing

The forecast costs of the Benchmark Scheme present a significant funding challenge. Given the transport, wider economic and regeneration benefits that Crossrail would produce, a case can be made for a direct contribution from the general taxpayer, subject to affordability in the context of the significant cost pressures elsewhere on the transport budget, especially from the railways. The scale of these pressures and the size of the scheme make significant direct Exchequer funding of the cost unrealistic.

The Review believes the level of Government support that might be justified could only be determined when considered: (i) against the benefits produced by the scheme and the extent to which these would fall to different parties; (ii) the amount of funding that might be raised from other sources and the extent to which direct Exchequer funding might serve to maximise such contributions; and (iii) the competing demands on the public purse. Given the likely amounts that could be raised from the identified revenue sources, and the Review's understanding of their willingness to contribute, any possible Government contribution could be offset but would still be over-large. This raises fundamental affordability concerns.

Overall assessment of CLRL's Business Case

Are the CLRL Business Case proposals likely to deliver to time?

230. CLRL's proposed timetable provides an adequate and reasonable amount of contingency, particularly in relation to the construction of the central tunnels and underground stations, which would be on the critical path of the construction programme. The Review has, however, identified a number of risks to achieving this timetable, including some in relation to undertaking the necessary preparatory work for deposit of a Hybrid Bill by CLRL's deadline of November 2004 - although here the Review notes that depositing the Bill on that date would not necessarily be critical for the construction of Crossrail. Work on the 'on network' section of the scheme would also depend critically on developing effective relationships with Network Rail and London Underground.

231. If any of these risks were to materialise and could not be managed effectively, the possibility of significant delay to the proposed timetable would be likely. However, with that proviso in mind, the Review believes that CLRL has developed a timetable that is relatively robust at this stage of the project and that would have acceptable prospects of being achieved in practice.

Are the CLRL Business Case proposals likely to deliver to scope?

232. The Review has identified a number of areas where the deliverability of the proposed scheme has not yet been demonstrated. Most critically, it appears that it would not be possible to deliver the envisaged 24 trains per hour peak service without some operational simplification of the Crossrail scheme, possibly segregating or prioritising Crossrail operations. It might also be necessary to make additional investments in the adjoining network, over and above those currently contemplated by Network Rail and the Train Operating Companies, to improve operational performance and reliability. A lower level of train service might still deliver significant benefits, but it could affect the fundamental appraisal of the scheme. The Review has put work in place to test further the viability of the envisaged level of service and to assess more accurately what might be deliverable in practice. The Review also recommends that CLRL undertake further work to assess how a service level of 24 trains per hour at peak could be reasonably achieved.

233. Setting aside this particular consideration, much of the rest of the Crossrail Benchmark Scheme appears technically feasible, and it is generally intended that tried and tested technology would be deployed. This is sensible. The Review considers that a scheme of this size and complexity should not expose itself to new technology risk in any critical area.

234. In relation to the western limbs of the Benchmark Scheme, the feasibility of extending to Heathrow Airport would depend specifically upon negotiating a mutually acceptable solution with BAA. While plans for the Richmond/Kingston branch remain at an early stage of development, there must also be some question as to its deliverability in practice. The practicality and benefits of a Maidenhead branch also need to be confirmed.

235. In conclusion, the Review considers that at this stage it is not possible to assert that the Benchmark Scheme proposals are fully deliverable in terms of scope.

Are the CLRL Business Case proposals likely to deliver to budget?

236. The Review has considered the costings for the CLRL Benchmark Scheme in some detail. Generally, while the projected costings are appropriate for this stage of project design, they are not sufficiently robust to enable a firm view yet to be taken on the likely outturn cost of the project. It also appears that a more consistent policy needs to be adopted in relation to contingencies.

237. In conclusion, at this stage in the development of the project, the Review cannot conclude that CLRL's proposals will deliver to budget, although the preliminary risk analysis carried out by the Review suggests a reasonably high probability that they would.

Will CLRL's Business Case proposals offer value for money?

238. The Benchmark Scheme appears to deliver value for money, together with a range of wider benefits. The Review has considered CLRL's analysis that leads to this conclusion and considers that the overall Business Case for Crossrail is robust. In terms of the economic transport evaluation, benefits of roundly twice the net costs are projected. While the Review considers that the methodology used by CLRL to assess Heathrow benefits in the July Business Case was unreliable, it expects that further work to optimise the western branches (including Heathrow services) would broadly validate the current benefit-cost ratios.

239. This judgement is, however, made on the assumption that the Benchmark Scheme is deliverable. In this respect, the Review has already indicated a number of areas where further work would be required to establish whether that is the case. Should these concerns materialise (in particular, the ability to deliver the envisaged 24 trains per hour peak service) there would inevitably be an adverse effect on value for money. While this would affect benefits, the scale of the shortfall is unlikely to be substantial.

What level of Government funding can be justified?

240. As the discussion on funding and financing has demonstrated, when the quantum of likely available revenues is set against the scheme's total cost (even on the current highly provisional basis), it is apparent that there is a considerable funding gap.

241. CLRL's Business Case assumes that the Exchequer would absorb any costs that could not be covered from other sources. Not least in the context of wider public spending pressures, it is difficult to justify these arrangements and the proposed quantum of Exchequer support.

What proportion of funding would be required from non-Government sources?

242. While there is some scope to vary the level of funding that might be raised through fares, and some variation in the level of property receipts that might be secured, the overall contribution from these two sources is likely to be relatively fixed in the context of costs as a whole. There is probably more scope through fares than from property receipts, but a substantial contribution would require an aggressive fares policy not just on Crossrail but across the network more widely. This would need to be considered in the context of other fare pressures faced by the Mayor and on the railways in SR2004 and beyond.

243. The balance would therefore need to be provided by the Exchequer or raised through London contributions. And, given that the Exchequer contribution would be fixed, then the whole remaining balance would need to be covered by Alternative Funding Mechanisms.

Overall assessment

244. On the basis of its work, the Review judges that the deliverability of the Benchmark Scheme has not yet been proved. However, the Review considers that, although not firm, CLRL's indicative costs for the scheme are reasonably robust.

245. CLRL's estimates suggest a total cost figure of £11,273 million NPV for the scheme (including all costs except financing costs, and allowing for net revenues generated by the scheme). The Review considers that this estimate underplays the potential for the scheme to generate revenues by potentially £1,200 million NPV. Even assuming no change in fares policy and a fixed Exchequer amount, the Review considers that raising the balancing amount would represent a significant challenge. Accordingly, the Review concludes that at present serious concerns remain in relation to the affordability of the Benchmark Scheme.

246. Given these concerns about both deliverability and affordability, and in accordance with the second part of its remit, the Review has therefore considered whether there are means of delivering a Crossrail project which might offer better performance than the Business Case proposals.

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C. Alternative Means of Delivering a Crossrail project

Identify any means of delivering a Crossrail project which would offer better performance than the Business Case proposals against the same tests

248. The Review's assessment of the Benchmark Scheme raises concerns over its deliverabilty, both on operational grounds and because of its likely costs, and the affordability constraints to which these would give rise. In line with its remit, the Review has therefore considered whether there might be some alternatives to the overall Crossrail Benchmark Scheme which would improve its deliverability.

249. It has not been possible within the scope of the Review to consider solutions of a substantially different specification, and the alternatives assessed are restricted to the routes and extent of the outer branches in the CLRL Benchmark Scheme. The central section alignment is well established and would be difficult to change, and much of it is already safeguarded; however, some station layouts can be simplified, and CLRL is proceeding with this. In the extreme, certain central stations could in theory be omitted, but this would create significant congestion elsewhere and has not been considered further in this Review. Further, the Review does not consider metro solutions (i.e. similar to London Underground lines) as these would be radically different in principle from the Crossrail concept and have little if any strategic value beyond London. In any event, a metro solution could not be developed to any degree of confidence in the Review's timescale.

250. Since the Benchmark Scheme, CLRL has developed proposals for services to Maidenhead in addition to Crossrail services to Heathrow, also using the Great Western relief lines out of Paddington. The Maidenhead service would unlock additional benefits at relatively small additional capital costs, and enable the Crossrail core section to be used more effectively. This service has been included in options 4, 5 and 6 below.

Improvement to the Benchmark Scheme itself

251. The obvious starting-point for examining alternatives is to consider whether the Benchmark Scheme might still be improved so that substantially the same benefits could be delivered in a way that would address the identified concerns. In particular, could the transport and regeneration benefits of the CLRL Benchmark Scheme be achieved at a lower cost, thus making the scheme more affordable?

252. The Review thus initially considered whether the Benchmark Scheme as it stands could be improved, i.e. without changing the geographical scope. Essentially, this would require reducing its cost or making the funding requirement less onerous; modifying the scheme to address market capacity issues; and making changes to allow a more robust 24 trains per hour peak service in the central section.

253. Cost savings could be achieved in a number of ways, including:

- using shorter trains (at least while demand grows if, against experience, it were to build gradually) - approximate savings of £150 million on rolling stock and an approximate saving of £100 million by delaying investment in extending stations on the branches
- building smaller or less elaborate stations or omitting stations (approximate saving of £200 - 300 million for each station)
- savings during project implementation, such as:
    a. value engineering of the engineering design to reduce costs to an essential level
    b. procurement savings (e.g. on construction materials) arising from economies of scale on such a massive project

c. savings during construction (e.g. by using project-wide labour agreements to contain wage levels)

d. construction sequence planning (e.g. to optimize the number of tunnelling machines and crews required)

e. management and control of scope, programme, and costs by means of effective project management.

The Review considers that savings of up to 10% of capital costs might well be achieved by a combination of these measures.

254. However, on even the most optimistic scenario, the whole July Benchmark Scheme could probably not be constructed for less than £6,000 million excluding contingency, and changes CLRL has made to its proposals since July could push the costs up. While geographical scope would be maintained, the level of service would be lower, and the benefit-cost ratio would fall correspondingly.

Staging

255. Given the size of any viable Crossrail scheme, the possibility of adopting a staged approach to construction requires careful consideration.

256. CLRL has explored staging in relation to the Benchmark Scheme, but only as a means of implementing the overall proposal. In other words, a staged approach is simply used to address construction market and other capacity issues, with the fundamental intention from the outset that the whole scheme should be built as quickly as practicable.

257. But this is not the only way in which a staged approach might be used. It would also be possible, at least in theory, to devise a Crossrail scheme as a series of separate but interlinking projects whose timing would be determined by priority for funding and demand. After the construction of the initial section, each subsequent component would be the subject of a separate decision, to be taken at some point in the future.

258. The advantage of adopting such a staged approach is that it would enable a large and complex project to be broken down into more manageable sections. This would allow both construction and financial market capacity issues to be more easily addressed and could also reduce the pressure on public finances. It would also mean that decisions on whether to proceed with particular limbs could be taken in the light of more up-to-date information. One of the difficulties in evaluating the Benchmark Scheme is that the reliance that may be placed upon the economic analysis depends critically upon the robustness of forecast growth in jobs and population a long way into the future. The risk of engaging in a high cost construction project for limited gain could thus be mitigated by adopting this staged approach.

259. A staged approach is not without difficulties of its own, however. Most importantly, it would clearly be necessary to ensure at the outset that the overall scale and scope of the full scheme were sufficiently developed to enable the individual sections to be designed and constructed in an integrated fashion. The system would need to have scalability designed into it. For example, terminal stations on the initial section would need to be designed so that extensions could, if necessary, be added at a later date; the capacity of stations on the initial section would need to allow for higher passenger numbers arising from later route additions; and signalling design would need to take account of later extensions. The integration of the various stages would also complicate the procurement processes for letting construction contracts.

260. None of these issues would be likely to prove insuperable, though it should be appreciated that they might have an additional cost that would not be immediately reflected in any increased benefit. For example, building a station on the initial section so that it were large enough to cope with increased passenger levels arising from possible future extensions would inevitably lead to a higher construction cost than would otherwise be necessary. However, the only benefits that could be scored against this cost would be those arising from passengers using the existing section, thus depressing the benefit-cost ratio. This need not be problematic, provided that appropriate caution were exercised in interpreting the benefit-cost ratio in an overall network rather than a component-by-component context.

