## Greater Bristol Strategic Transport Study

### Final Report

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Executive Summary

Background to the Study

The Greater Bristol Strategic Transport Study (GBSTS), undertaken by the consultant team led by Atkins, developed a series of transport strategies for the Greater Bristol sub-region covering the period to 2031, with intermediate years of 2011, 2016 and 2021. This report outlines the development and appraisal of the transport strategies.

GBSTS has its origins in the London to South West and South Wales Multi-Modal Study (SWARMMS) which explored the needs to 2016 of the main east-west transport corridors between London/South East and the South West. Within SWARMMS, insufficient time was available to deal in detail with the complex issues of the Greater Bristol sub-region. GBSTS followed on from SWARMMS, with the objective of fulfilling this requirement, building and drawing on the work undertaken by SWARMMS, but not constrained by it.

The principal partners for the study included:

♦ Department for Transport/Government Office for the South West;
♦ South West Regional Development Agency;
♦ Highways Agency;
♦ Bath & North East Somerset Council;
♦ Bristol City Council;
♦ North Somerset Council; and
♦ South Gloucestershire Council.

The study has been guided by a Key Stakeholder Advisory Group (KSAG) drawn from representative organisations with an interest in transport planning and operations in the study area. In addition to the study partners listed above, the KSAG included:

♦ South West Regional Assembly;
♦ Business West;
♦ Joint Strategic Planning and Transportation Unit;
♦ Strategic Rail Authority (until June 2005); and
♦ Sustainability South West.

In brief specified that GBSTS should:

♦ develop a series of integrated multi-modal transport strategies over time (detailed strategies for 2011 and 2016 and broader, high level, strategies for 2021 and 2031) for the study area identifying, analysing and appraising solutions on the national strategic transport networks, on the local strategic transport networks and at the interface between them, so as to improve strategic transport movements into, out of and through the study area;
♦ develop transport strategies that support existing economic activity, continue sustainable development and assist economic regeneration of urban areas and the wider process of urban renewal within the study area; and
♦ reduce the impact of transport on the environment.

Furthermore, in developing and appraising the strategies, the study was required to ‘make focused and realistic recommendations on transport policy and infrastructure provision across all modes and networks, focusing on the period to 2016 and taking full account of potential funding and deliverability constraints’. Hence, the strategies that are developed need to be both affordable and implementable.

**Growth in the Demand for Travel**

The development of the GBSTS transport strategy up to 2031 was based on significantly increased demand for travel, of which a key factor was the projected growth in population and employment within the Greater Bristol area, with the associated rise in freight movements. Working with the West of England Partnership, GBSTS prepared travel forecasts for 2031 based on 138,000 extra dwellings in the study area, equivalent to population growth of 245,000 from the existing 990,000. For employment, the forecast increase was 95,000 jobs in addition to the current workforce of about 500,000.

The additional dwellings were split between 78,000 on brownfield sites in existing built-up areas and 60,000 on greenfield sites formed by extensions to the principal urban areas, particularly Bristol and Weston-super-Mare. Further travel would be generated by growth in activity at BIA with air passenger numbers rising from the current 4 mppa to 12 mppa by 2031 with an associated increase in employee levels.

The growth in travel demand resulting from the increased population and employment would be significant. However, the growth is constrained by the limited capacity on the transport system which results in the suppression of some journeys. Nevertheless, even with some suppression, the additional demand creates severe problems for the operation of the transport network. By 2031, the study forecast a 34% rise in the number of vehicle trips on the road system in the morning peak but the limited capacity results in a 35% drop in average speeds from 44 km/hour to 28 km/hour and an increase in delay of 230%, indicating a large-scale growth in congestion. The rise in traffic occurs particularly on the motorway network, with a further 3000 passenger car units in the peak between 2003 and 2031 across the M5 Avonmouth Bridge and between Junctions 19 and 20 of the M4. Bus operators experience the impact of increased congestion on the road network with bus speeds dropping between 20% and 40%. Consequently the car mode share rises from 88.8% in 2003 to 90.8% in 2031. The decline in bus use is offset to a limited extent by an increase in rail patronage, although the restricted coverage and capacity on the rail system constrains the growth in passenger levels with a significant rise in crowding on trains.
The series of transport measures designed to cater for and accommodate the projected growth in demand for travel are outlined below and summarised on the attached diagram. The measures are considered in the following sequence which reflects the strategy development and appraisal process:

♦ encouraging the use of alternative modes;
♦ management of travel demand;
♦ public transport improvements; and
♦ highway measures.

**Measures to Encourage the Use of Other Modes**

Before embarking on measures that are potentially costly in resources or finance, in developing the transport strategy it was important to explore measures which are designed to influence the decision to make a journey to a particular destination or to encourage the use of alternative modes.

The transport strategy has been prepared against a background of significant developments in population and employment. The design and implementation of the new developments should be planned so as to reduce the total volume of travel and encourage the use of alternative modes to the car. Such policies should include the concentration of developments within transport corridors easily served by public transport; the creation of a mix of developments so that more activities are easily reached by walking or cycling; and an increase in the density of development such that there is a choice of facilities within a reasonable distance. Furthermore, the design of developments (especially major residential schemes), should pay particular attention to their operation in the most sustainable way.

Although detailed schemes to enhance walking and cycling are outside the scope of a strategic study like GBSTS, there are nevertheless benefits to be achieved from providing attractive schemes and facilities to encourage greater levels of these activities. At the same time, other policies, such as demand management or ‘Smarter Choices’ will encourage the use of alternative modes in general and hence will stimulate walking and cycling, if the supplementary measures are in place.

The expansion of initiatives under the heading of ‘Smarter Choices’ can have a positive impact on the overall volume of travel and the level of car use. Some of the policies contained in ‘Smarter Choices’ are within the responsibility of the public sector including workplace travel plans, school travel plans, car sharing schemes and car clubs. The unitary authorities within the Greater Bristol area already actively pursue these measures, and it is vital that renewed and enhanced efforts are made to expand their coverage. This will require a continuous application of resources to maintain the impetus and continue the level of benefits. The impact of ‘Smarter Choices’ would be strengthened and supported by other policy measures such as demand management which would provide further encouragement for the use of alternative modes. It is estimated that a comprehensive policy of ‘Smarter Choices’ combined with other complementary measures could reduce person trips in the study area by car by around 10%. Other elements of ‘Smarter Choices’ could include tele-working, tele-conferencing and home shopping; while these features would contribute to the use of alternative modes, much of the initiative behind them would come from market forces,
with the savings and benefits obtained by the private sector. Hence, because they are generally outside the control or influence of local authorities, their promotion is not included in the GBSTS transport strategy.

It will be important to develop the full potential of the range of approaches to encourage alternative modes before embarking on major infrastructure developments. However, there needs to be awareness that continued promotion of the measures is necessary if the full impact is to be achieved and maintained and therefore resources must continue to be allocated to ‘Smarter Choices’ in the future.

**Demand Management**

Within the transport strategy, it is important to include measures designed to control or manage the level of demand for travel by car across the study area. A number of measures to manage demand are available for implementation now and concentrate on varying the availability and cost of parking. The policies need to be adjusted and refined in order to reflect the growth in car traffic, by increasing charges, controlling the number and availability of spaces, raising enforcement, introducing controlled parking zones, exploring ways of controlling parking at Cribbs Causeway and introducing stringent parking standards. The expansion and variation of parking policy measures also need to take into account the potential impact on economic activity, especially within city and neighbourhood centres, in order to ensure that the prosperity of the centres is maintained.

The range of additional policy instruments to manage traffic demand includes workplace parking charges. Although there are potential limitations to the impact that such measures may have, it remains a possible tool for introduction in areas outside the scope of existing parking policy, e.g. the North Fringe, and hence should be examined further. The introduction of workplace parking charges would strengthen the operation of workplace travel plans.

However, the most effective additional form of demand management is likely to be some type of road user charging. The study has identified a number of potential charging mechanisms, including bridge tolls, cordon charging, motorway tolls, supplementary licences, congestion charging and distanced-based charging. In the longer-term, the study believes that the most effective form of demand management would be an area-wide charge. However, it is unlikely that such an approach would be feasible until later in the study’s horizon and hence it is important to explore charging systems that provide the opportunity for more immediate implementation. A cordon-based charge would be the most appropriate technique and the initiative by unitary authorities within the Transport Innovation Fund should be taken forward as quickly as possible.

The study does not believe that the introduction of tolls on the motorway network would produce overall benefits with the likelihood that such a system would encourage the diversion of traffic onto the uncharged local roads, generally unsuitable for the traffic volumes, and with only a small change in the overall level of traffic across the study area. For many of these journeys, there is a lack of an attractive public transport alternative. Hence, an area-wide road user charging system would be the most suitable long-term approach. We have examined alternative forms for the area-wide road user charging scheme and believe that the most appropriate is one in which the charge varies with the
level of congestion. As highlighted earlier, the benefits from charging are greater where the congestion is more severe. By varying the charge in line with the level of congestion, it is therefore possible to optimise the level of benefits. It is estimated that, with such a variable charge in 2031, it would be possible to reduce total vehicle delay across the study area by 20% and increase vehicle speeds by 9% for a lower average charge (14p/mile) than with a simple distance based charge of 50p/mile on all roads in the study area.

**Public Transport Improvements**

The study has examined a wide range of potential improvements to the public transport system in order to cater for the general growth in the demand for travel across Greater Bristol. The particular components of the public transport measures within the transport strategy range from improvements to the local bus services through to an expansion of the rail network.

Improvements to **urban bus services** would be a main focus in the strategy for enhancing the public transport system in the short to medium term. The Showcase bus corridors which form the Greater Bristol Bus Network are the subject of a Major Scheme Bid within the Local Transport Plan process and include a package of measures with junction improvements providing priorities for buses, new bus lanes, improved bus shelters, real-time passenger information and new low-floor buses. It is important that the Greater Bristol Bus Network is introduced as soon as practical.

Extensions to the **park and ride system** would involve expansion at the existing sites in Bristol and Bath to increase the capacity and improve the facilities. New sites are also identified in the strategy at Emersons Green, Hambrook, Whitchurch, Nibley and Lambridge.

The detailed consideration of **inter-urban bus services** is outside the main scope of GBSTS. Nevertheless, it is possible to identify new connections that would be necessary following the new population and employment developments across the study area. In addition, extensions to the highway network will provide the opportunity to offer service improvements such as journey time cuts and reliability gains on existing routes or through a re-routeing of services. The network of services will need to be reviewed in association with the priority measures in the Greater Bristol Bus Network together with the introduction of rapid transit routes and improvements to rail services.

Extensions to the **coach services** in the strategy would be a combination of enhanced operations through the use of priority measures within the Greater Bristol Bus Network together with potential new stopping locations outside city centres at the new Worle Parkway Interchange, Lambridge Park and Ride and in north Bristol at Parkway/UWE/Hambrook.

A particular growth area of future travel is **BIA** and public transport access to the airport must be enhanced to accommodate the growth in both air passengers and workers at the airport. The strategy identifies the current Flyer service as the foundation for future expansion, with increased frequency on the existing route together with expansion to serve north Bristol (Parkway) and Worle Interchange (for both Weston-super-Mare and the wider South West region). To cater particularly for the airport workers, a demand-responsive or shared taxi operation would be the most appropriate means of serving the widespread destinations.
The strategy identifies a number of **public transport interchanges** which should be developed outside town or city centres to serve local developments, including Worle Parkway (with multi-modal activity), UWE (serving the North Fringe), Yate and Filton Abbey Wood rail stations.

A major area of new development for the public transport system involves the network of **rapid transit** lines which would build on the priority measures within the Greater Bristol Bus Network to produce a system with further priorities including segregation from general traffic wherever possible. The lines would be designed to serve many of the new residential and employment developments, with the initial plans comprising:

- Ashton Vale – Emersons Green;
- Hengrove – North Fringe/Cribbs Causeway;
- Bath – Cribbs Causeway; and
- Whitchurch – Avonmouth/Portishead.

An early element of the rapid transit network would operate in Bath between Lambridge and Newbridge as part of the Major Scheme Bid which is being prepared within the JLTP process.

Further work is required to identify the type of vehicle used to operate the service but modern, low-floor, articulated buses are likely to be the most appropriate, flexible and cost effective vehicles to satisfy the requirements of the service. Further work is also necessary to specify the precise routes, taking into account the desire for significant levels of segregated operation.

The **rail** network within Greater Bristol represents a potential resource capable of wider and more intensive use although there are limitations brought about by the number and location of existing rail lines. The restricted penetration of the rail network into the city centres of Bristol, Bath and Weston-super-Mare and the poor links to the North Fringe contribute to low levels of current rail use, with just 2% of journeys in the morning peak period.

A range of measures has been identified to improve and expand the rail network, taking into account the availability of resources within the industry:

- improved rolling stock providing increased capacity and speed enhancements on the local rail services;
- additional facilities at Bristol Parkway with initially three and ultimately four platforms to increase capacity and improve reliability;
- expanded facilities at Worle station to create a major interchange location, including platform lengthening and an expansion of services;
- new turn-back facilities to enable more trains to operate to/from Weston-super-Mare and Yate; and
- increased services across Bristol linking Weston-super-Mare, Yate and Bath Spa – in view of the restrictions in turning trains at Bath Spa, it may be necessary to extend the local services to Westbury to provide better connections between the west Wiltshire towns of Trowbridge and Bradford-on-Avon and the employment centres of Bath and Bristol.
Although some of the improvements could be introduced in the short-medium term, the full extent of service increases would be dependent on the re-signalling of the Bristol area which is likely to be completed by 2018.

**Highway Measures**

The approach adopted within the study for the development of the transport strategy concentrated on examining and promoting alternatives to the private car before considering improvements to the highway network. This was designed to ensure that highway measures are only considered after all other possibilities have been explored. Within the highway improvements themselves, the emphasis was placed on making best use of the existing infrastructure before examining the need for schemes which increase highway capacity.

The examination of highway improvements was undertaken against the background of significant growth in the demand for travel in line with a 25% rise in population and 20% growth in employment by 2031. The identification of enhancements to highway capacity took direct account of the location, scale and timing of these developments; in some cases, additional highway infrastructure is necessary to connect new developments into the existing network.

The emphasis in identifying measures to make best use of the highway network in the study area concentrated on the existing infrastructure and capacity on the motorway and major trunk roads, although many of the measures are also suitable for the local network:

- **planned maintenance** should continue to be programmed to minimise disruption by avoiding periods of peak daily and seasonal flows, including the main summer holiday periods;
- wider measures to **reduce incidents** through better driving training, increased enforcement, stricter penalties and greater use of advanced warning signs;
- continued development of **incident management** by speeding up detection, evidence collection and documentation, incident clear-up and the initiation of diversionary routes; and
- wider application of **signing, surveillance and automated systems** including active traffic management techniques.

The assessment of capacity enhancements across the study area’s highway network considered a number of potential new schemes and appraised the full range of impacts before developing a preferred package of improvements. The identification of schemes concentrated on those which would have a direct impact on the strategic highway movements across the study area. The schemes within the strategy would not be the only highway measures which would generate potential enhancements; local measures, outside the scope of GBSTS, could also have merits but would need to be progressed separately by the local authorities. Hence, the schemes identified in the strategy are concentrated on the strategic highway network in the area.

The principal schemes which the study recommended should be taken forward included:
South Bristol experiences severe congestion on the constrained highway network in the area together with restricted accessibility to other parts of the study area, particularly the new employment areas of the North Fringe. Accessibility would be enhanced by extension of the Avon Ring Road with an indicative alignment from the junction with the A4 at Hicks Gate, following a new alignment south-west of Whitchurch to the A37, then running south of Hengrove before heading north to junction at Hartcliffe Way and Hengrove Way and finally, following an on-line alignment through Withywood before skirting Highridge Common to the A38. The scheme produces significant benefits through reduced delays across south Bristol, creating major new connections between south Bristol and the major employment areas. The scheme shows a strong economic performance with NPV of £950 million and BCR of 16.

A38 – A370 Link
Extension of the South Bristol Ring Road from A38 through to the A370, with the study’s preferred alignment following the path of the earlier Red route. The scheme provides relief to the congestion on the B3130 through Barrow Gurney and produces a strong economic performance with NPV of £70 million and BCR of over 8.

Links between south Bristol and M5
Current congestion levels on the highway network on the approaches to south Bristol from the south west would be exacerbated by planned future developments in housing and employment together with growth at BIA. The study identified alternative schemes to improve the connections to south Bristol and from the M5 motorway and the South West. The northern route would link M5 Junction 20 to the A370 near Long Ashton along an alignment to the north of the B3130 and would include bypasses for Nailsea, Tickenham and Wraxhall. The southern route would link M5 Junction 21 at Weston-super-Mare with BIA and northwards to the A370 with a bypass of Barrow Gurney. Outline alignments for the schemes have been identified for the purposes of the appraisal but considerable detailed work is necessary in order to identify potential environmental and other constraints. Both alternatives have strong transport economic case with a NPV of £270 million and a BCR of over 5 for the Junction 21 route and a NPV of £160 million and BCR of 3 for the Junction 20 option.

Improvements to M5 Junction 21
Current conflict at this junction, between traffic wishing to access the M5 and through movements on the A370 between Weston-super-Mare and Congresbury/south Bristol, will worsen with future growth in traffic. The most effective approach identified by the study is to separate the two movements by constructing a replacement junction to the south of the current Junction 20 which would be accessed by a new link to the A370 in Weston-super-Mare. The existing Junction 20 would be closed for access to the M5 and would therefore be restricted to A370 traffic alone. The scheme produces a strong economic performance with a NPV of £150 million and a BCR of 3.

M4 Widening between Junctions 19 and 20
The need to increase the capacity from three to four lanes in each direction on this section of the motorway was highlighted by forecast traffic flows consistently exceeding 85% of current capacity. Considerable journey time savings are achieved producing a NPV of £350 million. Due to an increase in distances travelled and a rise in vehicle operating costs, there is a growth in government indirect tax revenue which produces a negative BCR (-5). Despite this anomaly, the overall scheme performance is strong.
M5 Junctions 16 and 17 and M32 Junction 1
Problems at Junction 16 are created by a combination of high traffic levels to/from Aztec West and the North Fringe, conflicts between through traffic on the A38 and motorway access/egress and the proximity of Junction 16 with Almondsbury Interchange. Junction 17 serves the Cribbs Causeway regional shopping centre as well as other local destinations and experiences significant congestion, particularly on Saturdays. High traffic volumes through M32 Junction 1 create peak period congestion difficulties, exacerbated by the proximity to M4 Junction 19. Schemes to improve the operation of these junctions have been identified including the enhancement of the on and off slip roads and changes to the local road network and produce benefits to traffic movements. A more detailed assessment of operation of the junction is required, which is outside the scope of the study, before a full appraisal of the scheme can be completed.

Second Avon Crossing
M5 between Junction 18 and 19 is one of the few crossings of the River Avon and is a critical section of the region’s strategic road network. Incidents on this section have a widespread impact across the region and traffic levels are influenced by high levels of local traffic including movements to, from and between the two port areas on opposite banks of the river. The proposed second crossing would relieve the motorway and its junctions and improve access to Portishead and Avonmouth. The study has identified a potential low level crossing including an opening bridge or barrage which, in addition to carrying normal traffic, would also include a rapid transit link to Portishead. Because the scheme runs parallel to existing infrastructure, the journey time savings are low with a NPV of £30 million and BCR of 1.6 although this excludes the benefits from rapid transit and the improved resilience of the highway network.

A36 to A46 Link Road
The link road was recommended for further development by the earlier Bristol Bath to South Coast study. Located to the east of Bath, it produces significant benefits within Bath, through reduced congestion in the city on the A4 and A36, and traffic relief in the west Wiltshire towns of Trowbridge and Bradford-on-Avon. The overall economic performance is strong with a NPV of £700 million and BCR of 27 but there are significant environmental impacts which will need to be considered in the further development of the scheme.

Winterbourne and Stoke Gifford Bypasses
The scheme provides substantial relief to roads in the North Fringe including A38 and B4057 Winterbourne Road. The majority of the benefits occur south of the M4 and the northern section does not significantly add to the benefits and hence should not be progressed unless there are changes to developments in the area. The Stoke Gifford bypass and southern section of the scheme produces a NPV of £260 million and BCR of 8 and hence should be progressed further.

A number of additional schemes for highway capacity improvement were examined but were not included in the GBSTS strategy.

M4 to A4174 Link Road
The potential alignment for the scheme would involve close inter-relationship with M4 Junction 19 and a number of alternative designs were examined with the most effective being the construction of a new M4 junction (18A) with access limited to motorway traffic to/from the east and closure of the east-facing slip roads at the existing Junction 18.
Such a scheme in isolation recorded a NPV of £270 million and BCR of 12 but the generation of additional traffic on the M4 to the east of the new junction would create the need to add an additional lane on the M4 through to Junction 18 and hence the scheme was not recommended by the study.

♦ A4 Saltford Bypass
The scheme would relieve the congestion from traffic passing through the village but would involve high construction costs due to the terrain through which it would pass. Hence, the scheme’s economic performance, with a NPV of £17 million and BCR of 1.2, does not justify its inclusion in the strategy; although it produces some local relief, the strategic benefits are limited.

♦ A37 Whitchurch Bypass and Callington Road Link
These two schemes were identified as providing local relief to the highway network rather than having a strategic impact and hence were not included in the strategy although they produced a reasonable economic performance. Some of the benefits from the Whitchurch bypass would be achieved by the wider South Bristol Ring Road.

♦ Clutton and Temple Cloud Bypass
The construction of bypasses for the two neighbouring villages on the A37 would provide local relief but would not have a strategic impact.

♦ Banwell, Churchill and Sandford Bypasses
The three adjacent communities on the A371, A368 and A38 experience local congestion which is exacerbated by the restricted capacity through the village centres. The study examined the impact of a series of bypasses to provide relief to the villages and identified that, because the use of bypasses would increase the length of journeys, the net impact of the schemes was diminished such that the overall NPV was -£2 million with a BCR of 0.96. The scheme was therefore considered to have local rather than strategic merits and was not included in the GBSTS strategy.

♦ M49/Severnside Intermediate Junction
Projected increases in employment within the Severnside area are not sufficient to justify the potential highway improvements which include a new junction on the M49 and construction of a Spine Road through the main development area. While there are potential travel time savings for traffic to/from Severnside, the volume of traffic is small and the benefits do not justify the high scheme costs.

**Freight Aspects**

Although the movement of freight was not identified as a major feature of the GBSTS, measures designed to relieve particular congestion locations will also generally benefit goods traffic whether on the road or rail network. Other measures with a specific freight interest have been identified within the study, although a detailed appraisal has not been undertaken:

♦ review of the consolidation trial for goods deliveries to Broadmead area, with potential expansion in terms of types of goods covered and the extent of the area served;

♦ increased publicity for freight routes within and through the area and the facilities available to HGV drivers; and
accommodation of potential expansion in rail freight opportunities from Royal Portbury and Avonmouth Docks.

**Appraisal of the Strategy**

The contents of the GBSTS strategy and their impacts have been appraised under the key headings of environment, safety, economy, accessibility and integration. The detailed appraisals are summarised in the Appraisal Summary Table for the strategy shown in the attached table which highlights the key features in the appraisal of the strategy.

**The Next Steps**

The recommendations from the study outlined in this report will be presented to the partner group comprising officers from the organisations listed earlier. Having reviewed the outcomes from the study, the officers will develop recommendations on which schemes and measures should be taken forward by their organisations, identifying a potential timetable for implementation.

The Secretary of State for Transport and elected members of the unitary authorities will then consider which schemes and measures should be taken forward. Once decisions have been made, further work will be undertaken on the schemes and measures to enable them to be entered into the appropriate programmes of the Department for Transport, the Highways Agency and the unitary authorities. The schemes and measures will then be subject to the normal statutory planning processes.

One of the key aspects will be the potential sources of funding for individual schemes. These will depend upon the characteristics of the scheme, but will include Local Transport Plan, Regional Funding Allocation, Highways Agency and Network Rail budgets together with potential contributions from local developers and possible revenues from road user charging and other demand management measures. The development and appraisal of the schemes will need to make particular reference to the requirement of the appropriate funding processes.

The Secretary of State for Transport has asked the South West region to advise him on its priorities for transport investment in the next ten years or so. The recommendations from GBSTS will assist the region to understand the benefits of the schemes and measures, in terms of supporting future prosperity in Greater Bristol by investing in transport, compared with other areas in the South West. The advice to the Secretary of State will be based on evidence from GBSTS.

The study has been progressed in an open and consultative manner and the possible options have been discussed publicly. Many of the proposals are at a very early stage in the planning process and, if the recommendations are accepted, considerable further work will be required to prepare and consult on detailed designs for the schemes, including specific route alignments.
Water Environment Impacts of specific strategy measures on individual water network.

Local Air Quality

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>SUB-OBJECTIVE</th>
<th>QUALITATIVE IMPACTS</th>
<th>QUANTITATIVE ASSESSMENT</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Noise</td>
<td>Small net decrease in the number of people annoyed by noise (based on perceptible changes in noise levels). Increase in noise levels along new highways links on strategic road network. Decreases in noise spread across the study area network. The appraisal excludes the potential impacts attributable to the use of low noise surfacing and noise barriers in new schemes which would further reduce levels of noise pollution.</td>
<td>Number of zones experiencing noise impact:</td>
<td>Net decrease in estimated population annoyed of 18,803</td>
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<td></td>
<td></td>
<td></td>
<td>- Increase in population annoyed – 26 zones</td>
<td>- Decrease in population annoyed – 77 zones</td>
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<tr>
<td>Local Air Quality</td>
<td>Reduction in emission levels of NOx and PM10 between 2003 and 2031 through increasing use of cleaner, more efficient engines and improved fuels. Further moderate improvements achieved in 2031 by the strategy for both NOx (2%) and PM10 (4%) compared with Do Minimum. Within the local Air Quality Management Areas, there are reductions in emissions compared with 2031 Do Minimum. For NOx, reductions are 3% (Avonmouth), 7% (Bristol) and 8% (Bath) and for PM10 a 4% drop in Bath and no change in Avonmouth and Bristol. The appraisal excludes potential impacts attributable to possible supporting measures such as road building to reduce emissions testing, low emission zones and the further development of low emissions technologies.</td>
<td>Total annual emissions (tonnes) – NOx:</td>
<td>Changes in:</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Base (2003) = 13033</td>
<td>NOx:</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Do Minimum (2031) = 7150</td>
<td>- Base (2003) – 13033</td>
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<td></td>
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<td>Strategy (2031) = 6980</td>
<td>- Do Minimum (2031) – 196</td>
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<td>Total annual emissions (tonnes) – PM10:</td>
<td>- Strategy (2031) – 168</td>
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<td></td>
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<td>Base (2003) = 416</td>
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<td>Do Minimum (2031) = 196</td>
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<td></td>
<td></td>
<td>Strategy (2031) = 168</td>
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<tr>
<td>Greenhouse Gases</td>
<td>A moderate (5%) reduction in CO2 emissions in 2031 making a contribution towards meeting the UK Government’s obligations under the Kyoto agreement on tackling climate change. Due to growth in development between 2003 and 2031, the level of CO2 emissions increases by 33% between 2003 and 2031 Do Minimum.</td>
<td>Total annual emissions (tonnes) – CO2:</td>
<td>Changes in:</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Base (2003) = 2027705</td>
<td>CO2:</td>
<td></td>
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<td></td>
<td></td>
<td>Do Minimum (2031) = 2694531</td>
<td>- Base (2003) – 2027705</td>
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<td></td>
<td></td>
<td>Strategy (2031) = 2695328</td>
<td>- Do Minimum (2031) – 65756</td>
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<tr>
<td>Landscape</td>
<td>Impacts of specific strategy measures on individual landscape designations:</td>
<td>N/A</td>
<td>Potentially large adverse impact</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>- South Bristol Ring Road – potential impacts at western and eastern ends of the route;</td>
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<td></td>
<td></td>
<td>- Airport Link Road – potentially significant impacts on landscape in the Wrington area;</td>
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<td></td>
<td></td>
<td>- M5 Junction 17 – possible impact on local landscape designations to west of existing junction; and</td>
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<td></td>
<td></td>
<td>- A36 – A46 Link Road – potentially significant impact on AONB. Remedial measures may need to be included within the design as schemes are developed.</td>
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<tr>
<td>Townscape</td>
<td>Impacts of specific strategy measures on individual townscape designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
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<tr>
<td></td>
<td></td>
<td>- South Bristol Ring Road – parts of the urban sections of the route (Blightrow Ave, Hawkfield Rd, Hengrove Way, Cider Rd Link, King Georges Rd, Highridge Grn) could have potential townscape impacts; and</td>
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<td>- Stoke Gifford Bypass – potential local impacts. Remedial measures may need to be included within the design as schemes are developed.</td>
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<tr>
<td>Heritage of Historic Resources</td>
<td>Impacts of specific strategy measures on individual heritage designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- South Bristol Ring Road – runs through Avon Conservation Area in Highridge and Withywood area;</td>
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<td></td>
<td></td>
<td>- Airport Link Road – runs very close to Scheduled Ancient Monuments at Nye, Redhill and Felton;</td>
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<td></td>
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<td>- Nailsea Bypass – passes close to, but does not directly impact on, a Scheduled Ancient Monument at Nye and listed garden at Tyntesfield;</td>
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<td></td>
<td>- Widening of A370 – less close to a Scheduled Ancient Monument and runs through a narrow band of Avon Conservation Area;</td>
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<td></td>
<td>- Improvements to M52 Junction 1 – could potentially impact on Avon Conservation Area to the north-east of the junction; and</td>
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<td></td>
<td></td>
<td>- A36 – A46 Link Road – runs close to Avon Conservation Area. Remedial measures may need to be included within the design as schemes are developed.</td>
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<tr>
<td>Biodiversity</td>
<td>Impacts of specific strategy measures on individual biodiversity designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
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<tr>
<td></td>
<td></td>
<td>- South Bristol Ring Road – runs close to small ancient woodland at eastern end;</td>
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<td></td>
<td></td>
<td>- Airport Link Road – skims SSSI between Nye and Congresbury, crosses Local Nature Reserve along disused rail line between Congresbury and Winscombe, runs through ancient woodlands north of Wrington;</td>
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<tr>
<td></td>
<td></td>
<td>- Nailsea Bypass – skirts northern boundary of SSSI across Tickenham Moor;</td>
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<td></td>
<td>- Second Avon Crossing – runs close to important bird area when it crosses River Avon;</td>
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<td>- Improvements to M5 Junction 16 &amp; 17 – close proximity to areas of ancient woodland; and</td>
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<td></td>
<td></td>
<td>- A36 – A46 Link Road – passes close to small SSSI. Remedial measures may need to be included within the design as schemes are developed.</td>
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<tr>
<td>Water Environment</td>
<td>Impacts of specific strategy measures on individual water environment designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
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<tr>
<td></td>
<td></td>
<td>- South Bristol Ring Road – runs close to a number of landfills at western end;</td>
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<td></td>
<td></td>
<td>- Airport Link Road – crosses fluvial floodplain between Nye and Congresbury, crosses the floodplain of River Yeo to the south of Wrington, crosses Source Protection Zones near to</td>
<td></td>
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</tr>
</tbody>
</table>
Other Government Policies

Strategy assists other Government policies (e.g. sustainability and social inclusion) through improvements to public transport services and changes in mode split.

N/A Moderate beneficial impact
1. **Introduction**

1.1 This report describes the recommendations of the Greater Bristol Strategic Transport Study (GBSTS) which have been prepared by the consultant team led by Atkins. In developing the transport strategy for the area shown in Figure 1.1, the study has examined a wide range of potential measures and the individual components are considered separately in the different sections of the report.

1.2 GBSTS has its origins in the London to South West and South Wales Multi-Modal Study (SWARMMS) which was completed in May 2002. SWARMMS examined the strategic needs, up to 2016, of the main east-west strategic transport corridors for the South West region based on the M4 and M5 motorways, the A30, A303, A38 trunk roads, the Great Western, Waterloo to Exeter and the Berks and Hants rail lines. The large scale of this multi-modal study (MMS), together with its corridor based approach, meant that insufficient time was available to deal in detail, outside these main corridors, with the complex area-wide issues at play in Greater Bristol. GBSTS therefore follows on from SWARMMS, building and drawing on work undertaken by the MMS but not constrained by it.

1.3 The principal partners for the study included:

- Department for Transport (DfT)/Government Office for the South West (GOSW);
- South West Regional Development Agency (SWRDA);
- Highways Agency (HA);
- Bath & North East Somerset Council (B&NES);
- Bristol City Council (BCC);
- North Somerset Council (NSC); and
- South Gloucestershire Council (SGC).

1.4 The study has been guided by a Key Stakeholder Advisory Group (KSAG) drawn from representative organisations with an interest in transport planning and operations in the study area. In addition to the study partners listed above, the KSAG included:

- South West Regional Assembly (SWRA);
- Business West;
- Joint Strategic Planning and Transportation Unit (JSPTU);
- Strategic Rail Authority (SRA) (until June 2005); and
- Sustainability South West.
Figure 1.1 – The Study Area
OBJECTIVES OF THE STUDY

1.5 The brief for the study identified a series of objectives designed to direct the study’s development:

♦ to investigate the potential for transferring to local transport means, trips that start or end within the study area and use national strategic routes;

♦ having identified the potential for change, to look into the more detailed needs of the national and local strategic networks to deal with the residual problems on these routes; and

♦ to support, validate and inform development of the Regional Transport Strategy and future development scenarios reflecting the Principal Urban Area (PUA) status as defined by Regional Planning Guidance (RPG10).

1.6 In developing the strategies designed to satisfy these objectives, the brief specified that the study should:

♦ develop a series of integrated multi-modal transport strategies over time (detailed strategies for 2011 and 2016 and broader, high level, strategies for 2021 and 2031) for the study area identifying, analysing and appraising solutions on the national strategic transport networks, on the local strategic transport networks and at the interface between them, so as to improve strategic transport movements into, out of and through the study area;

♦ develop transport strategies that support existing economic activity, continue sustainable development and assist economic regeneration of urban areas and the wider process of urban renewal within the study area; and

♦ reduce the impact of transport on the environment.

1.7 Furthermore, in developing and appraising the strategies, the study is required to ‘make focused and realistic recommendations on transport policy and infrastructure provision across all modes and networks, focusing on the period to 2016 and taking full account of potential funding and deliverability constraints’. Hence, the strategies that are developed need to be both affordable and implementable.

1.8 There is a clear link between the demand for travel across the study area and the changes in the distribution of population and employment. The projections for spatial development have been developed, in parallel with the work of GBSTS, by the West of England Partnership (WoEP) as part of the Sub-Regional Spatial Strategy (SRSS).

1.9 These projections by the WoEP have been based on the features enshrined in its vision for the sub-region – that, by 2026, it will have:

♦ one of Europe’s fastest growing and most prosperous sub-regions which has closed the gap between disadvantaged and other communities – driven by major developments in employment and government backed infrastructure improvements in south Bristol and North Somerset;

♦ a buoyant economy competing internationally, based on investment by innovative, knowledge-based businesses and a high level of graduate and vocational skills;
a rising quality of life for all, achieved by the promotion of healthy lifestyles, access to better quality healthcare, an upturn in the supply of affordable housing of all types and the development of sustainable communities;

- easier local, national and international travel, thanks to transport solutions that link communities to employment opportunities and local services, control and reduce congestion and improve strategic connections by road, rail and through Bristol International Airport and seaport;

- cultural attractions that are the envy of competitor city regions across Europe, making the West of England the place of choice for talented, creative workers and affluent visitors;

- success secured in ways that are energy efficient, protect air quality, minimise and manage waste and protect and enhance the natural and built environment;

- built upon the benefits of its distinctive mix of urban and rural areas; and

- real influence with regional and national government, by demonstrating vision and leadership and delivering these achievements.

1.10 The vision for the sub-region is reflected in the series of key objectives for the WoEP in developing its spatial strategy to benefit the area and the regional and national economies, and to maintain and improve the quality of life of the area’s residents, by:

- as a priority, promoting urban renaissance, especially in Bristol, Bath and Weston-super-Mare, to make them better places in which to live, work, visit and invest, to create balanced communities, and to maximise the success of their future growth and development;

- regenerating areas of disadvantage, particularly in Bristol and Weston-super-Mare;

- promoting and enhancing prospects for sustainable development and investment in south Bristol and Weston-super-Mare;

- ensuring that the Green Belt continues to perform its fundamental roles in the area, while reviewing its extent in certain areas to meet the sub-region’s requirements for sustainable development;

- overcoming existing deficits in physical and social infrastructure in the West of England, and providing infrastructure to create balanced new communities, as part of the sub-region’s successful economic expansion;

- delivering a step change in the quality of public transport and traffic management within the Bristol urban area, Bath and Weston-super-Mare, and between the cities, smaller towns and rural areas across the sub-region;

- improving strategic communications to areas outside the West of England, by sea, air, rail and road;

- protecting and enhancing key environmental assets, especially those of national or international importance, and retaining, enhancing and restoring the diversity of wildlife and the landscape in the sub-region;

- improving efficiency in the use of resources, with waste production minimised and waste managed in a sustainable way;

- contributing towards achieving a carbon-neutral economy in the sub-region, with reduced household, transport and commercial energy consumption, reduced
environmental pollution, increased renewable energy generation, and positive adaptations to climate change and rising sea levels;

- encouraging the provision of green infrastructure throughout the sub-region, through environmental initiatives within the urban areas, maximising the potential of the Forest of Avon, and measures to encourage the appropriate use and management of the Green Belt and rural areas for amenity; and

- enhancing positive relationships between urban and rural areas for their mutual benefit.

