ATKINS

High Speed Rail Strategic Alternatives Study

Update Following Consultation

January 2012

Plan Design Enable

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1 Introduction

1.1 Background

Atkins was appointed by the Department for Transport (DfT) in August 2009, to consider road and rail improvement alternatives to the High Speed Rail proposition being developed by High Speed Two (HS2) Ltd. The main objective of HS2 Ltd at the time was to consider the case for new high speed services between London and the West Midlands. However, in appraising the HS2 business case and in approving the proposed investment decisions, it was necessary for DfT to also appraise a range of strategic alternatives to HS2 as comparators. Atkins therefore developed an incremental range of road and rail interventions on the existing road and rail networks between London and the West Midlands, designed both to increase capacity, and to bring down journey times on this corridor. These were then costed, modelled in terms of the impact on revenue and appraised to allow them to be compared with the HS2 proposals.

Atkins was subsequently re-engaged by the Department for Transport (DfT) in October 2010 to appraise a set of strategic alternatives to the Government's overall proposed high speed rail strategy for a Y-shaped network linking London with Birmingham, Manchester and Leeds. These scenarios were developed by DfT, and included enhancements to not only the existing line between London and the West Midlands but also to the East Coast Main Line (ECML) and the Midland Main Line (MML). Atkin's economic appraisal of these alternatives to the proposed Y network was published as part of the suite of HS2 consultation documents.

Alongside this work, Atkins was also commissioned to update the original economic appraisal of the London to West Midlands Strategic Rail Alternatives, to be consistent with the latest assessment of the HS2 London to West Midlands scheme.

Further to the HS2 Consultation process, further updates of the key Strategic Alternative packages have been commissioned, which are the subject of this report. These updates have concentrated on Rail Package 2 and its variants (including a package proposed by 51M, a grouping of local authorities), as this package was found to offer the most credible alternative to the business case for HS2 between London and the West Midlands and attracted the most comment in consultation responses, and on Scenario B as the most credible alternative to the wider HS2 'Y' Network.

These Strategic Alternatives have been revised, in this document, to take account of:

- The updated HS2 model (2010 baseline) – which itself takes account of recent high growth in demand on the West Coast Main Line following completion of the West Coast Route Modernisation (WCRM) programme and recent timetable changes; and
- Feedback from the HS2 Consultation process and from a report on the key alternatives which was commissioned by the Department for Transport from Network Rail in the light of the interest in these schemes raised in consultation.

At the same time and, in parallel, Atkins has taken the opportunity to review some of the assumptions used previously and add greater detail to the modelling, which has in some cases been able to ensure greater consistency between HS2 and the Strategic Alternatives.

1.2 Purpose of the Report

This document provides an update to the appraisal of the key Strategic Rail Alternatives to the HS2 proposition. The report outlines the appraisal of the alternatives being considered. It summarises the interventions developed, examines the Capital and Operating Costs, and then details the Economic Appraisal of the Alternatives.

This document should be read in conjunction with the earlier Atkins reports on the Strategic Alternatives.

1.3 Structure of the Report

The remainder of this report is structured in the following manner:

- Section 2 provides a description of the packages of potential interventions being examined;
- Section 3 details the results of the demand forecasting of the interventions;
- Section 4 details the Capital and Operating Costs;
- Section 5 presents the results of the Economic Appraisal; and
- Section 6 summarises the findings of the report and draws out conclusions from the work undertaken.

2 Strategic Alternatives

2.1 Introduction

This section outlines the process that was undertaken to derive 'packages' of interventions. The process involved examining the future year baseline situation to determine the key issues. A series of individual interventions were then developed that addressed these issues which were then packaged and appraised.

2.2 Network Rail Review

Following the HS2 Consultation process, DfT asked Network Rail, as the custodian of the existing network, to review the Strategic Alternatives proposed. This review concentrated upon RP2, RP2A, 51M and Scenario B. The review focused on the costs, deliverability and operational impacts of these key enhancement packages.

Network Rail's report, which sets out in detail their assessment of these packages, including their view of the potential impacts on suburban crowding and reliability, and potential areas of additional cost, is published on the Department for Transport's website. Where items of Network Rail's analysis have been incorporated into our work, these are discussed in the relevant sections of this document.

2.3 London – West Midlands Strategic Alternatives

2.3.1 The Alternatives

The London – West Midlands HS2 Strategic Alternatives were developed by Atkins as part of the original Strategic Alternatives study as alternative investment packages that could be used to test the robustness of HS2's business case. Due to the geographic scale of the proposed HS2 route between London and the West Midlands few individual interventions would be able, on their own, to deliver sufficient functionality, whether in terms of journey time improvements or capacity enhancements, to act as an "alternative" to the HS2 proposition. It was therefore considered more appropriate to examine packages of interventions.

A total of four packages were put together originally for consideration, with a couple of variations on the four packages. These were known as Rail Packages 2, 3, 4 and 5, with variations, Rail Package 2A and 3A. The packages were designed so that each subsequent package builds upon the preceding one, so the scope of Rail Package 5 (RP5) was much greater than that of Rail Package 2 (RP2).

The previous work indicated that RP2 and RP2A had the highest BCRs. These also attracted the most comment in consultation responses. Therefore, this update, following consultation with the DfT, has focused on the reassessment of the RP2 and RP2A packages. A further consideration or update of packages 3-5 was not deemed to be necessary at this point in time. However, as detailed below, a new package proposed by the 51M group of local authorities has also been tested.

2.3.2 Rail Packages 2 and 2A

2.3.2.1 The Intervention Packages

In Rail Package 2 (RP2), an increase in long distance capacity is delivered by an increase in train service frequencies on the West Coast Main Line – up to 16 trains per hour on the fast lines. To enable these to operate supporting infrastructure enhancements have been proposed.

In RP2, there are some modest speed improvements associated with the infrastructure improvements proposed, but most of the journey time improvements result from fewer intermediate station stops per train made possible by the higher train frequency. Some improvements in journey times in RP2 also come from removing the performance allowances currently included in the WCML timetable. A variant of RP2, known as RP2A, was also developed, which retained the current performance allowances.

The component schemes for RP2 and RP2A are therefore the same, the difference lies in the journey times assumed. The component schemes for the original RP2 and RP2A are given below:

- Stafford area by-pass;
- Grade separation between Cheddington and Leighton Buzzard;
- 3 new platforms at Euston;
- 3 extra platforms at Manchester Piccadilly (with grade separation at Ardwick);
- 4-tracking Attleborough - Brinklow (including freight capacity works at Nuneaton);
- Northampton area speed improvements; and
- 4-tracking Beechwood Tunnel – Stechford (on what is often known as the "Coventry corridor").

The component schemes of Rail Package 2 (and 2A), outlined above, have been revised for this update. Firstly, a lower specification Stafford scheme has been adopted, which involved the grade separation of Colwich junction and a 'Colwich cut-off', rather than the full Stafford area by-pass. The Stafford by-pass scheme included in the original Strategic Alternatives work was designed to meet both of the packages' twin aims of providing increased capacity and generating journey time savings (2.5 minutes on trains between Crewe and Colwich not calling at Stafford and 1.5 minutes on trains running between Colwich and Manchester).

Following further consideration, and in the light of consultation responses, the Department for Transport reached the view that this scheme should not be included in the updated appraisal, as the same capacity increase could potentially be achieved through significantly cheaper works at Colwich Junction (taking into account Network Rail's planned intervention at Norton Bridge).

Secondly, Network Rail's report indicated that, particularly in the light of the Government's decision to take forward the Ordsall Chord scheme in Manchester, the interventions at Manchester Piccadilly and Ardwick would not be required to deliver the service specification proposed.

As well as removing the costs of these projects, the removal of these schemes also means that some journey time savings would not be deliverable. Therefore, in replacing the full Stafford by-pass scheme with Colwich and in removing the Ardwick scheme, it has been necessary to also remove the 2.5 minutes saving in journey time on trains between Crewe and Colwich not calling at Stafford and the 1 minute saving between Stockport and Manchester. A 1.5 minutes saving on Manchester trains via Stoke has been retained.

The component schemes for RP2 (and RP2A), therefore, are now:

- Grade separation at Colwich junction (in place of Stafford by-pass and in addition to the current Network Rail scheme at Norton Bridge);
- Grade separation between Cheddington and Leighton Buzzard;
- Additional infrastructure at Euston Station;
- 4-tracking Attleborough - Brinklow (including freight capacity works at Nuneaton);
- Northampton area speed improvements; and
- 4-tracking Beechwood Tunnel – Stechford.

In summary, in this update, RP2 and RP2A, now exclude the proposal to build 3 extra platforms at Manchester Piccadilly (with grade-separation at Ardwick), and instead of the full Stafford scheme a lower cost alternative of Colwich Junction grade separation and cut-off line only is proposed.

2.3.2.2 Package Deliverables

RP2 (and RP2A) assumes that the train service frequency on the WCML "fast" lines is increased as far as practically possible without needing to provide six tracks north of Watford Junction. The maximum is assumed to be 16 trains per hour (tph) over the busiest section of the WCML: Euston – Ledburn Junction (just south of Leighton Buzzard), with the following service specification in a standard hour timetable:

- Euston - Manchester: 4tph "fasts";
- Euston – Birmingham: 4tph "fasts";
- Euston – Liverpool: 3tph "fasts" trains every 2 hours;
- Euston – Glasgow: 3tph "fasts" trains every 2 hours;
- Euston – Chester/North Wales 1tph calling stations on the Trent Valley;
- Euston – Milton Keynes - Northampton – Rugby: 4tph "fasts":
- 2 tph extended to Birmingham New Street;
- 1 tph terminating at Rugby; and
- 1 tph extended to serve stations along the Trent Valley route.

In both RP2 and RP2A, there is no difference in the level of train service provision proposed for the "peak" and the "off-peak" hours. This is to ensure that the capacity of WCML is utilised as effectively as possible given the significant investment proposed. No changes to fares levels or structures have been assumed, although it is recognised that a shift to a more sophisticated fare regime may help deal with some specific examples of crowding.

The slow line service specification under RP2 is the same as today.

2.3.3 The 51M Proposition

2.3.3.1 The Intervention Package

In response to the consultation, a grouping of local authorities along the proposed route of HS2 has produced their own alternative proposition. This proposition is based on RP2. It includes the infrastructure proposed in the original RP2 with the exception of four-tracking of the "Coventry" corridor, the extra platforms at Manchester and grade separation at Ardwick, and the additional platforms at Euston. It is based on 12 car Pendolino trains operating slightly fewer trains per hour over the course of the day but with a greater proportion of the services in the peak hour. It was the most developed of the alternative proposals received by DfT during consultation, and was supported in its development by a consortium of stakeholders. It was therefore tested in this update.

A number of infrastructure enhancements are proposed by 51M to support the overall increase in services.

- Grade separation of Ledburn Junction;
- Construction of a fourth line between Attleborough Junction and Brinklow Junction;
- Northampton line speed improvements and
- Stafford by-pass (full scheme).

The enhancements are also assumed to include platform lengthening as required to facilitate 12 car operation, and some additional electrification required to deliver the service specification proposed.

Key to the 51M proposal is an increase in long distance capacity on the WCML by lengthening the Class 390 train sets to 12-car formation (with the exception of those to Liverpool Lime Street, which remain at 11-cars), reconfiguring one first class carriage to standard class and running additional peak long distance services.

The 51M proposal also involves providing additional capacity to outer suburban stations on the WCML by running four fast line services per hour on the Northampton route. There is a new service pattern proposed on the slow lines between London Euston and Rugby, with one fewer train than today into Euston due to a service being diverted to Clapham Junction.

2.3.3.2 Package Deliverables

51M proposed a modified timetable. The peak hour timetable is as follows:

- Euston - Manchester: 3tph "fasts;
- Euston - Manchester: 1tph Trent Valley "semi-fast";
- Euston – Birmingham: 3tph "fasts";
- Euston – Liverpool: 2tph "fasts";
- Euston – Glasgow: 1tph;
- Euston – Preston – Oxenholme/Windermere or Blackpool: 1tph;
- Euston – N.Wales; and
- Euston – Milton Keynes - Northampton: 4tph (semi-fast) of which 2tph are extended via Rugby – Birmingham.

The text of the 51M document submitted to the HS2 consultation refers to a different off-peak pattern, but does not specify what this is. For modelling purposes, therefore, it was assumed that the entire peak service would operate except:

- Euston – Liverpool: only 1tph "fast"; and
- Euston - Manchester: 2tph "fasts; with the extra 1tph semi-fast still operating.

The slow line service pattern under the 51M proposal includes one fewer commuter train per hour out of Euston compared to today. The slow line specification for 51M is as follows:

- London Euston to Watford Junction: all stations 2tph;
- London Euston to Tring: 2tph with one semi-fast service;
- London Euston to Milton Keynes: 1tph calling at most intermediate stations;
- London Euston to Northampton: 1tph; and,
- A Milton Keynes to Clapham service: 2 tph

2.3.4 Summary of Journey Time Impacts

2.3.4.1 RP2, RP2A and 51M

In the original Strategic Alternatives study RWA Rail, a transport consultancy, were commissioned to model journey times for each proposed train service. These form the basis of the journey times modelled going forward. RP2 (and 51M) do not typically increase the existing line speeds, except at Northampton. However, some small speed improvements are delivered through three types of intervention.