261. If the principle of a staged approach were adopted, the choice of how it should be organised would be driven by a number of factors, including optimal engineering design, maximisation of benefits in relation to costs, overall cost, availability of funding, likely passenger demand and prioritisation of regeneration and agglomeration benefits. Depending on how these factors were weighted would inevitably lead to different solutions. Consequently, it would not be possible to identify an optimal staged solution without first deciding on the priority of the driving factors.

262. For example, if it were decided that the main driving factor should be the regeneration of the Thames Gateway, a staged scheme would need to give priority to constructing the section of the route from Liverpool Street to Abbey Wood and (possibly) Ebbsfleet. But this might well not be the best solution if the main driving factor were to be optimal engineering design (which might favour constructing the central Paddington-Whitechapel-the Isle of Dogs tunnel first) or cost. Consequently, if it were decided that a staged approach were to be adopted, more detailed work could only proceed with a clear enunciation of the priority that should be given to the different factors that would influence the design choice.

263. Staging along the lines described above would also give rise to particular problems in relation to the Hybrid Bill. The Bill would clearly need to be able to describe the route over which powers were being sought. If this were limited to the initial section alone, once this had been constructed there would be no powers to build any of the later stages. These would therefore require a further Hybrid Bill at some later date, which might be difficult to justify, or powers would need to be sought under the Transport and Works Act, which might prove less effective. Theoretically, it would be possible to seek powers for the full scheme in the Hybrid Bill, even though the initial intention would be to build only part of it in the immediate future. This approach would, however, be very controversial, not least in Parliament itself, since powers would be sought in relation to parts of a scheme that might never be constructed, given that at the time of the Hybrid Bill's passage only the initial section would have been authorised, with no specific commitment in relation to other sections. In addition, time periods for the exercise of powers would have to be extended well beyond the periods normally allowed in such legislation.

264. Generally, the Review believes it would be possible to use a combination of Hybrid Bill and Transport and Work Act powers to implement a phased scheme. However, in addition to potential handling problems with Parliament, a staged approach would almost certainly give rise to blight issues in relation to householders and businesses along the route. Unless care were taken in presenting a staged approach, it is possible that blight provisions might be triggered in relation to a significant number of properties which might eventually prove to be unaffected by Crossrail if it were later decided that a section or sections of the scheme should not proceed.

265. A staged approach would put each stage at the peril of the affordability limits then prevailing. The creation of blight in a staged approach would also need to be allowed for in costings. Perceived blight would also lead to disquiet amongst those affected which would be reflected in any Bill Select Committee hearings.

Alternative schemes

266. In order to test the value for money of the Benchmark Scheme and explore the potential for alternative lower net cost options, six alternatives have been assessed. These alternatives have been modelled and evaluated in detail while others have been considered qualitatively.

267. The Benchmark Scheme has been subject to further work by CLRL, the Strategic Rail Authority and Transport *for* London since July. The Review also identified potential improvements and alternatives. As a result of this work, a total of six options has been evaluated, namely;

Option 1:	Paddington to Shenfield and the Isle of Dogs
Option 2:	Paddington to Shenfield and Abbey Wood
Option 3:	Paddington to Shenfield and Ebbsfleet
Option 4:	Heathrow, Maidenhead and Paddington to Shenfield and Ebbsfleet
Option 5:	Heathrow, Maidenhead, Kingston and Paddington to Shenfield and Ebbsfleet
Option 6:	Heathrow, Maidenhead and Paddington to Shenfield and the Isle of Dogs (variant of Option 4)

Service patterns for these options are summarised in the table on the next page.

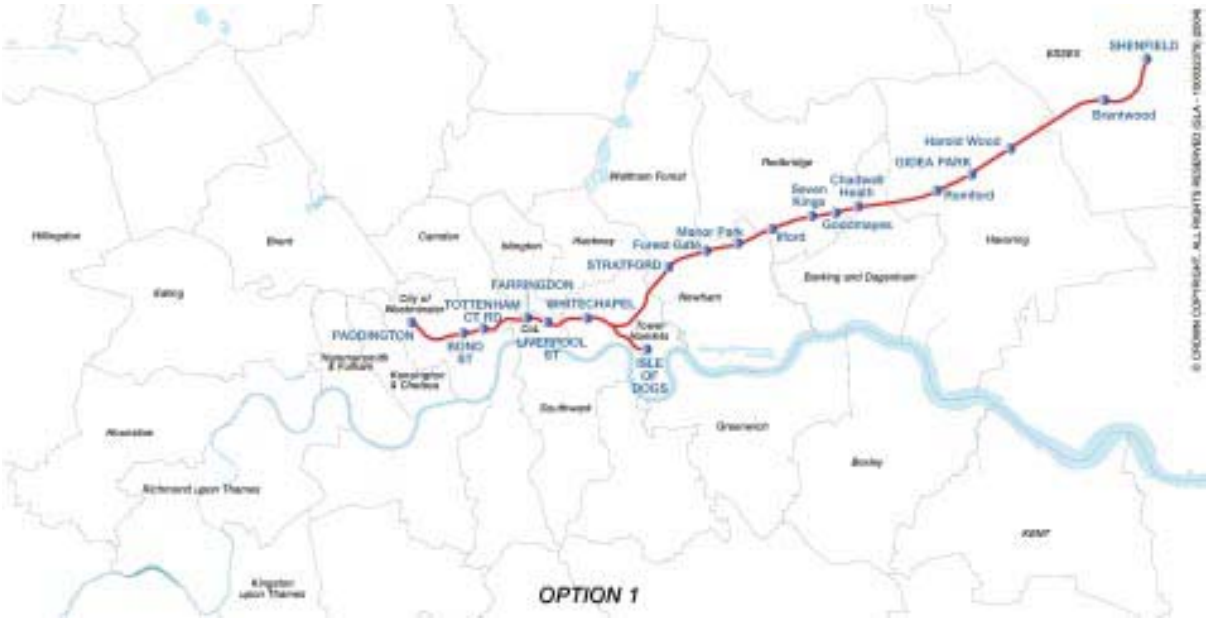
268. The following paragraphs describe the costs and benefits of these options. All costs below are on a whole-life PV basis, less net income. It is important to note that the January 2004 (current) modelling includes a number of significant changes to the appraisal methodology and to some key assumptions. The results are therefore not consistent with those presented in the July 2003 Business Case which had whole-life costs net of revenues of £11,273 million PV and a benefit-cost ratio of 1.99:1. The net effect of these changes would be to strengthen the benefit-cost ratio of the Benchmark Scheme: this has not been taken into account in the preceding analysis of the Benchmark Scheme, but is allowed for in the subsequent discussion of alternatives to it. The major changes made to the Business Case assumptions since July are:

- lower maintenance costs offset by higher capital and operating costs (net £350 million reduction)
- a reassessment of bus impacts (higher revenue losses and lower operating cost reductions) adding £240 million to Crossrail net costs
- new methodology for determining Heathrow impacts leading to lower benefits but higher revenues and savings arising from the retention of Heathrow Express
- a number of modelling enhancements.

269. The options described below were selected because they represent credible alternative schemes. A number of other options were rejected following consideration of their likely impacts. For example, providing only the central area tunnels with services running between Paddington and Liverpool Street would incur net costs of almost £6,000 million but could accommodate only an unattractive 12 trains per hour service. Few benefits would be delivered as there would be no congestion relief on services coming into central London and no new journey opportunities. Similarly a service from Farringdon eastwards to the Isle of Dogs and Shenfield would incur substantial cost and provide an unattractive low frequency service. For both these options, the benefit:cost ratio would be extremely weak.

270. Consideration was also given to a Paddington to the Isle of Dogs only option and Paddington to Shenfield only. In the former case, the lack of turnback capacity would limit operations to 12 trains per hour, leading to limited benefits, whilst expensive tunnelling costs would be incurred. A service to Shenfield only, while saving around £3,000 million in costs compared with the Isle of Dogs branch, would again have lower frequencies (16 trains per hour), limiting the attractiveness of Crossrail services. Further, a Shenfield only service would not serve the key Docklands and Thames Gateway development areas. A Shenfield only service would, however, allow all Shenfield/Gidea Park services to be operated by Crossrail, eliminating the inter-working of Crossrail with other services and securing greater reliability.

Option 1 - Paddington to Shenfield and the Isle of Dogs



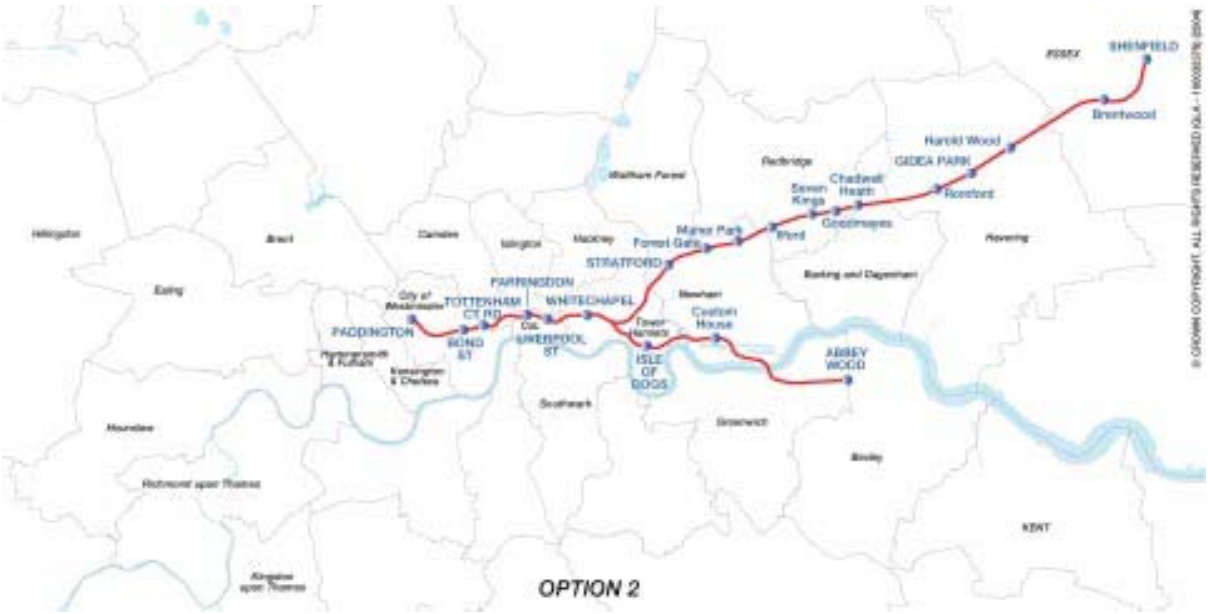
271. Option 1, from Paddington eastwards, provides for two eastern branches, linking the City with Stratford and the Isle of Dogs. It would contribute to agglomeration benefits but offer little in terms of regeneration benefit. It would be largely self-contained, thus allowing the provision of a robust 24 trains per hour peak service through the central section. The estimated net cost of this option would be £8,279 million NPV, with a benefit-cost ratio of 1.15:1. The benefits would arise through congestion relief, particularly on the Central Line (but also on District, Jubilee and DLR services), plus the use of extra capacity at Liverpool Street facilitated by Crossrail replacing existing services.