1.11 Furthermore, the WoEP has identified a series of additional objectives relating to the individual components of the SRSS. As far as transport is concerned, the objective identifies that an essential part of the 2026 Vision for the West of England is achieving a transport system that is capable of accommodating the proposed level of growth. This includes reducing dependence on the car, delivering a step-change in public transport provision that is reliable, safe, affordable and accessible, and investing in traffic management solutions and the road network.

1.12 The requirements outlined above have therefore formed an important role in the development of the transport strategies prepared by the study and outlined in this report.

1.13 The requirement that the study should be implementable has a particular repercussion on the inclusion of specific demand management measures, particularly forms of area-wide congestion or road user charging. As explained in Chapter 4, the study identified that the introduction of area-wide congestion charging would have a potentially significant impact on the level of travel on the highway network and, at the same time, would influence the relative shares of public transport and private car within the overall travel across the study area. However, to be cost effective, area-wide congestion charging across the study area would need to be part of a national scheme, and hence it would have to be an important element of national transport policy. In view of the technological, practical, financial and political hurdles that would need to be cleared before a national scheme could be implemented, and the length of time necessary to achieve implementation, it was felt to be impractical to develop a single transport strategy that relied on area-wide charging as a cornerstone for the strategy. As a consequence, two alternative strategies were developed – excluding and including area-wide charging.

THE STRATEGY DEVELOPMENT PROCESS

1.14 The process used in the development of the transport strategies followed a hierarchical approach designed to identify measures which seek to make best use of existing infrastructure before considering the impact of, potentially costly, new infrastructure.

1.15 At the outset, a wide range of potential measures was identified and each was considered in relation to its appropriateness to the problems in the study area, taking into account the objectives and timescale of the study, the characteristics of the area and the availability of resources. The range of potential measures was extensive and included:
1. Land-Use Measures
   ♦ location of new developments within transport corridors and near to transport nodes;
   ♦ creating a development mix with housing close to places of work, schools, shops and leisure facilities;
   ♦ higher development densities, especially residential and employment;
   ♦ setting maximum parking standards in development plans;
   ♦ promotion of company and school travel plans;
   ♦ flexible or staggered working hours; and
   ♦ increased use of teleworking, teleshopping and teleconferencing.

2. Infrastructure Measures
   ♦ new road construction;
   ♦ new off-street car parks;
   ♦ rail infrastructure provision – upgrades to existing infrastructure, reopening of closed rail lines and provision of new stations, etc;
   ♦ introduction of new light rail or rapid transit operations;
   ♦ introduction of new guided bus operations;
   ♦ new or expanded park and ride sites;
   ♦ new or improved terminals and interchanges;
   ♦ new or extended cycle routes, cycle lanes and priorities;
   ♦ new cycle parking facilities – secure cycle parking, lockers or supervised facilities;
   ♦ introduction of pedestrian crossing facilities;
   ♦ new or extended pedestrian areas;
   ♦ new lorry parks;
   ♦ new trans-shipment facilities; and
   ♦ encouragement of other modes for freight, e.g. by water and pipeline.

3. Management Measures
   ♦ conventional traffic management measures;
   ♦ new or extended Urban Traffic Control (UTC) systems;
   ♦ introduction of Intelligent Transport Systems (ITS) – motorway access control (ramp metering), Automatic Incident Detection (AID), image processing of CCTV records, selective vehicle priority, queue management techniques;
   ♦ accident remedial measures;
   ♦ traffic restraint measures – segregation (road closures, banned turns, etc) and integration measures (traffic calming techniques);
   ♦ other physical restrictions on car use e.g. pedestrian areas, traffic calming, bus lanes;
   ♦ regulatory restrictions on car use e.g. permits and number plate restrictions;
parking controls – supply of spaces, restricting duration or opening hours, regulating use through permits or charging;

- encouragement of car sharing or pooling;

- introduction of bus priority measures e.g. bus lanes, bus-gates or bus only sections, selective detection at signals;

- high occupancy vehicle lanes – to extend the use of bus lanes to selected other vehicles;

- new (inter-urban) bus services – to provide direct public transport links;

- enhanced public transport service levels – increased route density or frequency, new demand-responsive bus services and a wide spectrum of paratransit measures;

- bus service management measures to improve the reliability of services and reduce operating costs;

- Quality Bus Partnerships and Quality Contracts – between local authorities and bus operators to enhance bus services to achieve higher quality services; and

- introduction of lorry routes and bans to reduce environmental intrusion and improve safety.

4. Information Provision

- enhanced conventional direction signing;

- introduction of variable message signs, especially on the motorway network;

- expansion or real-time driver information systems and route guidance;

- introduction of parking guidance and information systems

- public awareness campaigns directed particularly at car users to increase awareness of the effects of their travel behaviour and to highlight alternatives;

- improved timetable and other public transport service information;

- extended real-time passenger information;

- public transport operation information systems including bus location;

- static direction signs for cyclists and pedestrians;

- static direction signs for freight traffic; and

- fleet management systems for freight vehicles for ‘Just in Time’ delivery schedules.

5. Pricing Measures

- variations in parking charges;

- introduction of workplace parking – charge on all private non-residential parking at the workplace;

- introduction of urban and inter-urban road user charging schemes;

- changes in fare levels;

- variations in fares structures – alternatives to conventional graduated fares including lower off-peak fares, travelcards and season tickets; and

- variations in concessionary fares schemes to provide lower fares or free travel to identifiable categories of passenger with special needs.
1.16 The identification of the potential range of measures provided the starting point for the preparation of transport strategies.

1.17 Once a ‘long list’ of potential measures had been identified, analysed and assessed, a series of packages was developed, reflecting different themes for the content of transport strategies:

♦ public transport improvements;
♦ public transport improvements with demand management measures; and
♦ highway measures.

1.18 Within each theme, a range of alternative components were examined to establish their relative impacts in resolving problems and issues on the transport system and satisfying the objectives of the study. The analysis of the performance of the individual themes provided a background for the preparation of strategies combining the key features of each theme in an overall package of measures.

1.19 The development of the measures considered for inclusion in the strategies examined the alternatives within a hierarchy which considered the following sequence:

♦ making best (or better) use of existing transport infrastructure;
♦ encouragement of alternative modes;
♦ demand management measures including parking and charging-based techniques;
♦ improvements to the public transport system; and
♦ enhancements to the highway network.

WHAT HAPPENS NEXT

1.20 The recommendations from the study will be presented to the partner group, identified earlier in this chapter. The Secretary of State for Transport and elected members of the unitary authorities will then consider which schemes and measures should be taken forward. Once decisions have been made by the appropriate bodies and authorities, further work will be undertaken on the schemes and measures to enable them to be entered into the appropriate programmes of the Department for Transport, the Highways Agency and the unitary authorities. This will take into account the procedures within the Regional Funding Allocation process and the preparation of the Joint Local Transport Plan by the four unitary authorities covering the period 2006/07 to 2010/11. The schemes and measures will be subject to the normal statutory planning processes.

1.21 The Secretary of State for Transport has asked the South West region to advise him on its priorities for transport investment in the next ten years or so. The recommendations from GBSTS will assist the region to understand the benefits of the schemes and measures, in terms of supporting future prosperity in Greater Bristol by investing in transport, compared with other areas in the South West. The advice to the Secretary of State will be based on evidence from GBSTS.
1.22 Some of the GBSTS recommendations outlined in this report may cause anxiety amongst residents and businesses which hear that they may be affected by the schemes and measures. However, it should be highlighted that no decisions have yet been taken about whether the strategy, or any of the measures within it, should go ahead.

1.23 The study has been progressed in an open and consultative manner and the possible options have been discussed publicly. Many of the proposals are at a very early stage in the planning process and, if the recommendations are accepted, considerable further work will be required to prepare and consult on detailed designs for the schemes, including specific route alignments.

1.24 At this stage, there are no provisions for compensation to be paid to those who consider that they may be affected by any of the recommendations. However, if the recommendations are taken forward, then statutory blight provisions in the Town and Country Planning Act 1990 will apply. These set out the circumstances in which those residential owner-occupiers and owners of small businesses, who are directly affected, can require the promoting authority to acquire their property. Any queries on this issue can be addressed to The Government Office for the South West, 2 Rivergate, Temple Quay, Bristol BS1 6EH. However, it is recommended that anyone who feels that they are affected by blight as a result of these recommendations should seek independent advice.

**CONSULTATION DURING THE STUDY**

1.25 Consultation has played an important role throughout the study, with concentrated activities at three main points in the study process:

- to establish the views on current problems and issues for the transport system in the study area;
- to understand attitudes towards different measures being considered in the development of transport strategies, under the themes of:
  - better public transport,
  - better public transport and controlling demand
  - better roads
- to obtain feedback on the contents of the emerging strategy.

1.26 The consultation process involved different groups who were engaged in a variety of ways:

- a Wider Reference Group formed by members of organisations with a direct interest in the planning and operation of the transport system in the study area; and
- members of the general public who live and/or work in the study area.

1.27 A variety of techniques were adopted to engage with the different groups, including:

- preparation of an explanatory leaflet describing the relevant issues for each of the three stages;
- inclusion in the leaflet of a questionnaire designed to gain views on specific aspects;
liaison with the local media (television, radio and newspapers) in order to publicise the consultation process;

 ♦ development of a website to provide a further source of information about the study, with regular updates, and the provision of a message board for members of the public and organisations to record their views; and

 ♦ organisation of events to which members of the Wider Reference Group were invited during which discussions were arranged on the contents of the specific focus for the consultation.

1.28 The results from the consultation on problems and issues provided an important input into the assessment of the transport system in the study area and the development of transport strategies to cater for the problems and issues.

1.29 The responses from the consultation process do not, of course, represent a statistical sample of views; they are the opinions expressed by stakeholders and members of the public responding to the consultation questionnaire and, hence, are to a large extent self-selecting. Nevertheless, the responses provide an indication of the range of views on a number of transport issues. Considerable effort was made to ensure that the leaflet was available as widely as possible, with publicity in the local press and media to announce it. The overall response to the consultation was reasonable, bearing in mind that GBSTS was one of a number of consultation events within the area in recent times. In addition, in the consultation the emphasis was on problems and issues rather than specific measures; it is recognised that greater response is achieved when seeking views on the implementation of measures, rather than perceived problems and issues.

1.30 The main conclusions from this stage of the consultation are outlined below.

Travel Issues

1.31 It was widely recognised, by both stakeholders and survey respondents, that the biggest problem facing Bristol and the surrounding area is that of congestion. As many as 93% of respondents agreed that this was a major problem. Further questions revealed that it is felt that the major towns and cities in the study area suffer worst (77% of those surveyed had experienced severe congestion in Bristol city centre).

1.32 It was also felt that the growth in the surrounding towns, particularly Weston-super-Mare and Portishead, without an increase in public transport provision, is making access worse – especially to the motorway network. Many stakeholders (especially transport operators) commented on this and stated that the delays create many problems for them. Interestingly though, despite many comments about it, only 28% of respondents had experienced delays in Portishead.

1.33 Access to Bristol Airport is also a concern with many people stating that the surrounding villages and lanes are used as ‘rat runs’. Only 41% of respondents agreed that access to the airport is easy by car.

1.34 The other major concern for the public is the local public transport services, which are generally viewed as poor.
Road

1.35 Apart from congestion, as mentioned above, the main concerns on the road network covered three areas; access to the network, accident management and the general condition of the roads.

1.36 Access to the road network was key to many stakeholders, especially bus and coach operators. Several locations were highlighted as being of particular concern, especially during the summer when much of the strategic road network in the region becomes congested. These include:

- crossing the M5 at Junction 21 (A370) – this is the main link to the motorway from Weston-super-Mare;
- M32 into and out of Bristol;
- A4 towards Bath;
- Inner Ring Road east of Bristol city centre; and
- A38 north and south of Bristol (especially in the summer) – this acts as an overspill when the M5 becomes congested.

1.37 There was also concern about the lack of east-west routes across the study area, which results in many people travelling via the centre of Bristol. The major contributor to this is felt to be the absence of a southern and south-eastern ring road for Bristol.

1.38 All stakeholders noted that accidents often result in a complete standstill on the road network – especially if they occur on the motorway network. Concern was raised that there are no effective diversion routes or other alternatives available.

1.39 Finally, although it is outside the scope of GBSTS, people are concerned about the condition of the roads, for example bad surfacing. Just over a fifth (22%) of survey respondents highlighted that they had experienced poor road conditions, with central Bristol being cited as the worst location.

Rail

1.40 The main comments on rail services, both for stakeholders and the public, were related to the vehicles. Only 36% of survey respondents agreed that “rail vehicles are comfortable”. A further 83% felt that “rail services are inconvenient and infrequent”; whilst concern was raised amongst the stakeholders that the vehicles are not good enough to attract people to use them.

“Pacers are worse than many third world trains – they’re dirty, noisy and have an awful ride quality”.

1.41 This was followed by ticketing and ticket prices. Amongst the public, over two-thirds of respondents (69%) felt that fares are too expensive whereas the stakeholders felt that the introduction of integrated ticketing and travelcards in the area would help increase ridership.

1.42 Several stakeholders were concerned at the standard of the stations and the facilities provided. It was felt that many of the local stations are especially poor and this
results in making the trains a less attractive journey option. The major stations, especially Bristol Temple Meads and Bath Spa, also came in for criticism regarding access. It is felt that Bath station has poor access to road vehicles whilst Bristol Temple Meads gives a poor first impression as a gateway to the city and that the links to the city centre are poor.

1.43 Finally, many survey respondents called for various routes and stations to be reopened. The majority of these commented that the Portishead branch, which is largely still in use by freight traffic, should be re-opened for passenger services to relieve the daily congestion faced by people who live in this growing town for which the only form of public transport provision is the bus.

Local Public Transport

Bus

1.44 The stakeholders’ major concern was the lack of progress on the delivery of bus priority measures, as it is felt that these will go a long way to helping to improve reliability of services. There were also concerns over the current operating times which were deemed not suitable for a modern society and many people cannot easily use buses for their work trip.

1.45 Only 9% of survey respondents agreed with the statement “buses are frequent and convenient”. In addition, 61% felt that fares were too high and only 15% felt that buses are comfortable. Concern was also raised at the level of information provision. Comments like this are typical of many received concerning buses.

“Buses are very expensive, uncomfortable and frequently late.”

Park and Ride

1.46 Stakeholders were concerned about the costs and opening hours. Whilst the public were not specifically asked about park and ride, 61% stated that they would be willing to use park and ride as an alternative to the car. At the same time, views were expressed about the impact of park and ride sites on the environment, especially when introduced on green-field sites in the Green Belt, and the possible effect on local bus patronage where passengers switch from local services to park and ride.

LRT

1.47 Survey respondents voiced support for a rail based transit system. The stakeholder group agreed that, whilst it meets many of the area’s needs, it could be expensive. Several stakeholders suggested that guided bus could be investigated as a cheaper alternative that would meet many of the facilities of a rail based system.

Walking and Cycling

1.48 The attention of the study was directed at strategic issues and hence there was not undue emphasis on the detailed or local impacts. Nevertheless, while it was not possible for the study to identify detailed walking and cycling issues, it was felt important to understand and record problems and issues associated with these modes. More people choose to walk rather than use public transport for all journey
types except commuting and just under half of respondents (46%) agreed that it is easy to walk around their local area. It was interesting, however, to note that few comments were received regarding improvements to facilities. One exception was the need to improve pedestrian links between Bristol Temple Meads and the city centre.

1.49 More suggestions were received for cycling improvements, which can mainly be divided between a lack of suitable and secure cycle storage facilities, inadequate cycle lanes and difficulties travelling on trains with cycles. Several respondents questioned why some cycle lanes only last for 50 metres or so before ending. If facilities were improved however, a higher percentage of people (54%) would prefer to walk than cycle (47%).

Other Issues

1.50 All stakeholders agreed that transport plays a significant role in a successful local economy and is vital to reducing social exclusion. It was noted how important it is that transport policies are linked with other regional plans, such as the Environment Strategy, to ensure the success of any plans.

1.51 Many stakeholders felt that road charging would be difficult to bring in (one stakeholder said it would be ‘political suicide’), although the concept of workplace charging was felt to be more acceptable. The role that attractive transport links plays to those companies looking to invest in a region was highlighted, and that a careful balance is required to ensure that the area does not become uncompetitive.

CONTENTS OF THE REPORT

1.52 This report contains a summary of the main contents of the transport strategies, considering the measures under the principal headings in turn:

- the contents and location of the future spatial developments and associated population and employment forecasts are described in Chapter 2;
- elements of the transport strategies designed to encourage the use of alternative modes through the introduction of “smarter choices”, together with important features to be included in the design of new developments are summarised in Chapter 3;
- Chapter 4 considers the range of potential demand management measures with the relative scale of their impacts;
- Chapter 5 concentrates on the range of enhancements to the public transport system within the transport strategies;
- the improvements to the strategic highway network are examined in Chapter 6, concentrating firstly on ways of making best use of the existing highway network before turning to the provision of additional capacity across the network;
- while many of the measures within the transport strategies will have an impact on all movements on the transport system, Chapter 7 concentrates on those measures designed specifically to deal with freight;
- Chapter 8 outlines the appraisal of the transport strategies including an assessment of the wider economic impacts of the measures; and
Chapter 9 summarises the range of potential sources of funding for the measures included in the transport strategies together with the next steps in the further development of the strategies.

1.53 Further details of the appraisal of the strategies are included in Appendices to the report:

- Appendix A contains the set of summary appraisal tables for GBSTS strategies;
- Appendix B includes maps and diagrams which summarise key site specific impacts of the strategies; and
- Appendix C lists the abbreviations used within the report.

**OTHER REPORTS PREPARED DURING THE STUDY**

1.54 The objective of this Final Report is to summarise and highlight the key aspects within the development of the transport strategies during the study. Details of the work undertaken during the study are included in the technical reports which have been prepared on specific aspects. The contents of the associated reports are summarised below.

- **Inception Report**
  Prepared at the outset of the study containing an outline of the process to be followed and a review of the available documents and reports of relevance to the study;

- **Review of Existing Problems and Issues**
  An assessment of existing data sources and relevant reports to identify the location and magnitude of current problems and issues across the transport system, together with the views expressed during the first consultation stage;

- **Review of Appraisal Methods Report**
  A description of the approach adopted in the appraisal of transport strategies developed within the study, together with key assumptions used in the calculation of the principal indicators;

- **Data Collection and Transport Surveys Report**
  A summary of the statistics assembled in the development of the study including the main transport modes (road, rail, bus, park and ride, etc) and incorporating the findings of surveys undertaken during the study;

- **Model Validation Report**
  A description of the development of the multi-modal transport model (Greater Bristol Model) prepared specifically for the study and its validation against observed travel patterns;

- **Forecasting Review Report**
  An examination of the range of alternative sources available for forecasts of travel behaviour across the study area, including a summary of the main assumptions about future levels of growth;
<table>
<thead>
<tr>
<th>Report Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>Forecasting of Spatial Planning Options Report</td>
<td>An outline of the steps followed to prepare projections for the growth in population, employment places, dwellings, etc for the study area to 2031 and the anticipated location of new development sites;</td>
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<tr>
<td>Model Forecasting Report</td>
<td>A description of the process by which the projections for the future growth in population, employment, etc has been translated into forecasts of travel demand levels and the resulting volume and patterns of demand on the different modes;</td>
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<tr>
<td>Future Problem Identification Report</td>
<td>An analysis of the outputs from the Greater Bristol Model relating to the impact of the alternative spatial development scenarios on the Do Minimum transport network, highlighting the location and severity of the future problems across the different transport modes;</td>
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<tr>
<td>Transport Model User Manual</td>
<td>A summary of the different components of the Greater Bristol Model developed during the study and the key features of its operation including input data requirements and principal outputs;</td>
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<tr>
<td>Model Results Report</td>
<td>A description of the main results for the wide range of tests undertaken using the Greater Bristol Model during the development of the transport strategies, including a summary of the major outputs for each of the different transport modes;</td>
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<tr>
<td>Strategy Development Report</td>
<td>A detailed description of the process adopted for the development of the transport strategies for the study area to 2031, examining the contents of the strategies for each transport mode in turn and the detailed features of the individual measures in the strategies;</td>
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<tr>
<td>Appraisal Report</td>
<td>A summary of the appraisal of the overall strategy from the viewpoint of impacts within the main headings of environment, safety, economics, accessibility and integration, together with a detailed appraisal of specific schemes identified for implementation in the short/medium term;</td>
</tr>
<tr>
<td>Wider Economic Benefits Report</td>
<td>A description of the likely impacts of the measures in the transport strategies on the economic performance of the study area, identifying the likely effects on the economic regeneration of the area and the potential for relieving current and future areas of deprivation; and</td>
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Consultation and Participation Report

An examination of the methods used at three key points during the study to establish the views of key stakeholders and the general public on:

♦ the current problems and issues for transport in the study area;
♦ the relative impacts of the main themes to be included in the transport strategy; and
♦ the contents of the emerging transport strategy from the study.
2. Spatial Development Forecasts

INTRODUCTION

2.1 As indicated in the previous chapter, there are close links between changes in the location of population and employment across the study area, and the requirements of the associated developments to the transport system. In addition, the content of the transport system, and changes to it, can play an important role in influencing the form, scale and timing of the population and employment changes. Hence, there is the potential for iterations between changes to the transport system and population/employment developments in order to achieve a balance between the two elements.

2.2 However, the consideration of such interaction was outside the scope of GBSTS. From the outset of the study, the attention was directed at the preparation of transport strategies designed to serve a single spatial development forecast prepared by the WoEP. Nevertheless, the preparation of the spatial development forecasts was not undertaken by the WoEP in isolation from transport issues. To assist the WoEP in the identification of the spatial development to form the basis of the transport strategy development, the study provided analysis of the transport impacts of a range of alternative spatial development scenarios. The components of this work are described within the remainder of this chapter. In addition, specific attention was directed at the potential future growth at two significant developments in the study area: Bristol International Airport (BIA) and Bristol Port and these are also described separately.

2.3 The modelled changes in population and employment across the study area by 2031 have a corresponding impact on the level and distribution of travel demand across the study area. The main aspects of the changes in demand, their effect on the operation of the transport system in 2031 without any improvements to it, and the creation of problems and issues are described in the final sections of the chapter.

INITIAL ALTERNATIVE SPATIAL SCENARIOS

2.4 In parallel with the work of the study in preparing transport strategies to 2031, the WoEP has been developing the future spatial distribution for the Greater Bristol sub-region within its work on the SRSS for the SWRA.

2.5 Initially, as part of GBSTS, a series of five spatial scenarios was prepared with officers of the unitary authorities and the Joint Strategic Planning and Transportation Unit (JSPTU), with each scenario representing an alternative distribution of the growth in population and employment across the study area. For one of the spatial scenarios (A), the overall growth was equivalent to RPG10 levels, while for the four other scenarios (B to E) a higher growth level of RPG10 + 25% was used. Each of the scenarios adopted different assumptions for the distribution of the extra population and employment developments across the study area:

♦ Scenario A – extensions to existing Principal Urban Areas of Bristol, Bath and Weston-super-Mare;
Scenario B – extensions to existing Principal Urban Areas;
Scenario C – growth concentrated to the north and east of Bristol;
Scenario D – growth concentrated to the south and west of Bristol; and
Scenario E – growth along current principal transport corridors.

2.6 With the higher growth scenarios (B to E), the increase in the number of dwellings represented by the RPG10 + 25% level was estimated at 138,000 or equivalent to population growth of 245,000 from the current 990,000 in the study area. For employment, the forecast increase was 95,000 from the current workforce of 500,000 across the study area.

2.7 The 138,000 additional dwellings were distributed between brownfield and greenfield development sites; it was estimated that 65,000 dwellings would be located on brownfield sites within the existing built-up areas, leaving 73,000 dwellings to be distributed on the greenfield sites identified for each scenario.

2.8 None of the scenarios was designed to be a distribution of developments that was expected to be implemented; they represented an extreme range of different assumptions whose impact on the transport system could then be estimated and assessed. From the transport analysis, it was possible to assess the effects that each scenario would have on the performance of the transport system and the types of measures that would be required in order to resolve some of the resulting transport problems. This analysis formed an input into the selection by the WoEP of a baseline spatial distribution (termed Scenario F) which has formed the basis for the preparation and assessment of the study’s transport strategy described in the remainder of this document. Scenario F does not always reflect the WoEP’s ‘First Detailed Proposals’ for the Regional Spatial Strategy, which are also understood to be subject to reconsideration in the light of this study.

**Spatial Scenario Used for the Development of the Study’s Preferred Transport Strategy**

2.9 There is a strong linkage between the modelled distribution of additional population and employment across the study area and the design of the future transport strategy emerging from the study. It is therefore important to highlight some of the main features of Spatial Scenario F developed for the study by the WoEP.

2.10 Firstly, compared with the preceding scenarios (A to E), with Scenario F there was a change in the assumption about the level of growth on brownfield sites within the existing urban areas and on greenfield sites outside these areas. The same overall growth level of 138,000 extra dwellings by 2031 represented the total increase. However, with Scenario F, there was a change in the assumed split between greenfield and brownfield sites, with a greater proportion (78,000) being positioned on brownfield sites in existing built-up areas. The remaining 60,000 dwellings located on greenfield sites represented an 11% reduction compared with earlier spatial scenarios.

2.11 The locations of the additional modelled housing developments on greenfield sites are shown in Figure 2.1. The main sites, including the overall dwelling growth level
and the approximate timing of the development, are shown below. As may be seen, many of the developments extend over a long timescale through to 2031.

- Ashton Vale – 15,000 (2011-2031);
- Emersons Green/Pucklechurch – 10,000 (2016-2031);
- Whitchurch – 10,000 (2021-2031);
- Locking – 7,000 (2021 - 2031);
- Harry Stoke – 4,500 (2011-2031);
- Portishead – 3,200 (2011-2031);
- Keynsham – 3,000 (2016-2031); and

2.12 From the summary above, it is evident that the majority of the modelled development is located to the south of Bristol with the major sites at Ashton Vale and, in the longer term, Whitchurch. These sites are also programmed for completion later in the study timetable. The location of these developments and their timing contribute to the contents of the transport strategy outlined in the following sections and in the proposed timetable for the introduction of some of the measures.

2.13 As with the new dwellings, the location of employment developments reflects the split between brownfield and greenfield locations as shown in Figure 2.2. Many of the modelled additional employment places are allocated to sites within the existing PUAs, particularly in the centres of Bristol, Bath and Weston-super-Mare and in the North Fringe of Bristol. However, in line with the new dwellings within the spatial development scenario, employment growth is located in the major new development areas identified above, with the following forecasts for growth by 2031 at these sites:

- Ashton Vale 6,500;
- Emersons Green/Pucklechurch 10,000;
- Whitchurch/Hicks Gate 6,000;
- Locking 1,750;
- Harry Stoke 4,000;
- Portishead 4,000;
- Keynsham 1,500; and
- Cribbs Causeway 5,400.

2.14 In addition, there is specific employment growth at BIA which is considered separately below.

2.15 The positioning of both new dwellings and employment within the same development increases the potential for self-containment on the sites, with residents living and working within the same broad location. Whilst this is an attractive aspiration, and developing sites with a combination of both homes and workplaces will encourage self-containment, it is not, of course, possible to guarantee such an eventuality. This is particularly true in the medium to long term, when residents of the area may tend to seek new employment outside the development while still maintaining their residence there.
Figure 2.1 – Location of Potential New Developments (Dwellings) in 2031 as modelled in GBSTS Scenario F
Figure 2.2 – Location of Potential New Developments (Employment) in 2031 as modelled in GBSTS Scenario F
DEVELOPMENT OF BRISTOL INTERNATIONAL AIRPORT (BIA)

2.16 In December 2003, the Government published its White Paper on ‘The Future of Air Transport’ that set the framework for development of airport capacity in the UK to 2030 and included the provision for growth at BIA from the current 4 million passengers per annum (mppa) to 12 mppa by that date. In parallel with GBSTS, the airport has produced a master plan which lays out the specific proposals for airport development up to 2015, and indicative plans up to 2030. The master plan includes the surface access initiatives planned by the airport to serve the predicted demand. In addition to the growth in passengers, employee levels would grow from an average in 2003 of 1950 (with 2350 in peak summer months) to 6700 (and 8100 in peak months) in 2030.

2.17 The projections of activity levels at BIA and the impacts on demand for surface access to the airport in the future were assessed by GBSTS with attention paid to the particular characteristics of BIA and the volume and timing of surface access journeys to and from the airport. The objective of the analysis was to estimate the volume of arriving and departing travel volumes in average peak and off peak hours for the base year (2003) and each of the forecast years (2011, 2016, 2021 and 2031). In addition to the travel volumes, the spatial distribution of trips was also investigated.

2.18 BIA’s own traffic forecasts for air passenger volumes formed the basis of the projections. The forecasts are similar to those prepared by the DfT for the White Paper but take greater account of the airport’s own aspirations for growth and the historical performance of other similar developing airports. Figure 2.3 summarises the growth profile through the study period. Note that passenger levels represent the combination of passenger arrivals and departures.

2.19 Existing airport passenger number forecasts were used to assess future surface access travel volumes with current and future usage profiles applied as appropriate. In addition, current staff numbers, shift patterns and predicted growth rates were used to estimate this element of the complete airport travel flows.

2.20 Forecasts of passenger numbers for a typical month were derived from the annual data via a time series analysis of historic trends. Daily flows were derived from an analysis of traffic count data recorded on the airport approach road. The conversion of daily forecasts into peak and off peak hours made use of the airport’s timetable of air traffic movements for a typical week, along with profiles of passenger arrivals and departures. This analysis was conducted separately for domestic/scheduled/charter traffic, and used a BIA supplied notional timetable for the situation with annual passenger levels of 9 mppa (around 2020) which was then extrapolated to represent the situation with 12 mppa.
2.21 The number of staff employed at the airport was estimated by using the relationship between staff numbers and total annual passenger levels. Adjustments were made for levels of seasonal work that occur at BIA. Around 95 percent of airport staff are employed on shift work and hence there are staff trip movements throughout the day rather than merely at the traditional highway peak times. The proportion of staff arriving and departing in peak and off peak hours was taken from work undertaken by BIA.

2.22 Vehicle movements were forecast from the estimated passenger and staff numbers using assumptions for mode split, car occupancy and the volume of ‘drop off’ vehicles (taxi and kiss and ride). Analysis undertaken by BIA indicated that 4.5 percent of current passengers use public transport to access the airport. Based on BIA’s own target for public transport mode share, this was estimated to grow by five percent each year and would result in a public transport mode share of 16.0 percent by 2030.

**BRISTOL PORT**

2.23 The overall Bristol Port operation comprises two ports: Avonmouth (opened in 1877) and Royal Portbury Dock (RPD) (opened in 1979). The two ports were owned by Bristol City Council until 1991 when they were sold to First Corporate Shipping Limited trading as Bristol Port Company (BPC).
2.24 The entire dock estate is 2,419 acres, of which 45% is useable for port operations. Portbury is the larger of the two ports and has received greater investment since privatisation. The port can handle vessels up to 130,000 dead weight tonne (dwt) and deals primarily with dry bulk goods, oil (aviation fuel), forest products and motor vehicles. Avonmouth can handle vessels up to 35-39,000 dwt. Cargo handled at Avonmouth covers a wide range of commodities including petroleum, fresh produce, gas, cement, scrap metals, containers, sand and gravel, grain, steel products and forestry products.

2.25 Since the purchase of the port by BPC in 1991 traffic has increased, making it the third fastest growing port in the UK over the last decade. The greatest increases have been in coal and vehicles while other cargoes have shown more modest growth.

2.26 The Bristol Bulk Handling Terminal opened in 1993 and can handle products such as coal and petroleum, coke, grain derivatives, fertilisers and aggregates. Coal is Bristol’s largest cargo and is mainly forwarded by rail to three inland power stations. UK coal imports have been rising steadily and are expected to fluctuate in the range 3-6 million tonnes over the next few years. Although carbon taxes are likely to cause a decline, the efficiency of Bristol Port could mean that it handles an increasing proportion of UK coal imports.

2.27 Most of the vehicle imports are from the Far East and South Africa. Vehicles are stored in the port and, when requested, are customised in pre-delivery buildings before being delivered direct to the customer. This has considerable implications for land requirements. National vehicle import growth of 7% p.a., an increasing market share of imports and the recent investment in the rail link at RPD suggest that prospects for future growth are good, although the refusal of planning permission for expansion on the Sheepway Farm site could constrain activity within RPD. However, this could encourage increased interaction with Avonmouth.

2.28 The construction of a new deep water container facility at Avonmouth is currently being considered although the proposal is at a very early stage. The proposal would increase the Port’s capacity from 150,000 to 850,000 container movements a year, with most containers being transported to/from the port by road although a proportion (perhaps 25%) could be attracted to rail with the good existing connections to both RPD and Avonmouth.

IMPACT OF SPATIAL SCENARIO F ON THE TRANSPORT SYSTEM

2.29 Spatial Scenario F has formed the basis for model testing using the Greater Bristol Model, a strategic multi-modal transport model developed specifically for GBSTS and representing an average hour in the morning peak (0700-1000) and inter-peak (1000-1600) periods. The model was based on an average hour because the incidence of relatively long-distance trips means that the peak hour occurs at various times in different parts of the study area. The model has been built and validated using 2003 base year data.

2.30 The land use changes represented by Spatial Scenario F create additional demand for travel in the period between 2003 and 2031. A Do Minimum transport scenario
has been defined to examine the effects on the transport system if no new transport measures are put in place. The Do Minimum is identical to the 2003 base year scenario, with the exception that it includes committed Highways Agency schemes to implement climbing lanes on the M4 and M5 motorways (which have now been completed or are under construction).

2.31 The forecasting of future travel demand levels following from the growth in population and employment is described in the Model Forecasting Report. The process involved the disaggregation of travel demand by journey purpose and car availability category, with the application of appropriate trip rates to each category.

2.32 The Future Problems Identification Report contains a detailed analysis of the impact on the transport system of the growth in travel demand, associated with Spatial Scenario F. Key elements of the analysis are examined below.

2.33 Table 2.1 shows the total trips by mode for an average hour in the morning peak period. In the Do Minimum case, there is an 18% increase in the total number of trips by motorised modes between 2003 and 2031, with a 21% increase in car trips. The level of bus usage drops because of the increased congestion on the road network which produces a worsening of bus journey times and hence a reduction in competitiveness.

<table>
<thead>
<tr>
<th>Mode</th>
<th>2003</th>
<th>2031 Scenario F Do Minimum</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>154700</td>
<td>187300</td>
<td>21%</td>
</tr>
<tr>
<td>Bus</td>
<td>13600</td>
<td>11700</td>
<td>-14%</td>
</tr>
<tr>
<td>Rail</td>
<td>4400</td>
<td>5550</td>
<td>26%</td>
</tr>
<tr>
<td>Park-and-Ride</td>
<td>1550</td>
<td>1750</td>
<td>14%</td>
</tr>
<tr>
<td><strong>Total Trips</strong></td>
<td><strong>174300</strong></td>
<td><strong>206300</strong></td>
<td><strong>18%</strong></td>
</tr>
</tbody>
</table>

2.34 Table 2.2 shows changes in demand in terms of the origins and destinations for person trips for different parts of the study area. To simplify this, a series of sectors has been defined; these are shown in Figure 2.4.

2.35 Table 2.2 shows that the growth in trips is distributed unevenly around the study area, with the largest increases in morning peak trip origins located in areas of increased housing development, including:

- Bristol city centre;
- the North Fringe;
- extensions to the Bristol urban area in the south-east (including Whitchurch and Hicks Gate), south-west (including Ashton Vale), and north-east (including Emersons Green and Pucklechurch);
- extension to Portishead; and
Weston-super-Mare – within the existing urban area as well as in the urban extensions.