- Firstly, certain of the infrastructure enhancements that are required to deliver additional capacity are also capable of delivering journey time reductions through line speed improvements, such as at Northampton;
- Secondly, the enhanced infrastructure and the extra capacity generated enable a reduction in the time allowed within current timetables for recovery from delays at key locations, such as from providing conflict free movement across the grade separated junction proposed between Cheddington and Leighton Buzzard.
- Thirdly, some of the indicative train service specifications are based on having a higher train frequency which has been used to reduce the average typical number of stops per train. This has typically improved journey times for through passengers by up to four/ five minutes per stop omitted, such as in package 2, where some London – Birmingham New Street "fast" trains are assumed to run non-stop to Birmingham International.

Most of the journey time benefits do not result from reductions in the point to point running time as detailed above. Most of the reductions in end to end journey time result from the increased frequency of the "fast" services and thus allowing them to have fewer intermediate stops.

However, in this update in replacing the full Stafford by-pass scheme with the Colwich scheme and in removing the Ardwick scheme, it has been necessary to also remove the 2.5 minutes saving in journey time on trains between Crewe and Colwich not calling at Stafford and the 1 minute saving between Stockport and Manchester. The 1.5 minutes saving on Manchester trains via Stoke has been retained.

The table below gives an illustration of some typical inter-urban journey times between some of the major cities on the WCML, and thus the time savings which could arise from the interventions. Please note that the times quoted (including the Do Minimum times) are average times of Inter-city services (except where via Northampton). It should be noted that the journey times between the major cities vary depending on the stopping patterns and routing assumed. The table below is not comprehensive. Other city pair route choices are not shown, and in some of these cases 51M package offers the fastest journey times.

Table 2.1 – Typical Modelled Average Journey Time Impacts (in minutes)

Rail Service Group	Do Minimum Journey Time	Package 2	Package 2A	51M
London – Birmingham New St	85	73	75	80
London – Manchester	129	124	127	127
London – Liverpool	132	126	128	123
London – Birmingham via Northampton	127	96	99	107

Network Rail were asked by DfT to review the journey assumptions in the original Strategic Alternatives Report. They state:

'The analysis undertaken confirms that the timings assumed by RP2 seem appropriate. The journey time savings assumed by RP2 appear to be predominantly delivered through removal of station calls, for example, two of the three station calls are removed from the London Euston – Birmingham New Street service. The journey time savings are also reliant on the procurement of higher performing rolling stock as suggested by RP2'.

Network Rail also raised a concern regarding the removal of timetabling allowances proposed in RP2, noting that they "would not support the removal of performance allowance in the timetable without evidence to quantify the performance of the RP2 proposal." For the purposes of this update, Atkins has agreed with the Department for Transport that the previous approach of testing RP2 both with and without performance allowances should be maintained.

51M produced their own set of timings for their service. These timings and the service specification were for the peak operation in the "down" direction only (i.e. away from London). For the purposes of modelling, Atkins has constructed an off-peak service specification. In this, the numbers of peak services are reduced by two. The Liverpool trains (the lightest loaded intercity services) are reduced to only one per hour and the Manchester trains reduced to three per hour only (from four). Network Rail has reviewed the timings proposed and state that 'the analysis undertaken confirms that the timings assumed by 51M seem appropriate'. Despite this, some minor alterations (up and down) were made to ensure consistency between the reference case, RP2, RP2A and 51M.

2.4 'Y' Network Strategic Alternatives

2.4.1 The Alternatives

The Strategic Alternatives to the 'Y' network were developed by a DfT Working Group and were then modelled by Atkins in the February 2011 study.

This section outlines the strategic rail interventions identified as potential alternatives to the proposed 'Y' high speed rail network between London and Manchester and Leeds. Due to the geographic scale of HS2, few alternative interventions would be able, on their own, to deliver an equivalent level of functionality, whether in terms of journey time improvements or capacity enhancements. It was therefore considered more appropriate to consider packages of interventions.

A total of three packages were developed as alternatives, known as Scenarios A, B and C. Scenario A was concerned only with extending the length of existing services. Scenario B was concerned with increasing passenger capacity and frequency through infrastructure upgrades, whilst Scenario C built upon Scenario B, and included additional schemes to reduce journey times.

The results of the previous study suggested that Scenario B had the highest BCR. The update following consultation has therefore focused on the reassessment of Scenario B. Following consultation with DfT further consideration of Scenarios A and C was deemed to be unnecessary.

The remainder of this section describes the rail interventions identified in terms of the overall theme of the package and the individual works which would lie behind the theme. The outputs from each of the packages are then described, in terms of service frequency and journey times.

2.4.2 Scenario B

2.4.2.1 Intervention Package Components

The individual interventions assumed to be required to deliver Scenario B are shown in the following table. Note that the interventions for the West Coast Mainline are the same as for the updated RP2 and RP2A as described in the previous section.

Table 2.2 – Scenario B Intervention Components

Package	Components
Midland Main Line	Infrastructure enhancements on the Midland Main Line include: • Electrification from Bedford to Sheffield; • Freight loop facility between London and Bedford; • Re-instatement of 4-tracks between Bedford and Kettering; • Re-instatement of 2-tracks between Kettering and Corby; • Station area re-modelling at Corby; • Re-modelling and 4-tracking in the Leicester area; and, • Electrification and increased stabling capacity at depots.
East Coast Mainline	Infrastructure enhancements on the East Coast Main Line include: • Kings Cross: Throat re-modelling. Re-instatement of a third tunnel and 6-track approach; • 4-tracking Digswell – Woolmer Green; • 4-tracking Huntingdon – Peterborough • Peterborough area works: Werrington Flyover; • 4-tracking Stoke Junction – Doncaster; • Newark – provide flyover for Nottingham to Lincoln route; • Retford – works to address low speed turnouts and restrictive signalling; • Electrify and upgrade Retford – Sheffield; • Re-modelling and extra platforms at Doncaster; • Electrification of Hambleton Junction to Leeds; • Platform capacity enhancements at Leeds; • York – re-modelling and grade-separation at Skelton Bridge Junction; • Darlington – headway/station layout enhancements; • Darlington – Newcastle: re-instate and electrify Leamside line; • Extra capacity at depots; • Power supply strengthening for overhead line equipment.

Package	Components
West Coast Mainline	• Replacing the existing outer suburban rolling stock with 390s (i.e. on those services that use the "fast" lines") • Grade separation at Colwich; • Grade-separation between Cheddington and Leighton Buzzard; • 3 new platforms at Euston Station; • 4-tracking Attleborough – Brinklow (including freight capacity works at Nuneaton) • Small-scale area speed improvements around Northampton; and • 4-tracking Beechwood Tunnel to Stechford ("Coventry corridor").

2.4.2.2 Scenario B Deliverables

An outline description of what Scenario B is intended to deliver is described below. The deliverables are unchanged from the previous report.

Midland Main Line

Scenario B assumes a higher service frequency with electrification of the MML. An 8tph timetable is provided North of Bedford with the following assumed service specification:

- St Pancras – Derby – Sheffield: 2tph (fast between London and Leicester);
- St Pancras – Nottingham: 2tph (fast between London and Leicester);
- St Pancras – Leicester: 2tph (calling at intermediate stations);
- St Pancras – Corby: 2tph (calling at intermediate stations).

East Coast Main Line

Scenario B assumes a higher frequency long distance timetable on the ECML. A 10tph timetable is provided, with all rolling stock comprised of 10 car 125mph IEP sets. The assumed service specification is:

- London – Leeds: 3tph (1tph via Hambleton);
- London – Newcastle: 4tph (with 2 tph extended to Edinburgh, and some services beyond);
- London – Sheffield: 2tph;
- London – Hull / Lincoln: 1tph (alternating).

West Coast Main Line

Scenario B assumes a higher frequency long distance timetable on the WCML as per Rail Package 2 (and 2A):

- Euston - Manchester: 4tph "fasts";
- Euston – Birmingham: 4tph "fasts";
- Euston – Liverpool: 3 "fast" trains every 2 hours;
- Euston – Glasgow: 3 "fast" trains every 2 hours;
- Euston – Chester/North Wales 1tph calling stations on the Trent Valley;
- Euston – Milton Keynes - Northampton – Rugby: 4tph "fasts":
- 2tph extended to Birmingham New Street;
- 1tph terminating at Rugby; and
- 1tph extended to serve stations along the Trent Valley route.

As part of their review of Scenario B, Network Rail stated that further interventions may be needed to deliver the assumed train service specifications. Conversely, feedback from the HS2 Consultation process questioned whether there was scope for optimisation of Scenario B. For the purposes of this update, the scheme has been appraised on the basis that it was previously specified. This provides a point of comparison with the appraisal previously undertaken.

2.4.3 Summary of Journey Time Impacts

Scenario B is designed to deliver journey time improvements between the key cities as well as capacity enhancements. The journey times on the ECML and the MML were estimated by the DfT and modelled by Atkins. The journey times on the WCML routes were calculated and modelled by Atkins and were based on RP2A. The table below gives an illustration of typical journey times between some of the major cities, based on average times of the inter-city services, and thus gives an indication of the savings which could arise from the interventions. It should be noted that there are a variety of train times between each of these city pairs, depending on the stopping patterns of each service, so the times below are only illustrative.

Table 2.3 – Typical Journey Time Impacts (in minutes)

Rail Service Group	Do Minimum Journey Time	Scenario B
London – Birmingham New St	85	75
London – Manchester	129	127
London – Nottingham	110	93
London - Sheffield	140	112
London – Leeds	131	121

In the current refresh, it is assumed that the operations in the Do Minimum on the MML and ECML make less use of IEP rolling stock, so the journey times have extended between London and Leeds and Sheffield.

3 Demand Forecasting

3.1 Introduction

The packages were assessed using the PLANET suite of models, which had been further developed specifically for the HS2 Ltd study. The HS2 Ltd models have been used to ensure consistency between the appraisal of the proposed high speed rail routes and the identified rail alternative packages.

The demand forecasting work described in this chapter has been undertaken using the HS2 modelling framework. This framework contains an all day demand model, so the utilisation rates quoted refer to the amount of passengers against the seated capacity over the course of a day. The approach taken, by averaging out congestion over the whole day, does not give an accurate reflection of the utilisation at peak hours

As part of their review, Network Rail examined the impact of the forecast levels of demand on utilisation rates at the busiest times of day. In addition, this analysis, based on the MOIRA model, differentiates between service types and estimates the spread of passenger loads over the different types of service. The results of this work, which indicates high levels of crowding on suburban services under all scenarios is set out in Network Rail's report.

3.2 Future Year Baseline

3.2.1 Introduction

The first step in forecasting the demand for the alternative interventions is to construct a future year scenario, against which the alternatives can be assessed. In line with the HS2 Ltd work on the proposed 'Y' network, two future year horizons have been examined: 2021 and 2037. The construction of future year models represent a Do-Minimum scenario, and the elements of supply and demand that make up this scenario are described in the remainder of this section.

3.2.2 Supply

Committed, or likely to be committed, rail schemes were taken directly from the HS2 Ltd study. These were derived from a number of published sources including the Network Rail Strategic Business Plan, and the TfL Business Plan. Advice on the 'Do Minimum' timetable for the West Coast was provided by the Department. For the committed Thameslink and Crossrail projects, and for the IEP Programme which the Department has continued to take forward, the timetable and capacity enhancements included within the DfT's Network Modelling Framework (NMF) to 2019 were used. No additional uncommitted schemes were incorporated into the models beyond 2019, such that the future year rail networks are assumed to be consistent between 2021 and 2037.

Consistent with the approach taken by HS2 Ltd, a number of schemes were identified for inclusion in the Future Year Do Minimum scenarios. Of particular interest to this study are the following schemes:

- West Coast Main Line – some of the nine-car Class 390 units lengthened to eleven-cars;
- East Coast Main Line – Inter-City Express Programme and Thameslink Programme capacity increases with new rolling stock;
- Midland Main Line – line speed improvements between St Pancras and Sheffield and Thameslink Programme capacity increases with new rolling stock; and,
- East Coast Main Line – infrastructure capacity provided by schemes to be delivered by Network Rail in the period to 2014.

The Do Minimum scenario constructed is different from that assumed in the March 2011 work. Key differences that have an impact on the current work are as follows:

- The March 11 Do Minimum assumed that Birmingham – Scotland services on the WCML would be operated by Class 221/222 Voyagers. The revised Do Minimum now assumes that these services will be operated by 9-car 390 Pendolinos;
- Retention of Class 91/Mk 4 sets on the ECML. The Do Minimum in the March 2011 work assumed that the Class 91 fleet would be replaced with IEPs;
- Introduction of 110mph suburban WCML services to Milton Keynes and Northampton;
- Extension of some existing London - Lancaster services to Glasgow;
- Introduction of 10 new off-peak London - Lancaster services;
- Ordsall Curve in Manchester is assumed to be constructed; and,
- Chiltern Line – Evergreen III.