272. A summary of the net present value of the whole life costs of Option 1 is provided below.

Table 5: Whole life net costs - Option 1	
CLRL Business case	£ million NPV
Costs	
Capital costs	6,851
Tax loss and other costs	114
Crossrail OMR costs	3,299

Cost savings from bus/Network Rail/London Underground	(766)
Total costs	9,498
Revenue	
Revenue Transfers from bus/ Network Rail/London Underground	(2,416)
Total revenues	1219
Total net costs	8,279
Total benefits	9,547
BCR	1.15:1

Option 2 - Paddington to Shenfield and Abbey Wood



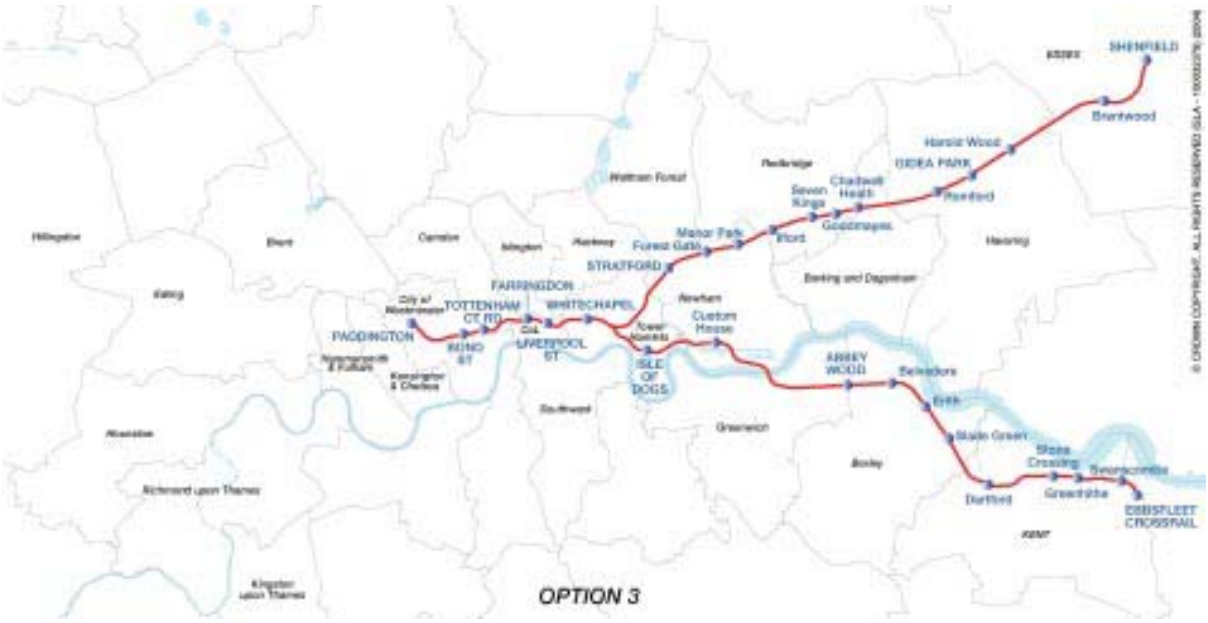
273. Option 2 builds on Option 1 with an extension from the Isle of Dogs to Abbey Wood. This would enable Crossrail to serve significant parts of the key Thames Gateway regeneration area to the south of the Thames. The branch would attract passengers away from congested routes into Charing Cross and Cannon Street through improved frequencies and journey times. The total cost of this option would be £9,087 million NPV, an additional £800 million. On an incremental basis, the benefit-cost ratio is 4.00:1. The overall benefit-cost ratio rises to 1.41:1. Option 2 costs and benefits have been estimated based on earlier work as CLRL has not remodelled this option.

Table 6: Whole life net costs - Option 2	
CLRL Business case	£ million NPV
Costs	

Capital costs	696
Tax loss and other costs	130
Crossrail OMR costs	3,520
Cost savings from bus/Network Rail/London Underground	(780)
Total costs	10.565
Revenue	
Crossrail gross revenues	4,604
Revenue Transfers from bus/ Network Rail/London Underground	(3,126)
Total revenues	1,478
Total net costs	9,087
Total benefits	12,779
BCR	1.41:1

274. There is a proposal from Greenwich Council that there would be greater benefit in serving Woolwich and Charlton rather than Custom House and Abbey Wood. CLRL is fully appraised of this proposal, and is continuing to examine the possibility, in particular, of a station at Woolwich. One of the merits of Option 1 is that further consideration could be given to future eastward extensions, reflecting the priorities and pace of economic development. This would reduce initial scheme costs by around £1,000 million, with further extensions added at a later date when Thames Gateway plans have been further developed.

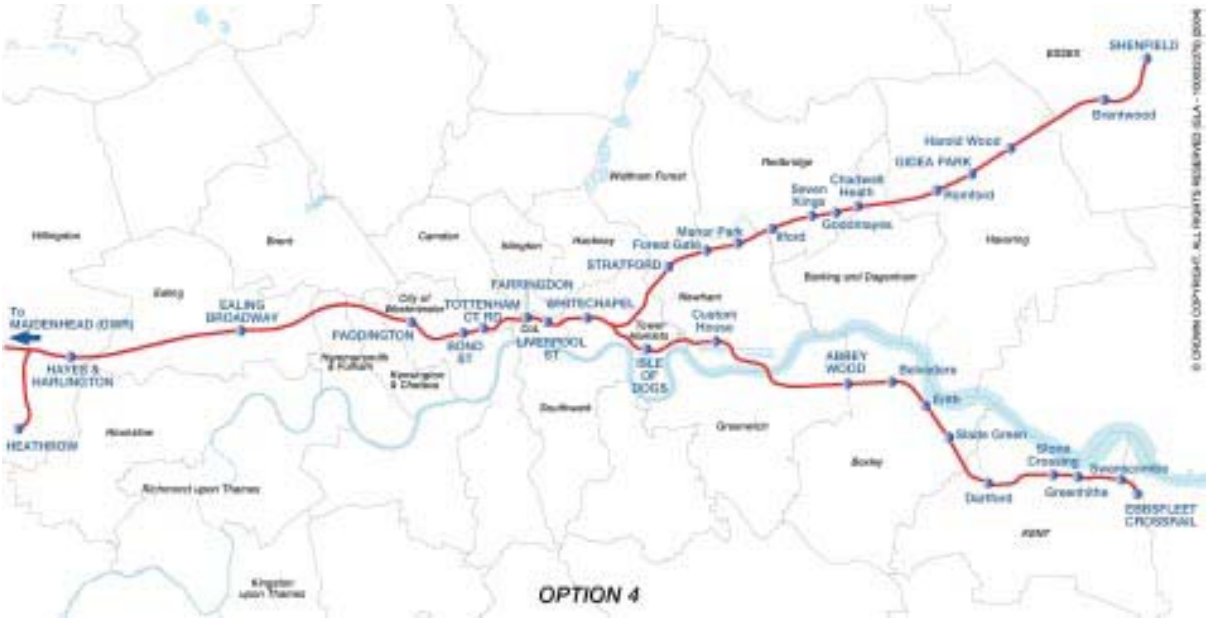
Option 3 - Paddington to Shenfield and Ebbsfleet



275. Option 3 would extend four trains per hour to Ebbsfleet at a modest incremental cost of £268 million. However, this assumes that Ebbsfleet station would be paid for by developers. Benefits would arise from further switching from crowded National Rail services with congestion and journey time improvements. Extension to Ebbsfleet would also support the regeneration of the Thames Gateway. The estimated cost of this option would be £9,355 million NPV, with an incremental benefit-cost ratio of 3.21:1. The overall benefit-to-cost ratio would rise to 1.46:1. However, this does not reflect the risk to service reliability arising from the four trains per hour that would operate over the shared section of track between Abbey Wood and Ebbsfleet. The net costs of Option 3 are summarised below. Comparison with Option 1 costs shows that extending from Isle of Dogs to Ebbsfleet would add a total net cost of £1,076 million with benefits of £4,090 million, an incremental benefit-cost ratio of 3.8:1.

Table 7: Whole life net costs - Option 3	
CLRL Business case	£ million NPV
Costs	
Capital costs	7,779
Tax loss and other costs	181
Crossrail OMR costs	3,725
Cost savings from bus/Network Rail/London Underground	(819)
Total costs	10,866
Revenue	
Crossrail gross revenues	4,879
Revenue Transfers from bus/ Network Rail/London Underground	(3,368)
Total revenues	1,511
Total net costs	9,355
Total benefits	13,637
BCR	1. 46:1

Option 4 - Heathrow, Maidenhead and Paddington to Shenfield and Ebbsfleet



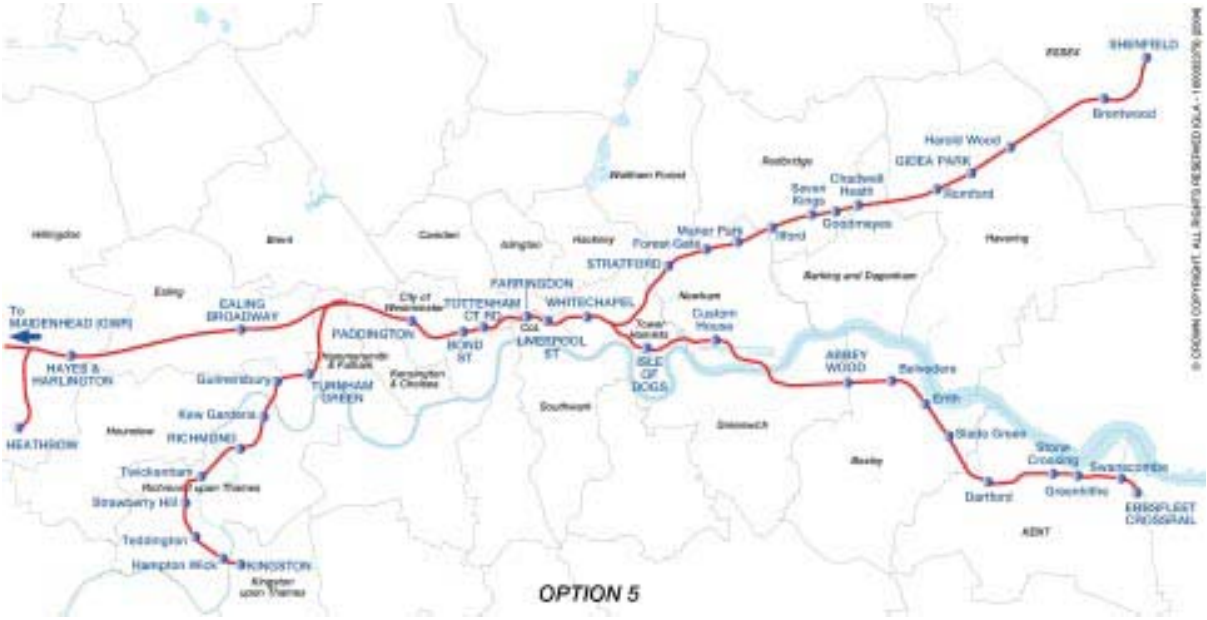
276. Option 4 adds western branches to Heathrow and Maidenhead, with other Crossrail services commencing at West Drayton and Paddington. This is a major departure from the July Benchmark Scheme and results from a re-modelling of Great Western services and reconsideration of the Heathrow package reflecting later Strategic Rail Authority thinking. Option 4 retains Heathrow Express at a frequency of four trains per hour and adds four Crossrail trains to Heathrow, providing a significantly enhanced Heathrow service overall. The July Benchmark Scheme in contrast assumed that six Heathrow trains would replace the current four trains per hour Heathrow Express service. It is worth recording here that almost regardless of the economic value of a link to Heathrow, the key London business interests regard it as essential and it would also be favoured by the Mayor.

277. The estimated net cost for Option 4 is £9,532 million showing a marginal increase of £177 million compared with Option 3. In large part, this modest increase reflects significant revenue gained from extending to Heathrow offsetting much of the cost. Option 4 shows significant additional benefit (and hence revenue) at low incremental costs. The additional benefits reflect improved frequencies, reduced journey times and reduced crowding on rail services from the West. The Great Western relief Lines would for instance, accommodate four additional Crossrail services to Maidenhead together with the four Crossrail Heathrow trains, as well as allowing current Oxford, Henley and Bourne End services to continue, possibly with some infrastructure enhancement. These benefits are derived from a new, more credible, methodology for assessing Heathrow benefits. There is a strong incremental benefit-cost ratio compared with Option 3 and overall this option would provide good value for money, with a benefit to cost ratio of 1.97:1. The net costs of Option 4 are summarised below.