Table 2.2 – Trips Origins and Destinations by Sector
(average hour in morning peak period)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Trip Origins</th>
<th></th>
<th>% Diff</th>
<th>Trip Destinations</th>
<th></th>
<th>% Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2003</td>
<td>2031 Do Min</td>
<td>% Diff</td>
<td>2003</td>
<td>2031 Do Min</td>
<td>% Diff</td>
</tr>
<tr>
<td>Bristol City Centre</td>
<td>8050</td>
<td>12750</td>
<td>58%</td>
<td>18000</td>
<td>19800</td>
<td>10%</td>
</tr>
<tr>
<td>NW Bristol (incl. Avonmouth)</td>
<td>15500</td>
<td>15500</td>
<td>0%</td>
<td>13900</td>
<td>14500</td>
<td>4%</td>
</tr>
<tr>
<td>NE Bristol</td>
<td>12650</td>
<td>14250</td>
<td>13%</td>
<td>12150</td>
<td>12400</td>
<td>2%</td>
</tr>
<tr>
<td>South Bristol</td>
<td>16650</td>
<td>15850</td>
<td>-5%</td>
<td>14450</td>
<td>14200</td>
<td>-2%</td>
</tr>
<tr>
<td>North Fringe</td>
<td>6600</td>
<td>11650</td>
<td>77%</td>
<td>11650</td>
<td>13800</td>
<td>18%</td>
</tr>
<tr>
<td>East Fringe</td>
<td>10900</td>
<td>11900</td>
<td>9%</td>
<td>8550</td>
<td>9250</td>
<td>9%</td>
</tr>
<tr>
<td>Bristol urban extension – north and north-east</td>
<td>4350</td>
<td>5700</td>
<td>31%</td>
<td>2600</td>
<td>3550</td>
<td>36%</td>
</tr>
<tr>
<td>Rest of South Gloucestershire</td>
<td>7650</td>
<td>7600</td>
<td>-1%</td>
<td>5650</td>
<td>5700</td>
<td>1%</td>
</tr>
<tr>
<td>Bath</td>
<td>14950</td>
<td>15550</td>
<td>4%</td>
<td>17450</td>
<td>18800</td>
<td>8%</td>
</tr>
<tr>
<td>Bath urban extensions</td>
<td>200</td>
<td>200</td>
<td>-4%</td>
<td>150</td>
<td>100</td>
<td>-13%</td>
</tr>
<tr>
<td>Bristol urban extension – South East</td>
<td>1500</td>
<td>3450</td>
<td>133%</td>
<td>2450</td>
<td>3950</td>
<td>61%</td>
</tr>
<tr>
<td>Rest of Bath &amp; NE Somerset</td>
<td>3700</td>
<td>3450</td>
<td>-7%</td>
<td>2000</td>
<td>1950</td>
<td>-4%</td>
</tr>
<tr>
<td>Weston-super-Mare</td>
<td>9750</td>
<td>11850</td>
<td>22%</td>
<td>9450</td>
<td>11500</td>
<td>22%</td>
</tr>
<tr>
<td>Weston-super-Mare extension</td>
<td>1600</td>
<td>2900</td>
<td>79%</td>
<td>1000</td>
<td>1500</td>
<td>53%</td>
</tr>
<tr>
<td>Portishead extension</td>
<td>450</td>
<td>800</td>
<td>81%</td>
<td>700</td>
<td>1200</td>
<td>72%</td>
</tr>
<tr>
<td>Bristol urban extension – South West</td>
<td>850</td>
<td>3300</td>
<td>296%</td>
<td>1400</td>
<td>2500</td>
<td>77%</td>
</tr>
<tr>
<td>Rest of North Somerset</td>
<td>9500</td>
<td>11150</td>
<td>17%</td>
<td>6450</td>
<td>7950</td>
<td>23%</td>
</tr>
<tr>
<td>Hinterland</td>
<td>41350</td>
<td>48900</td>
<td>18%</td>
<td>37900</td>
<td>52450</td>
<td>38%</td>
</tr>
<tr>
<td>Rest of UK</td>
<td>8200</td>
<td>9600</td>
<td>17%</td>
<td>8400</td>
<td>11200</td>
<td>34%</td>
</tr>
<tr>
<td><strong>Total Trips</strong></td>
<td><strong>174300</strong></td>
<td><strong>206300</strong></td>
<td><strong>18%</strong></td>
<td><strong>174300</strong></td>
<td><strong>206300</strong></td>
<td><strong>18%</strong></td>
</tr>
</tbody>
</table>
Figure 2.4 – GBSTS Sector System
2.36 The largest increases in morning peak destinations are correlated to areas of increased employment development, including:
- extensions to the Bristol urban area in the south-east (including Whitchurch and Hicks Gate), south-west (including Ashton Vale), and north-east (including Emersons Green and Pucklechurch);
- extension to Portishead; and
- Weston-super-Mare, within the existing urban area and urban extensions.

2.37 Table 2.3 compares the mode share in 2003 with that in 2031 under Spatial Scenario F. The results indicate an increase in the car mode share, due in part to increasing car ownership. The reduction in bus mode share is due to a number of factors including increasing car ownership and increased congestion on the road network, which makes bus travel less attractive by lengthening journey times and reducing reliability.

<table>
<thead>
<tr>
<th>Mode</th>
<th>2003</th>
<th>2031 Scenario F Do Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>88.8%</td>
<td>90.8%</td>
</tr>
<tr>
<td>Bus</td>
<td>7.8%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Rail</td>
<td>2.5%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Park-and-Ride</td>
<td>0.9%</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

2.38 Table 2.4 shows the impact of Spatial Scenario F on the highway network in the Do Minimum situation in the morning peak period. Over the period between 2003 and 2031, the model indicates a 34% increase in vehicle trips and a 44% increase in vehicle-kilometres. This gives rise to large increases in delay, with the total vehicle delay more than tripling and the time lost per vehicle-kilometre increasing from 34 seconds to 80 seconds. The proportion of vehicle-kilometres on relatively uncongested links falls from 91% to 69%, while the proportion on links at or above capacity increases from 6% to 17%.

2.39 The impact of Spatial Scenario F on the highway network in the Do Minimum is shown in more detail in Figures 2.5 and 2.6. Figure 2.5 shows that, in the Do Minimum situation, highway flows increase substantially on almost all roads in the Greater Bristol area in the average morning peak hour. On the M5 motorway, there is an increase in flow of around 2000 pcus per hour in each direction between J21 at Weston-super-Mare and J19 at Portishead. On the M5 Avonmouth Bridge, the increase is higher, at around 3000 pcus per hour. On the M4 motorway east of the Almondsbury Interchange, there is an increase of almost 3000 pcus per hour in the eastbound direction and 1000 pcus per hour westbound. The A4174 Avon Ring Road is also put under more pressure, with flow increases in excess of 1000 pcus per hour on some sections.

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1 pcu = passenger car unit, a standard unit used in traffic modelling whereby larger vehicles such as heavy goods vehicles are converted into the equivalent number of car units.
Table 2.4 – Key Highway Network Statistics (average hour in morning peak period)

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2031 Do Minimum</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips ('000)</td>
<td>154</td>
<td>207</td>
<td>+34%</td>
</tr>
<tr>
<td>Vehicle Kilometres ('000)</td>
<td>2,000</td>
<td>2,880</td>
<td>+44%</td>
</tr>
<tr>
<td>Vehicle Hours ('000)</td>
<td>45</td>
<td>101</td>
<td>+123%</td>
</tr>
<tr>
<td>Average Vehicle Speed (km/hr)</td>
<td>44.2</td>
<td>28.5</td>
<td>-35%</td>
</tr>
<tr>
<td>Mean Journey Length km (per vehicle)</td>
<td>13.0</td>
<td>13.9</td>
<td>+8%</td>
</tr>
<tr>
<td>Total Vehicle Delay ('000 Hours)</td>
<td>19</td>
<td>64</td>
<td>+233%</td>
</tr>
<tr>
<td>Time Lost per Vehicle-Km (seconds/veh km)</td>
<td>34.5</td>
<td>79.6</td>
<td>+131%</td>
</tr>
<tr>
<td>Vehicle-Hours of Delay per Network Km (veh hrs/km)</td>
<td>6.8</td>
<td>22.7</td>
<td>+233%</td>
</tr>
</tbody>
</table>

Proportion of Vehicle Kms on Links at Different Levels of Capacity Utilisation

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2031</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below capacity</td>
<td>91%</td>
<td>69%</td>
<td></td>
</tr>
<tr>
<td>Approaching capacity</td>
<td>4%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>At capacity</td>
<td>3%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Significantly over capacity</td>
<td>3%</td>
<td>9%</td>
<td></td>
</tr>
</tbody>
</table>

2.40 Figure 2.6 shows highway links which are approaching or above their capacity (defined as links with flows in excess of 85% of the link capacity in the average morning peak hour). Links marked in red are already above this capacity threshold in 2003, while those marked in blue are pushed above the threshold as a result of additional traffic on the network in 2031. There is therefore a general worsening of conditions, with particular areas of increased congestion as follows:

♦ on the motorway network, in particular on the M5 northbound and the M4 eastbound;

♦ on the approaches to motorway junctions, particularly where areas of new development adjoin the motorway network, i.e. at Portishead, Cribbs Causeway, Harry Stoke and Weston-super-Mare;

♦ within the principal urban areas of Bristol, Bath and Weston-super-Mare; and

♦ on the periphery of the principal urban areas, particularly around areas of new development such as Ashton Vale and Weston-super-Mare.
Figure 2.5 – Difference in Highway Flows between 2003 and 2031 Do Minimum (average morning peak hour)
Figure 2.6 – Difference in Highway Capacity Utilisation between 2003 and 2031 Do Minimum (average morning peak hour)

- **Links above 85 percent capacity**
  - Scenario F Do Min vs Base
  - Additional links above capacity threshold by 2031
  - Links already above capacity threshold
  - Links brought below capacity threshold by 2031
2.41 The changes exacerbate major problems of congestion on the strategic highway network already identified in 2003, including those at:

- M32 Junction 1 and on the northern section of the A4174 Avon Ring Road;
- M5 Junction 21
- M5 Junction 19;
- M5 Junction 17;
- M5 Junction 16; and
- M4 between Junction 19 and 20.

2.42 Without improvements in capacity, a number of the developments included in Spatial Scenario F create particular difficulties on the highway network in the immediate vicinity of the development, especially at key junctions.

2.43 Table 2.5 shows the impact of Spatial Scenario F on the public transport network. In line with the changes in bus patronage described above, there is a reduction in both bus passenger-kilometres and passenger-hours. On the rail network, however, a 6% increase in passenger-kilometres adds to pressure on the system, and the level of overcrowding more than trebles from 2003 levels. The level of overcrowding on the rail network is reflected by increases in the in-vehicle travel time, based on the degree of overcrowding. The size of the perceived crowding penalty was derived from the SRA Passenger Demand Forecasting Handbook. These trends are also illustrated in Figure 2.7, which shows changes in passenger flow on public transport routes. Increases in flow, primarily on the rail network, are shown in green while decreases are shown in blue.

### Table 2.5 – Public Transport Network Statistics (average hour in morning peak period)

<table>
<thead>
<tr>
<th></th>
<th>2003 Base</th>
<th>2031 Do Minimum</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Passenger Kilometres ('000)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td>104</td>
<td>81</td>
<td>-22%</td>
</tr>
<tr>
<td>Rail</td>
<td>601</td>
<td>639</td>
<td>+6%</td>
</tr>
<tr>
<td><strong>Passenger Hours, including walking and waiting time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td>12500</td>
<td>11900</td>
<td>-5%</td>
</tr>
<tr>
<td>Rail</td>
<td>32900</td>
<td>35600</td>
<td>+8%</td>
</tr>
<tr>
<td>Rail Crowded Time (Passenger hours)</td>
<td>300</td>
<td>970</td>
<td>+227%</td>
</tr>
</tbody>
</table>
Figure 2.7 – Difference in Public Transport Flows between 2003 and 2031 Do Minimum (average morning peak hour)
Thus, if no transport measures were to be put in place, Spatial Scenario F would have the following impacts on the transport system in the Greater Bristol area:

- increase the overall level of congestion on the road network, lengthening journey times and reducing journey time reliability;
- put additional pressure on the motorways and other strategic links, with the impacts exacerbated by developments close to motorway junctions;
- add to existing congestion problems at particular “hot spots” including: M32 Junction 1 and adjoining sections of the A4174; the M4 between Junctions 19 and 20; the M5 between Junction 15 (Almondsbury interchange) and Junction 19; and the M5 at Junction 21;
- reduce the attractiveness of bus services through increased congestion in urban areas, thereby strengthening the dominance of the car for travel in Greater Bristol; and
- increase pressure on already overcrowded rail services.

These changes, especially the increase in car use and associated worsening of congestion, would have a considerable impact on the environment of the Greater Bristol area. The environmental effects would include a 33% increase in CO₂ emissions and increased levels of traffic noise. However, improvements in vehicle efficiency between 2003 and 2031 are forecast to lead to a substantial reduction in emissions of local pollutants such as NOₓ (-45%) and PM₁₀ (-52%) despite the increase in traffic volumes.

**SUMMARY**

The development of the GBSTS transport strategy up to 2031 was based on the increased demand for travel, of which a key factor was the projected growth in population and employment within the Greater Bristol area, with the associated rise in freight movements. Working with the WoEP, GBSTS prepared travel forecasts for 2031 based on 138,000 extra dwellings in the study area, equivalent to population growth of 245,000 from the existing 990,000. For employment, the forecast increase was 95,000 jobs in addition to the current workforce of 500,000.

The additional dwellings were split between 78,000 on brownfield sites in existing built-up areas and 60,000 on greenfield sites formed by extensions to the principal urban areas, particularly Bristol and Weston-super-Mare. Further travel would be generated by growth in activity at BIA with air passenger numbers rising from the current 4 mppa to 12 mppa by 2031 with an associated increase in employee levels.

The growth in travel demand resulting from the increased population and employment would be significant. However, the growth is constrained by the limited capacity on the transport system which results in the suppression of some journeys. Nevertheless, even with some suppression, the additional demand creates severe problems for the operation of the transport network. There is a forecast 34% rise in the number of vehicle trips on the road system in the morning peak but the limited capacity results in a 35% drop in speeds from 44 km/hour and an increase in delay of...
230%, indicating a large scale growth in congestion. Growth in traffic occurs particularly on the motorway network, with an extra 3000 pcus between 2003 and 2031 across the M5 Avonmouth Bridge and between M4 Junctions 19 and 20. Bus operators experience the impact of increased congestion on the road network with bus speeds dropping between 20% and 40%. Consequently the car mode share rises from 88.8% in 2003 to 90.8% in 2031. The decline in bus use is offset to a limited extent by an increase in rail patronage, although the restricted capacity on the rail system constrains the growth in passenger levels with a significant rise in crowding on trains.
3. **Measures to Encourage the Use of Alternative Modes**

3.1 The first group of measures within the study’s transport strategy is designed to encourage the use of alternative modes or to influence the need to make a journey and the choice of destination. These are examined under the headings of:

- walking;
- cycling;
- ‘smarter choices’; and
- land use/development factors.

3.2 With each of these measures, there is the opportunity of making a significant change in the characteristics of journeys, by encouraging either an avoidance of travel, a change in destination (e.g. to more local facilities), a reduction in the frequency of travel or a switch in the mode used. However, there must also be awareness that, for the measures to be fully successful, they need to form part of a package which considers alternatives for the complete journey, for example, providing facilities at both the origin and destination ends of the journey. Furthermore, not all of the travelling public may be able to take advantage of the measures; for example, the disabled, elderly or unfit might be unable to take advantage of improvements to pedestrian and cycling facilities. In addition, there may be further issues, e.g. personal security, which have an impact on the take-up and success of initiatives within this heading. Finally, where the measures are successful in achieving a significant change in travel behaviour, thereby reducing the volume of car travel, there is the potential impact of generated or induced traffic which is encouraged by the newly increased availability of spare highway capacity.

3.3 Despite these potential effects, if introduced with care and skill the measures outlined below have the capability of influencing and altering travel behaviour.

**WALKING**

3.4 There is considerable scope for walking to provide an alternative to the car for short trips and (with high quality connections to, and between, public transport services) it can be a significant part of longer distance journeys. Walking schemes offer the opportunity to provide better access to local services, and also to enhance health, reduce congestion and improve air quality. Improvements to street environments can create vibrant and prosperous urban areas, and contribute to crime reduction.

3.5 Walking to work in the Greater Bristol area is already higher than average at 12%, rising to over 15% in the main urban areas, compared to the English average (10.0%) and the Metropolitan County average (9.8%). Schemes such as the Hillside First School Walking Bus in Weston-super-Mare have shown that it is possible to convert a situation where two-thirds of pupils are being driven to school into one where two-thirds regularly walk.
3.6 Walking is ideally suited to journeys of up to 2km, and integration with public transport can make this a wider catchment area, opening up employment and recreational opportunities across all four unitary authority areas. The use of planning policies and Section 106 agreements can help to achieve improved pedestrian and cycling facilities and enhanced patterns of development which encourage walking and cycling.

3.7 The pedestrian environment has a direct impact on the ease and attractiveness of walking activities, and infrastructure should be high quality and accessible to all. Better design and maintenance of public spaces, the removal of obstructive street furniture and the provision of high quality signing and lighting can create public spaces that are conducive to walking. With the likelihood that there will be extensive levels of new developments across the study area in the period to 2031, it will be vital that the urban design of the developments encourages pedestrian activity and facilitates walking access to the main facilities.

3.8 The aims of the unitary authorities’ Rights of Way Improvement Plan are to help promote walking throughout the Greater Bristol area, providing safe and attractive sustainable transport and recreational opportunities in each unitary authority area. Within the preparation of accessibility analysis for the Joint Local Transport Plan (JLTP), the current pedestrian links and opportunities are highlighted.

3.9 Due to the strategic nature of GBSTS, the transport strategy does not contain specific measures to promote increased walking, although a number of the strategy components (e.g. ‘Smarter Choices’ and demand management measures) are likely to encourage more walking. The study would, however, support measures designed to promote a higher proportion of trips being made by pedestrians and, where specific transport measures are proposed (e.g. public transport enhancements, highway schemes), the needs of the pedestrian should be incorporated actively in the design.

**CYCLING**

3.10 The Greater Bristol area, and Bristol in particular, has achieved considerable success in stimulating greater levels of cycling in recent years; Bristol recorded one of the highest increases in cycling in the UK from 1991 to 2001.

3.11 There is considerable scope for cycling to provide an alternative to the car for short trips. It is a healthy, emission-free and fairly cheap mode of transport which can provide access to local facilities and services, as well as links to the public transport network, especially rail. Furthermore, making the key trip attractors accessible to non-motorised modes is vital in creating an inclusive society. Cycling has an important role to play in progressing towards each of the shared priorities, e.g. improving accessibility for the 21% of households in the Greater Bristol area which do not have access to a car.

3.12 Given the skilful targeting of resources, the Greater Bristol area has great potential to achieve considerably higher levels of cycling. The key strengths of the area are the existing infrastructure, the recent successes in increasing cycling, and the considerable amount of cycle-planning expertise both at the local authority level and with organisations such as Sustrans and Life Cycle. The introduction of the National...
Cycle Network with long-distance trunk cycle routes has been important in raising the awareness of cycle routes. The key challenges will be the need to target new measures in carefully selected areas, ensure that residential and destination cycle parking are comprehensively available, and to strike the right balance between infrastructure and the ‘Smarter Choices’ (described later in this section). In the design of the new housing and employment developments to be implemented by 2031, it will be important to integrate the cycle facilities within the urban environment, with cycle paths incorporated within other transport infrastructure as appropriate. It will be important that cycle measures are included from the outset and due allowance is made in the design so that the cycle measures are fully integrated and not treated as an afterthought.

3.13 Cycle parking is arguably the most important of all cycle facilities. Without adequate secure cycle parking at both ends of the journey, people are more reluctant to cycle. Trip end cycle parking facilities should be encouraged at all major trip attractors (workplaces, shops, leisure activities, etc). Medium and long stay public cycle parking in town centres is particularly important (but often overlooked). Most important of all is the provision of residential cycle parking; all new residential developments should include resident (and, where possible, visitor) cycle parking facilities.

3.14 Design of cycle facilities should be based on the latest and most appropriate technical advice such as cycle-friendly infrastructure, local transport notes and traffic advisory leaflets. It should also reflect the hierarchy of measures as described in recently published Government guidance with traffic and speed reductions coming before re-allocation of road space and dedicated cycle facilities. Cycle audits should be carried out for all significant transport and development infrastructure proposals.

3.15 When cycling is combined with public transport for longer trips, journey times can compete with those achieved by car. Traditionally, heavy rail is the mode which best complements cycling. Catchment areas for cycle trips around train stations are likely to be in the order of 3kms to 5kms. Heavy rail offers good opportunities for both cycle parking (at stations) and cycle carriage (although current provision varies considerably between train operators). Bus travel does not offer the same opportunities as rail for integration with cycling. However, cycle parking should be provided at bus stations, especially if served by longer distance or limited stop bus or coach services.

3.16 The effectiveness and value for money of ‘soft’ measures has only been realised in recent years. Examples of such measures include cycle maps (which have been shown to be effective in increasing the number of cycle trips), personalised travel planning techniques and cycle training.

3.17 As with walking measures described above, the strategic nature of GBSTS means that specific cycling measures are not included in the strategy. Nevertheless, the study supports the introduction by the unitary authorities of the range of potential measures outlined above, particularly those designed to encourage greater use of public transport. At the same time, all new transport infrastructure should be designed to facilitate and stimulate increased cycling.
‘SMARTER CHOICES’

3.18 ‘Smarter Choices’ (also known as ‘soft measures’) are initiatives that seek to provide better information and opportunities to help people reduce their car use while improving the alternatives provided. Taken together, the various measures, if introduced effectively and comprehensively, have the opportunity of making a significant impact on the mode split of travel in the GBSTS area.

3.19 The Government has conducted a programme of research\(^2\) designed to establish the current position with UK experience in the implementation and operation of the ‘Smarter Choices’ measures. The research has been reviewed to highlight the potential impacts for the study area of the individual measures in terms of the level of trip-making and the changes to mode choice, together with the likely costs of implementing the measures. The most effective measures are included in the transport strategy and are described in turn below. However, there are two further general aspects that need to be taken into account when assessing the overall effects on travel behaviour if the measures were to be implemented:

- the distinction between short term and long term effects of the measures on travel behaviour; and
- whether the benefits of changes in travel behaviour, in terms of reduced private car use, created by the measures is eroded by new, induced traffic which takes up some of the newly released capacity.

3.20 In some cases, the local authorities within the Greater Bristol area have already been pursuing some of the ‘Smarter Choices’ policies. Where this is the case, account has been made of the traffic reductions that potentially have already occurred, and the appraisal results reflect the additional benefit that could be accrued over and above that already achieved. Correspondingly, the costs of pursuing the ‘Smarter Choices’ policies are additional to any expenditure that is already taking place.

3.21 In the appraisal of potential measures, the attention was directed at the ‘Smarter Choices’ as a whole. The appraisal did not explore the impact of individual measures on their own.

**Workplace Travel Plans**

3.22 Workplace travel plans (WTPs) are packages of measures put in place by an employer to try and encourage more sustainable travel amongst its employees. WTPs are aimed primarily at addressing the commuting habits of employees, although many also incorporate measures directed at travel during the course of work, including business and delivery travel, and also travel by patients, shoppers, tourists, or other visitors to the employer’s site.

3.23 In parallel with the introduction of workplace travel plans, there are potential benefits from the application of residential travel plans. These plans promote more sustainable travel, particularly for larger new residential developments. While the residential travel plans could assist in achieving some of the benefits identified later in this chapter under the ‘Land Use’ heading, they have so far concentrated on new developments. In the future, there might be the potential to extend the measures...

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\(^2\) ‘Smarter Choices – Changing the Way we Travel’ Cairns et al, Department for Transport (2004).
retrospectively to existing developments. However, the introduction is likely to be limited to sizeable developments and hence the impact might not be extended across the whole study area.

3.24 Currently around 13% of employees in the Bristol area are targeted by WTPs while the ‘Smarter Choices’ report indicates that, if sufficient resources are allocated to the promotion of measures, the figure could grow to 78%. For forecasting purposes, it is assumed that this increase will take place linearly from 13% in the base year to 78% by 2021, after which time it will remain unchanged. Overall, this would produce a reduction of 9.7% in the number of peak car trips to Bristol city centre in 2021, with car trips to destinations outside Bristol city centre falling by 7.6%.

3.25 Based on the costs of promoting WTPs in Bristol and elsewhere, it is estimated that travel plans will cost £4.30 per head in their first year, falling linearly to £2 per head by their third year. The £2 per head will need to continue to be incurred for as long as the plans are retained in order to maintain the impact of the measure. On this basis, the annual cost in 2021 would reach £800,000 and, thereafter, the additional on-going annual cost of WTPs to the local authorities would be around £770,000 per year.

**School Travel Plans**

3.26 School travel plans (STPs) include a range of potential components:

- consultation with the school or college as well as the local community;
- education and information measures;
- road safety training;
- changes within the school;
- initiatives such as ‘walking buses’ and ‘cycle trains’;
- measures to encourage bus use;
- traffic calming;
- cycle lanes; and
- safe crossings.

3.27 Within the South West region, around 15% of schools already have a STP while the DfT’s ‘Smarter Choices’ research indicates that there is unlikely to be an upper limit to the application of travel plans to schools and colleges. Thus, it is assumed that measures could be introduced such that the remaining 85% of schools in the South West have developed a school travel plan by 2021. The reduction in car trips for schools with travel plans is estimated to be the mid-point of the range of impacts identified by the research. This represents a reduction of 12% in the number of car trips to schools, resulting in a drop of 0.5% in the total number of peak car trips to Bristol city centre in 2021, and a 0.4% fall to destinations outside Bristol city centre.

3.28 The annual cost per head to the local authority of a school travel plan is likely to be substantial at around £3.50 to £4.00 per head. This includes the costs of the range of measures outlined above. Maintaining the benefits of the plan, with an ever-changing student population, means that this cost would be incurred every year – thus, the annual cost is estimated to reach £575,000 by 2021.
Tele-working

3.29 Tele-working is the term used to describe the situation where employers encourage employees to adopt a range of remote working practices including working at home or in a location closer to home than their main workplace, for some or all of the time. The impact of tele-working on traffic flows may not be straightforward and will be dependent upon its form and scale. For example, the impact will be affected by whether the tele-working is undertaken on a full-time or part-time basis and whether, in the latter case, it is spread evenly throughout the week. If the majority of tele-working occurs on, say, Fridays, the demand for highway capacity will remain high throughout the rest of the week. In addition, if tele-working encourages people to live remotely from their workplace, the total mileage travelled might actually increase.

3.30 ‘Smarter Choices’ research identifies that around 8% of the working population is engaged in tele-working for some of the time. In addition, the future potential for tele-working is placed at 22.6%. For peak trips to Bristol city centre, the reduction in car trips could represent 3.7% of journeys in 2021 and 2.9% to other destinations.

3.31 Tele-working can save companies money through reduced requirements for office space, parking etc. Its growth is likely, therefore, to come about through market forces and thus there are no public sector costs that need to be considered.

Tele-conferencing

3.32 Tele-conferencing can be defined as the use of telecommunications to facilitate contacts that might otherwise have involved business travel.

3.33 Research quoted in the ‘Smarter Choices’ report indicates that tele-conferencing is relevant to around 26% of employees who are company car drivers, in managerial occupations, who work from home or who travel on behalf of work. For peak trips to the study area, the impact of tele-conferencing is likely to be small; by 2021, the reduction in car trips to Bristol city centre could be less than 0.1% and around 0.25% to other destinations. Off-peak reductions are slightly greater, reflecting the potential for tele-conferencing to replace journeys made in the course of work.

3.34 It is assumed that tele-conferencing offers a commercial benefit to companies such that its growth will take place without further public sector intervention. The cost to local authorities is, therefore, assumed to be zero.

Car Sharing

3.35 Car sharing schemes aim to encourage individuals to share private vehicles for particular journeys. Formal schemes can be employer-led, and are thus assumed to form part of WTPs, or they can be promoted independently by private or public bodies. There are two aspects to the level of take-up for a particular scheme:

♦ the number of people encouraged to join the scheme; and
♦ the frequency with which they are in a position to share a vehicle for a particular journey.
3.36 The overall impact of car sharing is likely to be relatively low. For peak trips to Bristol city centre, the reduction in car trips could represent 0.8% of journeys in 2021 and 0.6% to other destinations.

3.37 The costs of running and promoting car share schemes are not insignificant with South Gloucestershire currently paying around £2,000 per annum for the software licence with £10,000 for promotion and operation. In May 2005, this equated to £20 per match per annum although it is not clear how these costs would change with the expanded coverage of the scheme across the Greater Bristol area.

**Car Clubs**

3.38 Under the scheme, car club members pay an annual membership fee to an operator who then provides a range of vehicles in their neighbourhood for the use of members. To be effective, the combined costs of membership and use are intended to be cheaper than personal car ownership.

3.39 Car clubs are already established in the Bristol area and are likely to continue to grow. However, the impact on overall vehicle mileage is unclear, with the impact on peak demand likely to be small with the main application being for leisure trips, particularly those involving group travel for medium to long distances, especially at weekends. Thus, although there are many benefits to be accrued from the expansion of car clubs, they have not been assessed in detail within GBSTS.

**Home Shopping**

3.40 Although home shopping is a growing phenomenon, in many cases its use does not replace a car journey; the items are purchased for convenience and regular journeys are still made to shopping centres to purchase other items.

3.41 The main area where home shopping could reduce car journeys is in grocery shopping, which accounts for around 40% of all shopping trips. The proportion of grocery shopping represented by internet or telephone shopping currently stands at around 5% and ‘Smarter Choices’ estimates that this could rise to 15% by 2021. The forecast impact of increased home shopping on car traffic in the peak period would be small – around 0.1% by 2021 – though in the inter-peak the reduction would be around 0.75%.

3.42 The promotion of home shopping would be likely to come from the private sector and thus no public sector costs need to be estimated.

**Public Transport Information and Marketing**

3.43 One of the perceived difficulties of existing drivers in using public transport is the absence or shortage of readily available information on services. While this is sometimes an excuse rather than a true reason, there is still a need for both enhanced availability and improved design of public transport information. The network of Showcase Bus Corridors, described in Chapter 5, includes the expansion of real-time passenger information at shops which will provide a significant benefit to passengers.
3.44 However, the provision of information needs to be widened and improved, not only at stops but also with a wider availability. This should involve, for example, identifying a number of key centres and preparing plans showing the range of services, routes and destinations available from the stops in the area. To provide further convenience to potential passengers, local maps showing the street plan in the vicinity of the stop and key facilities should be added. Such information could also be added to the Internet.

3.45 A key feature of the passenger information is that it must be maintained so that the public can have confidence in its accuracy and reliability. Sufficient resources therefore need to be devoted to the maintenance of the information sources.

3.46 There is evidence that the impact of improvements to public transport can be enhanced through effective marketing. In Bristol, following the introduction of the first Showcase bus corridor, it was found that the public transport mode share of groups targeted by marketing increased by 4% while that of the control group only increased by 2%.

3.47 However, while the benefits of enhanced levels of public transport marketing are accepted, it is not possible to estimate the level of traffic reduction that may be achieved from a general adoption of this policy. Furthermore, the impacts of the marketing would tend to be short-lived and hence would not have a major long term effect unless the marketing is maintained and updated regularly.

**Travel Awareness**

3.48 As with public transport marketing schemes, travel awareness campaigns are closely linked with other enhancements to the transport system. Similarly, it is not possible to predict the traffic reductions that may be expected from introducing the travel awareness initiatives and thus this measure has not been included in the core GBSTS strategy.

**Personalised Travel Plans**

3.49 Personalised travel plans provide information directly to individuals or households enabling them to make alternative travel choices and reduce car use. As they encourage changes in travel behaviour for trips to work and school, and promote measures such as car sharing, home shopping and tele-working, to consider personalised travel plans in addition to the other ‘Smarter Choices’ measures would risk significant ‘double counting’. For this reason, specific consideration of personalised travel plans has not been included within the GBSTS strategy.

**Overall Impact of ‘Smarter Choices’ on Car Trip Making**

3.50 The preceding analysis has examined the impact of individual measures designed to encourage changes in travel behaviour. Although the impacts of most of the measures can be added together to provide a prediction of the combined impact, research has shown that, for example, when both WTPs and car sharing policies are pursued, only around 80% of the aggregated benefits can be achieved. On this basis, the effect of implementing the full range of measures outlined above would be a reduction of around 10% in the number of peak period journeys by car across the study area. Using the research in ‘Smarter Choices’, a proportion of the reduction in
car trips is converted into public transport journeys and is allocated to the public transport network as appropriate; on average, about one-third of the reduced car trips transfer to public transport, although this will vary depending upon the quality of public transport services. For the remainder, the trip is either suppressed and removed from the highway network or adjusted through increased car occupancy. In the assessment of the full transport strategy, the impact of the ‘Smarter Choices’ is examined as a sensitivity test to identify whether the introduction of the ‘Smarter Choices’ avoids the need for other measures.

3.51 Figure 3.1 summarises the change in mode split in 2031 as a result of the introduction of ‘Smarter Choices’. Thus, there would be a 9.7% fall in the level of person trips by car, reducing the car mode share from 91% to 87%. The increase in public transport use is spread across the three sub-modes with comparable increases in bus (31%), rail (36%) and park and ride (42%).

Figure 3.1 – Impact of ‘Smarter Choices’ on Person Trip Rates and Mode Shares

3.52 To achieve this level of impact will require significant and constant investment and resources. Furthermore, as identified at the start of this chapter, without parallel schemes (e.g. demand management) to control the level of traffic induced by the capacity released through the ‘Smarter Choices’ measures, there is the danger that the overall impact would be less than predicted, based on the review of available research.

3.53 As the highway network statistics in Table 3.1 suggest, ‘Smarter Choices’ have a potentially large impact on highway congestion. Compared with the Do Minimum, highway trips are reduced by 8%, and total vehicle delay reduced by 32%. Nevertheless, even with ‘Smarter Choices’ in place, the total vehicle delay in 2031 is more than double that in 2003. This highlights that, while ‘Smarter Choices’ may
reduce the need for improvements to the highway network, other solutions are needed in addition to the ‘Smarter Choices’.

Table 3.1 – Impact of ‘Smarter Choices’ on Highway Network Statistics

<table>
<thead>
<tr>
<th></th>
<th>2003 Base</th>
<th>2031 Do Minimum</th>
<th>2031 with ‘Smarter Choices’</th>
<th>% Change – 2031 ‘Smarter Choices’ compared with 2003 Base</th>
<th>% Change 2031 with ‘Smarter Choices’ compared with Do Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>154200</td>
<td>207000</td>
<td>191100</td>
<td>24.0%</td>
<td>-7.7%</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>1998000</td>
<td>2899000</td>
<td>2665000</td>
<td>33.4%</td>
<td>-8.1%</td>
</tr>
<tr>
<td>Vehicle Hours</td>
<td>45200</td>
<td>102600</td>
<td>78600</td>
<td>73.8%</td>
<td>-23.4%</td>
</tr>
<tr>
<td>Average Vehicle Speed</td>
<td>44</td>
<td>28</td>
<td>34</td>
<td>-23.3%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Mean Journey Length km (per vehicle)</td>
<td>13.0</td>
<td>14.0</td>
<td>13.9</td>
<td>7.6%</td>
<td>-0.4%</td>
</tr>
<tr>
<td>Total Vehicle Delay (Hours)</td>
<td>19100</td>
<td>65200</td>
<td>44300</td>
<td>131.5%</td>
<td>-32.1%</td>
</tr>
<tr>
<td>Time Lost per Vehicle-Km (seconds/veh km)</td>
<td>34.5</td>
<td>81.0</td>
<td>59.8</td>
<td>73.6%</td>
<td>-26.1%</td>
</tr>
<tr>
<td>Vehicle-Hours of Delay per Network Km (veh hrs/km)</td>
<td>6.8</td>
<td>23.2</td>
<td>15.7</td>
<td>131.5%</td>
<td>-32.1%</td>
</tr>
</tbody>
</table>

Impact of ‘Smarter Choices’ on Public Transport Trip Making

3.54 The public transport network statistics in Table 3.2 illustrate the impact on the public transport network of mode switching due to the implementation of ‘Smarter Choices’. With no capacity enhancements, it is unlikely that the public transport network would be able to cope with such a widespread increase in demand. On the rail network, the level of crowding increases threefold compared with the Do Minimum. This equates to around 10 times the level of crowding experienced by passengers in 2003. Thus, it is vital that the implementation of ‘Smarter Choices’ is in association with other improvements to the transport system. In particular, increased public transport capacity is required to cater for the additional public transport demand generated by the ‘Smarter Choices’.
Table 3.2 – Impact of ‘Smarter Choices’ on Public Transport Network Statistics

<table>
<thead>
<tr>
<th>Passenger Kilometres by Public Transport Sub-Mode</th>
<th>% Change – 2031 with ‘Smarter Choices’ compared with 2003 Base</th>
<th>% Change – 2031 with ‘Smarter Choices’ compared with Do Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Kilometres by Public Transport Sub-Mode</td>
<td>2003 Base</td>
<td>2031 Do Minimum</td>
</tr>
<tr>
<td>Bus</td>
<td>104000</td>
<td>80000</td>
</tr>
<tr>
<td>Rail</td>
<td>601000</td>
<td>637000</td>
</tr>
</tbody>
</table>

Crowded Time (Passenger Hours)

<table>
<thead>
<tr>
<th>Crowded Time (Passenger Hours)</th>
<th>2003 Base</th>
<th>2031 Do Minimum</th>
<th>2031 with ‘Smarter Choices’</th>
<th>% Change – 2031 with ‘Smarter Choices’ compared with 2003 Base</th>
<th>% Change – 2031 with ‘Smarter Choices’ compared with Do Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>300</td>
<td>1000</td>
<td>3700</td>
<td>930%</td>
<td>209%</td>
</tr>
</tbody>
</table>

**LAND USE ISSUES**

3.55 The relationship between land use patterns and the transport system is well-appreciated. People need to travel between places in order to undertake their desired activities and thus the pattern and scale of development influences the pattern and scale of travel. Conversely, changes in accessibility brought about by adjustments to the transport system influence the uses made of available land and the locations where activities are undertaken.

3.56 Land use changes have had a significant impact on facilitating and encouraging the increase in the demand for car travel over the last 25 years. During this time, there has been some implicit travel demand management in the denser urban areas through rationing by congestion. This has had the impact of producing a major switch in population patterns away from congested urban areas where cars are costly to keep and run, and into suburban or rural areas where cars are easier to park and traffic speeds are higher. Research on national travel patterns over time has highlighted that people 'appear to have a need to travel to find resources and to socialise'. Individuals have, on average, spent 55-65 minutes a day travelling since records were first kept. So, the impact of improving the highway network has been to encourage people to travel further within the given available time and hence workplace and home have tended to become more remote. In the same way, the impact of increasing congestion, especially in the outer suburbs, would be to encourage a movement back into central areas.

3.57 Urban road improvements and the level of congestion have certainly not been the sole cause of population decentralisation, but they have acted as major contributory factors. There is already evidence of some recent changes in these trends: increasing road congestion has encouraged significant growth in rail movements within the study area although absolute rail demand levels are low.