In the March 2011 Strategic Alternatives work, there were issues with the models converging, particularly with trips to Scotland. In order to achieve model convergence additional capacity was added to the Do Minimum on the ECML and WCML for all the scenarios tested. It is understood that a similar exercise was carried out separately for HS2. These changes were acknowledged in the relevant reports. In this current work, the models achieve convergence with only the Do Minimum supply schemes in place, so an entirely consistent Do Minimum has been used across all schemes (including HS2).

3.2.3 Passenger Demand

Future year exogenous (background) rail demand growth is input directly into the PLANET Modelling Suite from a model called EDGE. This rail demand growth is forecast based on Departmental guidance on the use of the industry standard Passenger Demand Forecasting Handbook (PDFH), and recent GDP forecasts as used by HS2, which include the impact of the recession. Fares assumptions remain the same as in the February 2011 analysis. All of these assumptions are consistent with those used in the current HS2 Ltd modelling.

The decision in the recent Autumn Statement not to proceed with the planned RPI+3% fares increase in 2012 was taken too late to incorporate into the modelling. It is understood that the impact of this has been examined by HS2 Ltd as part of their sensitivity testing, but a similar exercise has not been carried out for the Strategic Alternatives.

The overall impact of the application of the exogenous growth is given in Table 3.1 below. This forecast is consistent with that used by HS2 Ltd and shows all of the demand in the models, rather than just the WCML, MML and ECML demand. Beyond 2037, the demand is capped to be consistent with the HS2 work.

Table 3.1 – Estimated 2037 Rail Demand (total trips per day)

Model	2010 Trips	2037 Trips	% Growth in Trips (2010 to 2037)
PLANET South	1,657,101	2,423,673	46%
PLANET Midlands	36,805	47,445	29%
PLANET Long Distance	1,012,899	1,462,539	44%

This shows that strategic demand, as represented in the PLANET Long Distance model, where the inter-urban trips are considered, is forecast to increase significantly, by approximately 44% between 2010 and 2037. Local demand increases are still noteworthy, with growth in PLANET Midlands and PLANET South forecast to be 29% and 46% respectively between 2010 and 2037.

The demand in the models used in the previous Strategic Alternatives update in February 2011, is given in Table 3.2 below, for comparison purposes.

Table 3.2 – Estimated 2043 Rail Demand (total trips per day) – February 2011 Update

Model	2008 Trips	2043 Trips	% Growth in Trips (2010 to 2043)
PLANET South	1,549,812	2,408,083	55%
PLANET Midlands	34,436	49,385	43%
PLANET Long Distance	974,804	1,562,615	60%

On the demand side, there are a number of major differences between the models used for the previous Strategic Alternatives study in February 2011, and this current study. Firstly, the HS2 Ltd model has been rebased to a 2010 model from a 2008 model. This means that the Base Year matrices for this study include the impact of the rapid growth in trips that followed on from the West Coast Route Modernisation project. This is reflected in the higher starting point for the demand matrices in the current piece of work. Secondly, the final year for modelling is now 2037, rather than 2043 as previously, and the forecasts now take into account the impact of the recent recession. These factors result in there being less demand in total at the final model year than previously although PLANET South's demand is slightly higher than in the previous exercise.

3.2.4 Rail Issues

In order to determine the forecast implications for both passenger volumes and crowding in the specific London to Manchester, Sheffield and Leeds corridors, analysis was initially undertaken using the PLANET Long Distance (PLD) model employed by HS2 Ltd. Crowding is defined as a proportion of the total passenger numbers to seated capacity. The PLD model is an all day (16 hour) model.

A description of the do-minimum impacts for the three major rail lines under consideration (West Coast Main Line, Midland Main Line and East Coast Main Line) is given in the remainder of this section. Outputs from the model, showing all-day demand, are shown in Figure 3.1.

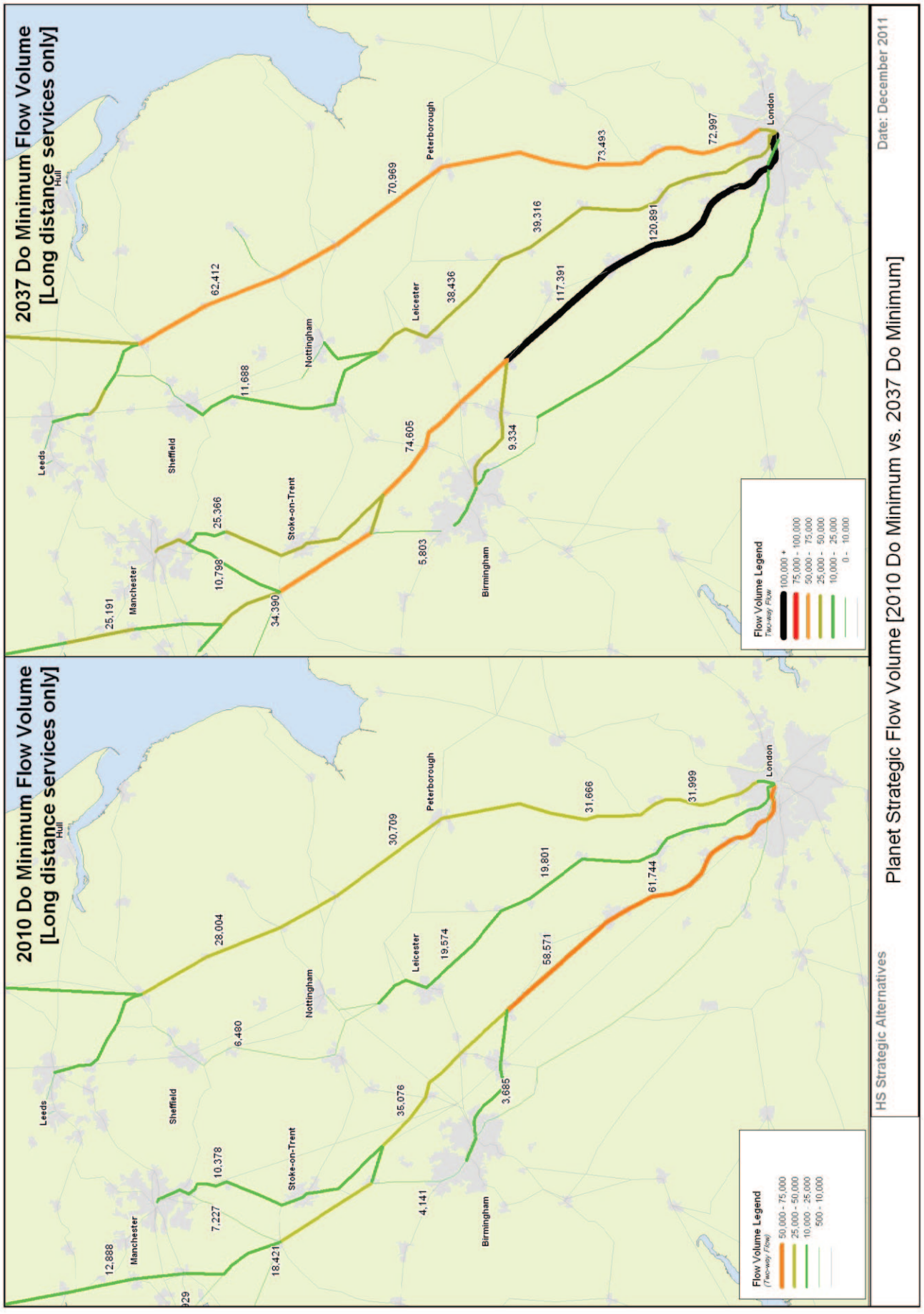


Figure 3.1 – All-Day Demand: 2010 & 2037 Do Minimum Scenarios

3.2.4.1 West Coast Main Line

Demand on the WCML long distance services is forecast to increase by approximately 100% up to 2037, with forecast (two-way) daily passenger volumes on long distance services on the approach to London increasing from approximately 62,000 to 121,000 trips. This is considerably larger than the average rail growth of 44% shown in Table 3.1. The PLD model contains a variety of journeys, including a large number of regional rail journeys of less than 50 miles in length. The PDFH Forecasting methodology employed assumes that longer distance trips grow at a faster rate than regional rail trips. These longer distance trips are found on the major inter-city rail routes, hence the growth on the route being much higher than the average for the model as a whole. All day load factors on the approach to London are forecast to increase from approximately 53% to 83% between 2010 and 2037.

3.2.4.2 Midland Main Line

Demand on the MML long distance services is forecast to increase by approximately 100% up to 2037, with forecast (two-way) daily passenger volumes south of Leicester increasing from approximately 20,000 to 39,000. This is again in excess of the average rail growth of 44% in strategic trips shown in Table 3.1. All day load factors on the approach to London are forecast to increase from approximately 35% to 67%.

3.2.4.3 East Coast Main Line

Demand on the ECML long distance services is forecast to increase by about 130% up to 2037, with forecast (two-way) daily passenger volumes on long distance services on the section between Peterborough and Stevenage increasing from approximately 32,000 to 73,000. This is considerably larger than the average long distance rail growth of 44% highlighted in Table 3.1. All day load factors on the approach to London are forecast to increase from approximately 46% to 80%.

3.3 Modelling of Rail Packages

3.3.1 Introduction

The timetables associated with the packages were coded into the PLANET model and run for the years 2021 and 2037.

This section shows the change in demand associated with the packages, and then highlights the impact of the packages on capacity and crowding on the major routes under consideration.

3.3.2 London - West Midlands Strategic Alternatives

3.3.2.1 Impact on Demand

Table 3.3 shows total additional rail trips that are estimated to occur as a result of the proposed rail interventions for the 2037 forecast year, compared to the Do Minimum.

Table 3.3 – Estimated 2037 Modal Transfer & Rail Trip Generation (total trips per day)

	Modal Transfer from Air	Modal Transfer from Highway	Generated Rail Trips	Total Additional Rail Trips
Package 2	1,956	4,775	19,444	26,175
Package 2A	1,764	4,490	17,685	23,939
Package 51M	2,039	3,433	16,096	21,568

The table above shows that the three WCML packages are all forecast to generate additional demand on the WCML. RP2 is forecast to result in the most trips being generated, with the difference between RP2 and RP2A a result of the slightly longer journey times in RP2A.

The number of trips forecast to be generated as a result of the interventions can be examined against the equivalent figures for the February 2011 update. These are shown in the table below.

Table 3.4 – Estimated 2043 Modal Transfer & Rail Trip Generation (trips per day) – February 2011 Update

	Modal Transfer from Air	Modal Transfer from Highway	Generated Rail Trips	Total Additional Rail Trips
Package 2	2,166	3,219	11,607	16,993
Package 2A	1,755	2,799	10.101	14,655

Comparison of Tables 3.3 and 3.4 shows that RP2 is forecast to attract an additional 9,000 rail trips, of which approximately 8,000 trips will be newly generated rail trips, in the new work. Examination of the origins of these additional trips suggests that they are primarily generated between London and North West England, and also between London and the West Midlands. There are three reasons for this:

- The starting demand on the WCML in the models in this current update is higher than in the February 2011 work as the demand impact of the West Coast Route Modernisation Programme is now included. This means that there is likely to be more crowding at an earlier stage on the WCML, and thus more crowding relief from the additional capacity and therefore some suppressed demand is released;
- There is a slightly slower average journey time to Manchester in the current Do Minimum model, which will result in the schemes generating more trips as they will be relatively faster than before; and,
- There are generally fewer seats on the WCML south of Manchester in the current model, due to the fact that it has not been necessary to add any additional capacity to address convergence issues in the new Do Minimum. This results in more crowding in the Do Minimum, and thus comparatively more crowding relief with the introduction of the packages. This is by far the most important cause of the additional demand that is forecast to result.

3.3.2.2 Summary of Capacity and Crowding Impacts

As a result of assessing each of the packages in the PLANET demand model, forecast additional capacity and crowding levels were obtained on long distance WCML services to and from London. A summary of the impact on capacity at a point approaching London is given in Table 3.5 below.

Table 3.5 – Forecast Capacity and Crowding Impacts, 2037

Rail Package	Long distance seated capacity (16 hour two way) to/from London WCML	% Increase in seated capacity over Do Minimum WCML	WCML 2037 load factor approaching London (16 hour two way) (% seats)
Do Minimum	144,795	n/a	83%
Package 2	222,080	53%	60%
Package 2A	222,080	53%	59%
Package 51M	221,434	53%	64%

Both 51M and RP2 provide additional long distance passenger capacity on the WCML route in the region of 53% of seated capacity to and from London. This level of additional seating then has a major impact on the all day load factor on the WCML, with daily crowding forecast to reduce from 83% in the Do Minimum to around 60% in the three alternatives.

3.3.3 'Y Network' Strategic Alternatives

3.3.3.1 Impact on Demand

The 2037 total modal transfer and the number of generated rail trips that are estimated to occur as a result of the proposed rail interventions, is summarised in Table 3.6 below.