Table 8: Whole life net costs - Option 4	
CLRL Business case	£ million NPV
Costs	
Capital costs	8,583

Tax loss and other costs	345
Crossrail OMR costs	4,475
Cost savings from bus/Network Rail/London Underground	(1,534)
Total costs	11,869
Revenue	
Crossrail gross revenues	7,389
Revenue Transfers from bus/ Network Rail/London Underground	(5,052)
Total revenues	2,337
Total net costs	9,532
Total benefits	18,802
BCR	1.97:1

Option 5 - Heathrow, Maidenhead, Kingston and Paddington to Shenfield and Ebbsfleet

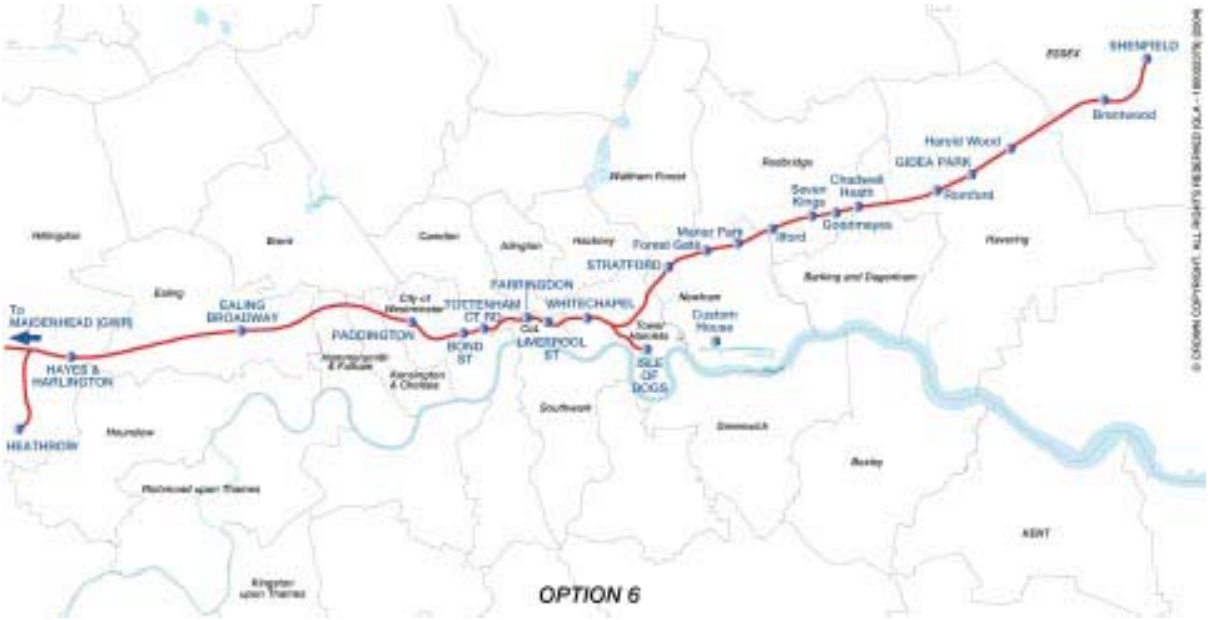


278. Option 5, corresponds to CLRL's 'new' Benchmark and adds the Richmond/Kingston branch to Option 4. In addition to the Option 4 service changes, Crossrail takes over the Richmond branch of London Underground's District Line. An interchange station is added at Turnham Green with a coherent package of changes to Great Western and Heathrow services, reflecting the results of consultation and further and improved modelling. It should be noted that there is significant local opposition at Richmond to the Richmond-Kingston branch (in particular as a result of the loss of London Underground services and the construction of a dive-under at Richmond station), the current major source of opposition to Crossrail.

279. Option 5 has a net cost of £10,422 million - an additional £890 million compared with Option 4. Benefits rise by £3,528 million between Options 4 and 5 giving an incremental benefit-cost ratio of almost 4:1. Overall Option 5 has a benefit-cost ratio of 2.14:1. This is slightly higher than in the July benchmark (1.99), although these figures are not comparable due to a number of changes in assumptions (for example, OMR cost estimates have been significantly reduced). It should be noted that the Strategic Rail Authority has been a particularly strong advocate of extending Crossrail to Richmond and Kingston, in part driven by the aim to relieve congestion at Waterloo. Option 5 costs are summarised below.

Table 9: Whole life net costs - Option 5	
CLRL Business case	£ million NPV
Costs	
Capital costs	9,527
Tax loss and other costs	439
Crossrail OMR costs	4,953
Cost savings from bus/Network Rail/London Underground	(1,728)
Total costs	13,191
Revenue	
Crossrail gross revenues	8,829
Revenue Transfers from bus/ Network Rail/London Underground	6,061
Total revenues	2,768
Total net costs	10,422
Total benefits	22,330
BCR	2.14:1

Option 6 - Heathrow, Maidenhead and Paddington to Shenfield and the Isle of Dogs



280. Option 6 is a variant of Option 4 with the Ebbsfleet branch terminating at the Isle of Dogs. This option may be seen as a potential first stage reflecting affordability constraints and merit further consideration of route options in the context of Thames Gateway regeneration priorities. It would have reduced benefits in the medium term but might allow enhanced longer term benefits to be secured. The benefits and costs have been approximately estimated as CLRL has not modelled this option. Net costs are estimated to be £8,456 million with benefits of £14,712 million and a resulting benefit:cost ratio for the scheme of 1.74:1.

281. It would be possible in principle to consider, as further options, the omission of one or more central section stations, in particular Bond Street or Tottenham Court Road. Significant cost savings could be realised, but with loss of benefit and possible overcrowding at remaining stations. The evaluation of these options is complex, and has not been undertaken in this Review; however, further assessment of this possibility would be useful if the project goes forward. In any event, simplification of station layouts and facilities is being addressed by CLRL: these are expected to lead to further reductions in cost.

282. The Review is concerned that the inter-working of services on the Western branches will reduce the scheme benefits and limit the level of service that can be reliably delivered. The latest CLRL service packages would need to be subject to rigorous operational testing before Options 4 or 5 could be considered robust and value for money. A summary of the benefit-cost ratios for the six options is shown below. This shows that the addition of branch services improves the overall value for money of the scheme, reflecting the concentration of costs in the central tunnel and, in the West, the potential benefits to be derived from re-optimising national rail services.

Table 10: Comparative Benefits/Costs	
Options	Benefit to Cost Ratios
July Benchmark[1]	1.99:1
Option 1 Paddington to Shenfield and the Isle of Dogs	1.15:1

Option 2 - Paddington to Shenfield and Abbey Wood	1.41:1
Option 3 - Paddington to Shenfield and Ebbsfleet	1.46:1
Option 4 - Heathrow, Maidenhead and Paddington to Shenfield and Ebbsfleet	1.97:1
Option 5 - -Heathrow, Maidenhead, Kingston and Paddington to Shenfield and Ebbsfleet	2.14:1
Option 6 - -Heathrow, Maidenhead and Paddington to Shenfield and the Isle of Dogs (variant of Option 4)	1.74:1

Note:

[1] -The July Benchmark is not directly comparable with the options, which are based on updated assumptions and analysis.

Conclusion

283. A number of options have been reviewed, including a re-definition of the Benchmark Scheme with enhanced Heathrow services and a branch serving Maidenhead. Curtailed options serving only Eastern destinations reduce value for money compared with the Benchmark Scheme, all with benefit-cost ratios of less than 1.5:1, with limited potential to reduce costs because of the high cost of the central tunnelled section. In the West, Crossrail facilitates a redrawing of Great Western services and provides enhanced frequencies (particularly to Heathrow) and through-journey opportunities achieving a strong benefit to cost ratio.

Wider benefits of alternative schemes

284. The changed potential for wider benefits to accrue as a result of options other than the Benchmark Scheme has not been modelled. Each of the options would have potential to deliver wider benefits in areas of FBS sector support, planning and transport policy support and regeneration. The relative extent of benefits in each area would vary considerably between options and further work would be required to evaluate the effects.

285. The Review has discussed in general terms the wider benefits potential of options with CLRL and with stakeholders. In relation to the regeneration benefits, it has consulted the Thames Gateway team within the Office of the Deputy Prime Minister and considered available study material. As a result of these discussions the Review considers that the following general comments are likely to apply:

- the central section alone would not deliver much in the way of wider benefits. In particular there would be very reduced transport planning and regeneration benefits and the potential to raise significant sums by way of AFMs would be lost
- the extensions to the East - Shenfield and/or Abbey Wood and Ebbsfleet, would offer increased regeneration benefits but these would still depend upon other infrastructure being completed in conjunction with Crossrail. In all options the main effect of Crossrail would be to focus development activity on areas where accessibility was increased, close to stations. The Shenfield line would offer potential benefits in terms of the development of Stratford as a major transport interchange and the release of capacity at Liverpool Street station (with concomitant benefits for access to Stansted), but would probably be less supportive of regeneration elsewhere in the Thames Gateway than the Isle of Dogs - Ebbsfleet branch. The extension to the Royal Docks and Abbey Wood is seen as being particularly important for supporting current regeneration plans for those areas, while the extension as far as Ebbsfleet would open up potential for longer-term development of areas around Erith as well as the North Kent regeneration area

- the extensions to the West would offer less in terms of regeneration benefits (although there are areas around Hayes in particular that could benefit) but may be seen as being more supportive in terms of transport policy and FBS sector support
- it is likely that the ability to raise significant sums from AFMs (and the willingness of businesses to pay) will be affected by changes to route options. While the majority of business interests that might be charged lie in the central area, they will only realise benefits from the scheme if various of the branch extensions are built. Excluding certain linkages may reduce the perceived benefits to business. Further work would be required to assess the detailed impact of route changes on AFM assumptions.

London Regional Metro (LRM)

286. London Regional Metro (LRM) is a private consortium comprising AECOM, ARUP, Bank of Scotland, Berwin Leighton Paisner and Jones Lang LaSalle. Its financial advisers are N.M. Rothschild and Sons. It has separately developed ideas for an East-West London railway that it describes as being affordable, financeable and deliverable. In line with the Secretary of State's 14 July 2003 statement, the Review invited LRM to set out its thinking.

287. On 9 October 2003. LRM met with the Review team to present its proposals. These proposals were only revealed at a high level, due to LRM's concerns to protect its intellectual capital. It has assured the Review that the concepts have been subject to scrutiny and detailed supporting analysis by its professional team. Subsequent technical meetings were held to clarify LRM's thinking, particularly on engineering and property issues, but detailed information was not discussed.

288. LRM presented an alternative East-West scheme to the CLRL Benchmark Case. It was based around connections between the Great Western and Great Eastern mainlines, via a tunnel along the route of the 1991 safeguarding directions. LRM said that its scheme would allow 24 trains per hour on the central section. It would use 8 car trains initially but move to 12 car trains as demand grows. These would comprise existing rolling-stock, not new dedicated vehicles, and any investment in longer trains would be at the initiative of individual Train Operating Companies.

289. LRM stated its scheme would cost £3,260 million at 2002 prices, with a benefit:cost ratio of 1.9:1 and estimated operating costs of £11 million per annum. Extra connections at Willesden, Bethnal Green and Forest Gate would allow full utilisation of the 24 trains per hour capacity, and would cost £650 million. LRM said these connections would increase the benefit:cost ratio to 3.2:1. A link to Canary Wharf and Whitechapel could be added for a further £800 million. Responsibility for building, and for funding these connections, would lie with Network Rail. LRM said that it had undertaken a risk assessment placing the £3,260 million cost at the 80% confidence level but there appeared to be no specific allocation of a general contingency as in CLRL's Business Case.

290. LRM presented illustrative proposals for financing the construction and the subsequent operation of the railway, based on a PPP approach with significant Government underpinning of the project debt. In addition LRM emphasises the potential for exploiting property as a material contribution to the financing package. It envisages creating partnerships with affected property owners and equity providers (which would save money needed for acquisition and facilitate the subsequent development to optimise value capture) and with Local Authorities to assist regeneration.

291. LRM presented ideas concerning the most effective means of governing and delivering the project through the development, construction and operational phases. These were based around the core concepts of a long term concession, supported by a construction manager during the development and construction phases and target price contracts with incentives for programme management, contractors and suppliers.

292. The Review has had access to high level LRM cost estimates. From the limited information available to the Review, it would appear that on a like-for-like basis the underlying costs of the tunnels and stations are about the same as CLRL's, albeit with a different treatment of costs (see below).

293. In the following table, the Review has compared LRM's base capital cost of £3,260 million, plus £800 million for its proposed extension to Canary Wharf (with stations at Whitechapel and Canary Wharf), to CLRL's base costs (i.e. excluding contingency) for a reduced scheme of similar scope.

Table 11: Comparison of LRM & CLRL capital costs

£ million at 2002 prices	LRM	CLRL
Tunnels	710	720
Stations	1,650	1,900
Whitechapel & Canary Wharf[1]	800	Included
Project management[2]	Included	496
Enabling works[2]	Included	134
Systems	140	380
Sub total	3,300	3,630
Connections (East)	185	160
Connections (West)	65	100
Sub total	3,550	3,890
Property[3]	270	600
Electrification[4]	240	270
Total	4,060	4,760

Notes:

[1] -CLRL has included for stations at Whitechapel and the Isle of Dogs in its Benchmark Scheme.