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3 Intelligent Infrastructure Futures Project Overview, Office of Science and Technology, Department of Trade and Industry, (Jan 2006).
3.58 The construction and improvement of the strategic road network has resulted in the generation of a series of developments within the GBSTS area. These developments represent a wide range of different land uses: residential, retailing, industrial, warehousing, etc. However, in many cases, the transport system has not kept pace with the traffic generated by the new developments, with the resulting increase in the level of congestion within the local road network. This is especially true in the North Fringe. This stems from a time when there was little integration between land use and transport planning policies. Many of the new developments were located in or adjacent to the Green Belt, creating additional pressures on the Green Belt with consequent environmental problems. Furthermore, the growth of the out-of-town developments, principally at Cribbs Causeway, was at the expense of the traditional urban centres which therefore experienced a significant decline with resulting economic problems. Finally, the out-of-town centres were designed with car access in mind and hence the centres frequently experienced low levels of public transport service thereby increasing the social exclusion for those without access to private transport.

3.59 The choice made by households about where to live is based on a complex number of factors including the size of the household, its age composition, number of workers, available schools, cost of housing, etc. However, once the family has found the house that they can afford, in an area where they wish to live, they are generally reluctant to relocate when one of the household members seeks alternative employment. Changes in the general employment market in recent years have strengthened the effect because of:

- an increased number of temporary and short-term contracts;
- a greater likelihood that both partners in a household are in employment and hence it becomes less likely that the household will move home when one partner changes jobs; and
- the perception that jobs are less secure and hence people are unwilling to move house to be nearer to a job that they may wish, or need, to change in the foreseeable future.

3.60 The diminished desire to move home is exacerbated by the costs involved in house sale and purchase, especially with the increase in property prices and the extra costs due to Stamp Duty.

3.61 The overall impact of such effects is that, due to the reluctance to change the home location, when seeking new employment the potential catchment area is drawn based on the available transport system – the road network and public transport services. As the highway network has been extended and improved in the past, so the employment catchment area has widened and the level and length of commuting has increased. Although congestion may have dampened the impact slightly, often the reaction has been to change the time of travel (especially to a time before the morning peak and after the evening peak periods) in order to avoid the main congestion. Hence, there must be an awareness of the implications of the location and form of new land use developments on the transport systems when the details of the spatial developments are being confirmed.

3.62 The starting point for the development of transport strategies within the study was the spatial development forecasts prepared by the WoEP. Our primary task was to design a transport system which best served the given land use pattern in Scenario
F. However, within the linkage between land use and transport, the form and density of any development can have a significant impact on the associated volume of travel.

3.63 Land use policies which may encourage both a reduction in the total volume of travel and a decreased use of the car include:

♦ concentrating developments within transport corridors and near to public transport nodes;

♦ mixing development so that homes are closer to schools, workplaces, shops and leisure facilities; and

♦ increasing the density of development so that more facilities can be reached within a given distance.

3.64 One argument against policies of this kind is that they tend to concentrate development where land is in shortest supply and where it is most costly to provide transport improvements. That aside, the policies ought, in principle, to reduce the need for travel. The three key questions are:

♦ would they actually result in less travel?

♦ how quickly could they have an effect?

♦ how much effect could they have?

3.65 Rather than inducing less travel, policies of concentration simply provide people with more choice within any given travel budget and, as a result, the effects are quite muted. Thus, on their own, land use policies might not have a large effect, but if they could be supported by other traffic restraint policies e.g. workplace travel plans, public transport improvements, the effects could be more significant. Moreover, in established areas where the need for regeneration is not strong, the pace of redevelopment is likely to be slow, thereby limiting what these policies can achieve within reasonable time frames. That is not to say that these policies are not worth pursuing; they are probably a step in the right direction, but, on their own, they will not lead to large reductions in traffic in short or medium timescales.

3.66 In summary, there are four points of particular note about land use policies:

♦ policies which, in principle, reduce the need for travel by mixing development and which focus the demand for travel on the public transport system are worthy of support;

♦ however, even though land use policies may reduce the need for travel by car, on their own, they would not be sufficient to reduce travel by car significantly – some other measure would be required to encourage or coerce people to use the facilities nearest to them;

♦ moreover, development in established areas is renewed at a relatively slow rate and therefore the effects of land use policies can take a long time to feed through into reduced car travel; and

♦ even if planning policies which reduce car travel are adopted, and people reduce their car travel voluntarily, and the rate of re-development is high, it is still necessary for the policies to be enforced for their effects to be felt – the desire for more jobs or housing often compromises the strict application of land use policies.
3.67 There is a strong need for increased quality in the general design of new developments, including the provision and incorporation of transport measures. Recent research undertaken by the Commission for Architecture and the Built Environment into private housing projects undertaken in the north of England over the past three years identified that 94% of the projects failed to provide the necessary design quality, including the provision and design of transport facilities. These results confirmed the conclusions from an earlier examination of developments in the south of England. Hence, there is strong evidence that more attention and efforts need to be taken in the design of the new developments proposed for the study area in the future.

3.68 One of the primary reasons that strategic roads fill up with new traffic so quickly after being built or widened is because new developments spring up close to them and it is often difficult for the planning and highway authorities to resist these development pressures. Clearly, a policy of restricting certain kinds of development (e.g. offices) at interchanges would avoid much localised congestion, both on the trunk road itself and on the connecting roads, although, of course, there are other kinds of development (e.g. warehousing and distribution centres) which are better located near to a motorway than elsewhere.

3.69 In terms of employment locations, there is a large number of competing sites in the study area, with the result that the planning system has great difficulty in influencing the overall pattern of development. The planning system is, generally, more effective in controlling residential and retail developments than other forms of development. However, in the case of residential development, the planning system cannot control the destination of trips from residents – i.e. their place of work.

3.70 The current position is one in which existing investment in the motorway network has resulted in strong pressures for development of traffic intensive facilities close to entry/exit points. These pressures remain, despite growing levels of motorway congestion.

3.71 It is recognised that certain kinds of development are acceptable, or even desirable, in proximity to motorway junctions. For example, warehousing and distribution in these locations can be argued to reduce heavy good vehicle mileage on less suitable roads. The problems arise where proposed developments are intensive in employment or retail terms, and hence are likely to be major traffic generators.

3.72 There may also be a need for a strengthening of policies. In particular, it may be argued that proponents of employment or retail developments close to motorways should have to provide evidence that modal shares for public transport, walking and cycling would be significant. Given that current Government policy identifies town centres as the preferred location for major employment and retail development, forecast non-car modal shares could be required to be of the same order of magnitude as is generally achieved for town centres. For most motorway junction sites, such non-car mode shares would not be achievable. In such cases, even if a suitable alternative town centre location is unavailable, logic, from the point of view of the management of the road system, suggests that the application should be refused.
3.73 Before embarking on measures that are potentially costly in resources or finance, in developing the transport strategy it is important to explore measures which are designed to influence the decision to make a journey or to encourage the use of alternative modes.

3.74 The transport strategy has been prepared against a background of significant developments in population and employment. The design and implementation of the new developments should be planned so as to reduce the total volume of travel and encourage the use of alternative modes to the car. Such policies should include the concentration of developments within transport corridors easily served by public transport; the creation of a mix of developments so that more activities are easily reached by walking or cycling; and an increase in the density of development such that there is a choice of facilities within a specified distance. Furthermore, the design of developments (especially major residential schemes), should pay particular attention to their operation in the most sustainable way.

3.75 Although detailed schemes to enhance walking and cycling are outside the scope of a strategic study like GBSTS, there are nevertheless benefits to be achieved from providing attractive schemes and facilities to encourage greater levels of these activities. At the same time, other policies, such as demand management or ‘Smarter Choices’ will encourage the use of alternative modes and hence will stimulate walking and cycling, if the supplementary measures are in place.

3.76 The expansion of initiatives under the heading of ‘Smarter Choices’ can have a positive impact on the overall volume of travel and the level of car use. Some of the policies contained in ‘Smarter Choices’ are within the responsibility of the public sector including workplace travel plans, school travel plans, car sharing and car clubs. The unitary authorities within the Greater Bristol area already actively pursue these measures, and it is vital that renewed and enhanced efforts are made to expand their coverage. This will require a continuous application of resources to maintain the impetus and continue the level of benefits. The impact of ‘Smarter Choices’ would be strengthened and supported by other policy measures such as demand management which would provide further encouragement for the use of alternative modes. It is estimated that a comprehensive policy of ‘Smarter Choices’ combined with other complementary measures could reduce person trips by car by around 10%. Other elements of ‘Smarter Choices’ could include tele-working, tele-conferencing and home shopping; while these features would contribute to the use of alternative modes, much of the initiative behind them would come from market forces and the savings and benefits obtained by the private sector. Hence, because they are generally outside the control or influence of local authorities, their promotion is not included in the GBSTS transport strategy.

3.77 It will be important to develop the full potential of the range of approaches to encourage alternative modes before embarking on major infrastructure developments. However, there needs to be awareness that continued promotion of the measures is necessary if the full impact is to be achieved and maintained.
4. Demand Management Measures

4.1 Chapter 2 highlighted the growth in the demand for travel by 2031, linked to the general increase in travel demand and the specific impacts of individual developments. It would not be feasible, or desirable, to satisfy the full extent of projected car usage by the provision of additional capacity on the highway network. Hence, within the transport strategy, it is important to explore ways of effectively controlling the growth in demand for travel by car while at the same time providing more attractive public transport alternatives before considering extensions to highway capacity. Such measures to control car demand would also act to support the policies, outlined in Chapter 3, to encourage the use of alternative modes. Within this chapter, we describe the impact of measures designed to manage the demand for private car use before examining public transport improvements in Chapter 5 and highway measures in Chapter 6.

4.2 There is a wide range of potential measures that can play an important role in influencing and controlling the volume of travel across the GBSTS study area, and the proportion of that travel that is undertaken by the private car. While many of the measures can be undertaken immediately (and many are already being employed by some or all of the unitary authorities as part of their current transport policies), many additional potential measures are not yet available. In some cases, the measures would require new legislation and may not be implemented for several years, perhaps towards the end of the GBSTS horizon of 2031.

4.3 In examining the available measures and their potential impacts, it is therefore important to distinguish between policies that can be implemented immediately and those that will require considerable development time and resources. In the latter case, it would not be prudent to develop an overall transport strategy that is critically dependent upon measures that have such a high risk associated with them. This is particularly true of various forms of road user charging which would require a combination of additional legislation, new technology and the resolution of significant technical and policy issues before they could be implemented, and may be more appropriate as part of a national scheme. As a result, the transport strategy has two elements within the heading of demand management measures: firstly, using conventional demand management tools and secondly including more innovative, charging-based policies and techniques.

4.4 Within the development of the transport strategy, there is therefore a distinction between the policies that are available at different stages in the timescale for the study:

- short term – parking controls and other existing policy instruments;
- medium term – introduction of workplace parking charges and local vehicle charging measures; and
- long term – application of wider regional or national charging measures.

4.5 Within this structure, the use of parking controls is considered before moving to various forms of charging for the use of different parts of the highway network.
4.6 There are several forms in which parking controls may have an impact on the use of the private car, each of which is currently implemented in various ways by the four unitary authorities in the GBSTS study area:

- increased or improved enforcement of existing parking controls;
- varying the cost of parking – this could include changes to the general charge level, the structure of charges or the area covered by the charging system, although the latter may also require increased resources for enforcement;
- controls on the number of spaces available, including a reduction in the absolute number of spaces, controlled levels of growth or restrictions in parking availability at specific times of day or for certain types of vehicle or driver;
- limits to the availability of spaces for specific categories of user, e.g. the introduction of controlled parking zones or the allocation of parking places to specific users, e.g. the disabled or drivers of vehicles with a high vehicle occupancy; and
- parking standards – controls on the maximum number of spaces provided in new developments.

4.7 Most of the measures identified above can be introduced or amended within a relatively short period of time and hence would have an early impact on demand. The exception is with parking standards which, although existing standards might be adjusted quickly to control the maximum permitted number of spaces, the speed with which they might reduce traffic levels would be dependent upon the rate at which new developments are completed. Hence, the policy will be effective in only a limited number of locations and over a lengthy period.

4.8 Parking controls are usually introduced and applied in major centres of activity such as town or city centres or local suburban centres. However, there is no reason, in principle, why the controls could not be introduced over wider areas, although the costs of enforcement would increase and resources would be spread over a wider area. Within the GBSTS study area, there is the additional constraint that parking at the main out-of-town shopping centre at Cribbs Causeway, which has about 10,000 spaces, is outside the control of the unitary authority and hence there is limited opportunity to use parking controls to influence the use of the private car at this site. Given the importance of Cribbs Causeway to traffic movements in the study area (especially in the north of the area and on the motorway network), this represents a restriction in the ability of the unitary authority to control traffic levels on the highway network in the area.

4.9 With increased parking controls, it is likely that there would be some induced traffic both in the controlled area and immediately outside it (where congestion is reduced as a result of parking restraint). Hence, other traffic restraint measures would also be required to supplement the effects of parking controls if they are to be fully effective. In addition, controls which limit the availability of parking spaces are likely to increase the volume of circulating traffic in search of spaces. The introduction of workplace travel plans or workplace parking charges could also require additional on-street controls (e.g. controlled parking zones) and enforcement, potentially over a wide area. This would therefore lead to the need for the development of a comprehensive area-wide parking plan.
4.10 An additional important factor with the introduction of parking controls is that they are an important potential source of revenue for the unitary authorities which in turn provides a means of redressing some of the adverse effects of traffic restraint, through investment in beneficial complementary transport projects, especially improvements to public transport.

4.11 Table 4.1 shows the results of testing parking restraint using the Greater Bristol Model, indicating that increased parking restraint would have a modest impact on delays across the study area in 2031, but could generate significant revenues.

**Table 4.1 – Impact of Parking Controls**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Reducing Parking Capacity</th>
<th>Doubling Public Parking Charges in City Centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car Trips</td>
<td>-0.2%</td>
<td>-1.0%</td>
</tr>
<tr>
<td>Total Vehicle Kilometres</td>
<td>+0.0%</td>
<td>-0.4%</td>
</tr>
<tr>
<td>Average Journey Length</td>
<td>+0.1%</td>
<td>+0.4%</td>
</tr>
<tr>
<td>Total Vehicle Delay</td>
<td>-0.4%</td>
<td>-2.6%</td>
</tr>
<tr>
<td>Average Vehicle Speed</td>
<td>+0.2%</td>
<td>+1.1%</td>
</tr>
<tr>
<td>Estimated Annual Gross Revenue</td>
<td>n/a</td>
<td>£30 million</td>
</tr>
</tbody>
</table>

4.12 Although increased parking charges and extensions to the coverage of parking controls could produce additional revenue for use in complementary measures, the variations in charges will need to take into account factors other than those related specifically to controls in private car usage. In particular, the levels of charges in town or city centres could have a significant impact on the level of retail activity and hence the economic prosperity of the area. Hence, any increases in parking charges would need to reflect this, perhaps by limiting the increases in charges during off-peak periods or for short stays so as to restrict the impact on shopping activities which are a major influence on the commercial prosperity of the area. Furthermore, not all parking revenue accrues to the public sector; there are significant volumes of parking capacity within the private sector. Revenue from these spaces is therefore not available for reinvestment in complementary measures.

4.13 In order to control traffic levels using parking policy instruments, the strategy should therefore include:
- increasing parking charges at rates above the level of inflation, with particular attention to long stay rates charged to commuters, rather than short term charges for shoppers;
- controls on the number and availability of parking spaces;
- increased enforcement;
- introduction of controlled parking zones on the periphery of the central areas and in locations where there is significant on-street employment-related parking;
♦ exploration of ways of controlling traffic levels at Cribbs Causeway; and
♦ introduction of more stringent parking standards at new developments, coupled with Travel Plans and ‘Smarter Choices’ described in Chapter 3.

**WORKPLACE PARKING CHARGES**

4.14 The 2000 Transport Act provided local authorities with the powers to introduce workplace parking charges, by which employers incur charges based on the availability of parking spaces provided for staff.

4.15 With no practical experience in the UK of implementing workplace parking charges, it is difficult to assess fully the effectiveness of the measures. In the first instance, the workplace charge would be incurred by the employer. Its effectiveness as a mechanism for reducing traffic is likely to be dependent upon the extent to which employers pass on charges to the users of the parking spaces, i.e. their employees, who are making the decision about which mode to use for the journey to and from work. There is the strong possibility that employers would not pass the charge onto the employee. Even if there was an obligation on the employer to pass the charge onto the employee, salary levels could be increased to compensate, if the employer was concerned about potential problems of staff retention. Hence, the impact on reducing traffic levels would be muted.

4.16 The introduction of the charge would, however, encourage employers to reduce the number of parking spaces on the site and, in parallel, provide an impetus for an active workplace travel plan to influence the travel behaviour of employees. Thus, the workplace charging scheme could be seen as a complement to travel plans, described in Chapter 3.

4.17 To be fully effective, the introduction of workplace charges would need to be combined with measures that:
♦ oblige employers to pass the charges onto the users of the parking spaces;
♦ control the level of induced traffic; and
♦ manage the volume of longer distance traffic that re-routes through the area in which parking is controlled.

4.18 Table 4.2 shows the results of testing workplace parking charges in the North Fringe area in 2031. The test assumes that employers pass the charges on to the users of the parking spaces, but takes into account the potential for induced traffic and the effects of the re-routeing of longer distance traffic. The results show that the workplace charge would have a greater impact on congestion and generate more revenue than increasing city centre parking charges because, by including private non-residential spaces, it involves more parking activity.

4.19 It should be highlighted that an obligation for the employer to pass on the charge would require a change to the existing legislation. Even if legislation were introduced, it is doubtful if the obligation to pass on the charge would be fully effective; employers could simply compensate employees through a higher salary (in order to attract or retain staff) and hence there would be little deterrence. Thus the impact on congestion shown in Table 4.2 indicates the upper end of what could be achieved.
Table 4.2 – Impact of Workplace Parking Charges

<table>
<thead>
<tr>
<th>Measure</th>
<th>Workplace Parking Charge (£5 per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Change compared with Background Transport Strategy</strong></td>
<td></td>
</tr>
<tr>
<td>Car Trips</td>
<td>-0.5</td>
</tr>
<tr>
<td>Total Vehicle Kilometres</td>
<td>-0.1</td>
</tr>
<tr>
<td>Average Journey Length</td>
<td>+0.3</td>
</tr>
<tr>
<td>Total Vehicle Delay</td>
<td>-0.8</td>
</tr>
<tr>
<td>Average Vehicle Speed</td>
<td>+0.3</td>
</tr>
<tr>
<td><strong>Estimated Annual Gross Revenue (in 2003 prices)</strong></td>
<td>£10 million</td>
</tr>
</tbody>
</table>

4.20 The potential imposition of workplace charging could result in either fewer parking spaces in new developments or the release of land currently used for parking in existing developments. However, the magnitude of the latter effect is likely to be limited because the packages of land would be small and it could take a long time to work through into changes in traffic levels.

4.21 Furthermore, where there is a predominance of office-based employment in leased accommodation, there would be a need to ensure that the workplace charging extends over the wider area, otherwise at the end of the lease, the employers may relocate out of the area covered by the workplace charge.

4.22 While we do not therefore see workplace charging as a major long term element of the transport strategy for the whole GBSTS area, there will be benefits from a local scheme in locations which are not otherwise subject to significant controls on car use (e.g. the North Fringe). Advantage should therefore be taken within the scope of the newly-created Transport Innovation Fund (TIF) to further develop this scheme. At the same time, with the operation of workplace travel plans in the area, the two measures will enforce each other.

**ROAD USER CHARGING**

4.23 Charging for use of the road network by private vehicles could take a number of forms. All such schemes would create benefits and disbenefits for different users of the transport system in terms of changes in journey times, vehicle operating costs and the level of charges paid. In line with the 2000 Transport Act, receipts from any charging scheme would need to be hypothecated to fund other transport initiatives in the area, which should then create further benefits to transport users.

4.24 For a road user charging scheme to be worthy of implementation, it should:

- be good value for money, taking account of environmental and safety impacts, economic benefits and disbenefits, and the costs of implementation, operation and enforcement;
be acceptable in terms of the distribution and equity of its impacts, particularly in terms of its effects on social exclusion; and

be financially viable, practical and broadly acceptable to the public.

4.25 Ideally, the charges should be set so as to yield the maximum net benefits to society as a whole. In principle, to achieve this, charges would need to vary by area, by road type, by vehicle type, by time of day or by the level of congestion. However, there will be limits to the variations that would be practical to implement and acceptable in practice if they are to be fully understood by the public. To be effective in influencing behaviour, the driver would need to know the likely charge before setting out. If there are too many potential reasons for variations to the charge, the lack of transparency could influence the successful operation of the scheme.

4.26 Benefits from the introduction of charging measures accrue to continuing road users as a result of reduced congestion, which arises because of the lower traffic levels in the road network. Disbenefits to the current road users arise in a number of ways, if, as a result of the charge, they decide to change their existing journeys to a less preferred alternative, including a change of mode, a change of destination or the suppression of the trip. People who change mode will experience a loss because the trip by the new mode will be less desirable or convenient in some sense than the current car trip, otherwise they would have used the new mode initially. Similarly, travel to the new destination will be less desirable or convenient than travel to the original one. If they are deterred from travelling at all, car drivers will clearly experience a loss of benefit in some form through their inability to undertake the desired activity at the destination.

4.27 If congestion is sufficiently high, the benefits arising from reduced congestion and faster travel times on the road system will outweigh the penalties experienced by those who are deterred from travelling as they wish. Thus, charging in areas where congestion is high will often yield a positive net travel time benefit, but charging in areas where congestion is lower may not actually yield a net travel time benefit.

4.28 There may also be some potentially undesirable side-effects, such as extra traffic and development pressures on roads which, without the charging system, would be relatively uncongested and therefore would potentially attract lower than average charges. In principle, the charging structure could be set up so that people pay for the costs they impose on society, whether in the form of congestion, accidents or environmental impacts.

**Urban Congestion Charging**

4.29 Charging for the use of the road network in urban areas by private vehicles could take a number of forms:

- charges for using a single link (e.g. a bridge toll) or one of a series of links forming a cordon around an area, with charging levels possibly varying by direction, time of day, type of vehicle, etc;
- payment for a supplementary licence – either a charge to enter an area (an entry permit) or to travel within an area (an area licence);
- congestion metering – a charge which reflects the congestion caused by each driver, varying according to traffic conditions;
time-based charging – a charge which is proportional to the time spent travelling within the charged area; and

- distanced-based charging – a charge directly linked to the distance travelled within the charged area.

4.30 With point-based or cordon charging, drivers would be charged for entering an area (for example inside Bristol Inner Ring Road), and a number of pay stations could be required to cover such an area adequately. Through the use of electronic payment and monitoring systems, the need for pay stations can be minimised. Supplementary licences charge for access but, once a payment has been made, the amount of travel is unlimited. The Mayor’s scheme for central London is a form of supplementary licence.

4.31 The schemes that have been considered in the past for Bristol and Bath city centres are a form of cordon charge with drivers paying each time they cross the cordon. There is merit in such schemes, although attention needs to be paid to the location of the cordon so that it is sufficiently large to influence the behaviour of a number of drivers; a small cordon would have little impact on overall traffic levels, although it could represent a means of testing the technology and payment systems as well as a source of revenue for investment in other transport improvements and a way of introducing the principle of charging. A large cordon, on the other hand (for example along the broad alignment of the Avon Ring Road), would mean that a large number of journeys are made wholly within the cordon and hence would not be intercepted by the charging system. A number of alternative alignments for a cordon charge have been examined by the study including an intermediate cordon midway between the Inner and Avon Ring Roads.

4.32 Further work is necessary to examine the full range of impacts of individual cordon alignments. A bid for funding under the Transport Innovation Fund for the further development of a cordon charging scheme for Bristol City Centre has been submitted recently to the Department for Transport and such a scheme is supported as an important initiative in the short/medium term.

4.33 Distance-based charging can now be achieved, in principle, through the use of GPS-based systems which are being developed for use in many parts of the world although a number of technical, administrative and political issues need to be resolved before a full system can be implemented. In the earlier section on parking controls, it was explained how the removal of traffic can cause secondary effects such as induced traffic and the re-routeing of traffic previously travelling around the controlled area. Congestion metering has the advantage that it can be used to control the amount of new traffic that would be induced when congestion in an area is reduced.

**Inter-Urban or Motorway Charging**

4.34 Motorway charging could be applied in order to fund improvements to the motorway system or to reduce demand on the motorways, particularly at peak times.

4.35 Studies of this mechanism have shown that the most likely reaction of drivers to a charge for use of motorways is to divert to the uncharged roads, and changes in overall demand are likely to be small by comparison. While this achieves the objective of reducing congestion on the charged roads, congestion, accidents and
environmental nuisance would all increase on the parallel uncharged roads. The propensity of drivers to divert away from motorways is dependent on the availability of other routes, on the comparative levels of congestion on charged and uncharged roads and on the size of the charge. For example, in the GBSTS study area, it would be feasible to introduce tolls on the M5 Avonmouth Bridge. As the alternative routes are fairly limited, the demand for the motorway is likely to be relatively inelastic to increases in the toll. However, if the construction of a parallel Avon Crossing was also included in the strategy, the demand for using the motorway would be more elastic because there would be more opportunities for traffic to divert from the motorway onto local roads, particularly onto the second Avon Crossing. Hence, the two crossings would need to be included in the charging system.

4.36 Charging is also an important instrument in avoiding the benefits of transport investments being diluted by the impact of induced traffic. By including charges on the new links, e.g. a second Avon Crossing, it would be possible to control the level of induced traffic and hence ‘lock in’ the benefits of journey time savings from the new investment so that they are not eroded by increased traffic levels and hence lower speeds and less journey time savings.

4.37 If tolls were located on the entry to the motorway and hence the charge on drivers was not dependent on the distance travelled, this would tend to reduce the use of the motorway by those people only travelling for a short section on the motorway. For example, as a fairly large proportion of the traffic crossing the M5 Avonmouth Bridge is of this kind, entry tolls could be an effective means of managing demand on such sections of the motorway.

4.38 In contrast to urban congestion charging, it is rare for motorway charging to be economically beneficial. This is because the disbenefits caused by traffic diverting from the motorway onto other roads will generally outweigh the benefits from reduced congestion on the motorway. For this not to be true, motorway congestion would have to be very severe and the uncharged roads relatively uncongested, and these conditions are rare and certainly not found within the study area. So, while motorway charging can provide revenues, it does not generally yield economic benefits.

**Area-Wide Congestion Charging**

4.39 The impacts of urban congestion charging schemes, especially those confined to central areas (such as the Mayor’s scheme for London and the schemes considered in the past for Bristol), will dissipate quite rapidly outside the charged area. The impacts of this kind of scheme on strategic traffic, e.g. on the M4 and M5, may therefore be quite limited. As explained in the previous section, applying charges to traffic using the motorways alone could cause significant diversion of traffic onto the uncharged non-motorway roads, which would be undesirable because of additional environmental nuisance, accidents and congestion. In other words, motorway charges on their own would simply move traffic and the related problems from the motorways to the non-motorway roads.

4.40 In order to reduce traffic on the motorways without causing major diversions to the local road network, congestion charging could be extended to cover all roads. This area-wide approach would provide a means of reducing congestion and controlling traffic levels across the network as a whole, thereby minimising the likelihood of additional traffic being induced due to reduced congestion. Furthermore, the
introduction of area-wide charging in parallel with other transport measures, e.g. parking controls or workplace travel plans, will tend to reinforce the other measures by controlling the level of induced traffic.

4.41 The revenue from an area-wide system, net of the costs, is expected to be very considerable. For the economy of the charged area to benefit, the net revenues should be spent in the charged area. As noted above, it is important that the revenues are spent wisely, so that the expenditure or investment of the revenues itself brings further benefits.

4.42 The DfT is currently investigating the possible implementation of a national road pricing scheme which would cover all roads. Its work has been focusing on:

- developing a scheme that is not too complex or costly to run;
- establishing the technological options for a reliable and cost effective system of recording distance, place and time of travel; and
- establishing safeguards to protect privacy of individuals and to ensure that an appropriate price is charged for each journey in a way that the motorist can see and understand.

4.43 Such aspects raise a range of issues and in order to ensure that full consideration is given to all the issues and allowing sufficient time for debate, legislation, preparation and implementation, the Government’s view is that such a national approach would not be feasible until after 2021. However, within the current bids for funding under the Transport Innovation Fund, there is the potential for schemes promoted by local authorities which have some of the characteristics of the possible national scheme to be introduced within a shorter timescale.

4.44 There had been a separate scheme to introduce distance-based HGV charging, which was due to be implemented in 2008, and hence could pilot some of the techniques and help to inform the debate on a future wider scheme extended to all traffic. However, the Government announced that the plans for the HGV scheme have been shelved and will now be considered as part of the wider national road pricing proposals, and hence could not be implemented before 2021.

4.45 Within GBSTS, alternative forms of area-wide charging have been assessed:

- distance-based charge applied at a standard rate on all roads in the study area; or
- variable charge linked to the level of congestion on individual roads.

4.46 With the distance-based charge, a wide range of different charge levels were examined ranging from 10p/mile to £1.25/mile, applied to all roads in the study area.

4.47 The area-wide distance-based charge was applied across the whole study area and, as would be expected, the impact increases at higher charge levels (see Figure 4.1), although the additional effect of an incremental increase in the charge reduces very slightly at higher charge levels. In addition, for simplicity, the tests assumed that the same charge would be applied to all vehicle types. In practice, a differential charge might be introduced, e.g. for HGVs. As noted above, until recently the Government had plans to introduce an initial distance-based charging scheme for goods vehicles which had the broad support of the UK freight industry which felt that the charge
would have the impact of equalising operating costs, especially with foreign based vehicles which currently have lower operating costs. Operators of goods vehicles perceived significant benefits from the introduction of area-wide road user charging, with the impacts of significant improvements in journey time reliability, a key aspect of freight operations.

4.48 At the 25p – 50p per mile level, the charge has a very significant impact, resulting in:

- 5%/10% reduction in car trips (at 25p/50p respectively);
- 13%/22% reduction in total vehicle delay;
- 7%/12% reduction in average journey length;
- 23%/51% increase in bus passenger km; and
- 10%/20% increase in rail passenger km, leading to an increase in rail crowding of 33%/73%.

**Figure 4.1 – Impact of Distance-Based Area-Wide Charging**

4.49 For the congestion-related charge, the research undertaken by the DfT within its Road Pricing Feasibility Study was adapted to provide relationships between the level of congestion (defined by the volume to capacity ratio – V/C) and the level of charge. These relationships are presented in Figures 4.2 and 4.3 which highlight the variations in charge due to the level of congestion for different types of road, distinguishing between urban and rural areas.
4.50 If the variable congestion-related charge system was introduced, based on the relationships between charge and capacity utilisation in the curves in Figures 4.2 and 4.3 then across the study area in 2031 the average amount paid by drivers would be 14p/mile.

4.51 Figure 4.4 shows the change in morning peak hour traffic levels on the strategic road network with the variable charge producing flow reductions on most roads within the study area. The exceptions are on the M48 Severn Crossing (where traffic re-routes from the M4 Severn Crossing), on the M49 and on a few rural roads.

4.52 Figure 4.5 shows links brought below the 85% capacity threshold by the variable charging scheme. These are shown in green, while links still above 85% capacity in
spite of the congestion-related charge are shown in red. This demonstrates that the variable charge relieves capacity problems on motorway links, including the M32, as well as within the urban areas. The only motorway link remaining above the threshold is M4 J20-19, which previous GBSTS work has identified as being under considerable stress in 2031.

**Figure 4.4 – Difference in Flow between Variable Charge Test and Do Minimum**

![Map showing difference in flow](image1)

**Figure 4.5 – Difference in Capacity Utilisation between Variable Charge Test and Do Minimum**

![Map showing difference in capacity utilisation](image2)
4.53 Comparing an overall distance-based charge of 25p/mile and the variable (congestion-related) charge, the overall number of car trips removed from the network in the 2031 morning peak would be similar – at around 4% of the total. As shown in Figure 4.6, with the variable charge around half of the car trips removed from the highway network are suppressed, i.e. the trips are no longer made by motorised modes in the morning peak time period. The variable charge is targeted at congested roads, which are mainly in urban areas and relatively well served by bus. Consequently, a much higher proportion of the removed trips (almost 40%) switch to bus, and there is markedly less trip suppression. The fixed 25p/mile charge has a greater impact on trip suppression with almost three-quarters of the removed trips being suppressed. The charge has most impact on longer distance trips, and therefore, in this test, a higher proportion of trips switch to rail.

Figure 4.6 – What Happens to the Removed Car Trips?

4.54 The study explored the impact of raising the scale of the variable congestion-based charge, with tests examining the impact of raising the charges by 25% and 50% above the initial levels implied by Figures 4.2 and 4.3. The impact on key indicators of the higher charges is shown in Figure 4.7.
4.55 Since the charge is linked directly to the level of congestion, raising the charging scale by 25% and 50% results in the removal of additional traffic from the road network, reducing congestion and therefore the increase in the average amount paid by the motorist is less than the increase in the charge level. For example:

- with the charge level raised by 25%, the average charge actually paid rises by just 16% (from 14p/mile to 16p/mile)
- with the 50% increase in charging levels, the average charge actually paid grows by 35% (from 14p/mile to 19p/mile).

4.56 Hence, as might be expected, there are diminishing returns (in terms of revenue) from increases in the scale of charge with the variable charging system. Furthermore, there is a diminishing impact on congestion levels, as indicated by the slight flattening of the total vehicle delay curve shown in Figure 4.7.

4.57 Table 4.3 summarises the results of testing several forms of road user charging. The location of the intermediate cordon is shown in Figure 4.8. The results show that, although urban congestion charging (either cordon- or distance-based) can have some impact on delays, area wide measures are much more effective. The most efficient option would be a flexible charge of the kind the DfT is investigating (i.e. with the level varying by road type and the level of congestion), which would target the areas of highest congestion. As shown earlier, by introducing charging on the most congested areas of the network, the greatest economic benefits are obtained. This charging structure, which gives an average charge of 14p/mile, delivers almost as much congestion relief as a fixed charge of 50p/mile, reducing delays by over 20% and increasing average speed by 9%. The differential impact of the two types of charge on total vehicle delay across the road network is illustrated by Figure 4.9, which shows that the variable congestion based charge reduces delays significantly at much lower levels of charge than a purely distance based scheme.
Table 4.3 – Impact of Road User Charging

<table>
<thead>
<tr>
<th>Measure</th>
<th>Bristol Intermediate Cordon (£5 charge)</th>
<th>Urban Area Charge (25p/mile)</th>
<th>Area-wide charge (25p/mile)</th>
<th>Area-wide charge (50p/mile)</th>
<th>Area-wide variable charge*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car Trips</td>
<td>-2.4%</td>
<td>-2.1%</td>
<td>-5.4%</td>
<td>-10.0%</td>
<td>-4.6%</td>
</tr>
<tr>
<td>Total Vehicle Kilometres</td>
<td>-1.0%</td>
<td>-1.9%</td>
<td>-10.3%</td>
<td>-18.1%</td>
<td>-5.0%</td>
</tr>
<tr>
<td>Average Journey Length</td>
<td>+0.7%</td>
<td>-0.5%</td>
<td>-6.9%</td>
<td>-12.2%</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Total Vehicle Delay</td>
<td>-2.5%</td>
<td>-3.7%</td>
<td>-13.4%</td>
<td>-22.3%</td>
<td>-21.2%</td>
</tr>
<tr>
<td>Average Vehicle Speed</td>
<td>+0.9%</td>
<td>+1.0%</td>
<td>+1.1%</td>
<td>+1.4%</td>
<td>+9.4%</td>
</tr>
<tr>
<td>Estimated Annual Gross Revenue (in 2003 prices)</td>
<td>£170million</td>
<td>£250million</td>
<td>£1050million</td>
<td>£2080million</td>
<td>£580million</td>
</tr>
</tbody>
</table>

This map is reproduced from Ordnance Survey material with permission of Her Majesty’s Stationery Office. © Crown Copyright. All rights reserved. Ordnance Survey Licence number: 100015688.
Table 4.3 shows that road user charging could generate substantial revenues, which could be used to fund other transport schemes. The table shows the gross revenues for each type of scheme, i.e. before infrastructure and operating costs are taken into account. Local schemes (cordon or urban area charges) could generate around £200 million per annum, while area-wide schemes would generate even more. The revenue reflects the charges paid by the motorist, and hence the highest revenues are derived from an area-wide distance based charge of 50p/mile. It should be noted, however, that the figures quoted assume the same charge would be levied in the inter-peak period as in the morning peak period; in practice the off-peak charges, and hence the revenue, would be lower.

POTENTIAL IMPLEMENTATION PROGRAMME

The preceding analysis has identified a range of potential demand management measures. However, due to a range of factors, it would not be possible to introduce many of the measures immediately, even though there might be merit in doing so. Hence, a potential programme has been developed with which the different elements can be introduced in a phased manner.

A potential implementation programme for demand management measures could therefore include:

- in the short term:
  - range of parking measures,
  - exploration of cordon charging in Central Bristol on the alignment of the Inner Ring Road (or further out) with a daily charge of, say, £2 rising eventually to £5,
exploration of workplace parking charges in key areas, e.g. North Fringe, where there are significant levels of private non-residential parking;

♦ in the medium term
  − continuation of parking measures,
  − introduction of the Intermediate Bristol cordon charge with gradual increases in the level of charge,
  − introduction of the workplace parking charging scheme in the North Fringe and potential extension to other areas,
  − introduction of additional cordons (central Bath and Outer Bristol – perhaps on the alignment of the Avon Ring Road); and

♦ in the long term
  − continuation of parking measures,
  − comprehensive congestion charging, with the system extending across the complete highway network in the study area and perhaps representing part of a national scheme – such a scheme would replace the cordon charging schemes, although workplace parking charging could be retained, although with adjustments to the charge levels.