Table 3.6 – Estimated 2037 Modal Transfer & Rail Trip Generation (total trips per day)

	Modal Transfer from Air	Modal Transfer from Highway	Generated Rail Trips	Total Additional Rail Trips
Scenario B	4,986	9,141	36,383	50,510

Table 3.6 shows that the introduction of Scenario B is likely to result in an additional 50,000 trips per day occurring on the long distance rail network. It is worth noting that given that Scenario B incorporates Rail Package 2A, that approximately half of these additional trips will occur on the WCML, as shown in Table 3.3.

The number of trips forecast to be generated as a result of the interventions can be examined against the equivalent figures for the February 2011 update. These are shown in the table below.

Table 3.7 – Estimated 2043 Modal Transfer & Rail Trip Generation (total trips per day) – February 2011 Update

	Modal Transfer from Air	Modal Transfer from Highway	Generated Rail Trips	Total Additional Rail Trips
Scenario B	6,023	6,084	24,320	36,427

Comparison of Tables 3.6 and 3.7 shows that Scenario B is forecast to attract an additional 14,000 rail trips between the March 2011 and the current update. Given that Scenario B incorporates RP2A, then it is apparent that the majority of these additional trips are occurring on the WCML. The reasons for this have been examined earlier. The source of the remainder of the additional trips is less apparent, with pockets of additional demand throughout the route of the ECML. These are likely to be as a result of the changes in the Do Minimum timetable on the ECML.

3.3.3.2 Summary of Capacity and Crowding Impacts

As a result of assessing each of the packages in the PLANET demand model, forecast additional capacity and crowding levels on the three long distance routes (West Coast Main Line, Midland Main Line and East Coast Main Line) to and from London were obtained. The long distance WCML services intervention in Scenario B is the same as for Rail Package 2A described earlier in the section. A summary of the impact on capacity and crowding is given in Tables 3.8 and 3.9 below, for the Midland Main Line and the East Coast Main Line respectively, at points approaching London.

Table 3.8 – Forecast Capacity and Crowding Impacts, 2037 – Midland Main Line

Rail Package	Long distance seated capacity (16 hour two way) to/from London MML	% Increase in seated capacity over Do Minimum MML	MML 2037 load factor approaching London (16 hour two way) (% seats)
Do Minimum	60,588	n/a	67%
Scenario B	141,240	133%	35%

Table 3.9 – Forecast Capacity and Crowding Impacts, 2037 – East Coast Main Line

Rail Package	Long distance seated capacity (16 hour two way) to/from London ECML	% Increase in seated capacity over Do Minimum ECML	ECML 2037 load factor approaching London (16 hour two way) (% seats)
Do Minimum	87,670	n/a	80%
Scenario B	187,436	114%	48%

Tables 3.8 and 3.9 show that the implementation of Scenario B provides a large amount of additional seats on the two major inter-city lines, with resultant load factors on the MML at 35%, down from 67% in the Do Minimum situation, and on the ECML at 48%, down from 80% in the Do Minimum situation.

It is worth noting that the number of seats provided by Scenario B in this update is slightly higher than in the February 2011 Update. Whilst, the infrastructure schemes remain the same there has been a change in the number of seats provided in the IEP Rolling Stock which is assumed to run on these two lines. The seating capacity on a standard 10-car IEP is now assumed to be 660 passengers compared to the 639 passengers in the previous update. Any further changes in the assumed capacity of IEP would be expected to impact on package BCRs.

4 Capital and Operating Costs

4.1 Introduction

The estimated costs of the packages are detailed in this section to inform the economic appraisal. These costs are at an order of magnitude level due to the early stage of development of the interventions.

4.2 Capital Costs

4.2.1 Methodology

The capital cost estimates have been prepared by cost consultants, Faithful and Gould, who are part of the Atkins group of companies.

The high level capital cost estimates presented have been developed using a model containing a series of high level unit rates, consistent with those used by HS2 Ltd, to determine the costs for each location within each package. The unit rates are grouped into the main elements of work, namely:

- Trackwork alterations and new work including renewals, realignment of track and turn outs, and provision of new track, grade-separated crossing or loops;
- Structural alterations to bridges, viaducts, tunnels, roads, etc.
- Signalling alterations including reconfiguring, repositioning and associated work including telecoms;
- Power and electrification alterations to suit, including realignment, plus new power requirements as appropriate; and,
- Platform extensions, alterations and associated and consequential work.

To the base costs a series of percentage additions have been applied for management and project on-costs to arrive at a total 'all in' scheme cost per location. These location costs have then been summarised into a cost per package.

In preparing cost estimates, a benchmarking exercise has been carried out in tandem to validate the unit rates, with the outturn costs of other comparable route improvement schemes.

4.2.2 Estimate Parameters

To determine the work necessary at each location to accommodate that particular package, workshops were held with DfT. For each package, the extent of work was determined, broken down into the following key elements of work:

- Trackwork;
- Structures;
- Electrification (Traction Power Systems);
- Signalling, telecoms and control systems;
- Buildings, including platforms;
- Other electrical and mechanical systems; and,
- Contractors' preliminaries and other project on-costs.
- Other electrical and mechanical systems; and,
- Contractors' preliminaries and other project on-costs.

Beneath this level, the main components of the physical works associated with the scheme itself are broken down.

The elements listed above are then linked to a unit rates file, and quantified to produce an overall base construction cost.

The template established also makes provision for the addition of other indirect costs associated with the management and execution of the works, namely:

- The cost of procuring or leasing land, as necessary, for either the permanent works or temporary requirements;
- Ancillary costs, including environmental works and landscaping;
- Provision of main power substations and enhancements to the national grid (as considered necessary);
- Design, Project Management and other fees, during implementation; and,
- Optimism Bias.

At this stage, the majority of the items listed above have been determined on the basis of an applied percentage. Of these, the largest item is Optimism Bias, which has been applied at 66% of the overall costs, to reflect this early stage in the project development. This is consistent with HM Treasury's Green Book guidance and with the Department's WebTAG guidance.

4.2.3 Estimate Exclusions

Whilst at this stage of the project development there remain a number of gaps in the information necessary to populate the capital cost in detail in all areas, we have endeavoured to make the estimate as complete as possible, minimising the number of excluded items. Those exclusions that do remain are detailed below:

- Potential property development, income or resale value;
- Local taxes;
- Development costs expended by the client to date;
- Costs associated with the client team including its duties, accommodation and services;
- Financing charges associated with borrowing or raising funds; and
- Future inflation to the implementation phase (costs are based at Average 2011 prices).

In the original Strategic Alternatives work, the costs for the scheme for Stafford was provided by DfT. In this update, the Colwich alternative has not been costed in detail. Instead, a comparative assessment was made by Atkins and DfT.

4.2.4 Estimate Assumptions

At this stage of the scheme development a number of high level assumptions have had to be made with regard to estimate content, both in terms of quantities of work and the rates applied to them. These can be summarised as follows, and should also be read in conjunction with the estimate exclusions detailed above:

- All construction, maintenance and renewal prices are based at a common base date of an average 2011 price;
- No consideration has been taken for any costs effect in programming and procurement arrangements and planning;
- Track work by location has been determined by desk top studies;
- The related structural works have been assumed to be kept to the minimum;
- Signalling works are assumed to be kept to a minimum and relate to moving and repositioning only, without major area reconfiguration or central control alteration;
- It is assumed that existing power supplies will need upgrading for the new infrastructure. These were assumed at 10% of the construction cost of the packages, including optimism bias;
- A further allowance of 10% of the construction cost was added to each package to account for other potential works on the WCML necessary to mitigate risks to operational performance arising from the high level of capacity utilisation proposed;
- An allowance for planned disruption of 10% of the construction cost was also added to each package. Note that in their review of the Strategic Alternatives, Network Rail have suggested that this allowance may be understated; and
- No costs have been assumed for unplanned disruption although experience with the West Coast Route Modernisation project and other schemes shows that this represents a significant risk. Over the Christmas / New Year period in 2008, works at Rugby over-ran by 2 days leading to severe disruption to passengers and freight customers.

If the schemes are progressed, and the estimates are developed further, then these assumptions will be challenged and addressed, although it is likely that a number of more detailed assumptions will still be required.

4.2.5 Capital Cost Estimate

The detailed capital cost estimate is given in **Appendix A**, broken down by package. A summary of the total capital cost of the alternatives are given in Table 4.1 below. This also includes the equivalent capital cost used in the March 2011 Update work. Please note that the March 11 costs are higher than previously reported as they have been uplifted to from 2009 prices to 2011 prices to enable direct comparison with the current cost estimate.

Table 4.1 – Capital Costs of Interventions (excluding rolling stock) (£ millions, average 2011)

Package	Total Cost (Current Update)	Total Cost (March 2011)
Package 2	2,551	3,837
Package 2A	2,551	3,837
51M	2,600	n/a
Scenario B	12,439	13,873

The costs for Packages 2 and 2A are significantly lower than previously reported, while the cost for Scenario B is also lower. The cost reduction is due to changes in infrastructure assumptions described in Chapter 2.

The capital cost of the 51M scheme (£2.062bn, 2009 prices) is presented in Appendix 1 of the 51M response to the HS2 consultation. These do not, however, include the additional costs required to enable the 12-car Pendolinos proposed by 51M to operate on the West Coast Main Line, the majority of which relate to platform lengthening. In its review, Network Rail made an estimate of these costs (and the costs for some additional electrification required to deliver the proposed service specification plus the conversion of first class coaches to standard class coaches). In accordance with Network Rail's findings, an additional cost of £345m (including 66% optimism bias) was included in the cost estimate for 51M to cover these elements.

4.3 Rolling Stock

Previous reports on these alternative packages have also included benefit cost ratios calculated on the basis of rolling stock being purchased and treated as a capital cost, consistent with the assumption made for new high speed HS2 rolling stock, rather than leased. This method removes the long-term financing costs of leasing rolling stock, and therefore led to an overall reduction in costs and hence an increase in the BCR.

In commissioning this update, the DfT advised Atkins that it does not consider that the purchased rolling stock variant represents a realistic approach, given that these packages are based on incremental additions to existing franchises and rolling stock fleets. An approach based on leased rolling stock is also consistent with HS2 Ltd's treatment of rolling stock costs for the use of released capacity on the current network. Therefore, BCRs have not been calculated on the basis of purchased rolling stock in this report. We note that if such a calculation were made it would lead to an increase in the BCRs.

4.4 Operating Costs

Rail operating costs were estimated for each of the packages. An estimate was made of the base costs for operating the West Coast Main Line, East Coast Mainline and Midland Mainline in the Do Minimum and in each of the alternatives. The difference between the alternative cost and the Reference Case cost was the figure carried forward to the appraisal.

The operating costs only included the variable elements of operating costs, as follows:

- Variable Track Access charges;
- Electricity and Diesel Fuel costs;
- Staff costs, based on £ per train set;
- Rolling Stock Lease costs;
- Capacity Charges;
- Electrification Asset usage charges;
- Insurance;
- Variable Overheads/Administration costs; and
- Rolling Stock maintenance.

As part of the current update, Atkins has undertaken a thorough review of the operating cost assumptions and updated where appropriate. As part of this review, Atkins has also liaised directly with HS2 Ltd to ensure consistency between the two studies in terms of the assumptions underpinning the operating cost estimates.

Changes to the operating cost assumptions made as part of the current study, as a result of the liaison with HS2 Ltd, are as follows:

- Electricity costs have been updated with the latest (October 2011) DECC electricity price series. Electricity costs also incorporate the cost of emissions trading allowances, which means that the cost of carbon emission is captured within the electricity cost rather than being valued separately as part of the appraisal;
- The cost of diesel was updated in line with the latest (October 2011) DECC price series. The cost of carbon was assumed to be embedded within the diesel cost as per the above, although we now understand this assumption to be incorrect. The impact of embedding the cost carbon within the diesel cost has been investigated and was not found to have a material impact on the incremental operating costs;
- Capacity charge rates and electrification asset usage charges based on Network Rail CP4 rates were introduced into the operating cost model (these costs were not previously included in the operating cost estimates);
- Rolling stock energy consumption rates for 390 Pendolinos and Class 91/Mk4 sets were changed to be based on rates provided in RSSB Report T618 'Traction Energy Metrics' rather than Network Rail CP4 rates. Energy consumption rates for Class 221 Voyagers and electric IEPs were revised following new advice from DfT;

- A revenue line to represent income from on-board sales was introduced into the operating cost model. This was assumed to be equivalent to 50% of the on-board catering staff cost, based on the assumption that if revenue was less than this amount then the service would not be provided. This assumptions was agreed with DfT and HS2;
- The cost of incremental sales assumption was removed from the operating costs;
- The operating costs are largely driven by mileage from the HS2 model. The number of days per year used to annualise the model mileage was reduced from 363 days per year to 350 days per year to be consistent with HS2. This reflects that the model represents an average weekday rather than an average day (as previously assumed);
- Driver costs were escalated at a rate of RPI+1.5% per annum up to 2037. All staff costs were assumed to increase in line with RPI beyond 2037 (consistent with HS2);
- Staff efficiency was assumed to be 57% (previously 50%) to be consistent with HS2. The number of drivers per inter-city train was reduced from 2 drivers to 1 driver;
- Lease and maintenance cost assumptions for rolling stock were confirmed by the Department for Transport.