[2] -LRM's costs for tunnels and stations include for project management and enabling works. £496 million is CLRL's proposed figure for project management for the whole Benchmark Scheme.

[3] -LRM has reduced its figure for land acquisition to £270 million by assuming over £300 million in benefits through the use of a property partnership approach whereas CLRL has considered development income separately.

[4] -LRM has included £240 million for the cost of electrification of the line to Reading. For comparison purposes, £270 million has been added to CLRL's costs using CLRL's unit costs for electrification.

While LRM state that its costings are at the 80% level, the Review has not had access to any information that suggests that LRM's costings should be treated as materially more robust on a like-for-like basis than those given for CLRL above. Further investigation would be required before it would be sensible to do so. On the basis of this comparison, the headline

difference between the two sets of figures is £700 million, of which £330 million arises from differing assumptions on property costs, and £240 million from a difference in costs for systems (e.g. signalling, controls, communications, track, electrical).

294. LRM's proposals for property partnerships do not appear to place LRM in a unique position for offering the prospect of significantly enhanced returns compared to the general market. However, LRM assumed in its costings that these proposals would significantly reduce land acquisition costs.

295. There are also differences in project management costs (where LRM has also used substantially lower costs than are being experienced on CTRL) and systems costs (where LRM may not have fully allowed for the costs of the complex interfaces with the adjoining network). Allowing for such factors, the largest difference between LRM and CLRL's overall costings for equivalent schemes is that CLRL has provided for a higher level of contingency to cover potential risks.

296. Recently (May 2004), LRM has made a further presentation to the Review, in which it revised some of the features of its previous proposals. LRM now suggests that only 15 trains per hour would operate through its central tunnel initially, as opposed to the 24 trains per hour previously suggested. LRM also revised upwards some of the costs for its proposals, notably an increase in the Capex costs for the Core section by £200 million to £3,460 million; for the Canary Wharf branch by £350 million to £1,130 million; and by £250 million to £490 million for electrification of all 4 tracks to Reading. LRM also now suggests that some new rolling stock would be required, at least if the Canary Wharf branch were included, and that existing diesel trains sets that operate out of Paddington would need to be replaced by electric units.

297. The Review is grateful for LRM's contribution. While the Review has neither the information nor the mandate to undertake a detailed analysis of the LRM proposal, it is apparent that the ideas are welcomed by certain sections of the stakeholder community and that there are substantial areas of commonality with CLRL's objectives.

298. The Review considers that the LRM scheme effectively represents a less ambitious version of the Benchmark Scheme, with consequential cost savings. Certain of the suggestions made by LRM may be worthy of further investigation as ways of reducing the cost of a Crossrail project. For example, reducing the physical scope of Crossrail is an obvious way to reduce its costs, and the potential and consequences of doing so, together with the effect on expected benefits, is considered elsewhere in this Report. The possibility of using existing rolling stock may also be worthy of further consideration, although any potential for cost savings would need to be very carefully weighed against the practical implications for Crossrail services of using stock not specifically designed for use on an underground railway. Any knock-on effect on other rail services would also need to be considered.

299. In so far as it has been able to examine the proposals, the Review therefore considers that the LRM scheme does not represent substantially new thinking, except in proposing a less ambitious Crossrail scheme than that proposed by CLRL. Its truncated scope is unlikely to deliver a railway offering some of the wider benefits of CLRL's Crossrail. Moreover, the LRM scheme, sharing as it does many of the main features and cost drivers of the CLRL scheme - in particular, a very substantial central tunnel - appears to be not significantly more easily fundable, financeable or deliverable than the CLRL proposals.

Metro scheme

300. As an alternative to the type of schemes put forward by CLRL and LRM, Canary Wharf Limited has mooted the idea of developing a metro style scheme that would link Canary Wharf to Heathrow and Abbey Wood. Such a scheme would be significantly cheaper to build than the CLRL Benchmark Scheme as shorter trains and smaller stations could be used and services would be run at a higher frequency. By running services at a higher frequency, passenger flow through stations is smoother and therefore less space is required to accommodate the crowding that occurs during boarding and alighting of trains.

301. A metro scheme, while potentially offering faster journey times, would at best be only a partial substitute for Crossrail, having only limited effects in relieving crowding and providing few if any strategic benefits on mainline routes forming part of, or connecting with Crossrail. Comparatively reduced benefits would accrue to regeneration areas.

Conclusion

302. It is clear that there is no cheap alternative Crossrail scheme. Essentially, the choice between any of the alternatives described above would depend upon the weight given to different factors, such as benefit-cost ratio, overall cost or highest transport or wider benefits. There is, as such, no single optimal scheme, but merely a series of alternatives any of which may be optimal depending on the criteria adopted.

303. In this regard, for example, the Strategic Rail Authority appears to consider it important that Crossrail should go to Kingston via Richmond. This is because they see Crossrail as primarily a means of relieving congestion at Waterloo. Equally, for Transport for London, the emphasis on regeneration benefits is highly significant, hence a desire to ensure that Crossrail provides a good service to the Thames Gateway. For other stakeholders, different considerations weigh more heavily. For example, the priority of London's business interests is that the service should extend to Heathrow. The Mayor also favours a link to Heathrow.

304. Meanwhile, BAA are unlikely to agree to Crossrail unless its current Heathrow Express Service is also maintained. Any agreement with BAA would require sensitive negotiations, but we believe these could be satisfactorily concluded.

305. It should, however, be noted that because of the high fixed cost of the central tunnel, any reduction in scope from the Benchmark Scheme reduces the estimated benefit-cost ratio, although doing a smaller scheme initially would not of course preclude further extensions at some later date. And, regardless of which scheme were chosen, there would still be affordability constraints. Much of the cost would lie in tunnelling and building stations in the central section and in practice it would be difficult to lower costs. In the light of the funding considerations outlined earlier, there would therefore be affordability difficulties with even a more modest scheme.

306. Clearly, a significant issue in deciding which scheme, if any, to pursue would be the likely availability of funding, in terms of timing, quantum and cost. The Review has therefore given particularly close attention to exploring a variety of financing options in an attempt to identify the most appropriate route for a project of this size, complexity and strategic importance. While there are obvious dangers in allowing funding considerations to limit optimal design in terms of engineering feasibility, value for money and delivery of other benefits, ultimately it would be impossible to decide on the most appropriate scheme without taking full account of the constraints (and opportunities) provided by different financing routes.

307. Before any decision could be taken on an optimal scheme, further work would be necessary in a number of areas. At the highest level, this would involve looking at Crossrail in the light of other transport projects in London, such as the East London Line, to ensure that the various initiatives were complementary and not conflicting.

It would also be necessary to consider new transport pressures that have emerged since CLRL presented its Business Case, such as the need for improved surface access to Stansted and Heathrow in the light of the recent Aviation White Paper and the extent to which Crossrail might support or exacerbate those pressures.

308. At a level of detail, these are some more specific tasks to be undertaken, principally:

- an evaluation of the likely detriment to achieving the regeneration benefits in the Thames Gateway should Crossrail not proceed
- an evaluation of the additional regeneration benefits of extending beyond Abbey Wood to Ebbsfleet
- an evaluation of the likelihood of reaching an appropriate agreement with BAA over the Heathrow link
- an evaluation of the wider benefits of extending Crossrail beyond Heathrow on the Great Western relief lines, probably to Maidenhead, and possibly beyond
- an evaluation of interfaces with other transport operators
- an evaluation of the sums that might be generated for AFM's from property or rating taxes
- an evaluation of the future net revenue likely to be generated from Crossrail
- an evaluation of the operability of the options
- if Ministers wished to consider a Metro scheme, this would require a full further study in its own right.

Managing the funding gap

Size of the gap

309. The Review's work has demonstrated some doubt about whether or not the Benchmark Scheme could be delivered in practice. The Review has identified concerns in relation to the level of services that the Benchmark Scheme could support; whether the construction market has sufficient capacity to handle the Benchmark Scheme in its entirety; and over the state of readiness of the design of the Benchmark's Scheme's western limbs. Undoubtedly, however, the major problem is one of funding. As outlined previously, the funding gap on the Benchmark Scheme is estimated to be of the order of £7,000 million to £8,000 million NPV, before allowing for the cost of any private sector financing and any Exchequer contribution. This was not provided for in the 10-Year Transport Plan.

310. The issue of cost is something the Review has considered in the context of all the various options that might be developed around a central Paddington-Liverpool Street tunnel. As already explained, it is clear that the cost of any alternative would also be high. For example, the Review considers that the option that would see services operate from Heathrow / Maidenhead via Paddington to the Isle of Dogs and Shenfield would have much to commend it, at least as a first stage. Such an option would still show an estimated net whole life cost of £8,515 million NPV.

311. This would still leave a whole life funding gap for a reduced scheme of as much as £4,500 million to £5,500 million NPV, even after allowing for: (i) the shortfall the Review has identified on CLRL's revenue forecasts; (ii) the contribution that London's business interests have indicated might be available from that source, but before allowing for any fixed general taxpayer contribution. See table:

	NPV

	(£ million)
Whole Life Net Cost of Reduced Scheme	8,515
(Heathrow/Maidenhead via Paddington to the Isle of Dogs and Shenfield)	
Revenue Adjustment	1,000[1]
Alternative Funding Mechanisms	2,000 - 3,000
Funding Gap	4,500 - 5,500

Notes

1 -Revenue adjustment for the reduced scheme is lower than for the Benchmark Scheme because of the overall smaller size

312. In certain respects, this represents a conservative analysis. For example, it makes no allowance for additional business rates that might arise even without a change to the business rate system, as a result of new developments along the route. Nor does it allow for any revenues from property developments directly connected to the project. Against that, no allowance for financing cost - over and above the public sector cost of capital implicit in the discount rate used when calculating net present values - has been included in these figures.

313. The Review's analysis suggests that only three candidates have the potential to contribute towards filling such a funding gap:

- Fares: The Review has assumed that fares are pegged to inflation over the whole of the 60-year appraisal period, even though long term trends suggest that public transport fares in London tend to rise at a rate above inflation
- Alternative Funding Mechanisms: The above analysis assumes that AFMs raise between £2,000 million and £3,000 million NPV, probably through business rates. One possibility would be to raise more from this source - the position as regards contributions from London business is discussed earlier in the report
- General Taxpayer Contributions: The third and final possibility would be for the general taxpayer to make a significant contribution. This however, would be severely problematic given the very substantial cost pressures across the transport budget, particularly on the railways.

314. Ultimately, the extent to which these three different sources can or should be used to fill the funding gap - either alone or in combination - is a matter for political judgement, rather than a question that this Review can answer.

Risk and financing

315. The analysis contained in the previous section gives a single point estimate of the size of the funding gap for a reduced-scale Crossrail, when considered across the 60-year appraisal period of the project.

316. However, there are substantial risks to this estimate. CLRL's cost and revenue estimates are broadly robust, subject to the specific points raised earlier. CLRL has also allowed an appropriate contingency. At this stage there remain many uncertainties.

317. Strategies do exist for mitigating these uncertainties. Robust project governance is undoubtedly part of the answer. Accordingly, the Review considers it essential that any procurement strategy for Crossrail should embrace:

- the use of a target price mechanism (assuming that a sufficiently robust price could be established)

- a strong project client
- a properly incentivised, strong, private sector project manager
- a risk sharing strategy that incentivises all project participants to deliver the entire project as efficiently as possible, allocates risks to the party best able to manage them and ensures that risks are appropriately priced, while fully aligning public and private sector interests when residual risks are left with the public sector
- a financial structure that is deliverable, affordable and offers value for money

318. Many of the above features are common to the procurement and financing strategy proposed for Crossrail by CLRL. However, as explained earlier in this report, CLRL's proposed strategy leaves certain questions open, particularly on the use of private finance. CLRL has sought to identify the extent to which private finance could be raised for Crossrail, without making a firm recommendation on the extent to which it would be sensible to do so.

319. CLRL has identified the limits of private sector equity at £350 million and private sector debt at £4,000 million. The Review's analysis estimates that introducing this amount of private finance would add a cost of around £2,400 million NPV, bringing the total whole life cost for the Benchmark Scheme to around £13,700 million NPV.