4.61 The Greater Bristol unitary authorities have recently received pump priming funding to develop a congestion charging scheme within the DfT’s Transport Innovation Fund. This will enable a detailed appraisal to be undertaken into the impacts of implementing potential schemes within the Greater Bristol area. Over time, the manner in which some of the policy measures are implemented could change, for example starting with a simple cordon charging approach before moving ultimately to a satellite-based technique.

4.62 In the examination of highway measures in Chapter 6, consideration is given to the potential for encouraging the use of alternative fuels. In this respect, the congestion charging system could encourage this by varying the charge according to the type of fuel used in a vehicle.

4.63 As indicated in the introduction to this chapter, any satellite-based area-wide road user charging scheme would have to be linked to the timescale and implementation programme for the national scheme. In view of the resulting risks, it would not be prudent for the study’s area-wide congestion charging measures to be a central part of a single transport strategy. Consequently, two separate strategies have been prepared and appraised; the central strategy excludes area-wide road user charging, while this forms a key part of the second strategy. As a result, the revenue generated by the congestion charging is not available in the central strategy to fund transport measures. The appraisal of strategies and their components in Chapter 8, therefore distinguishes between the two strategies; with and without area-wide road user charging.

**SUMMARY**

4.64 Within the transport strategy, it is important to include measures designed to control or manage the level of demand for travel by car across the study area. A number of measures to manage demand are available for implementation now and concentrate on varying the availability and cost of parking. The policies need to be adjusted and refined in order to reflect the growth in car traffic, by increasing charges, controlling
the number and availability of spaces, raising enforcement, introducing controlled parking zones, exploring ways of controlling parking at Cribbs Causeway and introducing stringent parking standards. The expansion and variation of parking policy measures also need to take into account the potential impact on economic activity, especially within city and neighbourhood centres, in order to ensure that the prosperity of the centres is maintained.

4.65 The range of additional policy instruments to manage traffic demand includes workplace parking charges. Although there are potential limitations to the impact that such measures may have, it remains a possible tool for introduction in areas outside the scope of existing parking policy, e.g. the North Fringe, and hence should be examined further. The introduction of workplace parking charges would strengthen the operation of workplace travel plans.

4.66 However, the most effective additional form of demand management is likely to be some type of road user charging. The study has identified a number of potential charging mechanisms, including bridge tolls, cordon charging, motorway tolls, supplementary licences, congestion charging and distance-based charging. In the longer-term, the study believes that the most effective form of demand management would be an area-wide charge. However, it is unlikely that such an approach would be feasible until later in the study’s horizon and hence it is important to explore charging systems that provide the opportunity for more immediate implementation. A cordon-based charge would be the most appropriate technique and the initiative by unitary authorities within the Transport Innovation Fund should be taken forward as quickly as possible.

4.67 The study does not believe that the introduction of tolls on the motorway network would produce overall benefits with the likelihood that such a system would encourage the diversion of traffic onto the uncharged local roads, generally unsuitable for the traffic volumes, and with only a small change in the overall level of traffic across the study area. For many of these journeys, there is a lack of an attractive public transport alternative. Hence, an area-wide road user charging system would be the most suitable long-term approach. We have examined alternative forms for the area-wide road user charging scheme and believe that the most appropriate is one in which the charge varies with the level of congestion. As highlighted earlier, the benefits from charging are greater where the congestion is more severe. By varying the charge in line with the level of congestion, it is therefore possible to optimise the level of benefits. It is estimated that, with such a variable charge in 2031, it would be possible to reduce total vehicle delay across the study area by 20% and increase vehicle speeds by 9% for a lower average charge (14p/mile) than with a simple distance based charge of 50p/mile on all roads in the study area.
5. Public Transport Measures

INTRODUCTION

5.1 Public transport represents a key element of the GBSTS transport strategy for the sub-region. There are a number of challenges to be resolved in the current public transport network which will experience further pressure in the future with the prospect of significant growth in the demand for travel within the timescale of the GBSTS study. The current public transport system contains a number of limitations including:

♦ an acute shortage of capacity on the rail network, especially through the principal rail stations in the study area;
♦ conflicts between different routes and types of rail traffic, e.g. between local and long distance passenger operations and between passenger and freight services;
♦ the locations of stations, some of which no longer reflect current passenger travel patterns;
♦ the condition of the rail assets (including rolling stock) on local passenger services and the need to replace them in an environment of a shortage of funding and resources in the rail industry;
♦ the impact of congestion on bus services, creating increased journey times and worsening reliability;
♦ the continuing growth in fare levels in contrast with reduced private vehicle operating costs, in real terms;
♦ the shortage of bus priority measures to counter the effects of the increased congestion;
♦ unreliability of public transport operations due to mechanical failures, staff shortages, etc;
♦ the poor quality of some vehicles across the bus fleet; and
♦ the need for better integration between bus and rail services, including ticketing arrangements.

5.2 The analysis summarised in Chapter 2 highlighted that, in the future, with the increased population and employment growth across the study area, if no improvements are made to the transport system, then the additional congestion will create significant problems for the operation of bus services with consequent reductions in the level of bus demand. The rail services are not affected by the increased congestion on the road network and, despite significant increases in car ownership across the study area, there are likely to be some increases in rail patronage.

5.3 In order to provide an attractive and competitive public transport system, it is necessary to consider a range of measures, each directed as specific aspects of the travel market, including:

♦ urban bus services;
park and ride;
inter-urban bus services;
coach services;
access to Bristol International Airport;
public transport interchanges;
rapid transit; and
rail infrastructure and services.

5.4 Each of these different aspects is considered separately below.

**URBAN BUS SERVICES**

5.5 In the short to medium term, enhancements to the urban bus networks represent the most effective means of improving public transport services in the study area.

5.6 The Joint Local Transport Plan has identified a series of Showcase bus corridors which are designed to build on the success of the first scheme (introduced by Bristol City Council along route 76/77 between Henbury and Hartcliffe) in increasing the level of public transport demand along the corridors. The first Showcase route achieved a net 12% increase in patronage through a package of measures including junction improvements, new bus lanes, improved bus shelters, real time passenger information and new low-floor buses which together produced improved reliability and faster journey times. Bristol City Council is in the process of extending the Showcase concept to the A420 corridor in the east of the city. Similar initiatives have been introduced by the other unitary authorities in the area in the form of Quality Bus Partnerships involving the bus operators. The study strongly supports the JLTP Major Scheme Bid for the Greater Bristol Bus Network which contains ten Showcase bus corridors (see Figure 5.1). These expand the principles of the first scheme to the new corridors which extend across the study area.

5.7 As the series of Showcase corridors develops from the initial routes to the network of corridors, there is the opportunity in the future to expand the concept to provide further improvements, including:

- the re-routeing of services to take advantage of the enhanced priority measures;
- more cross-city services to take advantage of the improved reliability to reduce the need for passengers to interchange;
- wider use of Travelcards, by more active promotion and aggressive marketing, in order to ease inter-modal interchange, speed up boarding times, etc and produce enhanced brand loyalty for public transport;
- as outlined in Chapter 3, enhanced passenger information on the availability of public transport services;
- a more extensive network of orbital bus services providing links to North Fringe and other non-central destinations, including improved interchanges outlined below;
- increased feeder bus operations, especially in areas not served by rapid transit (see below), and in association with the introduction of area-wide road user charging (see Chapter 4);
an extension of the Showcase corridors into the new areas of development, including Ashton Vale, Whitchurch and Emersons Green;

more extensive bus priority measures to form ‘Red Routes’ or clearways with no on-street parking;

increased enforcement of parking and other traffic measures along the Showcase corridors, perhaps through the use of surveillance cameras (on-bus or at the roadside); and

in the longer term, the possible conversion of some of the Showcase corridors into rapid transit routes (described below), with new vehicles, increased frequencies, some sections of segregated operation and further reductions in journey times.

PARK AND RIDE

5.8 With three formal bus-based park and ride sites in Bristol (Long Ashton, Brislington and Portway) and three in Bath (Lansdown, Newbridge and Odd Down), (see Figure 5.2) together with well-used car parks at many of the rail stations in the study area, park and ride represents a popular form of access. There is the opportunity to expand the system by:

♦ increasing the capacity at existing park and ride sites;

♦ enhancing the operation of sites, with extended hours, improved facilities (including security issues) and ticketing arrangements, etc;

♦ creating new park and ride sites; and

♦ expanding capacity at selected rail station car parks.

5.9 At times, some of the existing park and ride sites experience capacity problems and hence there is a need to expand the capacity, especially at the Brislington, Lansdown, Newbridge and Odd Down sites.

5.10 Carefully selected additional park and ride sites (shown in Figure 5.2) could also be added to the current capacity. In considering potential sites, it is important to identify the role of the site, its impact on the environment, its effect on the neighbouring road network and the extent to which it diverts demand from existing public transport services.

5.11 The introduction of a park and ride site is designed to attract existing motorists, who currently drive into the town or city centre, onto public transport for the final part of the journey which would normally be on the congested sections of the road network. Within Greater Bristol, the public transport component of the park and ride journey would normally be by bus, using one of the dedicated services, although there is some park and ride activity at key rail stations.
5.12 Where existing motorists have a bus service available for their whole journey, they currently prefer not to use the service for a variety of possible reasons, including frequency, journey time, convenience, etc. The objective of improvements is to make the public transport element of the Park and Ride journey sufficiently attractive (by bus priority measures, frequent operations, suitable hours of operation, etc) in order to outweigh some of the perceived benefits of the direct car journey. An important factor is the overall charge for the park and ride activity compared with the parking charge in the central area (taking into account the availability of parking spaces) and the prevailing bus fares. Hence, the success of park and ride is associated with the complementary policies of parking charges, availability of spaces (including restrictions designed to deter commuter use) and other measures such as bus fares and congestion charges aimed at deterring car use. In the operation of park and ride sites there is therefore a continuing need to monitor the balance in relative costs between park and ride and alternative direct journeys by car.

5.13 With the introduction of park and ride, there is sometimes the danger that existing bus passengers are encouraged by the enhanced public transport journey to switch from a current direct bus journey onto park and ride. This would therefore:

- increase the level of car activity in the vicinity of the park and ride site; and
- potentially impair the viability of the existing bus services by the switching of passengers.
5.14 The magnitude of these potential effects will vary between park and ride sites and it may be necessary to introduce remedial measures, such as:

♦ provision of improved feeder bus services to the park and ride site from neighbouring communities, with enhanced frequencies at the key commuting times;
♦ introduction of ticketing arrangements to encourage through ticketing between local bus and park and ride services; and
♦ potentially, provide revenue support for local bus services linking to the park and ride site.

5.15 The new park and ride sites identified by the study include:

♦ Lambridge to the east of Bath, adjacent to the A4 London Road – this scheme is currently being progressed by Bath and North East Somerset Council for early implementation and is included in the Bath Package Major Scheme Bid within the Joint Local Transport Plan process;
♦ Nibley to the west of Yate – to be introduced in the short term to aid links between Yate and central Bristol;
♦ Emersons Green – adjacent to the Avon Ring Road, the site would serve motorists from the Emersons Green developments as well as those approaching the Bristol area from Pucklechurch and other communities to the north-east;
♦ Whitchurch – in the longer term, and in association with the development of residential and employment sites in the vicinity, the park and ride site would cater for traffic currently using the A37 from the numerous communities along its route, extending into northern parts of Somerset; and

5.16 The park and ride schemes would tend to concentrate on traditional activities with a high frequency, fast and direct link into the central urban areas. However, in some locations, there may be the potential for expanded activities, for example by the provision of stops on the inter-urban bus or national coach network which would be attractive to passengers who do not wish to travel into the town/city centres to catch the bus/coach, e.g. at Lambridge for the Bath to London service.

5.17 There has been much discussion about the possible introduction of a park and ride site at Hambrook, adjacent to M4 Junction 19 and M32 Junction 1. Such a site would provide an alternative for traffic from the motorway wishing to gain access to Bristol city centre with the potential for a high speed bus connection along the M32, taking advantage of proposed bus priority measures along the route. The proposed capacity for the site is large at some 2,500 spaces and it will therefore be vital to ensure that the highway network in the area, and especially M4 Junction 19 and M32 Junction 1, is able to accommodate the movements created by the traffic using the site.

5.18 The study has explored the potential operating designs for the site and has identified that there would be significant practical difficulties in any design that placed additional stress on M32 Junction 1 from either commuter traffic wishing to access/egress the site or the operation of the park and ride bus services. Hence, the view is that access to the site should be from the west rather than the east, with possible connectivity with the construction of the Stoke Gifford bypass described in
Chapter 6 and the detailed design of the Harry Stoke development. The bus link could be routed so as to take advantage of priority measures associated with the proposed rapid transit route between the North Fringe and central Bristol via the M32 and UWE, described later in this chapter.

5.19 Bristol City Council has explored alternative locations for a park and ride site along the M32 corridor. The most attractive alternative site is to the east of the M32, north of the Coldharbour Lane overbridge. Such a site has the merit of avoiding the access and egress issues at M32 Junction 1, but care would need to be taken with its own access and egress and the impact on the M32 and B4058 Frenchay Park Road. The park and ride bus operation from this site could take advantage of the proposed priority measures (described below) for the rapid transit route through UWE and Bradley Stoke, including the potential new restricted junction between Coldharbour Lane and the M32 for public transport. Further work is therefore necessary on this alternative park and ride site.

5.20 In the past, Bristol City Council has explored the potential for a Park and Ride site at Bedminster Down adjacent to the A38. In view of other aspects of the GBSTS transport strategy, this site is not included within the long term strategy because:
- the construction of the South Bristol Ring Road would provide an improved link between the A38 and A370 corridors and hence between the A38 and the Long Ashton Park and Ride site;
- within the strategy, Long Ashton Park and Ride site would be served by the proposed rapid transit route which would offer a direct, frequent and fast link to central Bristol;
- journey times for buses between Bedminster Down and central Bristol are likely to be little different from those by car, given the limited scope for bus priority measures; and
- the level of demand for park and ride at the Bedminster Down site may not justify such a high frequency bus link as at Long Ashton and hence the attractiveness of the site would be diminished.

5.21 Although in the long term there may not be justification for Park and Ride facilities at Bedminster, there could well be a short-term need for park and ride facilities on the A38 corridor, covering the period until the South Bristol Ring Road provides links between the A38 corridor and an expanded Long Ashton site.

5.22 As described below under the rail measures and interchange, there is the potential for increased public transport activity at Worle rail station with the creation of a major multi-modal interchange including significant park and ride facilities. Other stations are experiencing pressure on car park facilities, including Bristol Parkway and Nailsea and Backwell and hence expansion of the capacity will be necessary in order to meet the expected future demands.

**INTER-URBAN BUS SERVICES**

5.23 The current network of inter-urban bus services (e.g. between Bristol and Weston-super-Mare) provides reasonable coverage across the study area, although perhaps not at the frequency of service and with journey times that would be attractive to existing car drivers. The network of Showcase bus corridors in Figure 5.1 extends...
beyond the urban areas and hence will provide the opportunity for the inter-urban services to take advantage of the priority measures to gain journey time and reliability benefits, perhaps through a change to routing. In addition, some of the enhancements to the highway network, e.g. the South Bristol Ring Road, and second Avon crossing, will offer the opportunity for further service improvements, journey time savings, reliability gains and frequency increases, in the medium term.

5.24 The specification of detailed changes to the inter-urban bus services is outside the scope of a strategic study. Nevertheless, in terms of the network of inter-urban services, there will be a need to review the connections in the light of new population and employment developments to ensure that there are opportunities to access the new developments by public transport. At the same time, it will be necessary to review the access to the North Fringe from different parts of the study area, including Weston-super-Mare, Bath and Yate, particularly where demand management and other measures are likely to encourage greater use of public transport.

5.25 The rapid transit routes, described below, would offer significant enhancements to public transport services to several of the new development areas. However, where new developments are not linked to the rapid transport network, it will be important to provide a network of local and inter-urban bus connections from the developments to key destinations.

**COACH SERVICES**

5.26 The coach services from and through the region are limited to regular links between Bristol and Bath to London and airports in the South East and more occasional services along the M5 corridor which also access Bristol. There is the opportunity to increase the level of coach usage by providing increased locations from which to access coach services in the area:

- expansion of operations at Worle Parkway rail station with the creation of significant facilities for interchange between rail, coach, airport bus, local bus and park and ride;
- if Hambrook park and ride is constructed (see above), there may be an opportunity to provide access to coach services for residents of north Bristol and South Gloucestershire without the need to travel into central Bristol (the site could also be used by coaches between South Wales and the South East) – attention would need to be paid to the impact of the coach movements on the adjacent junctions and also the local impact of pick-up and drop-off traffic;
- alternatively the expanded bus interchange at the University of the West of England could possibly satisfy the role of a connection in north Bristol;
- although it is less accessible from the motorway network, an alternative interchange point would be at Bristol Parkway station; and
- similar, although smaller, facilities at Lambridge park and ride site may also be useful for coach services between Bath and the South East.

5.27 It is outside the scope of the study to specify detailed changes to the network of coach services although improved connections with the rest of the public transport network in the area will provide the opportunity for expansion to the current services.
ACCESS TO BRISTOL INTERNATIONAL AIRPORT

5.28 As described in Chapter 2, air passenger demand through Bristol International Airport (BIA) has experienced significant growth in recent years from 2 million passengers per annum in 2001 to 4.6 million in 2004. The forecast in the Airports White Paper was that this would grow to 12 million by 2026. In parallel with the growth in passengers, there would also be a corresponding increase in employees at the airport from 2,500 in 2004 to around 6,500 in 2026.

5.29 Current public transport access to the airport is concentrated on the Airport Flyer, a limited stop coach service linking Bristol Bus Station and Bristol Temple Meads rail station to the airport, at a frequency of three buses per hour. A local bus service between Weston-super-Mare and central Bristol also serves the airport at an hourly frequency during the day. The nearest rail services are about three miles away at Nailsea and Backwell although there are no connections to the airport from this station. BIA is therefore relatively isolated in public transport terms with few other generators of travel in the neighbourhood of the airport. As a result, the airport has to be fairly self-sufficient in relation to public transport provision.

5.30 Table 5.1 shows demand forecast by the GBM for the Airport Flyer buses in 2031. This indicates that the service from Bristol would have a reasonable level of demand, particularly towards the airport in the morning peak period. Depending on the exact pattern of demand, this would require a headway of perhaps 5-6 minutes. To speed up passenger boarding and alighting, new vehicles with low floor entry/exit and spacious interior design could be introduced on the Flyer service. While the demand to and from Worle Parkway is lower, it would justify a dedicated service with two or three departures per hour.

<table>
<thead>
<tr>
<th>Route</th>
<th>Passengers per hour</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arriving at BIA</td>
<td>Leaving BIA</td>
</tr>
<tr>
<td>Bristol and Bristol Parkway</td>
<td>313</td>
<td>169</td>
</tr>
<tr>
<td>Worle Parkway</td>
<td>29</td>
<td>33</td>
</tr>
</tbody>
</table>

5.31 If associated highway infrastructure is available it would be possible for rapid transit services (described below) to be extended from Ashton Vale to BIA. However, we do not necessarily recommend the extension of rapid transit, because:

- it is anticipated that the demand to BIA would only be sufficient for a proportion of rapid transit departures to be extended to the airport;
- it would be important to retain the limited stop Flyer service, which would provide a better quality of service for through passengers from Bristol Temple Meads and Bristol Parkway;
- the rapid transit service would need to operate outside normal hours in order to serve the particular operating schedules of the airport;
- a shared use rapid transit service may be crowded with commuters and shoppers, causing difficulties for airport passengers with luggage; and
5.32 Current public transport access by employees to BIA is very low – perhaps around 3% of employees use the Flyer – and, with an increased level of shift working, this is unlikely to change dramatically with improved Flyer operations. Currently, employees use some of the early Flyer departures to the airport from central Bristol but even with increased numbers of employees and a continuation of the free travel for employees, they are unlikely to influence Flyer demand levels to the extent that the level of service would need to be increased. It would be more appropriate to use demand-responsive public transport modes (e.g. shared taxis) to cater for the variety of travel times and origins/destinations likely to be exhibited by airport employees.

5.33 The following range of public transport services could therefore act as the basis for serving the passenger and employee demand for travel to and from the BIA:

- increased frequency for the current Airport Flyer service from Bristol city centre to a frequency of at least six buses per hour rising to ten buses per hour in the long term;
- the period of operation of the Flyer should be extended to match early morning and late evening flights;
- extension of the Airport Flyer service (half of the expanded service, i.e. starting from three buses per hour) north to Bristol Parkway station via the M32, the UWE interchange and using priority measures described below for rapid transit, thereby providing an improved link to the airport for residents of north Bristol and South Gloucestershire and also offering connections to rail services from South Wales, Gloucestershire and Swindon;
- to speed up passenger boarding and alighting, use of new vehicles with low floor entry/exit and spacious interior design;
- new limited stop service between Worle Parkway station and BIA with a frequency of three buses per hour – as outlined in the following section, Worle Parkway could play a significant role as an interchange hub for rail, coach, local bus and park and ride operations;
- initially air passengers to/from Bath would probably find it more convenient to transfer onto the Airport Flyer at Temple Meads station, but when the South Bristol Ring Road is completed, this could provide a more suitable route for a direct bus services linking Bath and Keynsham with BIA, perhaps at a frequency of two buses per hour; and
- to cater for the extended travel times of employees following the expansion of the airport and the move to a 7 days a week and 24 hours a day operation together with the diffuse travel patterns demand responsive or shared taxi services would be the most effective means of catering for this type of demand with services to Weston-super-Mare and south Bristol (and potentially other locations such as Bath, Clevedon, Portishead, Kingswood, etc) that could also be used by air passengers.
Public Transport Interchanges

5.34 Within the study area, there are a number of established interchange points or transport nodes where transfer occurs between public transport modes, e.g. the principal rail stations at Bristol Temple Meads, Bristol Parkway, Bath Spa and Weston-super-Mare together with bus stations in Bristol, Bath, etc, as well as between on-street stops in the city centres. In addition, some of the smaller rail stations including Yate and Filton Abbey Wood experience reasonable levels of interchange. In recent years, there has been increased bus interchange activity at the University of the West of England site at Coldharbour Lane and at Cribbs Causeway.

5.35 With geographically dispersed levels of demand, it is difficult to design commercially viable public transport services that can provide the direct links desired by passengers. It is therefore inevitable that passengers will need to transfer in order to complete their journey and, if the overall public transport service is to be attractive, it becomes increasingly important for strong interchanges to be provided between modes and services.

5.36 The existing interchange points will continue to play a crucial role and extra facilities will therefore be required in order to strengthen the position, supplemented by facilities to encourage walking and cycling access to them. However, it will also be important to develop and promote new interchange locations in parallel with improvements to services. There are four main locations for potential improvements to interchanges:

- **Worle**
  There is scope for Worle to become a full multi-modal parkway station combining rail, local bus, coach and airport links together with park and ride and cycle facilities. The proximity to the M5, together with proposed improvements at M5 Junction 21, provide the opportunity for National Express coach services to use the location as a coachway with onward connections into Weston-super-Mare and BIA. Distances from the M5 to both these locations means that it is not viable to divert regular coach services to serve them and hence they currently experience poor coach links. With the potential for increased rail services and with new developments planned for the Locking area, the provision of new bus links from the northern and eastern areas of Weston-super-Mare to Worle station would represent a more attractive connection.

- **University of the West of England (UWE)**
  At the UWE site at Coldharbour Lane there is the opportunity to create a major bus interchange point serving the wider North Fringe area. The location already carries a significant level of interchange activity and this would be increased with enhanced facilities and services. The attractiveness of the site would be further increased with the provision of a direct bus-only link between the M32 and Coldharbour Lane to enhance potential bus connections to the south including the proposed rapid transit lines described below.
Yate
With the potential in the future for increased rail services to Yate (see below) there is the opportunity to increase the level of passenger activity through the station, with improved bus connections together with cycle and similar facilities.

Filton Abbey Wood
With the potential in the future for increased rail services to Yate which would also serve Filton Abbey Wood (see below), improved bus connections to the station together with cycle and similar facilities would provide the opportunity to increase the level of passenger activity through the station.

5.37 In addition to the interchange points based on rail stations, coach interchanges could be promoted at the Hambrook park and ride site adjacent to M4 Junction 19 and also, although to a lesser extent, at the proposed Lambridge park and ride site in east Bath. In each case, these interchange points would avoid the need for passengers to travel into the centre of Bristol or Bath and hence would make the coach journey more attractive. In SWARMMS, there was a proposal to develop a coachway at Cribbs Causeway but the traffic congestion in the area of Cribbs Causeway would suggest that the alternative site at Hambrook might be more attractive for this role.

RAPID TRANSIT

Definition of the Potential Lines

5.38 There has been considerable attention in recent years to the introduction of rapid transit in the form of a light rail system in the study area. Line One of the earlier light rail system contained a link from north Bristol to Bristol Temple Meads and Bristol city centre using an alignment which for much of its length would run parallel to the rail line between Bristol Temple Meads and Filton Abbey Wood. Recently, the development of Line One to Bristol Parkway has been suspended and the scheme is not currently being pursued by the local authorities, although the alignment continues to be safeguarded by South Gloucestershire and Bristol City Councils. As far as the GBSTS study is concerned, there are three major new factors that could influence the content of a rapid transit system in the study area:

♦ the identification of new development sites which will create significant growth in demand for travel;
♦ the major plans for the introduction of a network of Showcase bus corridors shown in Figure 5.1 which will produce significant improvements in the operation of bus services; and
♦ plans for the expansion of local cross-Bristol rail services (described below).

5.39 The study has explored the potential for a rapid transit system that:

♦ serves the major new development areas of Ashton Vale, Whitchurch and Emersons Green/Pucklechurch providing a high-quality, high-speed, public transport link between these locations and central Bristol;
♦ offers new and improved links between south Bristol, central Bristol and the North Fringe;
♦ provides new public transport links to Portishead;
where possible, has high degrees of segregation from other road traffic;
- creates new cross-Bristol linkages; and
- builds on the network of Showcase bus corridors by maximising the use of infrastructure already put in place with the Showcase corridors including priority lanes, shelters and real-time passenger information.

5.40 The study has completed an assessment of a system involving four cross-Bristol rapid transit routes shown in Figure 5.3, although the precise details of the routes would be the subject of review and revision as the scheme is developed:
- Ashton Vale – Emersons Green;
- Hengrove – North Fringe/Cribbs Causeway;
- Bath – Cribbs Causeway; and
- Whitchurch – Avonmouth/Portishead (using the potential second Avon Crossing).

5.41 An example of the form that the rapid transit operation might follow is demonstrated by the public transport measures included in the Bath Package which is currently being developed as a Major Scheme Bid within the Joint Local Transport Plan process. The rapid transit component of the Bath Package has been developed by B&NES in association with the bus operator First Group and local developers and contains one cross-city line (see Figure 5.4) formed by:
- a mainly segregated alignment between Newbridge and central Bath, linking an expanded park and ride site at Newbridge, adjacent to the A4 to the west of Bath, with the city centre using a former rail alignment and a segregated route through the proposed Western Riverside development and then on-street running through mainly bus priority areas; and
- an on-street alignment between the proposed Lambridge park and ride site on A4 London Road to the east of Bath and the city centre.

5.42 The proposals include the use of modern, spacious, low floor, articulated vehicles, currently being developed by the operator. The mixture of on-street operation and segregated running provides an example of the type of operation envisaged for the rapid transit system across the rest of Greater Bristol.

5.43 Considering each of the four lines of the Greater Bristol rapid transit network in turn, some of the key features are:
- Ashton Vale to Emersons Green:
  - at the southern end of the route, it would serve the current park and ride site at Long Ashton and the potential new development at Ashton Vale;
  - it is assumed that a dedicated alignment through the new development at Ashton Vale would be incorporated into its design;
  - if associated highway infrastructure is available, it would be possible for some of the services to be extended from Ashton Vale to BIA, although as indicated in paragraph 5.31, the Airport Flyer and rapid transit may not be compatible for joint working;
Figure 5.3 – Potential Bristol Rapid Transit Lines

Note: The schemes in this diagram are conceptual and defined for appraisal purposes.
Note: The schemes in this diagram are conceptual and defined for appraisal purposes.

- the alignment crosses the River Avon on the disused railway bridge;
- a segregated alignment through the floating harbour along the alignment of the existing rail line – in places the alignment may not be wide enough for two-way operation for the whole length and hence it may need to be single direction with passing places;
- in designing the route within the central area, a feature will be the identification of common sections for all rapid transit routes to enable easy interchange between lines;
- along the M32, the design would aim to achieve some form of segregation;
- the position of the northern terminal will depend upon the scale and location of development in the Emersons Green/Pucklechurch area;
- the precise alignment of the route would also be based on the location of the developments;
- if the focus of new development is to the east of Emersons Green, towards Pucklechurch, then a route through Mangotsfield would be appropriate with on-line priority measures;
- with developments to the north, a routeing using the HOV lanes on the A4174 Avon Ring Road and the M32 would be more appropriate.

♦ Hengrove to North Fringe and Cribbs Causeway:
- the southern section of the route would start within Hengrove Park, follow a new route across Hartcliffe Campus and then operate within the existing
highway with local priority measures and taking advantage of reduced traffic flows on the A37 associated with the South Bristol Ring Road;

- the route through the central area would enable interchange with other rapid transit routes at the same stop;
- north of the central area the route would follow the M32 with a segregated alignment/priority measures;
- at Coldharbour Lane, a new bus/transit only junction would be created to provide direct access, with new on/off access ramps between the M32 and Coldharbour Lane;
- the route would service an expanded bus interchange at UWE providing links to a wide range of feeder services linking to the North Fringe and other destinations;
- the route would then serve Bristol Parkway station and the core of the Bradley Stoke development;
- finally, the route would run through Aztec West and the potential bus gate linking to Cribbs Causeway; and
- the level of service on the route would need to be monitored – there is the potential for some short working of the service to intermediate points e.g. UWE, Bradley Stoke and Aztec West, with only a proportion of departures completing the full route.

♦ Bath – Cribbs Causeway:

- within Bath, the alignment would follow the planned rapid transit line in the Bath Package, i.e. from Lambridge via the city centre to Newbridge, using the segregated sections to the west of the centre through Western Riverside;
- west of Bath the route would follow the A4 serving Saltford and Keynsham, with appropriate priority measures along the route;
- west of the Hicks Gate, the proposed South Bristol Ring Road provides relief to the A4 and enables increased priority measures to be introduced;
- if the local highway scheme to introduce the Callington Road link is completed, this would provide further relief to the A4 and would therefore facilitate additional priority measures for rapid transit;
- after running through central Bristol, the alignment would follow Park Street and Whiteladies Road – with joint running with the Whitchurch to Avonmouth/Portishead rapid transit route (described below) there would be the opportunity to introduce more extensive priority measures;
- the gradient on Park Street may limit the type of vehicles able to operate the route – at 9% it is on the limit of conventional metal wheeled light rail vehicles;
- the route would take advantage of priority measures on the approaches to the Clifton Downs up Whiteladies Road and Blackboy Hill and across the Downs;
- the feasibility of diverting the service into Westbury-on-Trym would need to be explored to establish the potential for priority measures and the impact on operating speeds for the rapid transit; and
- north of Westbury-on-Trym, the route would take advantage of the dual carriageway A4018 to gain further priority measures on the approach to Cribbs Causeway.
Whitchurch – Avonmouth/Portishead:
- at the southern end of the route, the rapid transit service would serve major new residential developments at Whitchurch together with the proposed park and ride site adjacent to the A37;
- the construction of the proposed South Bristol Ring Road would provide relief to the A37 and hence enable increased priority measures to be introduced along the corridor to benefit the operation of the rapid transit route;
- within Hengrove the route would take advantage of sections of dual carriageway in order to achieve increased priority levels;
- across central Bristol, the route would serve common sections with the Bath to Cribbs Causeway route, increasing the potential for interchange and strengthening the opportunity for priority measures to benefit both routes;
- as with the Bath to Cribbs Causeway route, the Whitchurch – Avonmouth/Portishead route would operate on Park Street and Whiteladies Road, with potential priority measures along these roads, although, as noted above, there may be impacts on the type of vehicle that could operate the service due to the gradient on Park Street;
- at Clifton Down station, the proposed route takes over the section of the Severn Beach rail line between Clifton Down and Avonmouth, creating a more direct service between this area and central Bristol while at the same time significantly increasing the frequency of public transport services – the impact on rail services is examined in the next section;
- the segregated alignment through the Clifton Down tunnel and the northern sections through Sea Mills and Shirehampton will decrease journey times with the potential for creating additional stops;
- if it proves to be impractical to use the Severn Beach rail line between Clifton Down and Avonmouth, an alternative alignment from the Centre would be along Anchor Road, Hotwell Road and Portway – although the route would be slower and longer, it would enable the rail line to be retained although there may be some abstraction of passengers by rapid transit due to its better penetration of central Bristol and the opportunity for additional stops within Sea Mills and Shirehampton;
- to the north of Shirehampton, the route would divide with one section continuing to Avonmouth with potential extensions beyond Avonmouth rail station and with the second section using the proposed new Avon crossing road scheme to provide a direct link to Portishead;
- the Avon crossing would connect to the A4 and the existing highway network close to the current Portway park and ride site and hence the rapid transit service would serve the site;
- there are alternative routes between Royal Portbury Dock and Portishead – along the former rail alignment or along The Portbury Hundred, Bristol Road and Portishead High Street;
- on serving Portishead the route would penetrate through the centre of the town to provide access across the town.

The initial alignments have been designed to build on Showcase bus corridors with enhanced priority measures and hence to operate within the existing highway. The exceptions are the following possible segregated sections:
♦ the Severn Beach rail line which is part of the Whitchurch to Avonmouth/Portishead link;
♦ along the former rail alignment between Royal Portbury Dock and Portishead;
♦ the old Harbourside rail line for the Ashton Vale line;
♦ the proposed new public transport connection between the M32 and Coldharbour Lane, providing access to UWE and Bristol Parkway station; and
♦ use of a former rail line and a segregated route through the proposed Western Riverside development in Bath.

5.45 Although some sections of the rapid transit network could operate on a segregated alignment with no impact on other vehicles, for much of its length there would be direct contact with other traffic. This would result in a range of effects which would need to be incorporated in the detailed design of the scheme:

♦ the measures would be designed to build on the priority measures and other improvements contained in the Showcase bus scheme of the Greater Bristol Bus Network summarised in Figure 5.1;
♦ re-allocation of road space from private vehicles to rapid transit, through the introduction of separate lanes for use by rapid transit – this could reduce capacity and hence increase private vehicle journey times along rapid transit corridors;
♦ priority for rapid transit through junctions – by increasing the amount of green-time allocated to rapid transit vehicles, there would be reduced capacity for other traffic through the junctions, especially for traffic crossing the rapid transit route;
♦ in parallel with the increased priority measures along the rapid transit route, there would be need to control other traffic use, especially the volume of on-street parking and the access for delivery vehicles;
♦ the rapid transit vehicles could be longer than current standard buses and hence the infrastructure at stops may need to be amended, with more extensive passenger waiting facilities and the relocation of other street furniture in the immediate vicinity of the stops; and
♦ while there would be an aspiration to provide as much priority as possible for rapid transit, this will be constrained by the characteristics of infrastructure along the route, especially in the heavily built-up areas on the approaches to town and city centres.

5.46 With the introduction of the major network of rapid transit routes, attention will need to be paid to the financial and administrative structure of the system’s operation. Although the local bus operator is involved actively in the development of the smaller Bath rapid transit system, it is by no means clear whether there would be competition from bus operators for the rest of the proposed rapid transit network. To the extent that any competition from bus operators would abstract passengers from rapid transit, it would therefore diminish the viability of the new system.

5.47 Such a situation is not new: the introduction of rail-based light rail systems in the UK has encountered competition from bus operators, particularly in the early stages of operation e.g. South Yorkshire Supertram. Hence, institutional arrangements need to be established concerning the operation of rapid transit and its relationship with other public transport operators in the area. A number of alternative models are
available; however, the detailed consideration of these is outside the scope of the present study.

**Bus/Rapid Transit/Light Rapid Transit Costs**

5.48 There is a variety of alternative forms of public transport systems which include varying degrees of segregation:

- conventional bus with limited segregation:
  - traditional bus or new vehicle design,
  - limited segregation within existing highway e.g. high occupancy vehicle lanes, bus lanes, Red Routes, access to pedestrian areas,

- conventional bus with maximum segregation:
  - traditional bus or new vehicle design,
  - extensive segregation including outside the existing highway e.g. contra-flow bus lanes, bus-only sections, bus gates, e.g. Edinburgh ‘Greenways’, Showcase routes,

- guided bus with limited segregation:
  - buses using specially built bus lanes at key locations with raised kerbs or forms of guidance (e.g. Leeds ‘Superbus’, Crawley ‘Fastway’),

- guided bus with maximum segregation:
  - bus running on own alignment for most of the route using dedicated raised kerb bus lanes or segregated busways e.g. Edinburgh, proposals for Cambridgeshire,

- light rail:
  - lightweight vehicles operating at lower speeds from trains using rubber or metal wheeled vehicles.

5.49 There are a number of new technologies, many of which are relatively untried within the UK operating environment. These include:

- varying forms of guidance (optical or wire guidance);
- different types of propulsion (e.g. electric bus, hydrogen, etc); and
- personal rapid transit.

5.50 The development of the rapid transit elements of the GBSTS proposals have been based, at this stage, on a system using guided bus with levels of segregation where practical. In the further development of the schemes, it will be appropriate to consider other technologies, perhaps new ones as yet untried within the UK environment, before selecting the preferred approach. In the selection process, attention should be given to the changing availability and cost of technologies (especially for guidance and propulsion systems), the costs of alternative fuels and their availability, the relative impacts on the environment through the levels of different emissions and variations in the risks associated with alternative systems.