Following discussions with DfT, it was agreed that the amount of rolling stock required to operate the services proposed by the alternatives would be calculated based on the Do Minimum fleet size pro-rated by the ratio of Strategic Alternative timetabled miles to the Do Minimum timetabled miles. Rolling stock requirements for 51M were estimated using the same approach. This represented a change in approach to estimating rolling stock requirements when compared with the previous study, where the number of sets was estimated based on hours in traffic. The current approach is, however, consistent with the approach used by HS2 Ltd. A comparison of the current rolling stock assumptions for the RP2 intercity WCML services with the equivalent rolling stock assumptions in the March 2011 Refresh is shown in Table 4.2.

Table 4.2 – Comparison of West Coast Mainline Intercity Rolling Stock Assumptions

Scenario	West Coast IC 390 Vehicles	WC IC 11 car 390 sets	WC IC 9 car 390 sets	WC 12 IC car 390 sets	Total WC IC 390 sets	WC 221/222 Vehicles	WC 5 car 221 sets	WC 10 car 222 sets	Total Mileage (WC IC 390)	Total Mileage (WC 221/222)
Do Min (March 11 Refresh)	574	35	21	-	56	100	10	5	45446	12364
Do Min (Current Update)	574	35	21	-	56	100	10	5	54992	9894
RP2 (March 11 Refresh)	858	78	-	-	78	100	-	10	68110	6777
RP2 (Current Update)	785	64	9	-	73	100	-	10	69870	6777
51M (Stokes)	662	10	-	46	56	-	-	-	-	-
51M (modelled)	755	10	9	47	66	110	-	11	60756	7803

Table 4.2 shows that for the March 11 refresh, it was estimated that 78 x 11 car 390 sets were required to operate the services proposed for RP2 on the west coast mainline. For the current refresh, it was estimated that based on Do Minimum efficiency levels, 73 x 390 sets would be required for RP2, 5 fewer than previously modelled. This would be comprised of 64 x 11 car sets and 9 x 9 car sets, the latter of which are required to operate the Birmingham to Scotland services operated by Class 221 Voyagers in the March Do Minimum.

For 51M, it was estimated that one additional 12 car 390 set would be required to achieve the same level of efficiency as the Do Minimum based on the timetabled miles, compared to the assumptions in the 51M report. As with RP2, 9 x 9 car 390 sets would be required for the Birmingham to Scotland services because of the change in assumption between the March refresh and current study.

In addition to the Inter city stock shown in table 4.2, suburban class 390 equivalents are needed. The rolling stock assumptions for the suburban 390 services for the current update are presented in Table 4.3, and the total number of required 390 sets estimated for the current update is shown in Table 4.4.

Table 4.3 – Suburban 390 Rolling Stock Assumptions

Scenario	Suburban 390 Vehicles	Suburban 11 car 390 sets	Total Mileage (Suburban 390)
RP2 (Current Update)	198	18	14,728
51M (modelled)	165	15	11,572

Table 4.4 – Total Number of Required 390 Sets

SCENARIO	WC IC 390 Sets	Suburban 390 sets	Total 390 Sets	Total 390 Mileage
RP2 (Current Update)	73	18	91	84,598
51M (modelled)	66	15	81	72,328

Table 4.4 shows that the number of Class 390 sets estimated for 51M is lower than RP2. This is because the number of sets for 51M has been estimated using the same mileage-based system as for RP2. As shown in Table 4.4, the total modelled mileage for 390 Pendolinos in the 51M scenario is approximately 15% lower than for RP2 and, as a consequence, 51M requires less rolling stock. We recognise that this may not be entirely appropriate, given that 51M's peak service pattern is similar to that of Rail Package 2. Therefore, we have carried out some sensitivity tests on the basis of 51M requiring the same amount of stock as RP2. These are presented in section 5.3.4 later in this report, and it can be seen that the VCR is very sensitive to the amount of rolling stock assumed nessesary.

Costs were estimated for three forecast years of 2026 (opening year of HS2), 2030 and 2043. This enabled the effects of real growth in driver costs and energy costs to be reflected in the annual operating cost estimates. The incremental operating costs for each of the rail packages for the three modelled years are given in 2011 prices, in the table below.

Table 4.5 – Operating Costs, where rolling stock is leased, £ millions, per annum (2011 prices)

Package	2026 (£m pa)	2030 (£m pa)	2043 (£m pa)
Package 2	270	274	270
Package 2A	270	274	270
51M	209	212	211
Scenario B	675	684	673

The element of the annual operating costs that is related to the cost of leasing rolling stock for each of the rail packages is given in the table below.

Table 4.6 – Costs of leasing rolling stock, £ millions, per annum (2011 prices)

Package	2026 (£m pa)	2030 (£m pa)	2043 (£m pa)
Package 2	100	100	100
Package 2A	100	100	100
51M	83	83	83
Scenario B	387	387	387

The costs of operations without lease costs are given in the table below.

Table 4.7 – Cost of Operations without rolling stock lease charges, £ millions, per annum (2011 prices)

Package	2026 (£m pa)	2030 (£m pa)	2043 (£m pa)
Package 2	170	174	171
Package 2A	170	174	171
51M	126	129	128
Scenario B	288	297	286

The operating costs for Rail Packages 2 and 2A are lower than previously reported. This is due to the changes to the operating cost assumptions described above to bring this update in line with HS2 Ltd's assumptions. The operating costs for 51M have been estimated to be lower than Package 2. This is because the 51M scenario runs fewer train miles than Package 2 (as shown in Table 4.2), and because of this, requires less rolling stock (for example, 7 fewer 390 sets) than Package 2. Again, this has been subject to sensitivity testing.

The incremental impact of the key assumption changes on the operating costs for RP2 has been analysed in detail, and is presented in Tables 4.8 below.

Table 4.8 – Impact of Assumption Changes on Operating Costs – RP2

Assumption Change	Incremental Cost of Package	Change in Costs	% Change in Incremental Cost of Package	% Contribution to Total Reduction in Costs
Starting point - February 11 rolling stock assumptions	£333,380,761			
Revised rolling stock assumptions (DM & DS)	£317,782,739	-£15,598,021	-4.7%	25%
Revised staff cost growth assumption (15% to 6%)	£314,640,164	-£3,142,576	-1.0%	5%
Revised electricity cost growth assumption (77% to 45%)	£304,926,104	-£9,714,060	-3.1%	15%
Add on-board revenue assumption	£295,134,808	-£9,791,296	-3.2%	15%
Remove cost of sales assumption (8%)	£273,272,970	-£21,861,838	-7.4%	35%
Change annualisation from 363 days to 350 days	£270,036,393	-£3,236,578	-1.2%	5%
Total		**-£63,344,368**	**-19%**	**100%**

Table 4.8 shows that the changes to the operating cost assumptions have had the impact of reducing the operating costs by 19% from the starting point of £333m used in the February 2011 Update.

The removal of cost of sales assumption, which was taken out to be consistent with HS2 Ltd's approach had the biggest impact, accounting for 35% of the change in operating cost. The cost of sales assumption was originally included to represent the additional costs incurred in selling tickets to the additional demand generated by the packages, for example the cost of additional ticket agents. However, current appraisal guidance does not specify that such an item should be included in operating cost estimates and following discussions with the Department and HS2 Ltd, Atkins were asked to remove the cost of sales assumption from the operating costs.

The changes to the rolling stock assumptions, which led to a reduction in the amount of rolling stock required to operate the services proposed by the alternatives accounted for 25% of the change in operating cost. The revised electricity cost growth assumptions and the addition of a revenue line for on-board sales (to be consistent with HS2 Ltd's approach) both account for 15% of the cost change respectively.

A similar exercise was undertaken for Scenario B. The results of this are given in Table 4.9 below.

Table 4.9 – Impact of Assumption Changes on Operating Costs – Scenario B

Assumption Change	Incremental Cost of Package	Change in Costs	% Change in Incremental Cost of Package	% Contribution to Total Reduction in Costs
Starting point - March 11 rolling stock assumptions	£666,603,026			
March 11 rolling stock assumptions with November 11 ECML Do Minimum rolling stock assumptions	£827,990,286		24.2%	
Revised rolling stock assumptions (WCML & MML Do Minimum & Do Something)	£812,392,265	-£15,598,021	-1.9%	10%
Revised staff cost growth assumption (15% to 6%)	£797,071,320	-£15,320,945	-1.9%	10%
Revised electricity cost growth assumption (77% to 45%)	£771,505,853	-£25,565,468	-3.2%	17%
Add on-board revenue assumption	£737,816,745	-£33,689,108	-4.4%	22%
Remove cost of sales assumption (8%)	£683,163,653	-£54,653,092	-7.4%	36%
Change annualisation from 363 days to 350 days	£675,030,421	-£8,133,231	-1.2%	5%
Total		**-£152,959,865**	**-18%**	**100%**

Table 4.9 is split into two parts. The top part shows the impact of the change to the ECML Do Minimum rolling stock assumptions in the current analysis. This assumed that Class 91/Mk 4 sets are retained on the ECML rather than being replaced with IEPs. This results in a 24% increase in operating costs when compared to the operating costs based on the February 2011 rolling stock assumptions.

The lower part of the table starts from the rebased fleet assumptions and then looks at the impact of the other assumption changes on the Scenario B operating costs. Overall, the costs fall by £153m, a reduction of 18%. As with RP2, the removal of the cost of sales assumption has the biggest impact, accounting for 36% of the change, while the inclusion of a revenue line for on-board sales accounts for 22% of the cost reduction. The changes to the rolling stock assumptions on the WCML naturally have a proportionally lower impact on Scenario B than on RP2 due to the inclusion of the MML and ECML elements in Scenario B.

5 Economic Appraisal

5.1 Overview

This section presents the results of the economic appraisal for the Strategic Alternatives, focusing on the benefits that would be generated for users and transport providers as a result of the interventions, and the costs associated with their provision. For each set of interventions, the following information is presented:

- Derivation of Scheme Costs, which describes the methodology for converting base costs into a present value of costs used in the economic appraisal;
- Derivation of Scheme Benefits, which provides a summary of the modelling packages used to assess the impact of the interventions, and the appraisal tools used to generate the present value of benefits; and
- Summary of Results, which presents summary economic statistics (PVB, PVC, NPV and BCR) for each of the Strategic Alternatives.

5.2 Derivation of Scheme Costs

5.2.1 Introduction

The costs associated with the Strategic Alternatives are described in more detail in Chapter 4 of this document. This section below highlights how these costs were converted into a present value of costs for use in the economic appraisal.

5.2.2 Capital Costs

WebTAG-based economic appraisal requires realistic and accurate scheme costs to be produced. The costs of transport schemes are an integral component of the scheme appraisal process, particularly where they are subsequently used to form decisions on scheme funding.

There are three main elements of a scheme cost estimate:

- The base cost, which is the basic cost of a scheme before allowing for risks;
- Adjustment for risk and optimism bias, which should cover all the risks that can be identified, and reflect the well-established and continuing systemic bias for estimated scheme costs and delivery times to be too low and too short respectively, and results in the risk and optimism bias-adjusted cost estimate; and
- Conversion from factor costs to market prices.

Capital infrastructure costs for the Strategic Alternatives are presented in Table 5.1. These represent undiscounted real capital costs, in 2011 prices, expressed in factor cost unit of account. The costs do not include an allowance for future inflation (capex inflation is assumed to increase in line with general prices), to be consistent with the approach of HS2 Ltd.

Table 5.1 – Undiscounted Real Scheme Capital Costs (£m, Average 2011 prices and values)

	Base Costs	Risk and Optimism Bias	Total Scheme Costs
Package 2	1,537	1,014	2,551
Package 2A	1,537	1,014	2,551
51M	1,566	1,034	2,600
Scenario B	7,493	4,946	12,439

5.2.3 Operating Costs

The assumptions underpinning the calculation of base operating costs are set out in Section 4. This section presents the operating costs included in the economic appraisal, which form part of the overall PVC for each package of rail options, summarised in Tables 5.2 below.

Note that the application of Optimism Bias was consistent with the previous Strategic Alternatives study. An Optimism Bias allowance of 41% was applied to all operating costs (with the exception of lease costs) consistent with the approach taken by HS2 Ltd. An Optimism Bias allowance of 18% was applied to lease costs as agreed with DfT.

The following information is provided in Table 5.2:

- Total undiscounted factor costs;
- Total undiscounted costs (market prices);
- Discounted operating & maintenance costs including 41% optimism bias;
- Discounted leasing costs including 18% optimism bias; and
- Total discounted operating costs including optimism bias.