320. The Review considers that, in the case of Crossrail, it would not represent value for money to utilise private finance in this way. Looking solely at the headline cost of capital, private sector capital tends to carry a premium compared to public finance. However, one of the most compelling arguments for looking behind this headline premium is that the private sector is better able to manage and price the risk transferred and therefore better value for money is obtained overall. For this to be true, risks transferred to the private sector must remain with the private sector and not revert to Government under pressure of failure. In principle, the more risk that is transferred, the higher the cost of capital associated with that risk.

321. However, this relationship may break down in the case of major transport infrastructure projects like Crossrail where, despite incurring the cost of private sector capital, the public sector is often left with the most severe downside risk. This is either because the sheer size and complexity of the infrastructure means that the private sector is poorly placed to assume construction and revenue risk; or simply because it is in practice impossible for the Government not to be obliged by public pressure to participate in finding solutions when major problems occur.

322. In the case of Crossrail, CLRL's view is that the Government would need to guarantee very substantially against default. Assuming private finance was drawn from limited recourse debt markets, the Review considers this analysis to be broadly accurate.-

323. This would only allow strictly limited risk to be transferred to the private sector, principally that associated with the equity, which CLRL assumes would be provided by the envisaged project manager and possibly financial investors. Even assuming that this equity would be genuinely risk taking, it would be small in size. All the main project risks and the marginal risk would remain with the public sector. In the Review's opinion, it is unlikely that this would be reflected in the price at which the private sector would provide capital. Consequently, the Review does not consider that such an approach would represent value for money.

Possible use of alternative funding mechanisms

324. In the light of the Review's concerns over the ability to transfer risk effectively away from the public sector using conventional private finance, the Review has considered the potential for alternative strategies, focusing in particular on the possible pool of those who would benefit from Crossrail.

325. This pool is large and includes London transport users, property owners, occupiers and developers, the wider London community (which benefits through regeneration, reduced congestion and increased wealth) and the UK as a whole (through increased tax revenues). Potentially any or all of these groups could be required to make a contribution to the costs of Crossrail.

326. CLRL and Transport *for* London have considered the scope for Alternative Funding Mechanisms as an adjunct to Government funding, so that funds raised in this way are applied directly to the costs of Crossrail. Such funding would not in any sense represent an investment, would not generate the expectation of any kind of return, and would not bear risk at the margin. While this is clearly an important possible use, particularly given the scale of the funding gap, the Review considers that elements of this funding pool might be looked at as a potential source of risk capital, either instead of, or as well as, one of funding. This would allow some contributions from potential stakeholders to be used to give a tangible stake in Crossrail to those who have contributed to its delivery, in a way that would produce both an effective governance framework and, depending on the amount raised, lift the threshold in terms of cost overrun at which the general taxpayer would become exposed.

Stakeholder equity

327. The starting point underpinning the concept of Stakeholder Equity is that those who would benefit from Crossrail should have a genuine stake in its delivery and contribute towards its costs. As has already been noted, this contention appears to have been accepted at a level of principle by many of the stakeholders with whom the Review has engaged. The Review has considered the possibility of structuring such compulsory contributions as a financial investment, rather than treating them as a straightforward subvention towards costs. This would allow contributors to take a stake in the risks and rewards of the project. Apart from its compulsory nature, Stakeholder Equity could be fashioned in a way that would share many of the characteristics of conventional equity.

328. The key principles of Stakeholder Equity are:

- it would be collected and paid into an entity, whose purpose would be to promote the Crossrail project
- it would be structured as a funding buffer for the public sector and would therefore be at-risk against the project - both during construction and operations, and therefore against the risk of cost overruns on maintenance and renewals, as well as construction. The aim would be to fulfil a similar role to that played by conventional equity
- it would give real ownership interest and a controlling voice in the project
- there would be a financial return paid to the Stakeholders who contribute, the rate of which would depend on the financial outturn of the project
- the expected rate of financial return would be below normal equity market rates, reflecting the broader benefit stakeholders would receive from the successful development of Crossrail.

329. In principle, there is a large pool of potential contributors to Stakeholder Equity. The Review has focused its attention on one of these, the passengers who use London's public transport system, but other sources would be possible.

330. In this example, Stakeholder Equity would be raised through the existing ticketing system for Tube, bus and rail in the London area. Contractual arrangements would be agreed with Transport for London and, through the Strategic Rail Authority, with the Train Operating Companies to allow a network-wide supplement to be placed on public transport fares in London. This supplement would be added to the normal fares and be paid by every passenger.

331. In some respect a supplement of this kind bears similarities to passenger facility charges (PFCs) collected by certain US airports for the purpose of funding ancillary infrastructure such as light rail airport links and maintenance. Approximately US$14,700 million has been raised since the program was initiated in 1992, and many airports have leveraged their future PFC revenues by issuing bonds backed by these flows. These charges are currently capped at US$4.50 per every enplaned passenger.

332. The size of any supplement would depend on how much Stakeholder Equity needed to be raised. As a guide, a 1% fare supplement applied across London Underground, London Buses and South-East mainline rail services in or into London would be likely to raise between £20 million and £25 million a year. If applied only during the seven year construction period a 1% supplement would, therefore, raise between broadly £140 million and £175 million. It would be possible to raise significantly more by collecting the supplement over a longer period, in practice this could be achieved by either introducing it before construction began or continuing it beyond the construction period.

333. The supplement would be paid into a company responsible for promoting Crossrail, called, say, Crossrail Development Limited. This would act as the holding company and owner of Cross London Rail Links, which would be let a concession by Government to develop and operate the Crossrail infrastructure. The London passengers who pay the stakeholder contribution would have effective ownership and control of Crossrail Development Limited. This would either be direct or, possibly, indirect, in which case control would rest with passenger representatives, in a manner similar to Network Rail.

334. If Ministers wished to proceed as soon as possible, Crossrail Development Limited could be established in advance of the supplement being collected. London's business community could be invited to subscribe a relatively small sum to be 'founder members'. But, from as early a date as possible, passengers or their representatives would take the major say in all key policy decisions.

335. To finance the cost of constructing Crossrail, Crossrail Development Limited would raise debt alongside the Stakeholder Equity. However, a relatively small amount of conventional private limited recourse debt - perhaps £500 million - might also be of value, as it would bring the rigour of proper due diligence and monitoring from the lenders. This will leave a significant finance gap which could only be filled with the benefit of Government support.

336. The Review has assumed that Crossrail would not provide passenger services directly. This would be the responsibility of a separate operating company. Once passenger services began, Crossrail would receive a track access charge from the operating company. This access charge would be set in advance at a level sufficient to allow Crossrail to cover its ongoing costs, make payments on its debt, and, subject to its financial performance, pay a return on the Stakeholder Equity. Government would provide support to the company operating passenger services, in the same way as it does to existing rail franchisees.

337. Financial returns would be paid to the individual passengers who had contributed to the Stakeholder Equity. A mechanism for paying the return would need to be developed. One possibility might be to use the Oystercard stored-value ticketing system - financial returns might be paid in the form of credits onto contributors' Oystercards.

338. The size of the return would depend on the financial performance of Crossrail Development Limited. A target rate of financial return of, perhaps, 8% nominal might be appropriate - roughly half that which would be paid on conventional equity, given that stakeholders will also receive significant benefits-in-kind from the delivery of Crossrail. Achieving this target rate would be subject to Crossrail coming in on time and budget and on the continuing availability of the infrastructure for use by the train operating company. If it went over budget, the Stakeholder Equity's rate of return would fall.

Benefits to Government

339. As a potential option for financing Crossrail, Stakeholder Equity could bring real benefits.

340. First, it would see London's transport users - the main beneficiaries - take a genuine stake in the future of Crossrail by making a direct contribution to Crossrail. In return for that, they would get a direct controlling interest in the project. The Review considers that this could contribute towards effective governance framework for the development of Crossrail.

341. Second, it could provide a buffer against cost escalation raising the threshold at which the general taxpayer would become exposed.

342. In the light of these benefits, the Review considers the concept of Stakeholder Equity to merit serious consideration.

343. In the worst-case scenario, in which Crossrail Development Limited defaulted on its concession, the Stakeholder Equity and unguaranteed lenders would suffer financial loss, and the rights to Crossrail would return to Government who will remain to be the funder of last resort. In those circumstances, the Government would be faced with a choice of cancelling the project, funding the project itself or attempting to find an alternative private sector promoter willing and able to carry the project on its balance sheet.

Issues for resolution

344. Although fare supplements have been used to contribute to funding transport infrastructure in countries such as the USA, Stakeholder Equity could extend this concept by providing contributors with a financial return and a real interest in the infrastructure they are helping to fund, and will ultimately benefit from. There are many issues that would need to be resolved before it could be employed, particularly in relation to ensuring that an effective mechanism existed to pay a return to contributors. One other key issue is whether it would be publicly acceptable. A compulsory fare supplement (or else an alternative source) would be required at a time when there is upward pressure on fares in any case, and even if things went well, returns would not materialise until Crossrail services began, i.e. not for at least 7 years after the supplement is introduced.

345. And it would also be critical that key stakeholders are on-board. This is particularly the case for the Mayor/Transport for London and the Strategic Rail Authority and the Train Operating Companies who, apart from anything else, would need to agree to act as agents for the collection of Stakeholder Equity. Suitable sponsors would also need to be found to act as founder members for the Crossrail development company.

346. There are a number of technical issues where further work is required. Among the main issues:

- Size of Stakeholder Equity: A proper risk assessment of the Crossrail project would be required before a firm number could be given. Even then, there would need to be flexibility to reflect any changes that may occur during the Hybrid Bill process etc.
- Structure of Crossrail Developments Limited: The probable options are either a company limited by guarantee, similar to Network Rail, or a company limited by shares, with a mass shareholding. A company limited by guarantee may have advantages, since it would avoid the onerous logistical requirements associated with having such a large community of shareholders. A company limited by shares, on the other hand, might be more straightforward to implement initially
- Structuring "at-risk" project finance debt: The unique nature of Stakeholder Equity combined with the scale of the Crossrail project would make the raising of such debt challenging as lenders are unlikely to accept such levels of risk. A more detailed risk analysis of the project would need to be undertaken in order to demonstrate that the structure were sufficiently robust to support project finance debt, but a company limited by shares might be more straightforward to implement

- Procurement and State Aid: Given the Government's recent experience with negotiating large infrastructure projects, the Review does not consider it tenable to go forward on Crossrail without seeking to securing appropriate clearances from the European Commission, almost irrespective of the procurement route. This would certainly be the case if a novel concept such as Stakeholder Equity were to be employed. The Review would recommend seeking a formal state aid decision, which could take a year and possibly more from the point at which discussions are opened with the Commission. The Review would also recommend exploring with the Commission how Stakeholder Equity sits with EC procurement law, in order to obtain comfort that a Stakeholder Equity solution is legally sound

347. There is one further key issue that would need to be resolved. Stakeholder Equity is a financing option. It does not and could not represent a solution to any long-term funding gap. Before the project could go ahead, there would need to be a decision on how best to close that gap (including financing costs), almost certainly drawing from the three options set out under managing the funding gap.

D. Conclusions and next steps

348. The suggestion of building a new East-West cross-London rail link was first mooted over half a century ago and has been raised several times in the intervening period. That this idea should have been promoted so frequently and energetically of itself points to a perceived transport need that other developments and improvements have clearly failed to address.

349. This need appears no less strongly felt in 2004. While there may be scope for debate over the precise route that should be followed and how it should be funded, London residents, workers and employers continue to make a strong case for Crossrail. The Review's own engagement with a wide range of stakeholders has confirmed that there is broad enthusiasm for a new rail link across capital.

350. In no small measure, this support reflects the increasing pressures on public transport in the capital. While both the national rail companies and London Underground plan capacity increases in the next 20 years, these are widely seen to be unable completely to address the current levels of overcrowding in central London's rail network. Meanwhile, additional pressure is likely to be placed on public transport in the capital as a result of expansion in other transport modes, notably the construction of additional runways at Stansted and Heathrow as indicated in the recent Aviation White Paper. This perceived need for additional capacity is an important driver for the Crossrail project designed by CLRL.

351. The Review wishes to pay tribute to the quality of the work that CLRL has undertaken in developing the Benchmark Scheme. Its professionalism and dedication has provided a strong basis for the Review's analysis and allowed it confidently to move on to the consideration of alternative schemes that might deliver broadly similar value for money.