5.51 Following a number of cost increases in recently planned and implemented urban transit schemes, the costs of all such proposals have received a heightened level of scrutiny. In particular, the publication of the recent Commission for Integrated
Transport (CfIT) report ‘Affordable Mass Transit’ (2005) has highlighted the need to consider alternatives to standard ‘steel wheel on steel rail’ trams.

5.52 An important element within the comparison is the variation in capacities of systems applying alternative formats. The CfIT report summarises the maximum corridor capacity (in terms of passengers per hour per direction) of different systems as shown in Table 5.2. Although, by specifying the maximum capacity, the comparison includes the impact of variations in both the maximum frequency and the size of vehicle, it provides an indication of the relative performance of different approaches.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Maximum System Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard bus</td>
<td>2,500 – 4,000</td>
</tr>
<tr>
<td>Busway</td>
<td>4,000 – 6,000</td>
</tr>
<tr>
<td>Guided bus</td>
<td>4,000 – 6,000</td>
</tr>
<tr>
<td>Tram/light rail</td>
<td>12,000 – 18,000</td>
</tr>
<tr>
<td>Heavy rail</td>
<td>10,000 – 30,000</td>
</tr>
</tbody>
</table>

5.53 Within GBSTS, available cost data has been used for the dual purposes of selecting the nature of the rapid transit proposed in the strategy, and for estimating the cost of the proposals. To allow comparisons between systems within the UK and the rest of Europe, a cost per double track kilometre has been used with consideration given to the nature of the system built. This comparison excluded forecast costs for systems that had not yet been built and any outlying values as a result of local circumstances (e.g. a significant length of tunnelling). The costs quoted (in Table 5.3, Table 5.4 and Table 5.5) have all been adjusted to a 2005 base year.
### Table 5.3 – European LRT Construction Cost Rates (£ Millions)

<table>
<thead>
<tr>
<th>City</th>
<th>Cost per km (double track)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin</td>
<td>7.09</td>
<td>Track only</td>
</tr>
<tr>
<td>Bonn (Auerberg)</td>
<td>8.39</td>
<td>Track with new street design</td>
</tr>
<tr>
<td>Bremen (line 4)</td>
<td>5.63</td>
<td>Track with new street design</td>
</tr>
<tr>
<td>Bremen (Line 6)</td>
<td>9.91</td>
<td>Track and separated track with difficult bridge</td>
</tr>
<tr>
<td>Duisberg</td>
<td>4.61</td>
<td>Track (only rails and wires)</td>
</tr>
<tr>
<td>Nantes</td>
<td>10.26</td>
<td>Complete system cost – on former rail track</td>
</tr>
<tr>
<td>Nantes</td>
<td>21.00</td>
<td>Complete system cost – new build rate</td>
</tr>
<tr>
<td>Paris (T1)</td>
<td>11.80</td>
<td>Complete system cost – new build rate</td>
</tr>
<tr>
<td>Paris (T2)</td>
<td>7.13</td>
<td>Complete system cost – on former rail track</td>
</tr>
<tr>
<td>Strasbourg (line A)</td>
<td>17.24</td>
<td>Complete system with 10% tunnel and new street design</td>
</tr>
<tr>
<td>Manchester phase 1</td>
<td>6.57</td>
<td>Mainly former rail track</td>
</tr>
<tr>
<td>Sheffield Supertram</td>
<td>11.13</td>
<td></td>
</tr>
<tr>
<td>Midland Metro</td>
<td>8.06</td>
<td></td>
</tr>
<tr>
<td>Croydon Tramlink</td>
<td>8.27</td>
<td></td>
</tr>
<tr>
<td>Manchester phase 2</td>
<td>22.47</td>
<td></td>
</tr>
<tr>
<td>Nottingham Transit</td>
<td>13.36</td>
<td></td>
</tr>
<tr>
<td>Lyon</td>
<td>13.78</td>
<td></td>
</tr>
</tbody>
</table>


### Table 5.4 – Guided Bus Construction Cost Rates (£ Millions)

<table>
<thead>
<tr>
<th>City</th>
<th>Cost per km (double track)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adelaide</td>
<td>3.53</td>
<td></td>
</tr>
<tr>
<td>Ipswich</td>
<td>2.71</td>
<td></td>
</tr>
<tr>
<td>Leeds (Scott Hall Rd)</td>
<td>4.84</td>
<td></td>
</tr>
<tr>
<td>Paris</td>
<td>2.60</td>
<td>Part of a busway</td>
</tr>
</tbody>
</table>

Source: 'Bus or Light Rail: Making the Right Choice (April 2000)
Table 5.5 – Busway Construction Cost Rates (£ Millions)

<table>
<thead>
<tr>
<th>City</th>
<th>Cost per km (double track)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ottawa</td>
<td>6.96</td>
<td></td>
</tr>
<tr>
<td>Paris</td>
<td>5.83</td>
<td>Includes a section of Guided Light Transit</td>
</tr>
<tr>
<td>Pittsburgh (east)</td>
<td>12.84</td>
<td></td>
</tr>
<tr>
<td>Pittsburgh (south)</td>
<td>5.75</td>
<td></td>
</tr>
<tr>
<td>Quito</td>
<td>3.26</td>
<td></td>
</tr>
</tbody>
</table>

Source: ‘Bus or Light Rail: Making the Right Choice (April 2000)

5.54 Clearly, even with some outlying examples removed, as shown in Table 5.6 there remains a great variation in the costs of implementing rapid transit systems. However, the examples indicate that guided bus systems are generally the lowest cost option, rising through busways – with their greater level of segregation – to full LRT systems.

Table 5.6 – Summary of LRT/Guided Bus/Busway Cost Rates (£ Millions)

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRT</td>
<td>4.61</td>
<td>22.47</td>
<td>10.98</td>
<td>9.91</td>
</tr>
<tr>
<td>Guided bus</td>
<td>2.60</td>
<td>4.84</td>
<td>3.42</td>
<td>3.12</td>
</tr>
<tr>
<td>Busway</td>
<td>3.26</td>
<td>12.84</td>
<td>6.93</td>
<td>5.83</td>
</tr>
</tbody>
</table>

5.55 The proposed Greater Bristol rapid transit system described above was tested using the GBM using service frequencies of up to 12 departures per hour. The test assumed all other elements of the GBSTS strategy to be in place, and indicated a high level of demand for rapid transit, with a total of up to 20,000 trips per hour on the system in the morning peak period in 2031. In addition, there was an increase of around 2000 in trips by park and ride, with passengers taking advantage of the improved services by rapid transit from Long Ashton, Brislington, Whitchurch, Emersons Green, Avonmouth, Hambrook and Bristol Parkway park and ride sites. The forecast flows on the system are shown in Figure 5.5.
5.56 Figure 5.6 shows where the demand for rapid transit has come from, indicating that half the rapid transit passengers would otherwise travel by bus, while 20% have transferred from car.

5.57 Table 5.7 shows comparative journey times for bus, rail (where appropriate) and rapid transit. The times given are for the whole journey and include:

- time spent travelling on the public transport service;
time spent walking to the station or stop;
♦ time spent waiting (assumed to be half the combined service headway of available services); and
♦ an interchange penalty to reflect the inconvenience of having to change service.

5.58 Note that in practice, journeys could be shorter if passengers know the timetable and only arrive when a service is due, but these figures give a good indication of the level of service offered.

Table 5.7 – Comparative Journey Times in Morning Peak Period (minutes)

<table>
<thead>
<tr>
<th>Journey</th>
<th>Bus</th>
<th>Rail</th>
<th>Rapid Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hengrove to Bristol city centre</td>
<td>47</td>
<td>n/a</td>
<td>32</td>
</tr>
<tr>
<td>Newbridge P&amp;R to Bath centre</td>
<td>38</td>
<td>n/a</td>
<td>24</td>
</tr>
<tr>
<td>Portishead to Bristol city centre</td>
<td>151</td>
<td>n/a</td>
<td>49</td>
</tr>
<tr>
<td>Avonmouth to Bristol city centre</td>
<td>73</td>
<td>86*</td>
<td>57</td>
</tr>
<tr>
<td>Stoke Gifford to Bristol city centre</td>
<td>53</td>
<td>37</td>
<td>34</td>
</tr>
<tr>
<td>Keynsham to Bristol city centre</td>
<td>n/a</td>
<td>45</td>
<td>43</td>
</tr>
</tbody>
</table>

* Do Minimum journey time via Severn Beach line.

5.59 Table 5.7 shows that the rapid transit system delivers considerable time savings on routes currently served by bus, such as Hengrove to Bristol city centre and Newbridge to Bath city centre. Rapid transit would deliver a step change in the level of public transport service from Portishead, reducing the total journey time to a third of that offered by the infrequent bus service. Note that the journey times that could be achieved with the Portishead rail line are considered in the section below on rail.

5.60 Journey time savings are modest for routes already served by rail, for example Stoke Gifford (near Bristol Parkway station) to Bristol city centre and Keynsham to Bristol city centre, although the rapid transit would offer a new travel option and would improve accessibility to destinations outside the city centre. It should be noted that the rail travel times shown for these routes assume the introduction of new cross-Bristol rail services (see section on rail below). For trips from Avonmouth, Table 5.7 shows that the more frequent and direct rapid transit service offers a better level of service that the Severn Beach rail line.

5.61 Some key performance statistics are given in Table 5.8. These indicate the impact that the introduction of rapid transit could have on the transport system as a whole. The rapid transit system would reduce the number of car trips across the Greater Bristol area by 2% thereby reducing the car mode share from 80% to 76%. There would be a 4% reduction in total highway delay, which compares favourably with
most road schemes considered as part of the study. Rapid transit would also relieve pressure on the rail network, reducing crowding levels by around a third. In general, the rapid transit system would abstract demand from other public transport services although there would be an overall increase in public transport demand. In the detailed development of the rapid transit network, potential revisions to bus services would need to be identified.

**Table 5.8 – Impact of the Rapid Transit System (morning peak period)**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>2% reduction</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>1% reduction</td>
</tr>
<tr>
<td>Car Mode Share</td>
<td>Reduced from 80% to 76%</td>
</tr>
<tr>
<td>Total Vehicle Delay on Highway network (Hours)</td>
<td>4% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>2% increase</td>
</tr>
<tr>
<td>Rail Crowding</td>
<td>32% reduction</td>
</tr>
</tbody>
</table>

5.62 Table 5.9 gives a summary of the economic performance of the rapid transit system. The overall economic performance of the scheme is very strong. The user benefits generated considerably outweigh the scheme costs, resulting in an NPV and BCR of £2300 million and 5.3 respectively.

**Table 5.9 – Economic Performance of the Rapid Transit System**

<table>
<thead>
<tr>
<th>Rapid Transit System</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost (2005,Q1 prices) £mill, inc Optimism Bias</td>
<td>£166</td>
</tr>
<tr>
<td>Annual Operating Cost (2005,Q1 prices)</td>
<td>£12</td>
</tr>
<tr>
<td>PVC (£ mill, 2002 prices &amp; values)</td>
<td>£540</td>
</tr>
<tr>
<td>PVB (£ mill, 2002 prices &amp; values)</td>
<td>£2,900</td>
</tr>
<tr>
<td>NPV (£ mill, 2002 prices &amp; values)</td>
<td>£2,300</td>
</tr>
<tr>
<td>BCR</td>
<td>5.3</td>
</tr>
</tbody>
</table>

5.63 The majority of the benefits are related to time savings. These are experienced both by:

- those travellers directly benefiting from the more convenient, frequent and direct services provided by the rapid transit network; and
- those making use of the highway network and therefore benefiting from the congestion relief resulting from the attraction of trips to rapid transit from highway.
5.64 Travel time savings for public transport users are spread over the area covered by the rapid transit network, but particularly focused on trips to and from Bristol and Bath city centres from south Bristol and the development areas of Ashton Vale, Whitchurch, Hicks Gate and Portishead. The largest highway benefits are accrued in those areas experiencing the highest congestion levels, such as within the Bristol and Bath urban areas.

5.65 The additional trips drawn to rapid transit also cause a substantial increase in rapid transit revenue, although the associated reductions in parking, bus, rail and park and ride revenue act to offset this to some extent.

5.66 An additional consequence of the switch in trips from highway to public transport is the reduction in indirect tax paid (primarily due to a reduction in fuel duty paid and the lack of tax on public transport fares). This adds to the net cost of the scheme to the government.

5.67 The study has identified strong demand patterns for the rapid transit lines included in the study’s transport strategy. However, further work is required to take the measures forward. As demonstrated in the description of each individual alignment, there are a number of detailed issues that will need to be resolved. Included in this is the type of vehicle to be used as the basis for the rapid transit operation. Initially, the work has been based on the premise of a bus-based operation, using high quality vehicles currently being developed which are capable of operating along segregated alignments as well as within existing traffic.

5.68 The earlier analysis has identified the relative characteristics and costs of rubber-tyred and metal-wheeled rapid transit operations. However there is not a single type of system within each heading; rather there is a continuum with a wide range of alternative systems in terms of the characteristics of the vehicle (e.g. capacity, speed, reliability, performance, attractiveness, fuel efficiency, perception, etc) which would need to be taken into account in the detailed assessment.

5.69 Key factors will be the passenger capacity and quality of the vehicles. Although it is by no means a requirement, there would be merit in using a single type of vehicle for all four lines. This would produce benefits in the design, economics of scale in vehicle purchase, maintenance and operation, etc. The quality of the vehicles will be vital to establish a clear identity for the system. The vehicles should present a strong image designed to encourage existing car drivers to consider switching to public transport. Hence, the image should be as distinctive as possible, and a clear change from current public transport services in the area.

5.70 Many of the proposed rapid transit lines would serve new developments and, in many cases, the scale of the development in terms of population and workplaces has yet to be defined. Some initial assessments on the performance of the rapid transit routes have highlighted that, if the highest levels of density are achieved in the new developments, the volume of passenger demand would not easily or comfortably be satisfied by a bus-based rapid transit system. The frequency requirements to cater for the demand would require a frequency of service which is not compatible with a reliable operation. Hence, once clarity is obtained on the characteristics of the new developments, then a more precise specification for the vehicles to be used on the associated rapid transit system can be completed.
RAIL

5.71 The rail network within the Greater Bristol area represents a potential resource capable of wider and more intensive use, although there are significant limitations as to the extent to which its usage can be increased. The most obvious limitations lie in the number and location of the existing rail lines which provide only partial coverage of the area at a level which is much less than many other conurbations of a similar size. At the same time, the rail lines provide insufficient penetration of the current main passenger objectives, for example central Bristol and the North Fringe. These factors contribute to the current relatively low levels of rail use in the Greater Bristol area, with just 2% of peak journeys being made by rail, compared with 89% by car, although in some corridors (e.g. Bath and Weston-super-Mare to Bristol), rail has a more significant, although still minor, role. In the face of such levels of usage, the scope for rail improvements to make a significant impact on car use must therefore be limited; a doubling of rail demand through diversion from car would only produce a 2% drop in the car mode share.

5.72 With the present state of the rail industry, there are limited resources available for major enhancements to the rail network. The Network Rail Discretionary Fund, announced in 2005, comprises £200 million of government funding over the period to 2008/9 matched by a corresponding amount of Network Rail's own funds. It represents a mechanism by which funding is available for minor schemes costing less than £5 million. The construction of a third platform at Bristol Parkway has been authorised out of the NRDF and takes advantage of defunct Royal Mail infrastructure at the station. The third platform represents an opportunity for increased cross-Bristol links.

5.73 The objectives of GBSTS include the need to take into account the affordability and potential to implement measures and hence this represents a constraint on the types of measures that can realistically be pursued, especially in the short term. The Route Utilisation Strategy and the Greater Western franchise indicate the direction in which the development of the railway is likely to take in the short to medium term.

5.74 In the medium term, although unlikely to be completed until 2018, the scheduled resignalling of the Bristol area provides a further opportunity to increase the flexibility and capacity of the infrastructure with the potential to significantly increase the rail throughput across the area. While the completion of the re-signalling provides the opportunity for improvements to rail operations in the Bristol area, it should not be seen as a limiting factor – there is the potential to introduce measures in advance of the signalling scheme.

5.75 The combination of increased congestion on the road network and measures designed to encourage the use of public transport (i.e. ‘Smarter Choices’ described in Chapter 3) would produce significant increases in rail demand on the three main rail corridors compared with current levels, even without improvements to public transport. The passenger growth between 2003 and 2031 on the Bath line would be 50%; it would be 220% between Bristol and Weston-super-Mare and 140% between Bristol and Bristol Parkway. Even with these levels of growth on rail, the impact on car traffic growth is small. For example, even with the large growth in rail trips between Bristol and Weston-super-Mare, with around 1100 extra rail passengers, this represents just 4% of car traffic on the road network between the two places.
5.76 However, measures need to be introduced to meet the potential demand for rail to ensure that there is sufficient capacity on the rail network to accommodate the additional demand. The danger might be that, in the absence of sufficient capacity, the train operating company seeks to match supply and demand by raising real fare levels.

5.77 In addition to the measures outlined above, there are additional schemes which could be scheduled throughout the GBSTS study period and would contribute to a further extension of rail services in the GBSTS area.

**Rolling Stock and Train Capacity**

5.78 The transport strategy includes a number of measures designed to encourage car drivers to use other modes of transport. With the parallel growth in development in the sub-region including significant increases in population and employment, there will be pressure for additional capacity for the rolling stock used in the area. This pressure will be increased if other measures such as Smarter Choices and demand management are introduced and have the anticipated impact of influencing mode choice and hence increasing rail patronage levels.

5.79 The Route Utilisation Strategy (RUS) and the Greater Western refranchise specification have both highlighted the need to improve the quality of rolling stock used for local services with the proposed cascade of Thames Turbo stock onto the network; this will increase rail capacity by at least a third without lengthening trains.

5.80 The RUS suggested a rolling stock cascade which would see the trains currently used on local services around Bristol and Cardiff replaced by trains with a higher capacity. Class 143 and 150 trains would be replaced by Class 165 trains cascaded from the former Thames Trains operation, with an increase in seating capacity from 104 and 141 respectively to 170 seats per 2 car train (188 if the existing first class provision is replaced with standard class). The Class 165 trains also have a 90 miles/hour maximum speed as opposed to 75 miles/hour for the existing trains.

5.81 The growth in demand over time will further increase the need to raise capacity on the local stopping services by lengthening these new trains from two to four cars which can be achieved without the need to increase platform lengths.

**Worle**

5.82 As outlined above, there is potential in the expansion of the current station at Worle to play a greater role as a multi-modal interchange, providing a focus for local and regional rail services, local and regional bus services, airport buses, coach services and park and ride. The potential rail infrastructure improvements would involve lengthening platforms to accommodate Cross Country services; this lengthening could be implemented before signalling enhancements. The initial expansion of services may be limited in the short to medium term by the availability of paths, but the planned resignalling of the Bristol area in the medium term (around 2018) should permit the further expansion of services to Worle. The level of additional capacity, which the Bristol area re-signalling will generate, will not be known until the design of the work has been undertaken by Network Rail. This, together with other demands for capacity from cross country and mainline services, means that it is difficult to
assess the capacity available for local Bristol services and hence the need for further capacity improvements, for example the introduction of additional passing loops.

5.83 More intermediate improvements can be achieved to the operation of rail services through Worle Junction by introducing double tracks to replace the single lead junction. This can be undertaken as part of scheduled maintenance at the junction.

**Yate**

5.84 The opportunity for the extension of cross-Bristol services to Yate is precluded by the absence of turnback facilities there. The planned new platform at Bristol Parkway will increase capacity, but the provision of additional facilities at Yate would enable a significant increase in cross-Bristol services between Yate and Weston-super-Mare or Bath. The turnback facilities would enable the rolling stock unit to be parked clear of the two running lines. It is likely that the capacity of the signalling system will be an initial constraint but once the re-signalling is completed and the Yate turnback facilities are undertaken, a significant increase in services would be possible. Yate would also be the location for increased interchange, between local bus services and rail.

**Weston-super-Mare**

5.85 The single track section between Worle Junction and Weston-super-Mare station represents a constraint in the operation of rail services to Weston-super-Mare. Although the improvements at Worle and the associated increase in services would represent an increase in the overall rail services to Weston-super-Mare as a whole, the desire for increased cross-Bristol services between Bristol Parkway/Yate, Bath and Weston-super-Mare will put further pressure on the single track section. While it was a SWARMMS recommendation to reinstate the double track over this section, most of the benefits can be achieved by the improvement of turnback facilities at Weston-super-Mare at a much lower cost. The expansion of operations at Worle diminishes the need to provide the double track connections for the whole length between Worle junction and Weston-super-Mare. However, as highlighted above in relation to Worle station, there would be merit in removing the constraint of the single lead junction at Worle by introducing a double-track section of sufficient length to accommodate local services.

**Increased Cross-Bristol Services**

5.86 Much of the infrastructure improvements outlined above have been designed to increase the capacity and flexibility of rail operations across Bristol and to aid the expansion of services. Although the full expansion of services is likely to be dependent upon the completion of the re-signalling in the Bristol area to achieve the maximum benefits, it will nevertheless be possible to achieve noticeable improvements to services in advance of the resignalling. The increased links would represent a significant improvement to local services. The services would include links between Weston-super-Mare and Yate and between Bath Spa and Yate. There may be constraints in the capability of turning trains at Bath Spa, with a desire to avoid impacts on the operation of mainline services between Swindon and Bristol Temple Meads through Bath Spa. It may therefore be necessary to extend the cross-Bristol services beyond Bath Spa to Westbury which, although increasing the
cost of the additional services, would significantly improve connections between the west Wiltshire towns of Trowbridge, Bradford-on-Avon with the main employment centres of Bath and Bristol.

**Severn Beach line**

5.87 The Severn Beach line currently operates at an hourly interval service for much of the day and this level of service (combined with the circuitous nature of the route to Bristol Temple Meads) produces low passenger loadings along the route. There are currently 15 trains per day in each direction between Avonmouth and Bristol Temple Meads on Mondays to Saturdays, with no trains on Sundays. In the peak periods, the service is extended from Avonmouth to Severn Beach; in the off-peak this link is replaced by a connecting bus service. The estimated annual patronage level of 340,000 represents an average flow of about 40 passengers per hour although there are heavy loadings on individual trains in the morning peak towards Bristol and in the evening peak from Bristol.

5.88 The study has explored the feasibility of converting the line in the longer term to rapid transit with, at the same time, a possible extension to Portishead as part of a second Avon Crossing. The proposed replacement rapid transit services would offer an improved frequency of up to 10 services an hour. Within the Bristol area, the poor accessibility of the rail line to the central area would be corrected with rapid transit by the introduction of on-street operations between Clifton Down and central Bristol along Whiteladies Road, Park Street and The Centre to give a significantly enhanced link from the corridor as well as improved frequency. Additional stops in Sea Mills and Shirehampton would provide improved penetration in these areas.

5.89 However, while the rapid transit scheme provided benefits, there are other factors, apart from enhancement to the public transport service, to be taken into account in the conversion of the Severn Beach line to rapid transit operation. In particular, the Severn Beach line has been identified within the Government’s Community Rail initiative as the potential recipient of measures designed to encourage greater rail patronage. Furthermore, the line currently serves as a relief line for the main line passenger operation on Filton Bank and the freight operation from Avonmouth to Bristol Parkway Junction. There is likely to be a need to maintain this emergency provision and to continue the freight operation. However, it is likely that the, and whether it would be deemed to outweigh potential passenger benefits, needs to be explored with the appropriate authorities. As explained in the section on the rapid transit proposals, if it proves to be difficult to release the rail alignment for rapid transit, there is an alternative route for the rapid transit line from Bristol Centre via Anchor Road, Hotwell Road and Portway to Avonmouth.

**Bristol Parkway**

5.90 Network Rail is progressing a scheme to increase the capacity at Bristol Parkway station through the construction of a third platform. In the longer term, the increased operation of passenger and freight services through the station, including the mix of local, regional and national passenger services will place further pressure on the capacity. Hence, towards the end of the horizon for the study, it may become necessary to increase capacity through an additional fourth platform. The station would increase its role as an interchange point with the increased number of rail
services, including not only transfers between rail services (local, regional and main line), but also between local bus and rail and between rail and the extended Flyer service to BIA.

**TESTING RAIL OPTIONS WITH GREATER BRISTOL MODEL**

5.91 The GBM was used to test the following rail options:

- additional cross-Bristol rail services on the following routes:
  - Weston-super-Mare – Bristol Temple Meads – Bristol Parkway – Yate (semi-fast);
  - Weston-super-Mare – Bristol Temple Meads – Bristol Parkway (all stations);
  - Bath – Bristol Temple Meads – Bristol Parkway – Yate (all stations except Stapleton Road and Lawrence Hill); and
  - Bath – Bristol Temple Meads – Filton – Bristol Parkway (fast); and
- Portishead rail line.

**Cross Bristol Rail Services**

5.92 Introducing the new services leads to an increase in rail trips of 1950 per hour in the morning peak period. Furthermore, there are an additional 350 park-and-ride trips per hour making use of the improved rail service. This leads to a 10% increase in both rail passenger-kilometres and passenger-hours. The increase in rail demand due to the new services is shown in Figure 5.7. As indicated above, in order to achieve the increased volume of services, it will be necessary to provide enhanced turnback facilities and will also require additional capacity to be provided by the re-signalling of the Bristol area. Even with the increased capacity, there will be competition from mainline, regional and freight services as well as the aspirations for the local services. The content of the re-signalling scheme has yet to be specified and it will therefore be crucial that sufficient support and promotion is given for the merits of enhanced local services.

5.93 Figure 5.8 shows, the source of the additional rail demand, indicating that around a third of the passengers have transferred from other modes of public transport, a third has transferred from car and a third comprises completely new (generated) trips.
Figure 5.7 – Difference in Passenger Flow as a Result of Cross Bristol Rail Services

Figure 5.8 – Origin of Additional Rail Passengers

5.94 Table 5.10 shows the impact of the cross-Bristol rail services on rail journey times. As described in the section on rapid transit above, the journey times quoted include time spent travelling on the rail service, walking time, waiting time and an interchange penalty.

5.95 The results show that the new services offer considerable journey time savings on the routes covered, particularly to and from Yate. It should be noted, however, that the figures assume a wait time of half the service headway. In practice, journey times would be shorter as it is likely that passengers would know the timetable and
only arrive at the station when a train is due. This applies particularly to the infrequent Yate services.

### Table 5.10 – Effect of Cross Bristol Rail Services on Journey Times

<table>
<thead>
<tr>
<th>Journey</th>
<th>No cross-Bristol services</th>
<th>With cross-Bristol services</th>
<th>% reduction in Journey Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weston-super-Mare to Bristol city centre</td>
<td>73</td>
<td>62</td>
<td>15%</td>
</tr>
<tr>
<td>Weston-super-Mare to Yate</td>
<td>249</td>
<td>105</td>
<td>58%</td>
</tr>
<tr>
<td>Weston-super-Mare to Filton</td>
<td>87</td>
<td>69</td>
<td>21%</td>
</tr>
<tr>
<td>Bath to Filton</td>
<td>61</td>
<td>54</td>
<td>11%</td>
</tr>
<tr>
<td>Bristol to Yate</td>
<td>214</td>
<td>67</td>
<td>69%</td>
</tr>
</tbody>
</table>

5.96 Some key statistics are given in Table 5.11. These indicate the impact the introduction of the cross Bristol rail services could have on the transport system as a whole.

### Table 5.11 – Impact of Cross Bristol Rail Services

<table>
<thead>
<tr>
<th>Measure</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>0.3% reduction</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.5% reduction</td>
</tr>
<tr>
<td>Car Mode Share</td>
<td>reduced from 81% to 80%</td>
</tr>
<tr>
<td>Total Vehicle Delay on Highway network (Hours)</td>
<td>2% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>1% increase</td>
</tr>
<tr>
<td>Rail Demand</td>
<td>25% increase</td>
</tr>
<tr>
<td>Rail Crowding*</td>
<td>2% reduction</td>
</tr>
</tbody>
</table>

* Crowding is reflected by increases in the in-vehicle time to reflect passengers’ perceived dislike of travelling in crowded conditions. The size of the impact grows as the level of crowding increases (measured by relationship between seated capacity and passenger loadings).

5.97 The additional capacity provided on the rail network is largely taken up by new trips, formed by a combination of diversion from other modes and newly generated journeys. As a result, there is only a modest reduction of 2% in rail crowded time. However, the scheme provides some crowding relief for the bus and rail networks between Nailsea and Weston-super-Mare. On the highway network, there is a reduction of 2% in total vehicle delay across the study area as a result of car trips switching to rail.

5.98 Although there is a considerable increase in rail demand (25%), the impact on the overall car mode share is modest, indicating that, while rail improvements can
contribute positively to reducing congestion on the road network, other measures are needed in addition, e.g. Smarter Choices, demand management, new highway infrastructure etc.

5.99 The overall economic performance of the scheme is strong. The user benefits generated considerably outweigh the scheme costs, resulting in an NPV and BCR of £760 million and 3.2 respectively.

5.100 The majority of the benefits are related to time savings. These are experienced both by:
- those travellers directly benefiting from the reduced rail journey times resulting from the more frequent and direct services provided by the scheme (examples include trips to and from the Yate and Weston-super-Mare areas); and
- those making use of the highway network and therefore benefiting from the congestion relief resulting from the attraction of trips to rail from highway. The largest benefits are accrued in those areas experiencing the highest congestion levels, such as within the Bath urban area.

5.101 The additional trips drawn to rail also cause a substantial increase in rail revenue, although the associated reductions in parking, bus and Park and Ride revenue act to offset this to some extent.

5.102 A further consequence of the switch in trips from highway to public transport is the reduction in indirect tax paid (primarily due to a reduction in fuel duty paid and the lack of tax on public transport fares). This adds to the net cost of the scheme to the government.

Portishead Rail Line

5.103 The Portishead rail line was tested using the GBM at a service frequency of two trains per hour with intermediate stops at Portbury, Pill, Ham Green, Ashton Gate, Parson Street and Bedminster.

5.104 Introducing the Portishead line resulted in an increase in rail demand of 550 passengers per hour (or about 6%). Of these, around 200 transferred from car, causing a modest reduction of 0.3% in total vehicle delay.

5.105 The total journey time from Portishead to Bristol city centre (including time spent travelling on the rail service, walking time, waiting time and an interchange penalty) was 93 minutes – a considerable improvement on the level of service offered by bus (151 minutes). However, the rapid transit service described in the previous section gave a journey time of 49 minutes for the same point-to-point journey. This is due to a number of factors:
- more frequent service by rapid transit (at least 5 per hour, compared with 2 per hour for the train service);
- better penetration of the rapid transit route into central areas of Bristol, reducing walking time, and allowing convenient interchange with other routes in the rapid transit network; and
the location of the proposed rail station on the edge of Portishead would be much less accessible than the rapid transit stops, which could easily serve central areas of Portishead.

5.106 While the economic assessment of the Portishead rail line was relatively positive, with an NPV of £160 million and BCR of 2.3, the rapid transit scheme would offer a better quality of service and better value for money. The costs of the two schemes are set out in Table 5.12 below. The rapid transit capital cost is of the same order as the capital cost of converting the Portishead line. The greater difference is found in the operating costs, with those for rapid transit estimated at around a third of what would be required to run the Portishead rail line.

Table 5.12 – Cost Comparison – Portishead Rail Line vs Rapid Transit

<table>
<thead>
<tr>
<th>Cost (£M, 2005 Prices)</th>
<th>Rail</th>
<th>Rapid Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>29</td>
<td>25</td>
</tr>
<tr>
<td>Operating Cost (per annum)</td>
<td>5.2</td>
<td>1.9</td>
</tr>
</tbody>
</table>

5.107 Other rail schemes have been assessed including the potential for re-opening passenger rail services to Thornbury and from Avonmouth to Bristol Parkway on the current freight route. For each of these options, the forecast level of demand is very low and hence the schemes have not been progressed. Similarly, the potential for re-opening a station at Charfield, north of Yate was examined. The low levels of demand, together with the impact of the additional stop on the journey times of existing passengers, resulted in poor performance for the scheme.

POTENTIAL IMPLEMENTATION PROGRAMME

5.108 An implementation programme for the public transport schemes has been developed, based on a wide range of criteria, including the timing of new developments, timetable for scheme design and appraisal, availability of resources, implementation of associated measures, etc:

♦ in the short term:
  − Greater Bristol Bus Network;
  − Bath Package including new park-and-ride site at Lambridge, extensions to sites at Odd Down, Lansdown and Newbridge and rapid transit route between Newbridge and Lambridge via central Bath;
  − improvements to inter-urban buses including an extension of Airport Flyer services;
  − improved interchange facilities at UWE;
  − Bristol Parkway third platform;
  − new rolling stock for local rail services;
♦ in the medium term:
  − Worle public transport interchange
  − rapid transit on three routes: Ashton Vale to Emersons Green; Hengrove to North Fringe/Cribbs Causeway; Bath to Cribbs Causeway;
- extensions to park and ride sites at Brislington, Long Ashton and Bristol Parkway and to the station car park at Nailsea;
- new park and ride sites at Emersons Green, Hambrook and Nibley; and

♦ in the long term:
- Bristol Parkway fourth platform;
- new cross-Bristol rail services;
- rapid transit from Whitchurch to Avonmouth and Portishead;
- extensions to park and ride sites at Avonmouth and Nibley;
- new park and ride site at Whitchurch;

**IMPACT OF EXTENSIVE PUBLIC TRANSPORT MEASURES IN ISOLATION**

5.109 It had been suggested to the study team that the introduction of significantly enhanced public transport services would, on their own, produce a sufficient impact on travel across the study area to the extent that other measures, particularly increases in highway capacity through new road construction, would play a much decreased role in the transport strategy. To test this approach, a more extensive set of public transport improvements was tested to examine their impact. These measures included:

♦ in-vehicle times on the bus network reduced by 15%;
♦ bus frequencies increased by 25% with a corresponding reduction in waiting times;
♦ interchange penalties reduced by 25%;
♦ fares reduced by 10% in real terms;
♦ high-speed, limited stop, inter-urban bus services linking major centres (e.g. Weston-super-Mare, Bath, North Fringe, BIA) with average speeds of over 30 miles/hour;
♦ significant additions to the current rail network:
  - Weston-super-Mare to Bristol Parkway (extra 2 tph),
  - Weston-super-Mare to Yate and Thornbury (extra 1 tph),
  - Bath to Bristol Parkway (extra 2 tph),
  - Bath to Yate and Thornbury (extra 1 tph),
  - Portishead Line (3 tph),
  - Severn Beach Line (extra 2 tph)
♦ rapid transit network with average speeds of 20 miles/hour; and
♦ extensive park and ride network.

5.110 Table 5.13 shows the key impacts of the enhanced public transport package on its own in the morning peak period, which includes a doubling in the number of public transport trips and a 250% increase in park and ride trips, compared to the Do Minimum scenario. The rail capacity improvements bring the level of rail crowding down by two-thirds to 2003 levels.
### Table 5.13 – Key Impacts of Public Transport Package (morning peak period)

<table>
<thead>
<tr>
<th></th>
<th>2003 Base</th>
<th>2031 Do Minimum</th>
<th>2031 PT Package</th>
<th>PT Package vs Do Minimum</th>
<th>PT Package vs Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Transport Trips</td>
<td>18000</td>
<td>17000</td>
<td>35000</td>
<td>+ 102%</td>
<td>+ 93%</td>
</tr>
<tr>
<td>Park and Ride Trips</td>
<td>1550</td>
<td>1770</td>
<td>6220</td>
<td>+ 252%</td>
<td>+ 301%</td>
</tr>
<tr>
<td>Rail Crowding (passenger hours)</td>
<td>300</td>
<td>970</td>
<td>310</td>
<td>- 69%</td>
<td>+ 3%</td>
</tr>
<tr>
<td>Highway Vehicle Trips (‘000)</td>
<td>154</td>
<td>207</td>
<td>197</td>
<td>- 5%</td>
<td>+ 28%</td>
</tr>
<tr>
<td>Vehicle Kilometres (‘000)</td>
<td>2,000</td>
<td>2,880</td>
<td>2,790</td>
<td>- 3%</td>
<td>+ 40%</td>
</tr>
<tr>
<td>Car Mode Share</td>
<td>89%</td>
<td>91%</td>
<td>81%</td>
<td>- 2%</td>
<td>- 8%</td>
</tr>
<tr>
<td>Total Vehicle Delay on Highway Network (‘000 Hours)</td>
<td>19</td>
<td>64</td>
<td>54</td>
<td>-16%</td>
<td>180%</td>
</tr>
<tr>
<td>Average Vehicle Speed (km/hr)</td>
<td>44</td>
<td>29</td>
<td>31</td>
<td>9%</td>
<td>-29%</td>
</tr>
</tbody>
</table>

5.111 Although the significantly enhanced public transport system encouraged large levels of diversion onto the public transport services, the overall effect on the highway network was muted. The total number of vehicle trips on the highway network falls by 5% in 2031 and still represents a 28% growth from current (2003) levels. Furthermore, journey lengths on the highway network have increased, with the total vehicle-kms falling by just 3% which represents a 40% growth from current levels.

5.112 These effects demonstrate that, even though the public transport improvements stimulate extra usage of the system, the diversion from car to public transport encourages induced or generated traffic through the released highway capacity. At the same time, there would be an increased proportion of goods vehicles on the road network since these trips would not be affected by the public transport improvements. Such vehicles would also have a higher average trip length.

5.113 Hence, the public transport improvements would need to be combined with other policies to control the level of highway traffic, especially a means of limiting the level of induced traffic, e.g. demand management. Even so, the level of highway demand would be greater than current levels, leading to the need to expand the capacity of the highway network.