Table 5.2 – Real Rail Operating Costs included in the Economic Appraisal when Rolling Stock is Assumed to be Leased (£m, 2011, over 60 year appraisal period)

	Total Undiscounted Factor Costs	Total Undiscounted Costs (Market Prices)	Discounted Operating & Maintenance Costs incl. 41% OB	Discounted Leasing Costs incl. 18% OB	Total Discounted Operating Costs
Package 2	16252	19648	4736	2305	7041
Package 2A	16252	19648	4736	2305	7041
51M	12662	15308	3538	1919	5456
Scenario B	42336	51184	7513	7738	15251

5.3 Derivation of Scheme Benefits

5.3.1 Modelling of Rail Packages

The rail packages were assessed using the PLANET framework model developed by HS2 Ltd specifically for assessing the HS2 Proposition. The HS2 models have been used to ensure consistency between the appraisal of the HS2 Scheme and the Alternatives. A common Do Minimum has also been agreed between the two studies, enabling comparisons to be undertaken on the same basis.

The approach of using HS2 Ltd's Model is consistent with the approach taken in the previous assessment of the Strategic Alternatives. In the previous assessments, however, both the Strategic Alternatives and HS2 required additional services to be added to the Do Minimum to address convergence issues in the HS2 model. Improvements to the HS2 Model this time, however, have meant that the models now converge for all the schemes assessed (including both the Strategic Alternatives and HS2). This means that HS2 and the Strategic Alternatives can be examined against exactly the same Do Minimum, thus improving the consistency of the appraisal undertaken.

Model runs were undertaken for both 2021 and 2037, and an economic appraisal undertaken consistent with the approach taken by HS2 Ltd.

5.3.2 Economic Appraisal of the Rail Packages

The economic appraisal of the Alternatives has been undertaken using a bespoke spreadsheet model, using outputs from the PLANET Strategic model in conjunction with economic parameters and formulae contained in the DfT's WebTAG Unit 3.5.6. The spreadsheet is based on conventional consumer surplus theory and is therefore consistent with the TUBA methodology recommended by DfT and used on the appraisal of rail-based packages described above.

The appraisal is based on the same 60-year appraisal period as for HS2 Ltd. For Packages 2, 2A and 51M we have assumed that the infrastructure works in the packages are completed for opening in 2026. Next generation Pendolino type trains were assumed to be in place by 2026 on the WCML.

For Scenario B, we have assumed that the works on the West Coast Main Line are undertaken for opening in 2026, with the works on the Midland Main Line and the East Coast Main Line undertaken for opening in 2033. This approach is consistent with the HS2 Ltd working assumption that if the decision is taken to proceed with a high speed rail network, the section of the proposed Y network from London to Birmingham would be open in 2026, with the remaining sections through to Manchester and Leeds opened in 2033. The total appraisal period is therefore from 2026 through to 2092.

Annualisation factors ensure that all 8,760 hours of the year are represented.

Summary economic statistics are presented in Table 5.3 for the Alternatives. The full TEE tables for each package are presented in **Appendix B**.

Table 5.3 – Economic Summary Statistics – Core Scenarios (£m, 2011 prices & values)

Economic Summary Statistic	PVB	PVC	NPV	BCR
Package 2	7,912	1,971	5,941	4.01
Package 2A	6,984	2,570	4,414	2.72
51M	6,063	1,173	4,891	5.17
Scenario B	13,740	9,742	3,998	1.41

The results in Table 5.3 show that all of the alternatives have BCRs of greater than 1, reflecting the fact that the Present Value of Benefits is higher than the Present Value of Costs.

In the case of the London to West Midlands Strategic Alternatives, all three packages 2, 2A and 51M, have BCRs of greater than two.

The relatively low capital cost of the packages means that the BCRs for the packages are extremely sensitive to the changes in assumed journey times between the major population centres. The BCR falls from 4.01 in RP2 to 2.72 in RP2A, when the only difference between the packages is that RP2A maintains the current performance allowances.

In the case of the 'Y' Network Strategic Alternative, Scenario B, the BCR is at 1.41.

The economic summary statistics for those alternatives appraised in the February 2011 study are given in Table 5.4 below.

Table 5.4 – Economic Summary Statistics – Core Scenarios – February 2011 Refresh (£m, 2009 prices & values)

Economic Summary Statistic	PVB	PVC	NPV	BCR
Package 2	5,979	4,725	1,255	1.3
Package 2A	5,218	5,258	-40	1.0
Scenario B	10,916	11,558	-642	0.9

Please note that the PVB and PVC figures are not directly comparable as the February 2011 appraisal was undertaken using a 2009 price base.

All of the BCRs are higher than in the February 2011 Update. The differences in the demand figures underlying the benefits, and the costs associated with the packages, have been discussed in detail in earlier chapters of this report. At the end of this chapter a section is included which breaks down the BCR into individual components, so allows the differences in the BCRs to be understood in more detail.

Note that these all of the results exclude Wider Impacts which are also addressed in a later section of this chapter.

5.3.2.1 Disaggregation of Rail Passenger User Benefits

User benefits for rail passengers are comprised of a number of different components. To understand how the benefits have been generated the rail user benefits for the core scenarios reported in Table 5.3 have been disaggregated and are shown in Table 5.5.

Table 5.5 – Disaggregation of Rail User Benefits (£m, 2011 prices & values)

	Package 2	Package 2A	51M	Scenario B
Journey Time Savings	2,888	1,822	3,041	6,811
Crowding Benefits	2,617	2,655	2,576	4,975
Access/Egress/ Wait Time Savings	2,544	2,531	639	2,389
Boarding Penalty Savings	92	49	85	59
Rail Plan Time Savings	-1	0	5	4
Total Rail User Benefits	**8140**	**7,057**	**6,345**	**14,238**

The benefits for Rail Package 2 are generally split equally between journey time savings, crowding benefits and access/egress/wait time savings. The journey time savings for package 2A are around a third lower than for package 2, which is to be expected, since this package retains the current performance allowances on the WCML, thus resulting in lower journey time savings. Just under half of the benefits for Scenario B arise from journey time savings, with just over a third of the benefits coming from crowding.

51M has slightly higher journey time savings compared to package 2. This is due to the inclusion of the full Stafford scheme in this scenario, which provides a journey time saving over the reduced scheme at Colwich assumed in package 2. 51M also runs fewer services in the off-peak than in packages 2 and 2A which results in lower wait time savings. Overall, the Rail Packages have higher benefits than 51M, and this is largely due to the benefits from a more frequent off-peak service.

A full breakdown of the benefits presented for the core scenarios in Table 5.3 is shown in Table 5.6.

Table 5.6 – Disaggregation of Benefits for Core Scenarios (£m, 2011 prices & values)

	Package 2	Package 2A	51M	Scenario B
Rail User Benefits	8,140	7,057	6,345	14,238
Road User Benefits	531	623	383	948
Noise	6.1	5.8	4.9	12.2
Local Air Quality	10.9	10.3	8.7	21.8
Accidents	77.2	73.2	61.6	154.0
Loss of Indirect Tax	-854	-786	-740	-1,634
Present Value of Benefits	**7,912**	**6,984**	**6,063**	**13,740**

5.3.3 Wider Economic Impacts

Wider economic benefits were not previously considered for the Strategic Alternatives. This issue was highlighted during the consultation process and has been addressed as part of the current study.

A broad assessment of Wider Impacts has been undertaken using a similar approach to that adopted for HS2. Wider Impacts have been directly calculated for Package 2 based according to WebTAG guidance, with the results then pro-rated for the other packages examined. For the other West Coast options, this was undertaken directly on the basis of the relative levels of business user benefits (as business user benefits drive Wider Impacts). For Scenario B, only half of the proportional difference implied by the change in business user benefits was applied, which is consistent with the approach taken by HS2 Ltd for the 'Y' network.

The estimated Wider Impacts are shown in Table 5.7, below.

Table 5.7 – Estimated Wider Economic Impacts (£m, 2011 prices & values, 60 year appraisal period)

Economic Summary Statistic	Agglomeration	Labour Market Effects	Imperfect Competition	Total
Package 2	810	16	442	1,268
Package 2A	650	13	355	1,018
51M	667	13	364	1,044
Scenario B	1,227	25	671	1,923

Table 5.7 shows that all of the Alternatives generate wider economic benefits. Approximately two-thirds of the benefits are attributable to agglomeration effects. Benefits associated with effects on the labour market comprise a very small proportion of the total wider benefits. The effect of the Wider Impacts on the BCRs is shown in Table 5.8.

Table 5.8 – Effect of Wider Impacts on BCRs

	BCR Excluding WIs	BCR Including WIs
Package 2	4.01	4.66
Package 2A	2.72	3.11
51M	5.17	6.06
Scenario B	1.41	1.61

Table 5.7 shows that incorporating the Wider Impacts into the BCRs increases the BCR for Package 2 to 4.7, while the BCR for Package 2A increases to over 3. The BCR for Scenario B increases to 1.61.

5.3.4 Cost Sensitivity Tests

Network Rail's review indicated a number of risks in relation to the cost estimates developed for these schemes. These included in particular concerns around the potential scale of works required at Euston, the possibility of significant works being required at rolling stock depots (or potentially of new depot facilities), and the impacts of a highly intensive service pattern on the overall costs of maintaining the network. Network Rail was not able to provide detailed alternative cost estimates in relation to these risks, but noted that the cost impacts could be significant. Therefore, we have carried out sensitivity tests to assess the impacts of additional costs of £250m, £500m and £750m on each of the scenarios considered. Note that in their review of the Strategic Alternatives, Network Rail considered that the allowance of 10% of the construction cost for disruption was understated and that an allowance of 18% may be more appropriate. The £250m additional capex test can be thought of as giving a rough indication as to the impact of disruption costs being of this order for Rail Package 2.

The results are presented in Table 5.9.

Table 5.9 – Effect of Capital Cost Increases on BCRs

Economic Summary Statistic	Current BCRs	Additional £250m CAPEX	Additional £500m CAPEX	Additional £750m CAPEX
Package 2	4.01	3.63	3.31	3.04
Package 2A	2.72	2.51	2.34	2.18
51M	5.17	4.39	3.81	3.37
Scenario B	1.41	1.38	1.35	1.33

We have also looked at a scenario where the assumed operational efficiency improvements turn out to be unachievable and the results are presented in Table 5.10 below. As this is not fully consistent with the base it should only be regarded as indicative, but it illustrates that the BCRs are highly sensitive to changes in operating cost assumptions. If additional work is undertaken on the Strategic Alternatives then this would warrant further attention.

The following rolling stock scenarios have been considered:

- Scenario 1: 51M with the same rolling stock assumptions as the central RP2 case (91 Class 390 Pendolinos); and
- Scenario 2: RP2, RP2A, Scenario B and 51M with a 10% increase in Class 390 Pendolinos over that assumed for the RP2 central case.

The results are shown in Table 5.10.

Table 5.10 – Effect of Rolling Stock Changes on BCRs

Economic Summary Statistic	Current BCRs	Rolling Stock Scenario 1	Rolling Stock Scenario 2
Package 2	4.01	N/A	2.57
Package 2A	2.72	N/A	1.90
51M	5.17	2.45	1.61
Scenario B	1.41	N/A	1.26

5.3.5 Change in BCRs from March 11 Refresh

The BCRs for the Strategic Alternatives examined in the current update have changed since the February 2011 Refresh work. There are a number of reasons for the changes in the BCRs, with all component elements being refreshed.

On the benefits side, the HS2 Ltd model has been completely updated since the previous analysis of the Strategic Alternatives. In particular, this now takes into account the major growth in rail trips associated with the implementation of the WCRM Programme. The alternatives have also now been assessed against the same Do Minimum as the HS2 scheme. As noted earlier in the report, in the previous studies additional capacity was included in the Do Minimum to assist with model convergence. This means that the increment between the test specification and the Do Minimum is greater than previously, hence the scheme results in more benefits.

On the costs side, changes to infrastructure assumptions have led to a significant reduction in the capital costs of the Alternatives. Additionally, changes to the assumptions underpinning the operating cost models, have led to a reduction in operating costs compared to the previous analysis. Key in this is the removal of the Cost of Sales element previously incorporated into the operating costs, and the assumption of a more efficient Do Minimum operating pattern.

The change in the BCR as a result of the changes in the elements described above is illustrated in the table below for RP2. The changes to the individual component elements have been considered in isolation, to demonstrate the impact that each element has on the BCR compared to the February test.

Table 5.11 – Changes to the BCR of Rail Package 2

	BCR
February 11 Refresh Test	1.27
February 11 Model with January 12 Capex & February 11 Operating Costs	1.57
February 11 Model with February 11 Capex & January 12 Operating Costs	1.91
January 12 Model with February 11 Capex and February 11 Opex	1.81
New Model with January 12 Revised Capex & Operating Costs	4.01

Table 5.11 shows that when considered in isolation, each of the changes to the individual component elements produces a higher BCR when compared to the February 2011 Refresh BCR, which shows that the increase in BCR is not being driven by one element alone. Furthermore, the scale of each of the changes is similar, with the major increase in the BCR being due to the cumulative impact of all three elements together. Examination of RP2A would show a broadly similar pattern to that for RP2. Table 5.11 shows the following:

- The change in capital costs due to removal of Manchester interventions and the replacement of the full Stafford scheme with the lower-cost scheme at Colwich increases the February 2011 Refresh BCR from 1.27 to 1.57;
- The reduced operating cost in the current update increases the February 2011 Refresh BCR from 1.27 to 1.91. The higher BCR is driven by a reduction in PVC of the order of £2bn compared to the February 2011 work;
- The combination of the old costs from the February 2011 Refresh with the new benefits and revenues from the current model increases the BCR from 1.27 to 1.81. This change is mainly driven by higher revenues from the new model, which produces a lower PVC compared to the February 2011 Refresh test BCR; and,
- For the new model test with both the revised capital and operating costs, the combination of reduced costs with higher revenues produces a substantially lower PVC compared to the February 11 refresh test (of the order of £3.5bn). Combined with higher user benefits, this produces a BCR of 4.