352. The transport benefits that CLRL's Crossrail scheme would deliver have been demonstrated in the work that it has undertaken in developing its proposals and the Review does not dissent from those findings. The precise value of the CLRL scheme benefits in relation to the cost of delivering them is open to differing interpretations, but even if only some of the expected population and employment growth takes place, a cross-London rail link is likely to score favourably in any formal economic evaluation.

353. However, a decision on whether to proceed with a scheme of this size and complexity cannot be taken on the basis of an economic analysis of those transport benefits we can quantify alone. Crossrail has the potential to deliver a range of wider benefits that cannot necessarily be quantified in terms that could be fully reflected in a conventional benefit-cost ratio. Such benefits have an altogether more strategic aspect that must be given due weight in the overall judgement of the Crossrail concept.

354. Underpinning some of these potential benefits is the recognition that Crossrail could catalyse economic growth in support of wider Government policy. Crossrail could complement and contribute significantly to delivery of the plans for the regeneration of the Thames Gateway, and to sustainable development more widely. Similarly, it is clear that through its agglomeration benefits, Crossrail could play a major role in bolstering and further enhancing London's reputation as a major financial centre. However, in the longer term beyond 2016 there is also the potential for Crossrail to be seen as a catalyst for enduring change in the pattern of London's growth - bringing the City closer together, advancing enterprise, breaking down prejudice between East and West as areas for investment and helping to ensure that London remains pre-eminent as a financial capital.

355. The single largest factor affecting any consideration of Crossrail is its reliance on tunnels to link the East and West of the capital. As the Review's work has demonstrated, the majority of the costs would be tied up in this core section and, even if reduced to a minimum by de-scoping and imaginative value engineering, would still represent a significant amount. Thus, any project that could be legitimately described as a 'cross London' rail link has a high irreducible cost.

356. It is against this backdrop that the Review has considered the proposals brought forward by CLRL, which would appear to fulfil many of the aspirations of those who have for so long promoted the concept of a Crossrail scheme while delivering other Government objectives and offering measurable economic and wider benefits.

357. In summary, the Review has identified some concerns in relation to a number of engineering and operational aspects of the Benchmark Scheme. Some of these relate to the design of the scheme itself, but a significant constraining factor is the scale and complexity of the interfaces with the mainline railway and with London Underground. While no single concern is of itself sufficient to cast doubt on the deliverability of the Benchmark Scheme, the concerns in aggregate cannot be set aside. Meanwhile, while the Review has identified grounds to question a number of cost and revenue items, the net effect is broadly neutral; i.e. CLRL's net cost estimate of the Benchmark Scheme appears broadly robust for a scheme at this stage of project design.

358. There are three main reasons why the Review believes the Benchmark Scheme could not be delivered exactly as proposed:

- the currently expected level of performance on the mainline railway with which Crossrail interfaces would not permit the envisaged 24 trains per hour peak service level to be reliably maintained
- plans for the Richmond-Kingston branch are still relatively underdeveloped; coincidentally, this is also the aspect of the current route design that has attracted most public opposition
- it is uncertain whether the construction market has sufficient capacity to undertake a project of this size and scope as a single initiative.

359. In practice, the first of these concerns could be addressed relatively easily by reducing the scope of the interface with the mainline railway, i.e. by reducing the overall size of the scheme. Removal of the Richmond/Kingston branch, which would also address the second concern, would make a significant contribution here. This would affect both the benefit-cost ratio and the likely level of wider benefits but not so materially as to rule it out on those grounds. Any reduction in the size of the scheme would, of course, also go some way to address concerns about construction market capacity. The Review's judgement on the construction and operational aspects of the Benchmark Scheme has been formed independently of any considerations of funding or financing. However, it is beyond question that while, with some modification, the Benchmark Scheme is likely to be deliverable and operationally viable, a large funding gap would need to be bridged before the project could be taken forward. Though there is some potential for reducing the costs of the Benchmark Scheme within its current scope, the quantum of savings is likely to be relatively modest in relation to the overall cost. On the basis of both CLRL's analysis and financing proposals, the Review does not believe that this gap could be addressed without leaving the public sector exposed to an unduly high level of project risk.

360. This high level judgement naturally embraces a wide range of more detailed recommendations about the Benchmark Scheme that are set out in the body of the Report. For convenience these are reproduced below:

Conclusion 1: Scope

The Review considers that the proposed 24 trains per hour peak service in the central section might not be achievable without further investment in the adjoining network or curtailment of some of the outer branches. Work is currently underway to establish what level of service might be possible,

although this is difficult to predict given the uncertainty over other improvements which are forecast in the Network Rail Plan: preliminary indications are that without improvements it could be as low as 16-18 trains per hour at peak times. Further work would be necessary by CLRL to assess what levels of additional investment would be required and how operation of the Benchmark Scheme could be simplified to achieve a reliable service level of 24 trains per hour at peak.

Conclusion 2: Costs and Revenues

In conclusion, the Review considers that while significant elements of the project scope and definition remain to be decided, cost estimates must be treated with some caution.

CLRL's analysis suggests that the net present cost of its Benchmark Scheme would be £11,273 million NPV, allowing for all costs except for financing costs, and less net revenues generated by the project. However, within CLRL's Business Case analysis there are both understatements and overstatements. These might necessitate a net upward cost adjustment approaching £1,000 million NPV to CLRL's July 2003 assessment of capital costs, but this would largely offset by reduced OMR costs. There is also a potential positive variance in net revenue that could see this increase by up to £1,200 million from CLRL's own estimate.

The Review has concluded that further work is necessary by CLRL to firm up the scope and definition of the project before more reliable cost estimates could be established.

Conclusion 3: Project governance arrangements

If Crossrail were to proceed, robust project governance arrangements would need to be in place. The Review does not consider that CLRL's current constitution would be appropriate and believes it would need to be restructured in anticipation of any legislation. A 'GoCo' has shown itself to be a suitable structure in the past.

Conclusion 4: Procurement

The Review is not convinced that a concessionaire solution along the lines initially proposed by CLRL would provide satisfactory risk transfer for the additional costs incurred and considers that further work would be necessary before the other alternatives now put forward by CLRL could be properly evaluated. It does, however, believe that target price contracts, supported by robust project client and project management arrangements, would be the appropriate way to deliver a project of this complexity, though further work would be necessary to determine an appropriate structure and target price. While the Review supports the choice of the Hybrid Bill route, it notes the significant amount of work that would be necessary if CLRL's proposed timetable were to be met and the ramifications of a General Election being called while the Bill were in Parliament.

The Review also concludes that the current governance structure of CLRL would not be likely to meet the rigorous demand of a hybrid Bill process. A better relationship would be significantly closer and more direct - i.e. with CLRL formed as a 'GoCo'.

Conclusion 5: Construction market capacity

Crossrail would make considerable demands on the construction market and it is not yet clear whether the necessary capacity exists. The Review therefore recommends that two surveys should be carried out: one on construction industry capacity per se, the other on likely industry pricing. This work should be carried out in discussion with OGC.

Conclusion 6: Financial market capacity

The Review has concerns about the capacity of both financial and construction markets to take on a project of the size of CLRL's proposals without significant levels of Government financial support. Given the size of the transaction and its projected internal rate of return, it is unlikely that it would prove possible for a significant proportion of equity funding to be raised. While market capacity for project debt would fall well short of the total financing required for Crossrail, value for money

concerns lead the Review to conclude that such project funding should be limited. This raises significant affordability issues.

Conclusion 7: Environmental and heritage considerations

The timetable for completing the Environmental Statement within the current programme would be challenging, especially if there were delays in obtaining necessary information. Work would need to be prioritised to resolve inconsistencies in appraising and managing environmental risks. A robust strategy would need to be developed for disposal of spoil as a delay could jeopardise the proposed programme.

Conclusion 8: Timetable

CLRL's proposed construction timetable includes adequate and reasonable contingency provisions though there are a number of risks which, were they to materialise, might have a significant impact on its achievability. More work, however, would be needed to make the programme more robust, such as binding in key third parties like Network Rail and London Underground.

Conclusion 9: Value for money

Overall, the Review has concluded that the Business Case for the Benchmark Scheme is Robust and could provide good value for money. It is, however, critically dependent upon the extent to which the expected population and employment growth in London materialises.

Conclusion 10: Wider benefits

The Review has not sought to replicate CLRL's work in assessing the wider benefits of Crossrail, but it agrees that such benefits will accrue, contributing to the Government's transport and planning policies, helping to develop new communities in the Thames Gateway and supporting the FBS sector in London. However, it believes CLRL's methodology is open to debate and that ultimately it may not be possible to predict the empirical valuation of these benefits over the long term accurately.

Conclusion 11: Funding and financing

The forecast costs of the Benchmark Scheme present a significant funding challenge. Given the transport and regeneration benefits that Crossrail would produce, it is generally accepted, including by HM Treasury, that a direct contribution from the Exchequer would be appropriate. Equally, however, the size of the scheme would make direct Exchequer funding of the whole cost unrealistic.

The Review believes the level of Government support that might be justified could only be determined when considered: (i) against the benefits produced by the scheme and the extent to which these would fall to different parties; (ii) the amount of funding that might be raised from other sources and the extent to which direct Exchequer funding might serve to maximise such contributions; and (iii) the competing demands on the public purse. Given the likely amounts that could be raised from the identified revenue sources, and the Review's understanding of their willingness to contribute, the Government contribution could be offset but would still be over-large. This raises fundamental affordability concerns.

361. In line with its remit, the Review has also gone on to consider alternative ways of delivering a Crossrail project that would offer better performance against the Secretary of State's key criteria. The Review's work in this area has proceeded by examining how the individual components might be combined in different ways. This creates a number of options. As explained earlier in the Report, it is not possible to identify a single optimal scheme without first deciding on the relative importance of the different factors that must be weighed in any evaluation. However, taking into account CLRL's work, the Review's findings and the views of stakeholders, it is clear that some alternatives have more obvious merit than others; and that all would require further detailed work before any final decision could be taken on which might be optimal.

362. A decision on whether or not to proceed with the Benchmark Scheme or with any alternative would also require a judgement on the merits of Crossrail as against a number of other possible transport infrastructure projects in London and existing pressures on public spending in relation to transport and elsewhere. This lies beyond the Review's terms of reference.

363. Ministers will also wish to take account of factors beyond forensic issues of price and risk, costs and benefits, and funding and financing. The very scale of the project, and the Government's expressed support for it in principle, have invested Crossrail with a symbolic importance. In London's financial community and beyond, there is a general belief that the capital's status as a major financial centre would be under threat without Crossrail. To that extent, the decision is seen as a test of the Government's commitment to London and therefore has broader ramifications than simply whether or not to commission an admittedly very large transport infrastructure project.

364. In summary the Review believes that if Ministers wished to proceed with a Crossrail scheme, there are a number of alternatives to the Benchmark Scheme that would be worthy of closer examination. Each has its own advantages and disadvantages and some would clearly be more promising than others. If Ministers wished, they could view the CLRL Benchmark Scheme as an ultimate intention, and the individual components as building blocks, to be proceeded with as and when funding permitted. But clearly any scheme which sought to meet the key aims of serving the regeneration areas to the east of the Capital with Heathrow to the west would involve significant and a significant funding challenge would therefore remain.

365. Given the likely costs of even the most modest configuration, the Review believes there are only two ways in which a Crossrail scheme could be financed. The first would involve extensive use of direct public funding, possibly allied to a small amount of private equity and debt to promote disciplined project management. Alternative funding mechanisms would need to be used to the maximum. A scheme funded along these lines would represent a heavy burden on the public purse, particularly in the light of competing transport and other pressures.

366. The second approach would involve the use of stakeholder equity. This could help to narrow the funding gap at the margin, providing a buffer to the public purse against the risk of cost overruns, However it would still leave a very substantial affordability challenge.

367. A number of options have been reviewed, including a re-definition of the Benchmark Scheme with enhanced Heathrow services and a branch serving Maidenhead. Curtailed options serving only Eastern destinations reduce value for money compared with the Benchmark Scheme, all having benefit-cost ratios of less than 1.5:1, with limited potential to reduce costs because of the high cost of the central tunnelled section. In the West, Crossrail facilitates a redrawing of Great Western services and provides enhanced frequencies (particularly to Heathrow) and through-journey opportunities achieving a strong benefit to cost ratio.