**SUMMARY**

5.114 The study has examined a wide range of potential improvements to the public transport system in order to cater for the general growth in the demand for travel
across Greater Bristol. The particular components of the public transport measures within the transport strategy range from improvements to the local bus services through to an expansion of the rail network.

5.115 Improvements to urban bus services would be a main focus in the strategy for enhancing the public transport system in the short to medium term. The Showcase bus corridors which form the Greater Bristol Bus Network JLTP Major Scheme Bid include a package of measures with junction improvements providing priorities for buses, new bus lanes, improved bus shelters, real-time passenger information and new low-floor buses.

5.116 Extensions to the park and ride system would involve expansion at the existing sites in Bristol and Bath to increase the capacity and improve the facilities. New sites are also identified in the strategy at Emersons Green, Hambrook, Whitchurch, Nibley and Lambridge.

5.117 The detailed consideration of inter-urban bus services is outside the main scope of GBSTS. Nevertheless, it is possible to identify new connections that would be necessary following the new population and employment developments across the study area. In addition, extensions to the highway network will provide the opportunity to offer service improvements such as journey time cuts and reliability gains. The network of services will need to be reviewed in association with the priority measures in the Greater Bristol Bus Network together with the introduction of rapid transit and improvements to rail services.

5.118 Extensions to the coach services in the strategy would be a combination of enhanced operations through the use of priority measures within the Greater Bristol Bus Network together with potential new stopping locations out of city centres at the new Worle Parkway Interchange, Lambridge Park and Ride and in north Bristol at Parkway/UWE/Hambrook.

5.119 A particular growth area of future travel is BIA and public transport access to the airport must be enhanced to accommodate the growth in air passengers and workers at the airport. The strategy identifies the current Flyer service as the foundation for future expansion, with increased frequency on the existing route together with expansion to serve north Bristol (Parkway) and Worle Interchange. To cater particularly for the airport workers, a demand-responsive or shared taxi operation would be the most appropriate means of serving the widespread destinations.

5.120 The strategy identifies a number of public transport interchanges which should be developed out of town or city centres to serve local developments, including Worle Parkway (with multi-modal activity), UWE (serving the North Fringe), Yate and Filton Abbey Wood rail stations.

5.121 A major area of new development for the public transport involves the network of rapid transit lines which would build on the priority measures within the Greater Bristol Bus Network to produce a system with further priorities including segregation from general traffic wherever possible. The lines would be designed to serve many of the new residential and employment developments, with the initial plans comprising:
Ashton Vale – Emersons Green;
• Hengrove – North Fringe/Cribbs Causeway;
• Bath – Cribbs Causeway; and
• Whitchurch – Avonmouth/Portishead.

5.122 An early element of the rapid transit network would operate in Bath between Lambridge and Newbridge as part of the Major Scheme Bid which is being prepared within the JLTP process.

5.123 Further work is required to identify the type of vehicle to be used to operate the service but modern, low-floor, articulated buses are likely to be the most appropriate, flexible and cost effective vehicles to satisfy the requirements of the service. Further work is also necessary to specify the precise routes, taking into account the desire for significant levels of segregated operation.

5.124 The rail network within Greater Bristol represents a potential resource capable of wider and more intensive use although there are limitations through the number and location of existing rail lines. The restricted penetration into the city centres of Bristol, Bath and Weston-super-Mare and the poor links to the North Fringe contribute to low levels of current rail use, with just 2% of journeys in the morning peak period.

5.125 A range of measures has been identified to improve and expand the rail network, taking into account the availability of resources within the industry:

- improved rolling stock providing increased capacity and speed enhancements on the local rail services;
- additional platforms at Bristol Parkway to provide initially three and ultimately four platforms;
- expanded facilities at Worle station to create a major interchange location, including platform lengthening and an expansion of services;
- new turn-back facilities to enable more trains to operate to/from Weston-super-Mare and Yate; and
- increased services across Bristol linking Weston-super-Mare, Yate and Bath Spa – in view of the restrictions in turning trains at Bath Spa, it may be necessary to extend the local services to Westbury to provide better connections between the West Wiltshire towns of Trowbridge and Bradford-on-Avon and the employment centres of Bath and Bristol.

5.126 Although some of the improvements could be introduced in the short-medium term, the full extent of service increases would be dependent on the re-signalling of the Bristol area which is likely to be completed by 2018.
6. Highway Measures

INTRODUCTION

6.1 The preceding chapters have outlined the series of measures which were identified and appraised in the development of the GBSTS strategy, starting with measures designed to encourage the use of alternative modes to the car, followed by the management of demand and then improvements to the public transport network. This sequence highlighted the emphasis within the strategy development process adopted by the study; examining and promoting alternatives to the car and making best use of existing infrastructure before considering changes or additions to the road system.

6.2 As highlighted in Chapter 2, the impacts of the growth in population and employment across the study area between the base year, 2003, and the forecast year, 2031, together with the increased prosperity over the period, are to increase the car mode share from 89% to 91% in the morning peak period, while at the same time raising the level of delay across the road network by 230%. The introduction of the measures outlined earlier to encourage the use of alternative modes and to enhance public transport have a significant impact on the operation of the transport system, with the mode split for car use reduced to 76% in the morning peak period with the level of congestion cut by over a third (36%) from the 2031 Do Minimum position.

6.3 Although the other measures had made large inroads into resolving the problems, there were still residual areas of significant congestion which remained. Highway improvement measures were therefore designed to solve the remaining congestion and delays across the study area.

6.4 The consideration of highway measure followed a similar pattern to the overall process adopted throughout the study. Firstly, opportunities to make better use of the existing highway capacity were assessed before the potential of enhancements to the highway capacity were considered, with emphasis on the strategic highway network. This process is reflected in the format used to describe the highway measures in this chapter.

MAKING BEST USE OF THE STRATEGIC HIGHWAY NETWORK

6.5 Before embarking on extensions to the highway network in the study area, it is important to ensure that the best use is being made of the existing infrastructure and capacity across the strategic highway network. This may be achieved through a wide range of potential measures which are outlined below. In concentrating on the strategic road network, there is emphasis on the measures designed to resolve issues on the motorway and major trunk roads. However, many of the measures are also appropriate to the rest of the main road network in the study area.

Planned Maintenance

6.6 Planned maintenance can help to minimise disruption on the motorway and trunk road network. Seasonal and daily variations in traffic flows and the regular
occurrence of congestion on the motorway network are well known. Maintenance works, particularly those requiring lane possessions, should be programmed to avoid periods when traffic volumes are greatest in order to minimise the disruption to traffic especially overnight. With significant levels of holiday traffic to/from Devon, Cornwall and Somerset passing through the study area, the HA is adopting a policy of no maintenance on its network during the summer. A further strategy, recently tested by the HA, has been to promote hybrid improvement and major maintenance schemes in order to combine new works and maintenance operations within a single contract.

Reductions of Incidents

6.7 An important factor in the causes of congestion on the strategic road network is the occurrence of accidents and incidents. A number of measures could be implemented to reduce the occurrence of incidents, particularly on motorways:

♦ better training and instruction to drivers in motorway driving;
♦ increased police activity on the motorway to identify drivers behaving in such a way as to cause incidents;
♦ use of CCTV to identify poor driving;
♦ stricter enforcement of penalties for drivers who are found behaving dangerously; and
♦ use of variable message signs to control speeds, and to warn motorists of accidents, incidents and other hazards ahead.

6.8 The above measures would complement ongoing initiatives, such as accident hotspot identification, being operated by the HA and local authorities.

Incident Management

6.9 Incident management is vital for minimising the impact of:

♦ accidents;
♦ breakdowns;
♦ spillages;
♦ shedding of loads;
♦ removal of debris;
♦ fires; and
♦ terrorist threats.

6.10 As vehicle flows on the network increase, incidents are likely to become more frequent and to lead to significant reductions in capacity. Any incident that reduces the capacity below traffic demand creates queues. There are significant benefits from clearing up incidents quickly. However, this is becoming more difficult with increasing legislation governing procedures that must be carried out at the scene of the incident. Such procedures include extensive investigation, particularly in the case of a fatality, and the increasing possibility of litigation by those involved in the incident if, during clearance of the incident, the authorities inflict damage on vehicles, goods or property. Continued partnership working between the HA, police and other authorities is key to the management of incidents in the study area. The HA and
police are seeking ways of speeding up the clearance of incidents; trials are underway in the use of satellite navigation systems and digital recording in order to accelerate the re-opening of roads following major incidents.

6.11 The Highways Agency’s recent introduction (December 2005) of Traffic Officers within the study area will help in reducing the occurrence and impact of incidents. Operating on the motorway and trunk road network, the role of the Traffic Officers includes:

♦ participation at motor vehicle accidents;
♦ removal of damaged and abandoned vehicles;
♦ clearance of debris from the carriageway;
♦ undertaking high visibility patrols;
♦ provision of mobile or temporary road closures; and
♦ supporting the police in their duties.

6.12 The introduction of Traffic Officers is supported by seven Regional Control Centres across England operated by staff from the HA which has taken over responsibility from the police. Altogether, when the scheme is fully implemented, there will be about 1,200 Traffic Officers and 300 Regional Control staff working across England. There are clear limits and delineation between police and Traffic Officers with the police retaining responsibility for investigating criminal offences and, in the case of major accidents, the police will continue to be in charge at the scene.

Incident Occurrence

6.13 An incident is brought to the attention of the control room in a number of different ways:

♦ automatic detection – through the Motorway Incident Detection and Automatic Signalisation (MIDAS) system, data from the loop detectors is fed into pre-set algorithms that determine present and future flow characteristics and recognise the occurrence of flow breakdown;
♦ CCTV control room – the occurrence and severity of the incident can be determined, followed by a decision on the appropriate level of attendance, which can be arranged without waiting for a patrol to investigate the incident. This can immediately reduce incident duration by about 10 minutes, which may be significant for some types of injury;
♦ detection by police patrol and HA Traffic Officers;
♦ public detection – using the emergency phones on the side of the motorway or via their mobile phones; and
♦ ‘Eye in the Sky’ – helicopters reporting on congestion levels.

6.14 Once an incident is detected, the control room has to assess its severity. Traditionally, this is by immediate attendance of the nearest police patrol, which then identifies the scale of the incident and the action to be taken. CCTV permits control room staff to start assessment immediately, thus shortening the time to despatch the appropriate services.
6.15 Fast detection of an incident on its own reduces the response time by only a few minutes and its direct impact on the total duration of an incident is therefore limited. However, there may be a significant indirect effect e.g. by the avoidance of secondary accidents. Also, a few minutes earlier medical treatment can significantly affect survival rates.

6.16 The introduction of incident detection systems will have a range of effects, including:
- reducing the duration of the incident;
- increasing the hourly vehicle flow;
- reducing the consequent delays experienced by traffic; and
- reducing the severity of injury experienced by those involved.

6.17 Traditional practice has been to alert a police vehicle on patrol to attend the scene of the incident immediately. The Regional Control Centres also alert the HA Traffic Officers who will deal with the incident unless the police need to be involved. The scale of the incident can be assessed and any additional resources can be called upon. The need for patrol attendance for validating the initial report before all the necessary resources can be mobilised contributes significantly to the response time.

6.18 Excluding the overall co-ordination of the incident clear up, a major duty of the police or the Traffic Officer is to gather the required level of evidence from the incident scene. In the case of a fatality, this is a process that can take several hours. The police service Road Death Investigation Manual (which incorporates the requirements from the European Human Rights Legislation) requires that all deaths, whether on a road or otherwise, should be investigated to the same standard. From the police point of view, there are few opportunities to shortcut this process. The documentation of evidence is critical to the determination of the overall clear-up time of an incident and, if anything, the evidential requirements are likely to become more stringent. The police and HA should therefore continue to focus on areas where their operation can be speeded up through more advanced methods such as electronic and videogrammetry techniques which are currently under trial.

6.19 The use of standard diversionary signs should minimise the level of police effort necessary to achieve the benefits of significant traffic diversion. However, in practice, it can be time-consuming for the police to gain access to and operate the diversion route trigger signs, and these resources could often be better employed in dealing with the incident itself. With the increasing deployment of higher technology solutions, electronic VMS would be preferable. Diversions off the motorway network may, in general, be best limited to major incidents when, for example, the motorway is completely closed for a significant duration. Often the impacts of diversions on the local road network produce significant levels of congestion which take long periods to dissipate. This is particularly true on sections of the network in the study area where there are limited alternative routes, e.g. the River Avon Crossing. The increased availability of in-car satellite navigation systems will help in the wider use of alternative routes without the need for additional signing.

**Incident Clear-Up**

6.20 Once the police are satisfied with their documentation of the incident scene, the clear-up operation can begin perhaps in stages. Appropriate clear-up resources
include Route Stewards and Incident Support Units, and also approved recovery garages. Liability over the vehicle involved in an incident and its load is a particular issue for recovery crews. Insurance companies, wishing to minimise loss payouts by maximising the salvageable remains of the vehicles and goods (instead of writing them off) hold the recovery crews liable. The crews therefore spend more time and care over the recovery process. A change to legislation is needed so that the police and recovery crews can assess the most efficient means to clear the debris and put the liability with the insurers.

**Signing, Surveillance and Automated Systems**

6.21 Recent advances in technology have led to the potential to introduce more ‘intelligent’ signing/traffic control systems that can provide information in response to changing traffic conditions. Although available elsewhere in the UK, there would be merit in extending their availability across the study area. The systems more commonly available are:

- driver information systems which use variable message signs (VMS) and can increase journey times for some traffic when there is congestion;
  - real-time response to incidents, enabling immediate activation of lane control signals, incident warning signs, and advisory alternative route signs;
  - reduction in congestion, which lowers the chances of additional accidents occurring and eases the route for emergency services; and
  - reduced need for manual resources, with staff concentrating more on directing emergency services and road crews.

- incident warning systems with roadside displays designed to reduce accidents by highlighting congestion, obstructions or incidents ahead; and

- Controlled Motorways which use detectors to reduce speed limits automatically during peak periods in response to traffic speed and flow conditions to improve traffic flows and journey times and to reduce accidents by delaying or preventing the onset of stop-start conditions.

**Active Traffic Management (ATM)**

6.22 A trial of ATM is underway on the M42 between Junctions 3A and 7. ATM aims to make best use of the existing road space through the application of new and existing technologies and infrastructure and new operational procedures.

6.23 ATM contains the follow menu of potential techniques:

- lightweight gantries with lane specific signals and signs, variable speed limits, digital enforcement equipment and enhanced message signs;
- CCTV cameras and automatic queue detection (i.e. MIDAS) to monitor traffic conditions;
- rapid incident response teams to remove obstructions, assist with traffic management and repair roadside equipment;
- ramp metering by signal control on the entry slip roads;
- lane marshalling by destination and/or vehicle type; and
- controlled use of the hard shoulder as an additional traffic lane.
6.24 The benefits of ATM are:
♦ reduced congestion through more efficient use of existing road space;
♦ faster response to incidents and reduced clear-up times;
♦ enhanced driver information;
♦ more reliable journey times; and
♦ reduced driver stress.

6.25 GBSTS supports the introduction of ATM measures on the motorway network in the Greater Bristol area. Much of the infrastructure necessary to implement the measures, in terms of improved telecommunications equipment and signs, is being installed across the area to facilitate the widespread use of ATM, with resulting benefits to the operation of the network.

NEW HIGHWAY SCHEMES

6.26 As identified at the start of this chapter, the improvements to the highway network were considered after the range of alternative policy measures. They were designed to resolve residual congestion on the strategic road network.

6.27 There were two elements to the identification of potential highway schemes to be assessed by the study:
♦ specific schemes identified in the study Brief; and
♦ further schemes designed to resolve particular highway capacity constraints in the future, which are not addressed by schemes in the Brief, dealing separately with:
  - the motorway network,
  - schemes on the remainder of the strategic network.

Schemes Identified in the Study Brief

6.28 In the Brief for GBSTS, a number of highway improvement schemes were identified, many of which have had a long history of development and assessment. These schemes represent a mixture of strategic and local improvements. One of the aims of the study was to establish whether such schemes could play a role in resolving the residual problems on the highway network or whether new measures would be required. In this assessment, one of the key issues for GBSTS is whether a scheme’s impact is purely local or whether there are wider strategic benefits from its implementation. At the same time, in examining the performance of the long-established schemes, there was the opportunity to identify whether they would be likely to have a role in the future highway network in the sub-region or whether they should no longer be considered.

6.29 The principal highway schemes identified in the Brief for the study were:
♦ Avon Ring Road Southern Section (A4 Bath Road to A370) including:
  - A4320 St Philips Causeway to A4 Bath Road to Callington Road Link,
  - A4 Hicks Gate to A37,
- Cater Road to A38 Bridgwater Road,
- A38 Bridgwater Road to A370 Link;
- Link Road from A370 to M5 Junction 20;
- Link Road from M4 to A4174;
- provision of M5 Junction 21A in support of Weston-super-Mare regeneration, taking account of the diversion on east-west routes across the Mendip Hills;
- A4 Saltford Bypass;
- A37 Whitchurch Bypass;
- A37 Clutton/Temple Cloud Bypass;
- Banwell Bypass and associated schemes; and
- M49 Intermediate Junction, Avonmouth/Severnside.

6.30 Figure 6.1 shows the location and broad alignment of the schemes which were specified in the Brief.

6.31 In the initial appraisal of the individual highway schemes, it was important to assess the performance of schemes on a consistent basis; hence, the attention was concentrated on the morning peak period in the GBSTS horizon year of 2031. At the same time, an initial economic appraisal was undertaken to provide an estimate of the relative performance of each scheme together with their broad environmental impacts. On the basis of this initial appraisal, the performance of the individual schemes could be assessed to help decide whether they should be included in the more detailed appraisal of the strategy itself.

6.32 At the outset, it is necessary to understand the importance of the interface between the local and strategic networks. On occasions, problems on the strategic network (e.g. at motorway junctions) are caused by capacity constraints on the local network and hence measures may be necessary on the local network to resolve the problems on the strategic network. At the same time, the reverse effect may also be encountered, in which constraints on the strategic network have impacts on the local network; this is particularly true through the heavy traffic volumes on the motorway network in the summer.

6.33 In the following section, we summarise the initial appraisal of the schemes identified in the Brief, before considering additional schemes designed to solve specific residual problems on the strategic highway network, particularly in relation to the motorway system in the study area.
Figure 6.1 – Potential Highway Schemes Considered by the Study

Note: The schemes in this diagram are conceptual and defined for appraisal purposes.
ASSESSMENT OF HIGHWAY SCHEMES IN THE STUDY BRIEF

6.34 Within this section, we summarise the initial assessment and appraisal of highway schemes identified in the GBSTS Brief, considering the schemes in the order listed in the previous section. The initial appraisal considered each scheme on a consistent basis. Within the Greater Bristol Model, a network containing all the schemes was developed and the effect of the full package of schemes was assessed. The impact of an individual scheme was then assessed by removing the scheme from the overall package and reviewing the consequent change in the performance of the package. One consequence of this approach was that the impact of schemes was tested in relation to the full package of potential schemes, some of which would not be retained in the eventual strategy.

6.35 The appraisal of the individual schemes includes an estimate of the capital costs of the scheme including preparation and supervision. In line with guidance from HM Treasury, the costs also include an allowance for optimism bias which recognises that, in scheme appraisal, there has been a tendency to understate capital costs and hence the optimism bias represents a correction to the initial estimate. To provide an indication of the magnitude of the optimism bias, the costs are shown inclusive and exclusive of the bias. At this stage, the overall costs exclude an estimate for land acquisition; such costs are likely to be closely linked to the precise alignment of the scheme and hence are not appropriate for inclusion in the costs of conceptual schemes.

Avon Ring Road (Southern Section) or South Bristol Ring Road

6.36 Currently, traffic movements between the southern end of the Avon Ring Road (at the junction with the A4 at Hicks Gate) and the A37, A38 and A370 corridors involve circuitous routes along heavily congested radial sections of the highway network in south Bristol with significant delays at key junctions. The position could be exacerbated in the future with the potential addition of significant levels of development in south Bristol by 2031, including Ashton Vale, Whitchurch and Keynsham, as well as further growth on brownfield sites and new employment-related growth within Bristol.

6.37 In considering the schemes in south Bristol that might form an extension to the Avon Ring Road, we examined the connection between the A4 and the A38 separately from the A38-A370 link, although the two elements are strongly inter-connected and together are termed the South Bristol Ring Road (SBRR).

6.38 A number of alternative means of catering for the additional traffic have been examined (see Figure 6.2). The on-line route (currently safeguarded) between the A4 and A38 would include the following sections:

♦ from Hicks Gate along A4 Bath Road to West Town Lane junction with A4174;
♦ along A4174 West Town Lane/Callington Road/Airport Road/Hengrove Way to the roundabout junction with Hartcliffe Way;
6.39 An alternative route through Whitchurch could include:

- from Hicks Gate, following a new alignment south-west towards Whitchurch, to the east of the existing Stockwood residential area;
- crossing A37 at Whitchurch and then running to the south of Hengrove before heading north on Hawkfield Road to the roundabout junction with the existing A4174 at Hartcliffe Way and Hengrove Way; and
- following the alignment of the on-line route along Hengrove Way, Cater Road link, King George’s Road, Highridge Green and Highridge Common to the A38.

6.40 In each case, the route would be designed to dual carriageway standard.

**Figure 6.2 – Alignments of South Bristol Schemes**

Note: The schemes in this diagram are conceptual and defined for appraisal purposes.

6.41 In the assessment of the options, it was found that the volume of traffic using the on-line alignment would lead to significant congestion at major junctions along the route particularly at Brislington between the A4 Bath Road and the A4174 Callington Road and between the A4174 and A37. To relieve the congestion at these junctions would require significant measures involving grade-separated junctions with extensive property acquisition likely. Furthermore, the alignment does not provide satisfactory links to the proposed new developments at Whitchurch and Keynsham. Hence, although the option is not recommended at this time, it could be given further consideration at a later date.
6.42 The study’s preferred option for the scheme is therefore to extend the current alignment of the Avon Ring Road as a dual carriageway with two lanes in each direction across the A4 at Hicks Gate towards Whitchurch, then following the southern boundary of the built-up area before joining the A4174 at the southern end of Hartcliffe Way and continuing south-west along the on-line alignment outlined above. The alternative southern option achieves the bypass role more effectively. Some key aspects of the performance of the scheme are shown in Table 6.1.

Table 6.1 – Key Impacts of Avon Ring Road (Southern Section) (average morning peak hour)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>0.6% increase</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.9% reduction</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network (hours)</td>
<td>6% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>4% increase</td>
</tr>
<tr>
<td>Bus Passenger Kilometres</td>
<td>9% increase</td>
</tr>
</tbody>
</table>

6.43 Overall, implementing the Avon Ring Road Southern Section (ARR(S)) results in a 6% reduction in total vehicle delay across the whole study area; consequently, the average speed across the network is increased by 4%. There is a substantial increase in bus passenger kilometres (9%) brought about by increased bus speeds due to the relief to roads, especially the main radial routes, inside the Bristol urban area.

6.44 Figures 6.3 and 6.4 show the impact of the ARR(S) on the highway network, both in terms of vehicle flow (Figure 6.3) and capacity utilisation (Figure 6.4).

6.45 Figure 6.3 shows that the ARR(S) scheme provides benefits to the strategic highway network; there is relief to the motorway network from M5 Junction 19 round to M4 Junction 19 and on the M32 as vehicles take advantage of the new direct routes using the new road. Large sections of the local road network within Bristol receive some relief due to the scheme. This occurs because, for many journeys, the ARR(S) provides a good route where there is no clear alternative, avoiding the need for traffic to find a path through congested parts of central and south Bristol. Links brought into the relatively uncongested category as a result of the ARR(S), i.e. with flows less than 85% of their capacity, are shown in green in Figure 6.4. The scheme has impacts over a wide area, and certain links, shown in blue, are pushed above the 85% capacity threshold as a result of changing traffic patterns.

6.46 Flows on the existing Avon Ring Road increase as a result of the scheme, particularly between Hicks Gate and the junction with the A420 at Warmley (see Figure 6.3). This puts a number of junctions on the ring road under pressure, and suggests that, in the absence of any other measures such as demand management, secondary measures would be required to increase junction capacity.
Figure 6.3 – Difference in Flow as a Result of Implementing ARR(S) (average morning peak hour)

Figure 6.4 – Difference in Capacity Utilisation as a Result of Implementing ARR(S) (average morning peak hour)
6.47 Table 6.2 shows the impact of the ARR(S) on the travel times for typical journeys across the south Bristol area. This indicates that orbital journey times are improved considerably by the scheme. In addition, there are journey time savings of between 4 and 6 minutes per trip for local journeys within south Bristol which benefit from congestion relief. For trips from central Bristol to BIA, congestion relief results in a time saving of around 3 minutes.

Table 6.2 – Impact of ARR(S) on Journey Times (minutes in average morning peak hour)

<table>
<thead>
<tr>
<th>Route</th>
<th>Without ARR(S)</th>
<th>With ARR(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whitchurch to Kingswood</td>
<td>43</td>
<td>9</td>
</tr>
<tr>
<td>Keynsham to Long Ashton</td>
<td>42</td>
<td>20</td>
</tr>
<tr>
<td>Nailsea to Pucklechurch</td>
<td>48</td>
<td>38</td>
</tr>
<tr>
<td>Bristol City Centre to Bristol</td>
<td>22</td>
<td>19</td>
</tr>
<tr>
<td>International Airport</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.48 Table 6.3 gives the key indicators for the economic performance of the scheme. This shows that the overall economic performance is very strong, with large user benefits which considerably outweigh the scheme costs, resulting in an NPV of £960 million and a BCR of 16. The benefits mainly come from the travel time savings experienced by a large number of highway users. A significant feature of the scheme is that it serves major areas of new development. Although the demand for travel created by the new development plays an important role in the appraisal of the scheme, further analysis showed that, even without the new developments, there is a strong economic performance.

Table 6.3 – Economic Performance of Avon Ring Road (Southern Section)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (2005,Q1) £mill, inc Optimism Bias</td>
<td>£112</td>
</tr>
<tr>
<td>Cost (2005,Q1) £mill, excl Optimism Bias</td>
<td>£77</td>
</tr>
<tr>
<td>PVC (£ mill, 2002 prices &amp; values)</td>
<td>£63</td>
</tr>
<tr>
<td>PVB (£ mill, 2002 prices &amp; values)</td>
<td>£1,020</td>
</tr>
<tr>
<td>NPV (£ mill, 2002 prices &amp; values)</td>
<td>£957</td>
</tr>
<tr>
<td>BCR</td>
<td>16.2</td>
</tr>
</tbody>
</table>

6.49 The Avon Ring Road (Southern Section) would provide a completely new route around south Bristol, avoiding the need for traffic wishing to make orbital journeys to follow routes along congested radial roads in the built-up urban area. The scheme would also serve the major new developments at Whitchurch, Keynsham and Ashton Vale. It delivers large travel time savings...
and has a very strong justification in transport terms. For this reason it is included as a key element of the GBSTS strategy.

**A38-A370 Link**

6.50 Two separate alignments for the link have been considered – the Red and Orange routes identified in earlier work on alternative schemes linking the A38 and A370. The Red route follows an alignment that extends the Avon Ring Road (see Figure 6.1 above) in a north-west direction from the A38 to the A370 while the Orange route lies further to the south-west and provides more local links including a bypass of Barrow Gurney. The potential extensive developments in the area generate significant increases in demand compared with the present. The two schemes are located close to the proposed developments, with the Red route lying broadly at the eastern boundary and the Orange route on the western boundary. Hence, there is close interaction between the schemes and the development, with the potential for private sector contributions for the scheme.

6.51 A comparison of the overall performance of the Red and Orange schemes is given in Table 6.4. This shows that, while the Red route has a modest impact on delays across the network, implementing the A38/A370 Orange route along with the Red route has very little effect on the overall network performance, with no additional reduction in total vehicle delay above that achieved by the Red route on its own.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Red Route</th>
<th>Orange Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>0.1% increase</td>
<td>impact not significant</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>impact not significant</td>
<td>impact not significant</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network (hours)</td>
<td>0.4% reduction</td>
<td>0.04% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>0.2% increase</td>
<td>impact not significant</td>
</tr>
<tr>
<td>Bus Passenger Kilometres</td>
<td>impact not significant</td>
<td>impact not significant</td>
</tr>
</tbody>
</table>

6.52 Figures 6.5 to 6.8 show the impact of the Red and Orange routes on the highway network, both in terms of vehicle flow (Figures 6.5 and 6.7) and capacity utilisation (Figures 6.6 and 6.8).

6.53 Figures 6.5 and 6.6 indicate that the Red route relieves the congestion on the B3130 through Barrow Gurney, on the A370 and through Long Ashton and, as a result, a number of links are brought below the 85% capacity utilisation threshold. However, the scheme generates additional traffic on the A38 to the south of its junction with the Red route which pushes this section slightly above the 85% capacity threshold and hence some local measures may be required to solve the outstanding problems.
6.54 Figures 6.7 and 6.8 show the additional effects of implementing the Orange route, assuming the Red route is already in place. The joint scheme introduces some local re-routing from the Red to the Orange route. Although its impacts are local, the Orange route plays a role in providing some additional relief to the B3130 through Barrow Gurney.

6.55 Table 6.5 shows the effect of introducing the A38-A370 Red and Orange routes on journey times. As shown in the table, neither link on its own has a great impact on journey times to the airport, although both schemes contribute to reductions in orbital journey times, for example between Keynsham and Long Ashton.

Table 6.5 – Impact of Red and Orange Routes on Journey Times (minutes in average morning peak hour)

<table>
<thead>
<tr>
<th>Route</th>
<th>No A38-A370 Link</th>
<th>A38-A370 Red Route</th>
<th>A38-A370 Red and Orange Routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keynsham to Long Ashton</td>
<td>42</td>
<td>41</td>
<td>40</td>
</tr>
<tr>
<td>Bristol City Centre to</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Bristol International Airport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thornbury to Bristol</td>
<td>47</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>International Airport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portishead to Bristol</td>
<td>22</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>International Airport</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 6.5 – Difference in Flow as a Result of Implementing A38-A370 Red Route (average morning peak hour)

Figure 6.6 – Difference in Capacity Utilisation as a Result of Implementing A38-A370 Red Route (average morning peak hour)
Figure 6.7 – Difference in Flow as a Result of Implementing A38-A370 Orange Route (average morning peak hour)

Figure 6.8 – Difference in Capacity Utilisation as a Result of Implementing A38/A370 Orange Route (average morning peak hour)
Table 6.6 summarises the economic performance of the two schemes, assuming that the rest of SBRR is in place between the A38 and the A4. The table shows that, while the impact of the Red route on the network as a whole is relatively modest, the journey time savings it generates considerably outweigh the scheme costs to produce an NPV of £70 million and a strong BCR of 8.5.

In contrast, assuming the Red route is already in place, the Orange route performs poorly at the strategic level. It has a negligible impact on journey times for strategic journeys and results in a negative NPV.

### Table 6.6 – Economic Performance of A38/ A370 Link Road Schemes

<table>
<thead>
<tr>
<th></th>
<th>Red Route</th>
<th>Orange Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (2005,Q1) £mill, inc Optimism Bias</td>
<td>£16</td>
<td>£12</td>
</tr>
<tr>
<td>Cost (2005,Q1) £mill, excl Optimism Bias</td>
<td>£11</td>
<td>£8</td>
</tr>
<tr>
<td>PVC (£ mill, 2002 prices &amp; values)</td>
<td>£9</td>
<td>£9</td>
</tr>
<tr>
<td>PVB (£ mill, 2002 prices &amp; values)</td>
<td>£80</td>
<td>-£2</td>
</tr>
<tr>
<td>NPV (£ mill, 2002 prices &amp; values)</td>
<td>£70</td>
<td>-£10</td>
</tr>
<tr>
<td>BCR</td>
<td>8.5</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

The Red route forms an element of the SBRR, has a strong economic justification in its own right, and is therefore included in the GBSTS strategy. The Orange route mainly provides local links, with relief to Barrow Gurney being the main benefit together with links to the new Ashton Vale development. Further analysis of the effects of implementing the Orange route in conjunction with a wider scheme to improve access to the airport is given in the section on airport links below.

**Link Road from A370 to M5 Junction 20**

The construction of a link between the A370 at Long Ashton and Junction 20 of the M5 would provide a more direct connection between the motorway and south Bristol, replacing the range of existing routes from the M5, i.e. via Junction 19 and A369, Junction 20 and B3130 and Junction 21 and A38/A370. None of these routes represents a satisfactory link between the M5 and south Bristol due to a combination of limited capacity on rural single carriageway roads, passing through local communities with infrequent passing places and variations in gradient.

Although, in this section, the analysis concentrates on the link from M5 Junction 20, an alternative scheme between M5 Junction 21 and south Bristol via BIA is examined later in this chapter; this Airport Link Road scheme was not identified specifically in the study Brief and hence was considered
separately, although its performance is compared with the A370 to M5 Junction 20 link.

6.61 The link between M5 Junction 20 and south Bristol would mainly follow a new alignment within the B3130 corridor and hence would also provide a bypass for a number of communities of differing sizes along its route, including Nailsea, Tickenham and Wraxall. The scheme would significantly increase traffic on the A370 between Cambridge Batch and Bristol and hence the widening of this section to dual carriageway standard would need to be included in the scheme definition.

6.62 Figures 6.9 and 6.10 indicate the impacts of the scheme, which include:
- new connection to the M5 from Nailsea and south Bristol, also providing both areas with enhanced links to Weston-super-Mare;
- some relief to the M5 between Junctions 19 and 20 and to Junction 19 itself; and
- transfer of some traffic from the A38 and A370 onto the M5 between Junctions 20 and 21, although the extent of the diversion is not sufficient to have a significant impact on the M5 capacity utilisation on this section of the motorway.

6.63 Table 6.7 summarises some of the overall impacts of the M5 Junction 20 Link Road scheme. It indicates that the scheme has a relatively small impact on the operation of the transport system across the study area.

### Table 6.7 – Key Impact of M5 Junction 20 Link Road

<table>
<thead>
<tr>
<th>Measure</th>
<th>M5 Junction 20 Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>0.1% increase</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.3% increase</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network</td>
<td>1% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>1% increase</td>
</tr>
<tr>
<td>Bus Passenger Kilometres</td>
<td>1% increase</td>
</tr>
</tbody>
</table>
Figure 6.9 – Difference in Flow as a Result of Implementing M5 Junction 20 Link Road

Figure 6.10 – Difference in Capacity Utilisation as a Result of Implementing M5 Junction 20 Link Road
The M5 Junction 20 Link Road produces some small journey time savings between Weston-super-Mare and Bristol city centre (about two minutes). The time savings are small because, although it raises the average speed for the journey, the scheme is indirect and hence increases the journey length.

Table 6.8 summarises the economic performance of the scheme. The time savings are mainly experienced by drivers whose origins or destinations lie close to the alignment; drivers for whom the link increases the journey length (e.g. between central Bristol and Weston-super-Mare) only gain small time benefits. In particular, 30% of the benefits are gained from savings (of 9 to 12 minutes per trip) occurring between Nailsea and Weston-super-Mare.

<table>
<thead>
<tr>
<th>Table 6.8 – Economic Performance of M5 Junction 20 Link Road</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost (£ mill, 2005,Q1)</strong></td>
</tr>
</tbody>
</table>
| &nbsp;&nbsp;&nbsp;&nbsp;Optimism Bias &nbsp;&nbs...
distance trips between Junctions 18A and 19 which were a feature of the first alternative; and

- at Junction 19, only westbound access and eastbound egress would be permitted (i.e. west-facing slip roads) while at Junction 18A only eastbound access and westbound egress would be available (i.e. ‘east-facing’ slip roads) – however, this option produced extremely high levels of diversion onto the Avon Ring Road (A4174).

6.69 Of the three alternatives, the second one was the most operationally efficient and therefore formed the basis for the detailed appraisal.

**Figure 6.11 – Alignment of M4 to A4174 Link at Emersons Green**

![Alignment of M4 to A4174 Link at Emersons Green](image)

Note: The schemes in this diagram are conceptual and defined for appraisal purposes.

6.70 Table 6.9 shows the main effects of the possible new M4 to A4174 Link. The scheme provides a more direct route for traffic to and from Emersons Green and other areas to the east of Bristol, reducing the average trip length by 0.5%. There is an associated reduction in congestion on alternative routes, leading to a fall in total vehicle delay across the study area of 1.5%.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>0.1% increase</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.4% reduction</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network (hours)</td>
<td>1.5% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>0.6% increase</td>
</tr>
<tr>
<td>Mean Journey Length</td>
<td>0.5% reduction</td>
</tr>
</tbody>
</table>

6.71 Figures 6.12 and 6.13 show the impact of the scheme on highway flows and capacity utilisation. Figure 6.12 shows that the scheme provides some relief for M4 J19, although much of the released capacity is taken up by traffic...
making other movements, leading to an increase in flow on the M4 between J20 and J19.

6.72 There is also a substantial increase in flow on the north-eastern sections of the A4174 Avon Ring Road, and a corresponding reduction on the M4 between J19 and J18A as vehicles use the new junction when travelling to and from the east. This exacerbates capacity problems on the A4174. Furthermore, significant levels of additional traffic on the M4 to the east of the new junction pushes this section of the motorway (J18A-J18 eastbound) above the 85% capacity threshold (see Figure 6.13).

Figure 6.12 – Difference in Flow as a Result of M4 to A4174 Link at Emersons Green
Figure 6.13 – Difference in Capacity Utilisation as a Result of M4 to A4174 Link at Emersosn Green

Table 6.10 shows the significant journey time savings for trips from the east to Emersosn Green – for example the journey time from Swindon is reduced by 7 minutes. However, there is little benefit for trips from the study area to Emersosn Green or for trips from the east to central Bristol. Journeys between the North Fringe and Emersosn Green take longer as a result of the scheme because of increased congestion on the A4174 ARR.