6 Summary and Conclusions

6.1 Introduction

In this report, a number of the Strategic Alternatives to the HS2 Proposition have been updated, to take into account the findings of the HS2 Consultation process.

The report has concentrated on the most promising Strategic Alternatives, in terms of the Business Case, from the previous elements of work, plus an alternative put forward following the HS2 Consultation process. The Strategic Alternatives examined are as follows:

- London to West Midlands Strategic Alternatives RP2, and RP2A;
- The London to West Midlands Strategic Alternative proposed by the 51M grouping, known in this document as 51M. and
- The 'Y' Network Strategic Alternative, known as Scenario B.

The findings of this update are summarised in the remainder of this section, grouped by London to West Midlands and 'Y' Network alternatives.

6.2 London to West Midlands Strategic Alternatives

The London to West Midlands Strategic Alternatives, Rail Packages 2, 2A and the 51M alternative which arose from the Consultation process, show that with infrastructure investment (in the region of £2.6 billion) the capacity of longer distance services on the West Coast Main Line could potentially be enhanced. Subject to further engineering and capacity modelling, it could be possible to operate up to an additional five trains per hour (tph) in a standard off-peak hour, resulting in a total of 16 tph into/out of Euston.

All of the packages could have an impact on journey times. The maximum journey time savings are provided in Rail Package 2, as this removes the performance allowances currently incorporated into the WCML timetable to ensure punctuality. In RP2, journey times to Manchester are forecast to decrease by approximately 5 minutes. Journey times to Birmingham are forecast to decrease by approximately 12 minutes although the savings to Birmingham are primarily achieved as a result of serving fewer intermediate stations.

The relatively low cost of these schemes compared to the benefits means that the BCRs are extremely sensitive to slight changes in some of the component elements, as witnessed by the drop in the BCR with the retention of the performance allowances in RP2A and the impact of changes in rolling stock efficiency assumptions.

Whilst all of the schemes achieve a high BCR there are issues around them. All of the packages will result in significant disruption to the existing rail network during construction, which will have a negative impact on passengers.

If any of these packages are to be progressed, further, more detailed work would be required to confirm that they are fit for purpose including a detailed timetabling, and subsequent train diagramming exercise. Such an exercise would ensure that the timings proposed can be achieved, and that there is the correct level of rolling stock to operate the timetable proposed.

In the case of RP2 and RP2A, a detailed timetabling exercise was undertaken in the original study, but there have been significant changes in the Do Minimum timetable in the intervening time period, so there is the need to ensure that the timings are still valid. In the case of 51M, a detailed timetabling exercise has not been undertaken as far as we are aware, so the timings proposed would need to be validated. Included in the train diagramming study is the need to examine depot capacity.

6.3 'Y Network' Strategic Alternatives

The BCR for Scenario B is 1.41. This represents a change on the previous update, where it had a BCR of 0.9. If wider benefits are included in the BCR for the current work, the BCR increases to 1.61.

Less detailed work has been undertaken on those aspects of Scenario B which do not involve the WCML and Atkins would recommend that Scenario B should be subject to more detailed work if a 'Y' Network alternative is to be progressed.

Appendix A

Summary of Capital Costs

Rail Package 2/2A

Package	Scheme Name	Cost (£ Billions)
Package 2	Colwich	£ 0.522
Package 2	Cheddington / Leighton Buzzard Grade Separated Jct	£ 0.253
Package 2	Works at Euston Station	£ 0.065
Package 2	Attleborough to Brinklow	£ 0.195
Package 2	Northampton Line Speed Improvements	£ 0.003
Package 2	Beechwood / Stechford 4 Track	£ 0.943
	Sub-Total Package 2 Cost (£Billions)	**£ 1.982**
Extras:		
Power +10% of total package cost (inc OB)		£ 0.20
Other WCML locations +10% (inc OB) cost		£ 0.20
Disruption +10% of costs (excluding OB) cost		£ 0.09
Carlisle to Scotland works (£49m plus OB at 66%)		£ 0.08
	Total Cost Package Two (£Billions, Av 2011 Prices)	**£ 2.551**

51M

Package	Scheme Name	Cost (£ Billions)
51M	Stafford Area Bypass	£ 1.285
51M	Cheddington / Leighton Buzzard Grade Separated Junction	£ 0.253
51M	Attleborough to Brinklow	£ 0.195
51M	Northampton Line Speed Improvements	£ 0.003
51M	Additional Network Rail Costs for Infrastructure Enhancement	£ 0.360
	Sub-Total 51M Cost (£Billions)	**£ 2.097**
Extras:		
Power supply + disruption + other items (+24%)		£ 0.503
	Total Cost 51M (£Billions, Av 2011 Prices)	**£ 2.600**

Scenario B – WCML Interventions

Package	Scheme Name	Cost (£ Billions)
Package 2	Colwich	£ 0.522
Package 2	Cheddington / Leighton Buzzard Grade Separated Jct	£ 0.253
Package 2	Works at Euston Station	£ 0.065
Package 2	Attleborough to Brinklow	£ 0.195
Package 2	Northampton Line Speed Improvements	£ 0.003
Package 2	Beechwood / Stechford 4 Track	£ 0.943
	Sub-Total Package 2 Cost (£Billions)	**£ 1.982**
Extras:		
Power +10% of total package cost (inc OB)		£ 0.20
Other WCML locations +10% (inc OB) cost		£ 0.20
Disruption +10% of costs (excluding OB) cost		£ 0.09
Carlisle to Scotland works (£49m plus OB at 66%)		£ 0.08
	Total Cost Package Two (£Billions, Av 2011 Prices)	**£ 2.551**

Scenario B – ECML Interventions

Package	Scheme Name	Cost (£Billions)
B1	Kings Cross – Platform Lengthening, Throat Remodelling, Tunnel Works and New Tracks	£ 0.409
B2	Digswell to Woolmer Green – 4 Tracking	£ 0.440
B3	Huntingdon to Peterborough – 4 Tracking	£ 0.376
B4	Peterborough – Remodelling, Werrington Flyover	£ 0.249
B5	Stoke Jcn – Doncaster – 4 Tracking	£ 1.460
B6	Newark Flyover	£ 0.191
B7	Retford – Signalling and Track Works	£ 0.009
B8	Retford to Sheffield – Electrification, Route Upgrade	£ 0.639
B9	Doncaster – New Platform and Track Works	£ 0.048
B10	Hambledon Jcn to Leeds – Electrification and Track Works	£ 0.244
B11	Leeds – Platform Remodelling and Track Works	£ 0.071
B12	York – Remodelling, Skelton Bridge fFlyover	£ 0.365
B13	Darlington – Signalling and Track Works	£ 0.027
B14	Darlington to Newcastle – Reinstate and Electrify Leamside Line	£ 0.807
B15	Depots & Stabling Modifications	£ 0.015
	Sub Total Package B ECML Cost (£Billions)	**£ 5.352**
Extras:		
Power Enhancement+10% of total package cost (inc OB)		£ 0.535
Other ECML locations +10% (inc OB) cost		£ 0.535
Disruption +10% of costs (excluding OB) cost		£ 0.323
	Total Cost Package B ECML (£Billions, Av 2011 Prices)	**£ 6.745**

Scenario B – MML Interventions

Package	Scheme Name	Cost (£ Billions)
B1	Power supply feeders	£ 0.165
B2	Bedford to Sheffield Electrification	£ 1.398
B4	London to Bedford - Freight Loop	£ 0.012
B6	Bedford to Kettering (Sharnbrook Jcn to Desborough Summit) - Four Tracking	£ 0.597
B7	Kettering Nth Jcn to Corby - Twin Tracking	£ 0.240
B8	Kettering - Platform Lengthening	£ 0.022
B10	Wellingborough - Platform Reinstatement	£ 0.031
B12	Leicester - Four Tracking and Remodelling	£ 0.214
B13	Depots & Stabling Modifications	£ 0.030
	Sub-Total Package B MML Cost (£Billions)	**£ 2.710**
Extras:		
Other MML locations +10% (inc OB) cost		£ 0.271
Disruption +10% of costs (excluding OB) cost		£ 0.163
	Total Cost Package B MML (£Billions, Av 2011 Prices)	**£ 3.143**

Appendix B

TEE Tables

Rail Package 2 – Central Case

	ALL MODES TOTAL		ROAD	RAIL
Consumers				
User Benefits				
Travel Time	4334		134	4200
Vehicle Operating Costs	98		98	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	4432	(1)	232	4200
Business				
User Benefits				
Travel Time	4238		297	3941
Vehicle Operating Costs	2		2	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	4240	(2)	299	3941
Private Sector Provider Impacts				
Revenue	7113		0	7113
Operating Costs	-7041		0	-7041
Investment Costs	-2043		0	-2043
Grant/Subsidy	9084		0	9084
Revenue Transfer	-7113		0	-7113
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	4240	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	8672	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

	ALL MODES TOTAL		ROAD	RAIL
Local Government Funding				
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	7041		0	7,041
Investment Costs	2043		0	2,043
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-7113		0	-7113
NET IMPACT	1971	*(8)*	0	9,084
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-854	*(9)*	0	-854
TOTALS				
Broad Transport Budget	1971	*(10) = (7) + (8)*		
Wider Public Finances	-854	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	6	*(12)*
Local Air Quality	11	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	77	*(16)*
Economic Efficiency: Consumer Users	4432	*(1)*
Economic Efficiency: Business Users and Providers	4240	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	854	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	7912	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	1971	*(10)*
Present Value of Costs (see notes) (PVC)	1971	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	5941	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	4.01	BCR=PVB/PVC

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

Rail Package 2A – Central Case

	ALL MODES TOTAL		ROAD	RAIL
Consumers				
User Benefits				
Travel Time	4062		157	3904
Vehicle Operating Costs	90		90	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	4151	(1)	247	3904
Business				
User Benefits				
Travel Time	3528		375	3153
Vehicle Operating Costs	1		1	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	3529	(2)	376	3153
Private Sector Provider Impacts				
Revenue	6514		0	6514
Operating Costs	-7041		0	-7041
Investment Costs	-2043		0	-2043
Grant/Subsidy	9084		0	9084
Revenue Transfer	-6514		0	-6514
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	3529	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	7680	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

	ALL MODES TOTAL		ROAD	RAIL
Local Government Funding				
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	7041		0	7,041
Investment Costs	2043		0	2,043
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-6514		0	-6514
NET IMPACT	2570	*(8)*	0	9,084
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-786	*(9)*	0	-786
TOTALS				
Broad Transport Budget	2570	*(10) = (7) + (8)*		
Wider Public Finances	-786	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	6	*(12)*
Local Air Quality	10	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	73	*(16)*
Economic Efficiency: Consumer Users	4151	*(1)*
Economic Efficiency: Business Users and Providers	3529	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	786	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	6984	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	2570	*(10)*
Present Value of Costs (see notes) (PVC)	2570	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	4414	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.72	BCR=PVB/PVC

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

51M – Central Case

	ALL MODES TOTAL		ROAD	RAIL
Consumers				
User Benefits				
Travel Time	3195		88	3106
Vehicle Operating Costs	83		83	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	3278	(1)	171	3106
Business				
User Benefits				
Travel Time	3448		209	3239
Vehicle Operating Costs	3		3	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	3451	(2)	212	3239
Private Sector Provider Impacts				
Revenue	6366		0	6366
Operating Costs	-5456		0	-5456
Investment Costs	-2083		0	-2083
Grant/Subsidy	7539		0	7539
Revenue Transfer	-6366		0	-6366
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	3451	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	6729	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

	ALL MODES TOTAL		ROAD	RAIL
Local Government Funding				
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	5456		0	5,456
Investment Costs	2083		0	2,083
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-6366		0	-6366
NET IMPACT	1173	*(8)*	0	7,539
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-740	*(9)*	0	-740
TOTALS				
Broad Transport Budget	1173	*(10) = (7) + (8)*		
Wider Public Finances	-740	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	5	*(12)*
Local Air Quality	9	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	62	*(16)*
Economic Efficiency: Consumer Users	3278	*(1)*
Economic Efficiency: Business Users and Providers	3451	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	740	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	6063	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	1173	*(10)*
Present Value of Costs (see notes) (PVC)	1173	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	4891	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	5.17	BCR=PVB/PVC