368. If the Government saw merit in proceeding with a Crossrail scheme, then further work would be necessary before a final decision could be taken on an optimal project. If Ministers wished the scheme would be delivered by means of a Hybrid Bill, during the fourth session, then the Review believes that this would just be possible. The intervention of an Election during the period to June 2006 would need to be taken into account; this would be a two-session Bill. A large amount of work would need to be undertaken to ensure that the Hybrid Bill were adequately prepared and supported. In headline terms, the key tasks would be:

- *Identification of a preferred scheme***:** including appropriate economic analysis and consideration of wider benefits
- *Engineering***:** develop scheme design in line with whatever configuration were chosen by Ministers to sufficient level of detail for adequate description in Hybrid Bill, and preparation of a revised cost estimate. This work would necessarily include ensuring that the chosen scheme was operationally deliverable

- *Financial***:** first assess whether the Government can afford to meet additional pressures of the order of £5,000 million to £6,000 million against the background of other pressures on the transport budget. If and when it is clear that these pressures can be accommodated, refine the stakeholder equity concept, including detailed financing plan, and consult on the deployment of Alternative Funding Mechanisms
- *Procurement***:** establishment of Crossrail Development vehicle
- *Regulatory:* seek appropriate comfort on state aid and other regulatory issues
- *Project management:* ensure that CLRL were appropriately resourced to perform the project client role
- *Negotiations:* if a Heathrow link were desired, conclude negotiations with BAA over the future of the Heathrow Express. Negotiations with key property stakeholders (e.g. Canary Wharf) would also be necessary to identify quantum and timing of any contribution
- *Hybrid Bill:* administrative development of legislative vehicle so that it were ready for introduction by early 2005
- *Department:* ensure that internal resources and external resources were in place to support development and introduction of Hybrid Bill, together with appropriate external advisers
- *Property:* confirm identity of properties required for acquisition, devise strategies for their subsequent development and for maximising developer contributions.

369. The Review has developed a detailed timeline setting out all the work that would need to be completed before introduction of the Hybrid Bill. This been prepared on two bases. The first, an 'accelerated' version, assumes introduction of a Hybrid Bill into Parliament at the end of November 2004. For this timetable to be met, a decision to proceed would need to be taken at the beginning of March.

370. Even if Ministers were able to take a decision to this deadline, the overall timetable would still be aggressive for a project of this size and complexity. Consequently, the Review has also prepared an indicative timetable on an 'unconstrained' basis, i.e. allowing enough time for each of the key activities with an allowance for some problem arising. Under this scenario, a Ministerial decision at the beginning of March would allow deposit of the Hybrid Bill in March 2005.

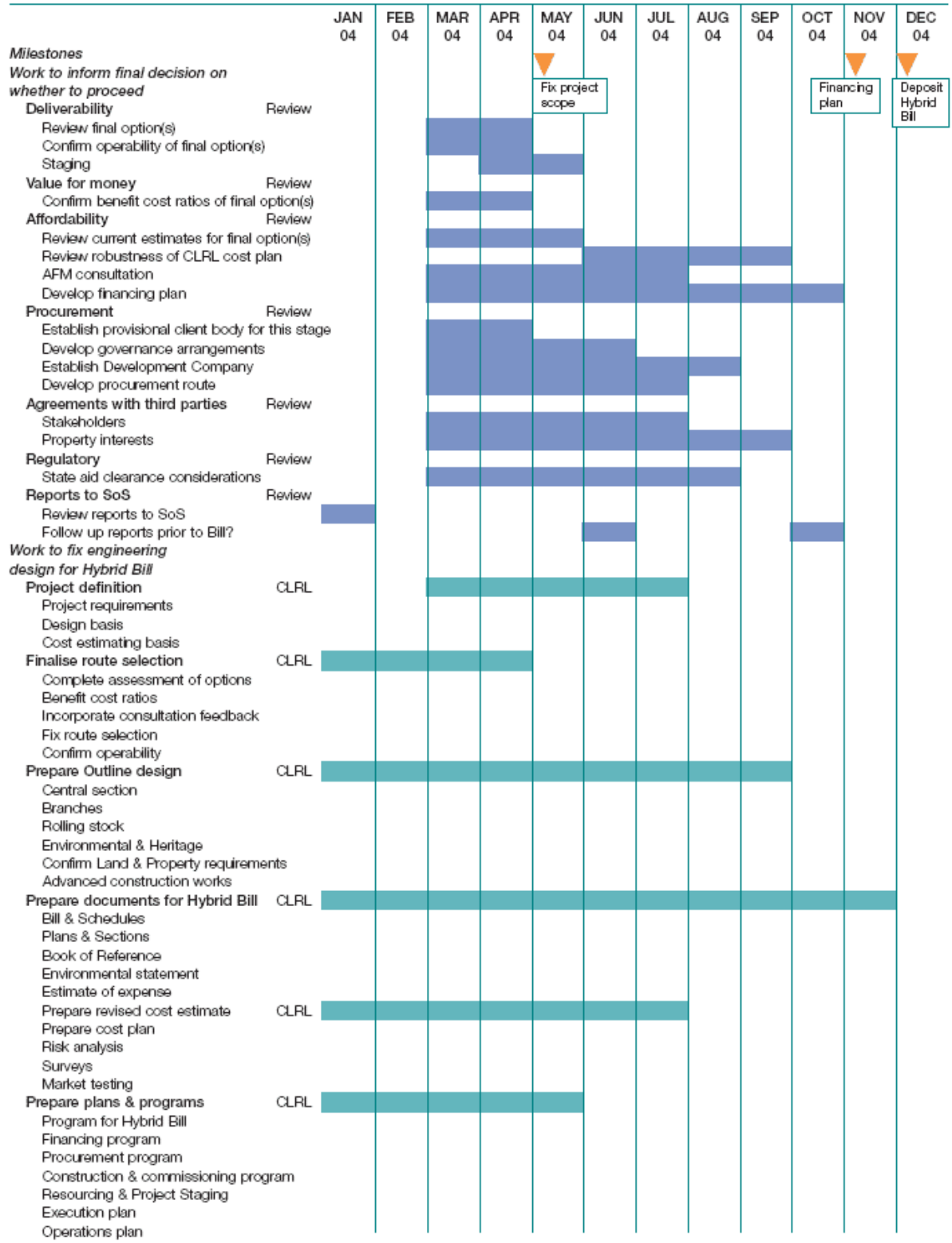
371. Under either of these two scenarios, therefore, a Hybrid Bill could be deposited during the next Parliamentary session (though the second would require the agreement of the Standing Committee) and hence reach Second Reading before a General Election in mid 2005, should one be called.

372. It will be clear from the two timelines that there is a significant number of tasks to undertake before deposit of a Hybrid Bill. However, there is an irreducible minimum of work that would need to be undertaken in advance of deposit of a Bill; and some tasks would take longer depending on the point in the year at which they were commenced. For this reason, the Review believes that the very latest a decision on Crossrail could be taken while still allowing for deposit of a Hybrid Bill in the next Parliamentary session would be June. Should a decision be taken later than June 2004, it would not be possible to ensure deposit during the next Parliamentary Session even if the 'accelerated' timings were followed.

Crossrail Preliminary Timelines

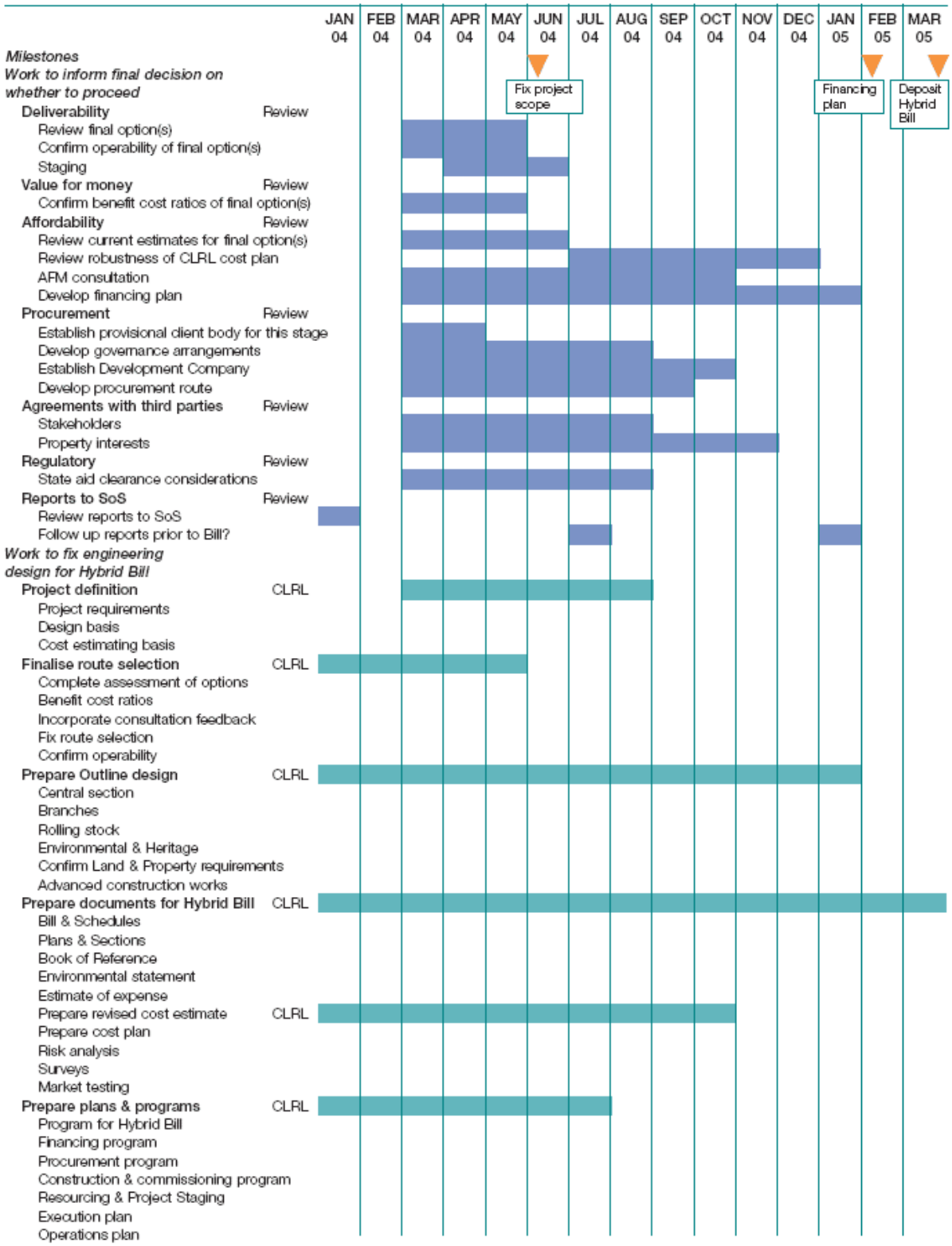
Version 1 - Assumes decision to proceed in principle in Mar 04 and Hybrid Bill Submission in Nov 04

CROSSRAIL PRELIMINARY TIMELINE
VERSION 1 – ASSUMES DECISION TO PROCEED IN PRINCIPLE IN MAR 04 AND HYBRID BILL SUBMISSION IN NOV 04



Version 2 - Assumes decision to proceed in principle in Mar 04 and hybrid bill submission in Mar 05

CROSSRAIL PRELIMINARY TIMELINE
VERSION 2 – ASSUMES DECISION TO PROCEED IN PRINCIPLE IN MAR 04 AND HYBRID BILL SUBMISSION IN MAR 05



Annex A: List of review team members

The Review Team comprised a large number of experts drawn from the following organisations. The Review was supported by a High Level Group, led also by Adrian Montague.

Review Leader: Adrian Montague
Department for Transport
HM Treasury
Booz Allen Hamilton
CMS Cameron McKenna
DTZ
KPMG
MPG
Partnerships UK
UBS Investment Bank
High Level Group
Adrian Montague
Jim Steer - Strategic Rail Authority
Jay Walder - Transport for London
Lewis Atter - Her Majesty's Treasury
Kate Mingay - Department for Transport
Mike Fuhr - Department for Transport
Ewan West - Department for Transport

Annex B: List stakeholders seen in the course of the review

Canary Wharf Group
CBI London
Corporation of London
Federation of Small Businesses
London Chamber of Commerce and Industry
London First
London Transport Users Committee