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

Scenario B – Central Case

Consumers	ALL MODES TOTAL		ROAD	RAIL
User Benefits				
Travel Time	6603		232	6371
Vehicle Operating Costs	177		177	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	6780	(1)	409	6371
Business				
User Benefits				
Travel Time	8402		535	7867
Vehicle Operating Costs	4		4	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	8406	(2)	539	7867
Private Sector Provider Impacts				
Revenue	13778		0	13778
Operating Costs	-15251		0	-15251
Investment Costs	-8269		0	-8269
Grant/Subsidy	23520		0	23520
Revenue Transfer	-13778		0	-13778
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	8406	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	15186	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

	ALL MODES TOTAL		ROAD	RAIL
Local Government Funding				
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	15251		0	15,251
Investment Costs	8269		0	8,269
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-13778		0	-13778
NET IMPACT	9742	*(8)*	0	23,520
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-1634	*(9)*	0	-1634
TOTALS				
Broad Transport Budget	9742	*(10) = (7) + (8)*		
Wider Public Finances	-1634	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	12	*(12)*
Local Air Quality	22	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	154	*(16)*
Economic Efficiency: Consumer Users	6780	*(1)*
Economic Efficiency: Business Users and Providers	8406	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	1634	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	13740	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	9742	*(10)*
Present Value of Costs (see notes) (PVC)	9742	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	3998	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.41	BCR=PVB/PVC

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

Rolling Stock Scenario 1 – 51M

Consumers	ALL MODES TOTAL		ROAD	RAIL
User Benefits				
Travel Time	3195		88	3106
Vehicle Operating Costs	83		83	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	3278	(1)	171	3106
Business				
User Benefits				
Travel Time	3448		209	3239
Vehicle Operating Costs	3		3	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	3451	(2)	212	3239
Private Sector Provider Impacts				
Revenue	6366		0	6366
Operating Costs	-6759		0	-6759
Investment Costs	-2083		0	-2083
Grant/Subsidy	8842		0	8842
Revenue Transfer	-6366		0	-6366
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	3451	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	6729	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

Local Government Funding	ALL MODES TOTAL		ROAD	RAIL
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	6759		0	6,759
Investment Costs	2083		0	2,083
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-6366		0	-6366
NET IMPACT	2476	*(8)*	0	8,842
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-740	*(9)*	0	-740
TOTALS				
Broad Transport Budget	2476	*(10) = (7) + (8)*		
Wider Public Finances	-740	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	5	*(12)*
Local Air Quality	9	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	62	*(16)*
Economic Efficiency: Consumer Users	3278	*(1)*
Economic Efficiency: Business Users and Providers	3451	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	740	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	6063	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	2476	*(10)*
Present Value of Costs (see notes) (PVC)	2476	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	3588	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.45	BCR=PVB/PVC

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

Rolling Stock Scenario 2 – RP2

	ALL MODES TOTAL		ROAD	RAIL
Consumers				
User Benefits				
Travel Time	4334		134	4200
Vehicle Operating Costs	98		98	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	4432	(1)	232	4200
Business				
User Benefits				
Travel Time	4238		297	3941
Vehicle Operating Costs	2		2	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	4240	(2)	299	3941
Private Sector Provider Impacts				
Revenue	7113		0	7113
Operating Costs	-8154		0	-8154
Investment Costs	-2043		0	-2043
Grant/Subsidy	10197		0	10197
Revenue Transfer	-7113		0	-7113
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	4240	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	8672	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

	ALL MODES TOTAL		ROAD	RAIL
Local Government Funding				
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	8154		0	8,154
Investment Costs	2043		0	2,043
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-7113		0	-7113
NET IMPACT	3084	*(8)*	0	10,197
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-854	*(9)*	0	-854
TOTALS				
Broad Transport Budget	3084	*(10) = (7) + (8)*		
Wider Public Finances	-854	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	6	*(12)*
Local Air Quality	11	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	77	*(16)*
Economic Efficiency: Consumer Users	4432	*(1)*
Economic Efficiency: Business Users and Providers	4240	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	854	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	7912	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	3084	*(10)*
Present Value of Costs (see notes) (PVC)	3084	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	4828	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.57	BCR=PVB/PVC

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

Rolling Stock Scenario 2 – RP2A

	ALL MODES TOTAL		ROAD	RAIL
Consumers				
User Benefits				
Travel Time	4062		157	3904
Vehicle Operating Costs	90		90	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	4151	(1)	247	3904
Business				
User Benefits				
Travel Time	3528		375	3153
Vehicle Operating Costs	1		1	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	3529	(2)	376	3153
Private Sector Provider Impacts				
Revenue	6514		0	6514
Operating Costs	-8154		0	-8154
Investment Costs	-2043		0	-2043
Grant/Subsidy	10197		0	10197
Revenue Transfer	-6514		0	-6514
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	3529	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	7680	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

	ALL MODES TOTAL		ROAD	RAIL
Local Government Funding				
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	8154		0	8,154
Investment Costs	2043		0	2,043
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-6514		0	-6514
NET IMPACT	3683	*(8)*	0	10,197
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-786	*(9)*	0	-786
TOTALS				
Broad Transport Budget	3683	*(10) = (7) + (8)*		
Wider Public Finances	-786	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	6	*(12)*
Local Air Quality	10	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	73	*(16)*
Economic Efficiency: Consumer Users	4151	*(1)*
Economic Efficiency: Business Users and Providers	3529	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	786	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	6984	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	3683	*(10)*
Present Value of Costs (see notes) (PVC)	3683	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	3301	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.90	BCR=PVB/PVC

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

Rolling Stock Scenario 2 – 51M

	ALL MODES TOTAL		ROAD	RAIL
Consumers				
User Benefits				
Travel Time	3195		88	3106
Vehicle Operating Costs	83		83	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	3278	(1)	171	3106
Business				
User Benefits				
Travel Time	3448		209	3239
Vehicle Operating Costs	3		3	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	3451	(2)	212	3239
Private Sector Provider Impacts				
Revenue	6366		0	6366
Operating Costs	-8060		0	-8060
Investment Costs	-2083		0	-2083
Grant/Subsidy	10143		0	10143
Revenue Transfer	-6366		0	-6366
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	3451	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	6729	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

	ALL MODES TOTAL		ROAD	RAIL
Local Government Funding				
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	8060		0	8,060
Investment Costs	2083		0	2,083
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-6366		0	-6366
NET IMPACT	3777	*(8)*	0	10,143
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-740	*(9)*	0	-740
TOTALS				
Broad Transport Budget	3777	*(10) = (7) + (8)*		
Wider Public Finances	-740	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	5	*(12)*
Local Air Quality	9	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	62	*(16)*
Economic Efficiency: Consumer Users	3278	*(1)*
Economic Efficiency: Business Users and Providers	3451	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	740	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	6063	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	3777	*(10)*
Present Value of Costs (see notes) (PVC)	3777	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	2287	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.61	BCR=PVB/PVC

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

Rolling Stock Scenario 2 – Scenario B

	ALL MODES TOTAL		ROAD	RAIL
Consumers				
User Benefits				
Travel Time	6603		232	6371
Vehicle Operating Costs	177		177	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
NET CONSUMER BENEFITS	6780	(1)	409	6371
Business				
User Benefits				
Travel Time	8402		535	7867
Vehicle Operating Costs	4		4	0
User Charges	0		0	0
During Construction & Maintenance	0		0	0
Subtotal	8406	(2)	539	7867
Private Sector Provider Impacts				
Revenue	13778		0	13778
Operating Costs	-16407		0	-16407
Investment Costs	-8269		0	-8269
Grant/Subsidy	24676		0	24676
Revenue Transfer	-13778		0	-13778
Subtotal	0	(3)	0	0
Other Business Impacts				
Developer Contributions	0	(4)	0	0
NET BUSINESS IMPACT	8406	(5) = (2) + (3) + (4)		
TOTAL				
Present Value of Transport Economic Efficiency Benefits	15186	(6) = (1) + (5)		

Notes: **Benefits** appear as **positive** numbers, while **costs** appear as **negative** numbers

Table 2: Public Accounts

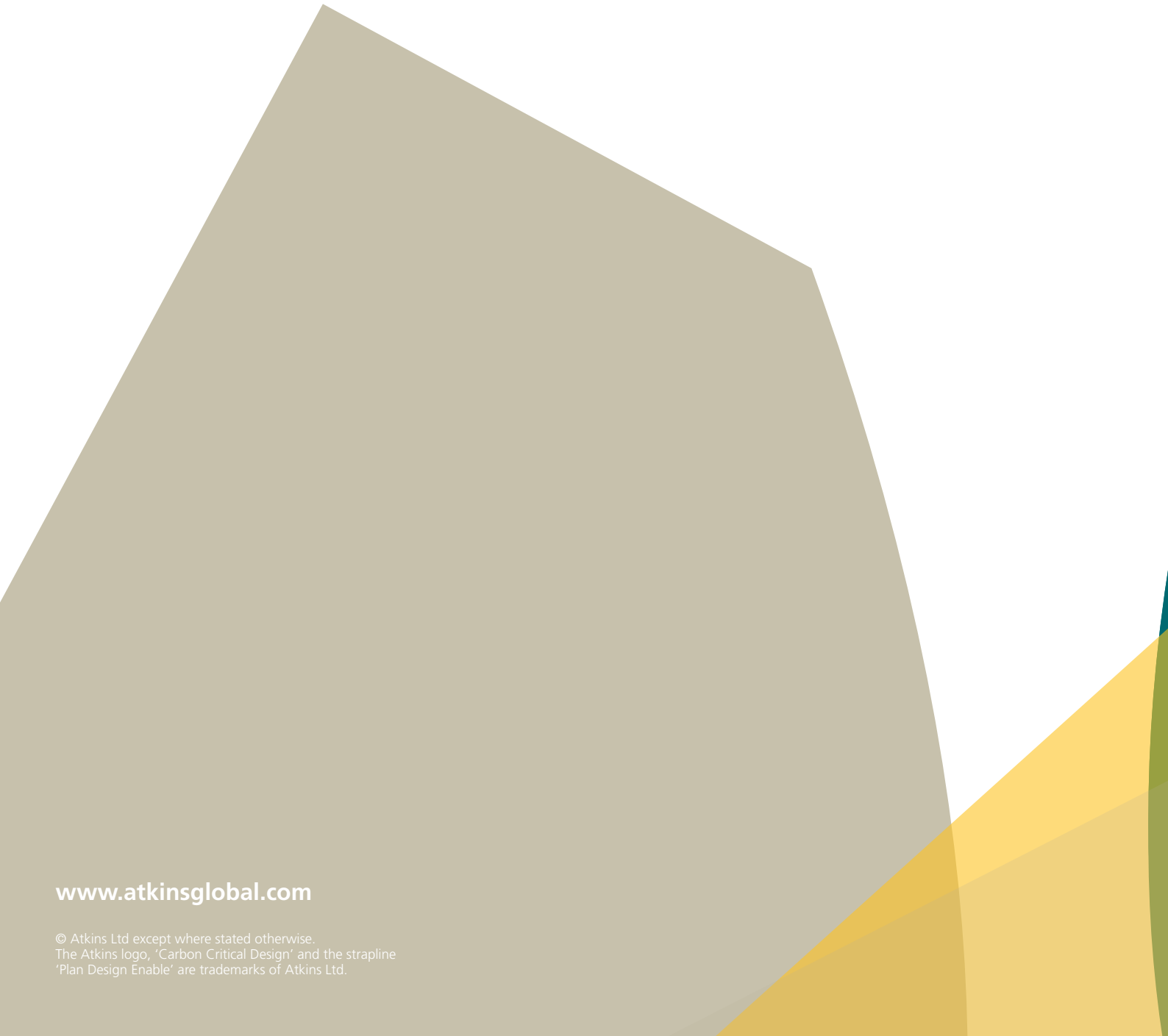
	ALL MODES TOTAL		ROAD	RAIL
Local Government Funding				
Revenue	0		0	0
Operating Costs	0		0	0
Investment Costs	0		0	0
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
NET IMPACT	0	*(7)*	0	0
Central Government Funding: Transport				
Revenue	0		0	0
Operating costs	16407		0	16,407
Investment Costs	8269		0	8,269
Developer and Other Contributions	0		0	0
Grant/Subsidy Payments	0		0	0
Revenue Transfer	-13778		0	-13778
NET IMPACT	10898	*(8)*	0	24,676
Central Government Funding: Non-Transport				
Indirect Tax Revenues	-1634	*(9)*	0	-1634
TOTALS				
Broad Transport Budget	10898	*(10) = (7) + (8)*		
Wider Public Finances	-1634	*(11) = (9)*		

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2002 prices and values.

Table 3: Analysis of Monetised Costs and Benefits

Noise	12	*(12)*
Local Air Quality	22	*(13)*
Greenhouse Gases	0	*(14)*
Journey Ambience	0	*(15)*
Accidents	154	*(16)*
Economic Efficiency: Consumer Users	6780	*(1)*
Economic Efficiency: Business Users and Providers	8406	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	1634	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Option Values	0	*(17)*
Present Value of Benefits (see notes) (PVB)	13740	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1) + (5) + (17) - (11)*
Broad Transport Budget	10898	*(10)*
Present Value of Costs (see notes) (PVC)	10898	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	2842	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.26	BCR=PVB/PVC

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



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