<table>
<thead>
<tr>
<th>Route</th>
<th>No scheme</th>
<th>M4 J18A and Emersosn Green Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swindon to Emersosn Green</td>
<td>39</td>
<td>32</td>
</tr>
<tr>
<td>Patchway to Emersosn Green</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Swindon to Bristol City Centre</td>
<td>58</td>
<td>57</td>
</tr>
<tr>
<td>Yate to Emersosn Green</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Bath to Emersosn Green</td>
<td>21</td>
<td>21</td>
</tr>
</tbody>
</table>

6.74 Almost all trips using the M4 to A4174 Link are travelling between the study area and the hinterland and external areas (see Table 6.11), because the scheme creates a new route into and out of the Bristol urban area from the east.
Table 6.11 – Select Link Analysis for M4 to A4174 Link at Emersons Green

<table>
<thead>
<tr>
<th></th>
<th>Emersons Green Link</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northeast-bound</strong></td>
<td></td>
</tr>
<tr>
<td>Total Flow (pcus)</td>
<td>1491</td>
</tr>
<tr>
<td>% Within Study Area</td>
<td>1%</td>
</tr>
<tr>
<td>% Study Area to Hinterland</td>
<td>40%</td>
</tr>
<tr>
<td>% External</td>
<td>60%</td>
</tr>
<tr>
<td><strong>Southwest-bound</strong></td>
<td></td>
</tr>
<tr>
<td>Total Flow (pcus)</td>
<td>1231</td>
</tr>
<tr>
<td>% Within Study Area</td>
<td>0%</td>
</tr>
<tr>
<td>% Study Area to Hinterland</td>
<td>30%</td>
</tr>
<tr>
<td>% External</td>
<td>70%</td>
</tr>
</tbody>
</table>

6.75 Table 6.12 summarises the economic performance of the M4 to A4174 Link. The overall economic performance is strong, with an NPV of £274 million and BCR of 12. The time savings are mainly derived from a large number of long distance trips saving typically 3 to 5 minutes on their journey by taking advantage of the quicker, more direct route between the A4174 and M4. Over 80% of the time savings accrue to trips starting or ending beyond the study area.

Table 6.12 – Economic Performance of M4 to A4174 Link at Emersons Green

<table>
<thead>
<tr>
<th></th>
<th>M4 to A4174 Link at Emersons Green</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost (2005,Q1) £mill, inc Optimism Bias</strong></td>
<td>£41.9</td>
</tr>
<tr>
<td><strong>Cost (2005,Q1) £mill, excl Optimism Bias</strong></td>
<td>£28.8</td>
</tr>
<tr>
<td>PVC (£ mill, 2002 prices &amp; values)</td>
<td>£25.0</td>
</tr>
<tr>
<td>PVB (£ mill, 2002 prices &amp; values)</td>
<td>£299.4</td>
</tr>
<tr>
<td>NPV (£ mill, 2002 prices &amp; values)</td>
<td>£274.4</td>
</tr>
<tr>
<td>BCR</td>
<td>12.0</td>
</tr>
</tbody>
</table>

6.76 Although the new M4 to A4174 Link road scheme has a strong economic case, mainly derived from travel time savings for journeys from outside the study area, it is not being recommended by the study. The new link would alter flow patterns in the congested area between M4 J20 and M4 J19, M32 J1 and the northern stretch of the A4174 Avon Ring Road, putting additional strain on the A4174 and causing congestion problems on the M4 to the east of the new junction with the strong likelihood that the widening of the M4 between Junctions 18A and 18 would be necessary. The improved linkage to the M4 is likely to encourage long-distance commuting to and from
developments in Ememsons Green and Pucklechurch, which would go against the principles of sustainable development.

**M5 Junction 21**

6.77 M5 Junction 21 currently experiences significant delays on the approaches from the A370 from the west (especially in the morning peak period) and also on the southbound exit slip road from the motorway (particularly in the evening peak period). A major influence on the level and location of the congestion is the conflict between traffic wishing to access/egress the motorway and through traffic travelling across the motorway on the A370 between Weston-super-Mare, Congresbury and south Bristol.

6.78 A major factor behind the congestion is the high level of out-commuting from Weston-super-Mare due to the imbalance between housing and employment in the town following the significant increases in the housing stock in recent years. The Weston Vision aims to resolve the imbalance through an employment-led strategy to develop Weston-super-Mare and to bring forward other developments. This is reflected in the emerging Area Development Framework which is being given development plan status through an Area Action Plan. It will be vital that the imbalance between housing and employment is corrected if further increases in out-commuting are to be avoided with consequent additional pressures at Junction 21.

6.79 The study has explored a wide variety of measures designed to improve the operation of the junction, in parallel with the significant increase in development in the Weston-super-Mare area. The initial analysis highlighted that the most effective schemes were ones that aimed to split the movements at the junction between the traffic wishing to access the motorway and the traffic seeking to cross the motorway on the A370. Measures designed to improve the operation of the junction without splitting the two movements resulted in significant continued congestion on the A370 distributor road to the west of M5 Junction 21 and did not resolve the underlying problem. These included additional flyover lanes and other improvements to M5 Junction 21.

6.80 The two alternatives which provided the most effective solutions to the problems were:

- the preferred alternative comprising the closure of the current Junction 21 and the construction of a new junction to the south near Woolvers Hill, with connections to the A370 at West Wick; or
- the construction of a new Junction 21A with the A371 together with the closure of the south-facing slip roads at the current Junction 21.

6.81 Both of the schemes performed well, producing high levels of benefits with reductions to journey times and reduced flows on the A370 Primary Distributor Road (PDR) to the west of the M5.

6.82 The separate work on the Weston Vision identified a third option involving the retention of the existing motorway junction and the construction of a new crossing over the motorway to the south of the junction and linking into the A370 to the east of the junction. The operation of this scheme will need to be included in the detailed assessment of the alternatives although there is the
potential for it to encourage routeings which will not resolve the problems at the junction.

6.83 The key impacts of the preferred scheme to relocate the junction are given in Table 6.13.

Table 6.13 – Key Impacts of M5 J21 Relocation (average morning peak hour)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>impact not significant</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.4% increase</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network</td>
<td>1% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>0.7% increase</td>
</tr>
<tr>
<td>Mean Highway Journey Length</td>
<td>0.3% increase</td>
</tr>
</tbody>
</table>

6.84 The scheme has a significant impact on congestion in the vicinity of the motorway junction, reducing total vehicle delay across the study area by around 1%. The changes to the road network result in some trips taking longer routes, producing a slight increase in the mean journey length.

6.85 Figures 6.14 and 6.15 show the effect of relocating Junction 21 on the highway network, in terms of vehicle flow and capacity utilisation.

Figure 6.14 – Difference in Flow as Result of Relocating M5 J21 (average morning peak hour)
Figure 6.15 – Difference in Capacity Utilisation as a Result of Relocating M5 J21 (average morning peak hour)

6.86 Figure 6.15 shows that there is reduced congestion on the A370 PDR in Weston-super-Mare on the approach to the old J21 which brings all links in the immediate vicinity of the old junction below the 85% capacity utilisation threshold. Conversely, increases in flow on the Wolvershill Road and at the West Wick roundabout push some links in this area above the 85% capacity threshold.

6.87 Table 6.14 shows that relocating the junction reduces journey times to and from Weston-super-Mare. Hence, the scheme produces good journey time savings between Weston-super-Mare and central Bristol.

Table 6.14 – Impact of M5 J21 Relocation on Journey Times (average morning peak period, in minutes)

<table>
<thead>
<tr>
<th>Route</th>
<th>No Relocation</th>
<th>M5 J21 Relocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weston-super-Mare to Bristol City Centre</td>
<td>66</td>
<td>64</td>
</tr>
<tr>
<td>Weston-super-Mare to BIA</td>
<td>37</td>
<td>35</td>
</tr>
<tr>
<td>BIA to Weston-super-Mare</td>
<td>41</td>
<td>40</td>
</tr>
</tbody>
</table>

6.88 Table 6.15 presents the main characteristics of the scheme’s economic appraisal. This shows that the benefits associated with the relocated junction
option outweigh the costs, resulting in an NPV of over £150 million and BCR of 3.2.

**Table 6.15 – Economic Performance of M5 J21 Relocation**

<table>
<thead>
<tr>
<th>M5 J21 Relocation</th>
<th>Cost (2005,Q1 prices) £mill, incl Optimism Bias</th>
<th>£80</th>
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<td>Cost (2005,Q1 prices) £mill, excl Optimism Bias</td>
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<td>PVC (£ mill, 2002 prices &amp; values)</td>
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<tr>
<td></td>
<td>PVB (£ mill, 2002 prices &amp; values)</td>
<td>£221</td>
</tr>
<tr>
<td></td>
<td>NPV (£ mill, 2002 prices &amp; values)</td>
<td>£151</td>
</tr>
<tr>
<td></td>
<td>BCR</td>
<td>3.2</td>
</tr>
</tbody>
</table>

6.89 Improvements at M5 J21 are essential to solve problems with the operation of the M5 motorway in this area, which will only be exacerbated with the additional development planned for Weston-super-Mare. As part of the new developments, it will be vital to resolve the current imbalance between housing and employment in Weston-super-Mare and hence cut the current levels of out-commuting. The junction relocation option would separate traffic crossing the motorway from that accessing it, which would resolve conflicts and hence reduce delays. The scheme is therefore included in the GBSTS strategy.

**Saltford Bypass**

6.90 The scheme carries reasonable hourly traffic flows of 1100 pcus to the south-east and 700 to the north-west which, in the peak periods, would justify a single carriageway road. As shown in Figures 6.16 and 6.17, there would be relief to Saltford village with flows falling to 300 pcus per hour in each direction through the village, and modest travel time savings of 1-2 minutes for trips between Keynsham and Bath. The overwhelming majority of the traffic using the scheme is local, with around 90% of trips travelling wholly within the study area.

6.91 However, the scheme would have high construction costs due to the difficult terrain, and it does not produce an effective economic performance. Furthermore, as shown by Figures 6.16 and 6.17, the impact of the scheme on the highway network is of a local rather than strategic nature.

6.92 The scheme produces a net reduction in average journey costs, generating user benefits of £90 million (PVB). However, the high cost of the scheme (PVC = £72 million) means that the resulting NPV and BCR are moderate, at £17 million and 1.2 respectively. Time savings represent about 95% of the benefits and these savings are predominantly experienced by trips between areas to the south/east of Bristol and Bath. Bypassing the congested area in Saltford provides average savings of between 5 and 6 minutes for these trips. However, the release of the capacity constraint in Saltford creates additional traffic in Bath producing some further congestion and hence net disbenefits in this area.
6.93 Thus, although the scheme produces some local relief, it does not provide strategic benefits and hence is not taken forward to the GBSTS strategy.

Figure 6.16 – Difference in Flow as a Result of Implementing the Saltford Bypass

Figure 6.17 – Difference in Capacity Utilisation as a Result of Implementing the Saltford Bypass
**Whitchurch Bypass and Callington Road Link**

6.94 The two schemes were tested in combination, although much of the impacts are local in nature. Figures 6.18 and 6.19 summarise the changes in traffic flows and capacity utilisation in the local network as a result of the schemes.

6.95 Both schemes provide some additional capacity and carry more than 800 pcus per hour in the morning peak in the dominant northbound direction. The Callington Road link provides some relief to the A37 but less relief to the more heavily congested A4 which is probably due to the longer routeing and the difficulty in negotiating the junctions to gain access to the new link from the A4. The majority of the traffic is local, with over 86% having both its origin and destination in the study area.

6.96 The impact of the Whitchurch bypass is very localised with traffic switching from the existing A37 through the village. Congestion remains at other locations along the A37 to the south, including through Pensford. There is some use of the road by non-local traffic with 25% of trips having either its origin or destination outside the study area.

6.97 Both schemes would provide additional capacity in relatively congested parts of south Bristol. The Callington Road link would provide some congestion relief, particularly to the A37, but in overall terms, the impact of the scheme is moderate.
The impact of the Whitchurch bypass is localised, simply allowing traffic to switch to the new route rather than travel through Whitchurch. The benefits are diminished by the serious problems that remain on other sections of the A37, particularly further south at Pensford. Nevertheless, it may be possible to incorporate a scheme that would provide a bypass of Whitchurch in the detailed design of the South Bristol Ring Road.

**Clutton/Temple Cloud Bypass**

The two neighbouring villages on the A37 are bypassed by the scheme which provides local relief although there is little strategic impact as shown by Figures 6.20 and 6.21. The peak traffic levels on the new road are around 800 pcus per hour in each direction. There is limited relief to other roads in the area and no impact on other strategic routes or on the overall network. Since the scheme is near the edge of the study area, the majority of the traffic has its origin and/or destination outside the study area.

The schemes provide local benefits but have little strategic impact and hence are not included in the GBSTS strategy.
Figure 6.20 – Difference in Flow as a Result of Implementing the Temple Cloud/Clutton Bypass

Figure 6.21 – Difference in Capacity Utilisation as a Result of Implementing the Temple Cloud/Clutton Bypass
Banwell, Churchill and Sandford Bypasses

6.101 The three adjacent communities of Banwell, Sandford and Churchill experience significant levels of local congestion, due to the volumes of through traffic associated particularly with Weston-super-Mare, BIA and the Mendip Hills:

- Banwell – on the A371 with particular constraints within the centre of the village (especially in relation to goods vehicles) due to a very narrow section of road;
- Sandford – general traffic volumes on the A368; and
- Churchill – at the junction of the A368 and A38, the latter being a major route to BIA and south Bristol from M5 Junction 22 and the South West.

6.102 A linked series of bypasses was examined to establish the impact on traffic flows through the villages. Such bypasses would increase the length of journeys and hence forms of traffic calming within the villages were included in the schemes to ensure that traffic was deterred from continuing to travel through the villages. Figures 6.22 and 6.23 present the changes in traffic flows in the morning peak hour and the associated impact on the capacity utilisation of the local highway network.

6.103 The bypass carries hourly flows in the morning peak of around 800 pcus eastbound and 400 pcus westbound. There are variations in the characteristics of the traffic between the two directions. For the eastbound flow, less than a quarter (22%) of the traffic has both origin and destination in the study area, with 40% travelling between Somerset and the study area. In the westbound direction, there is a much higher level of local traffic, with around two-thirds (65%) having both origin and destination in the study area; this probably reflects the proximity to Weston-super-Mare and its attraction as a destination for work trips.

6.104 The overall economic performance of the scheme is poor, with the net user benefits produced by the scheme being small in scale (PVB of £40 million) and therefore not sufficiently large to offset the scheme costs (PVC of £42 million) resulting in a negative NPV of £2 million and a BCR of 0.96. The time savings experienced by drivers using the new road are limited because the road adds to travel distance, offsetting some of the improvements in average speed.

6.105 The introduction of the bypass has little impact on traffic movements apart from the relief of the three communities; Figure 6.22 highlights that there are negligible changes in traffic flows away from the communities. Hence, the scheme is considered to have a local rather than strategic importance and is not included in the GBSTS strategy.
Figure 6.22 – Difference in Flow as a Result of Implementing Banwell/Saltford/Churchill Bypass

Change in flow (pcus)

-1,000 -500 -200 -100 0 100 200 300 500 1,000

Weston-super-Mare

Figure 6.23 – Difference in Capacity Utilisation as a Result of Implementing Banwell/Saltford/Churchill Bypass

Nailsea

Weston-super-Mare

Links over 85 percent capacity in Scenario F
Banwell/Saltford/Churchill Bypass

Links brought below capacity threshold by scheme

Links above capacity threshold and not affected by scheme

Additional links brought above capacity threshold by scheme
6.106 The Severnside area is due to experience moderate increases in employment by 2031, based on the projections used by the study. The Avonmouth and southern Severnside area would gain about 4000 jobs by 2031 while for the north Severnside area, the growth would be around 1200. Neither of these areas would have an increase in dwellings although there would be 200 extra houses in the area between the M49 and M5.

6.107 In the past, there have been proposals for more extensive development containing both industrial and residential uses. In association with these proposals, there were plans for significant enhancements to the strategic highway network with the construction of a new junction on the M49 linked to a new spine road through the core of the new development. The scale of the possible development has diminished in recent years, due in part to limits to the scope for residential development through the threat of flooding. The study examined the potential of the highway schemes in the light of the less ambitious development plans.

6.108 The alignment of the M49 Intermediate Junction and Spine Road scheme is shown in Figure 6.24.

Figure 6.24 – Alignment of M49 Intermediate Junction

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Note: The schemes in this diagram are conceptual and defined for appraisal purposes.

6.109 In the absence of significant levels of development in the vicinity, the impacts of the scheme on the study area traffic system are modest, as indicated by Table 6.16.
Table 6.16 – Key Impacts of M49 Intermediate Junction

<table>
<thead>
<tr>
<th>Measure</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>impact not significant</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>impact not significant</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network (hours)</td>
<td>0.2% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>0.2% increase</td>
</tr>
</tbody>
</table>

6.110 The effect of the scheme on highway flows is shown in Figure 6.25. There is localised relief to the M5 between J17 and J18 and to the B4055. In addition, there are travel time savings of around 4 minutes for trips around the Severn Beach, Avonmouth and Portbury areas, although the volume of traffic enjoying these benefits is small.

6.111 These impacts are unlikely to justify the large cost of the scheme, and it has not been included in the GBSTS strategy.

Figure 6.25 – Difference in Flow as a Result of the M49 Intermediate Junction

MOTORWAY WIDENING AND JUNCTION IMPROVEMENTS

6.112 The schemes identified in the study Brief included a number of measures associated directly with the operation of the motorway network in the study area:
   ♦ Link Road from A370 to M5 Junction 20;
   ♦ Link Road from M4 to A4174;
   ♦ relief of M5 Junction 21; and
6.113 In most cases, these schemes are not designed to provide benefit to the motorway network; they are more concerned with relieving capacity problems on the local road network, although (as at M5 Junction 21) there are local conflicts at the motorway junctions between traffic wishing to access the motorway and through or crossing traffic.

6.114 Within this section, we concentrate on specific measures associated directly with the operation of the motorway system in the study area, examining capacity issues on links and at junctions within the area. The appraisal of measures (Chapter 8) also contains an objective review and comparison of the performance of links and junctions across the motorway network in the study area.

6.115 While the study has been progressing, the HA has been implementing schemes to improve the performance of the motorway network in the study area through the construction of climbing lanes on critical sections of the M4 and M5. These schemes form part of the Do Minimum network for the study.

6.116 The previous SWARMMS study recommended the widening of the M4 between Junctions 19 and 20 and the M5 between Junctions 15 and 17. One of the requirements of the study was to comment on these SWARMMS proposals. The assessment of the need for further widening of the motorway network has highlighted that the section on the M4 between Junction 19 (M32) and Junction 20 (M5 Almondsbury) will require widening from three to four lanes over the study period.

6.117 With some of the new developments planned close to the motorway junctions, for example at Junction 17 (Cribbs Causeway) and with existing pressures at Junction 16 (Aztec West), there will be a need for specific local measures to resolve the problems. These could include improvements to the design of Junctions 16 and 17 which, given the close proximity of the junctions, might also incorporate a widening of the main carriageway from three to four lanes in line with SWARMMS.

**M4 Widening between Junction 19 and Junction 20**

6.118 As indicated above, the SWARMMS study identified the widening of the M4 between Junctions 19 and 20 as a key improvement to the motorway network. Our own analysis confirmed this conclusion. With each of the measures designed to encourage mode shift away from the private car (i.e. encouragement of alternative modes, Smarter Choices, public transport improvements and increased demand management), this section of the network consistently experienced flows at levels above 85% of available capacity throughout peak periods. It was the only section of the network to exhibit such high and consistent levels of congestion.

6.119 The widening of the section from three to four lanes in both directions can be achieved within the existing highway boundary. Table 6.17 summarises the economic performance of the scheme and confirms the strength of its performance.
Table 6.17 – Economic Performance of M4 Widening between Junctions 19 and 20

<table>
<thead>
<tr>
<th></th>
<th>M4 Widening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (2005, Q1) £mill incl Optimism Bias</td>
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<td>Cost (2005, Q1) £mill excl Optimism Bias</td>
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<tr>
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<td>PVB (£mill, 2002 prices &amp; values)</td>
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</tr>
<tr>
<td>NPV (£mill, 2002 prices &amp; values)</td>
<td>£349</td>
</tr>
<tr>
<td>BCR</td>
<td>-4.5</td>
</tr>
<tr>
<td>BKR</td>
<td>10.4</td>
</tr>
</tbody>
</table>

6.120 The vast majority of benefits generated by the scheme are time savings. Those journeys using the widened section experience reduced delay and therefore shorter journey times. However, this effect is offset, to an extent, by increased delay on adjacent sections of the road caused by the increased volume of traffic attracted to the widened road. Therefore, for instance, a trip travelling the length of the M4 through the study area would typically save around a minute with the widening in place (in 2031, morning peak). However, trips from central Bristol, travelling eastward (via the M32 and M4) would experience slight journey time increases as they travel along the more congested section to the east of J19 but do not experience the benefits of the widened section.

6.121 The scheme also increases overall vehicle operating costs for both cars and HGVs. This is the result of a slight increase in average journey distance caused by drivers taking marginally longer routes to take advantage of the widened section. For HGVs, this distance effect is supplemented by an increase in average speed which causes a decrease in operating efficiency.

6.122 The changes in vehicle operating costs are a small part of total costs but, when considered over the full 60 year appraisal period, have a present value of over £130 million, offsetting approximately one third of the time savings. The increase in costs, particularly for HGV fuel, also results in a rise of over £100 million (present value) in indirect tax revenue received by government. This represents income to the public sector and is worth over 250% of the scheme’s cost. The net impact of the widening is therefore to provide an income to the public sector. This results in a benefit or ‘negative cost’ on the denominator of the BCR measure and therefore produces a negative BCR, which in this case is not a useful measure of the economic performance of the scheme.

6.123 The Highways Agency’s benefit cost comparison ratio (the BKR) is probably more useful in this context. This includes the public sector income as a benefit on the numerator of the ratio with only the scheme’s capital and operating costs included in the PVC in the denominator. The value of the BKR for the M4 widening is over 10, confirming the strong economic performance of the scheme and its inclusion within the GBSTS strategy.
M5 Junction 17

6.124 M5 Junction 17 provides access to Cribbs Causeway, the large regional shopping centre (The Mall), as well as to the B4055 towards Easter Compton and Pilning and to the A4018 towards Bristol, see Figure 6.26.

**Figure 6.26 – M5 Junction 17 and Surrounding Area**

6.125 Congestion occurs at busy times, particularly on Saturdays and this can cause backing up onto the motorway because the traffic cannot exit the motorway onto the roundabout. This congestion is likely to increase as more development takes place and traffic volumes increase.

6.126 Some work is programmed to be carried out shortly to improve the capacity of Junction 17:

- changes are to be made to the white lining of the off slips – on the southbound off slip this will encourage traffic to Cribbs Causeway to use two lanes of the slip road; and
- new signal controllers are to be installed and Microprocessor Optimised Vehicle Actuation (MOVA) will be implemented to replace the current fixed time signal controller – this will make the signals more reactive to the volumes of traffic on the various approaches to the junction.

6.127 These changes will improve matters in the short term but, with further development and growth in traffic, a more radical solution will be required in the future.

6.128 With the currently proposed improvements to white lining and traffic signals, it is unlikely that any further significant capacity can be ‘squeezed’ out of the current junction layout. Other possible options are:
close the section of the A4018 between Junction 17 and the first roundabout (Harry Ramsden)
  - this would reduce the number of routes accessing the roundabout;
  - by reducing the number of roads accessing the roundabout at Junction 17, this option would improve the operation of the junction;
  - however, this is only likely to produce a marginal improvement and would not be adequate in the long term.

♦ an underpass/flyover between the B4055 and the A4018 or Cribbs Causeway;
  - this would take out the through traffic on the A4018 or to/from Cribbs Causeway and the B4055;
  - however, traffic flows on the B4055 are relatively light and this option would not significantly reduce the traffic using the roundabout at Junction 17.

♦ close one or more slip roads to reduce the volume of traffic using Junction 17;
  - this could significantly reduce traffic using the junction;
  - however tests suggest that the redistributed traffic would cause more congestion at other motorway junctions and on local roads, and it is unlikely to be acceptable to the local authorities.

♦ construct a northbound off slip road that flies over the B4055 and then under the M5 to access Cribbs Causeway at the ‘Asda’ roundabout, together with a northbound on slip that leaves the A4018 at the Harry Ramsden roundabout, passes under the M5 and over the B4055 to join the M5 north of Junction 17.
  - this option (see Figure 6.27) would allow traffic from the south, wishing to access Cribbs Causeway, direct access to the Asda roundabout without using the roundabout at Junction 17;
  - similarly, traffic accessing the M5 to travel north from Cribbs Causeway and from the A4018 could join the motorway from the Harry Ramsden roundabout and avoid the Junction 17 roundabout;
  - this would significantly reduce traffic on the Junction 17 roundabout and, in particular, the right turning traffic that causes most of the conflict.

6.129 While Figure 6.27 represents a potential solution to the capacity issues at Junction 17, a number of variations of this scheme have also been identified. A detailed analysis of the alternatives is therefore necessary before completing a full appraisal of the scheme. However, such a detailed assessment is outside the scope of the Greater Bristol Model and the strategic study.
Figure 6.27 – M5 Junction 17 Improvements
M5 Junction 16

6.130 The junction between the M5 and A38 at Junction 16 is subject to considerable congestion during peak periods, with the position being exacerbated by the close proximity between Junction 16 and the access roundabout to Aztec West Business Park, located 350 metres to the south. There are three lanes in each direction between Aztec West and M5 Junction 16, with the southbound carriageway widened to four lanes on the approach to Aztec West roundabout. North of the M5, the A38 is a dual two lane road with the southbound carriageway widening to three lanes on the approach to Junction 16.

6.131 Junction 16 is located 1.1 kms south of the main Almondsbury Interchange between the M5 (Junction 15) and M4 (Junction 20). With the extensive levels of weaving activity over this section of the M5, the motorway is up to 12 lanes wide to accommodate the traffic movements. The westbound off slip at Junction 16 has been widened to four lanes with three lanes directed south onto the A38 towards Aztec West. The eastbound off slip is two lanes wide and there are three lanes for circulating traffic at the junction roundabout which is signal controlled.

6.132 The signal controlled roundabout junction on the A38 at Aztec West provides access to the Aztec West Business Park to the west and Bradley Stoke to the east. The signals are linked to the corresponding signals at M5 Junction 16. The two roads to the east and west of the roundabout are dual carriageways on their approaches to the junction. There is an uncontrolled single lane slip road that allows traffic from Aztec West to turn northwards onto the A38, forming a third lane on the A38 towards Junction 16. Bradley Stoke Way, to the east of the roundabout, is a two lane dual carriageway which widens to three lanes on the approach to the roundabout. There are three lanes for circulating traffic on the roundabout.

6.133 There are two further junctions within close proximity of the Aztec West roundabout. About 150 metres to the west is a roundabout which links different access roads within the Aztec West development. About 150 metres to the east, on Bradley Stoke Way, there is a traffic signal controlled junction with Woodlands Lane which provides access to the main business area of Bradley Stoke.

6.134 The heavy congestion in the morning peak period at Junction 16 is such that the traffic backs up on both off slip roads and can affect the mainline traffic on the M5, leading to regular delays and the danger of accidents on the motorway. At Junction 16, the bulk of traffic is entering or leaving the M5; only 15% of vehicles are travelling through the junction on the A38. Hence, there would be limited benefits from introducing new infrastructure to remove the A38 through traffic from the junction by introducing some form of bypass lane.

6.135 To ease the congestion on the eastbound off slip, it would be possible to increase capacity by providing an extended auxiliary lane to increase the number of lanes from two to three. However, this would probably require land acquisition with the potential for a public inquiry within the scheme approval process.

6.136 A principal factor behind the congestion is the lack of capacity in the peak periods at the Aztec West roundabout. Hence, there was merit in exploring potential schemes which would improve the operation at this junction and hence alleviate some of its
construction of a southbound underpass for A38 traffic beneath the Aztec West roundabout – in the morning peak, about 40% of traffic is travelling through the junction on the A38 and hence removing these vehicles from the junction would significantly ease its operation and reduce the blocking back to M5 Junction 16. However, there is insufficient space between the two junctions to construct a full, grade-separated underpass and hence it will be necessary to restrict access to light vehicles, which form the overwhelming element of traffic in the peak periods.

♦ replacement of the Aztec West roundabout with a signal controlled junction incorporating a displaced right turn (DRT) which is contained in the HA toolkit and has been implemented at the A4311 Motorola intersection in Swindon. The concept behind DRT is to relocate one or more of the movements at a junction from the centre of the intersection, thereby reducing the number of conflicts and increase intersection capacity.

♦ the preceding options could be combined with a widening of the A38 which would increase the storage at the Aztec West roundabout junction although would not in itself raise capacity through the junction. Any widening would need to take into account constraints from the developments in Aztec West on the west and the potential need to relocate a gas governor station.

6.137 Within the study, it has been possible to identify these potential solutions to the traffic issues at the junction although, because the Greater Bristol Model does not permit detailed modelling of the operation of the two main junctions, it has not been feasible to undertake a detailed appraisal. It is therefore necessary for further work to be undertaken to produce a detailed appraisal of the option and to progress them in order to confirm their applicability in solving the extensive congestion at this location.

M32 Junction 1

6.138 The grade-separated intersection of the M32 Junction 1 with the A4174 Avon Ring Road includes a flyover for the M32 over the surface level roundabout carrying the A4174. The proximity between M32 Junction 1 and M4 Junction 19 results in traffic blocking back from M32 Junction 1 to the M4 and then onto the M4 eastbound and westbound off slip roads. The position is exacerbated by the volume of traffic on A4174 and the adjacent junction on both the western and eastern sections of the road.

6.139 A number of measures have been introduced on the roundabout in order to increase the effective capacity of the junction by improving the traffic circulation. Further planned measures include improvements to the northbound and southbound off slip roads to increase the queue storage capacity. In addition, there are plans to widen the A4174 from two to three lanes to the west of the M32 junction with the additional lanes being allocated to High Occupancy Vehicles. While this will increase the overall capacity of the road, further changes involve the introduction of a new signal controlled junction between the M32 and UWE to permit access to new development at Harry Stoke; it is likely that the creation of the new junction will reduce capacity on the A4174.
Plans have also been prepared for the introduction of a new Park and Ride site to the north-west of M32 Junction 1 at Hambrook. As outlined in the description of park and ride sites in Chapter 5, the study has explored the potential operating designs for the site and has identified that there would be significant practical difficulties in any design that placed additional stress on M32 Junction 1 from either commuter traffic wishing to access/egress the site or the operation of the park and ride bus services. Hence, the view is that access to the site should be from the west rather than the east, with possible connectivity with the construction of the Stoke Gifford bypass and the detailed design of the Harry Stoke development.

A variety of measures are therefore planned to extract the maximum vehicle capacity from the M32/A4174 and it is likely that little further can be implemented without significant new construction work. This would probably need to involve the separation of the through traffic on the A4174 from the traffic moving between the M32 and A4174 through the creation of a segregated link. However, this is likely to represent a major design and construction exercise and the impact of demand management, public transport improvements and other measures in the vicinity before embarking on the new link.

Car Sharing and High Occupancy Lanes

Any increases in capacity on the motorway network, either on links or at junctions, will produce benefits to motorway users through reduced journey times and improved reliability. However, it is important that these benefits are not eroded through additional traffic which is induced or generated by the increase in capacity. Hence, measures designed to maintain or 'lock in' the benefits should be introduced in parallel with the other enhancements. The need to lock in the benefits is particularly important where local (short distance) commuting trips could be the main users of the additional capacity.

One of the most appropriate techniques to achieve the desired effect is the allocation of any additional lane for the use of car sharing or high occupancy vehicles (HOVs) for part or all of the day. Although there are local schemes within the study area (i.e. sections of the A4174 Avon Ring Road and the A370 near Long Ashton) and there is experience in the operation of HOV lanes on motorways outside the UK, particularly in the United States, there is no direct experience on the UK motorway network. The recently announced pilot scheme to introduce a car sharing lane on the short (one mile) section of the M6/M606 in West Yorkshire in 2007 will represent the first such measure. The scheme will be concentrated on the link between the southbound M606 and the eastbound M62. This is to be followed by a much larger pilot scheme to include a seven mile car sharing lane on the M1 between Junction 7 (Hemel Hempstead) and 10 (Luton Airport).

The success of these schemes will, of course, have a direct impact on the extension of the principle elsewhere on the UK motorway network. With that condition, there are two main locations where the introduction of a car sharing or HOV lane could be appropriate:

- M4 between Junctions 19 and 20; and
- M5 between Junctions 18 and 19.
6.145 With the M4 between Junctions 19 and 20, attention will need to be given to the length and location of the car sharing/HOV lane. The distance between Junctions 19 and 20 is relatively short due to the allowance for the merging of traffic between the M4 and M5 at Junction 20 and the exit/entry slip roads at Junction 19. Hence, the scope for a major car sharing/HOV lane is limited. At the same time, it is likely to be difficult to include such a lane on the connections between M4 and M5 because of the extensive weaving operation. It may therefore be necessary to restrict the car sharing/HOV lane to the M4 alone, from Junction 19 and through Junction 20. Because of the weaving movements at the two junctions, the car sharing/HOV lane would probably need to be located in the outside lane. If it proves difficult to introduce an effective, safe scheme, it will be necessary to explore other techniques to control access to the widened section of road, for example ramp metering. However, this may only be appropriate in the westbound direction on the slip roads at Junction 19 with some difficulties in extending the principle to the eastbound direction.

6.146 The construction of a Second Avon Crossing (see below) would not include a direct widening of the M5 but would provide additional capacity on a parallel route between Junctions 18 and 19. It is expected that there would be a significant diversion of local traffic onto the new crossing which would therefore provide relief to the motorway. To avoid the released capacity being dissipated by the generation of additional trips, there would be the potential to create a car sharing/HOV lane on the M5 over this section. Although the motorway is not being widened, there are sufficient lanes to enable the conversion of one lane to the priority use. Further research would need to be undertaken into the appropriate design of the car sharing/HOV lane, taking into account the levels of weaving at Junctions 18 and 19 and the relatively high proportion of slow moving vehicles on the climb over the existing bridge.

**ADDITIONAL HIGHWAY SCHEMES**

6.147 The earlier section has examined the various highway schemes identified within the study Brief. In this section, we summarise the assessment of further improvements to the highway network, considering the following specific schemes:

- links to BIA and south Bristol from the south of the study area;
- Second Avon Crossing;
- A36 to A46 Link; and
- Winterbourne and Stoke Gifford Bypass.

**Links to Bristol International Airport and South Bristol from the South**

6.148 A number of different schemes have been examined to attend to the potential increase in traffic approaching Bristol from the south, including from Weston-super-Mare. In the future, there will be major increases in travel through this area, including the anticipated growth at Bristol International Airport (BIA) as well significant levels of additional residential and employment-related development in the Weston-super-Mare area and in Ashton Vale.
The two alternatives found to be most effective were:

- Direct link from the existing M5 Junction 21 to BIA – this new cross-country route would provide a direct link to the BIA from Weston-super-Mare. Early work indicated that the scheme would have little impact without associated measures to increase capacity on the A38 and provide a good quality onward route into south Bristol, and therefore the scheme includes:
  - widening of the A38 in the vicinity of the airport (in practice the road may need to be re-aligned to limit property acquisition);
  - A38-A370 Orange route (described earlier in this chapter) with a slightly revised alignment – this would split the Bristol-bound traffic between the A38 and the A370, avoiding putting excessive pressure on the A38 at the Barrow tanks junction; and
  - widening of the A370 to dual carriageway standard between the existing dualled section and the Cumberland Basin.

- Direct link from M5 Junction 20 north of Nailsea to A38, connecting to the A38-A370 link and South Bristol Ring Road (SBRR) – this new cross-country link to the north of Nailsea does not serve the BIA directly but would provide a more direct connection to the SBRR (described earlier). Again, the scheme was tested in conjunction with widening the A370 to dual carriageway standard.

The indicative alignments of the BIA and M5 Junction 20 link schemes are shown in Figure 6.28, with the locations of SBRR and the relocated M5 J21 shown for reference.

Figure 6.28 – Alignment of BIA and South Bristol Access Schemes
Table 6.18 compares the key impacts of the BIA and M5 Junction 20 Link schemes with the details for the latter scheme repeated from Table 6.7 shown earlier.

**Table 6.18 – Key Impacts of BIA and M5 Junction 20 Link Road**

<table>
<thead>
<tr>
<th>Measure</th>
<th>BIA Link</th>
<th>M5 Junction 20 Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>0.2% increase</td>
<td>0.1% increase</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.3% increase</td>
<td>0.3% increase</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network</td>
<td>2% reduction</td>
<td>1% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>1% increase</td>
<td>1% increase</td>
</tr>
<tr>
<td>Bus Passenger Kilometres</td>
<td>3% increase</td>
<td>1% increase</td>
</tr>
</tbody>
</table>

Overall, the BIA link scheme has around twice the impact on congestion across the study area as the M5 Junction 20 link, with a significant reduction in total vehicle delay of 2%. Figures 6.29 to 6.30 show the impact of the BIA link scheme both in terms of vehicle flow and capacity utilisation.

The BIA link provides a new route from Weston-super-Mare to the airport and south Bristol, giving substantial relief to the M5 between Junctions 21 and 19. In addition, there is relief to the A370 between Weston-super-Mare and Nailsea. In the north-east bound direction, almost two-thirds of the traffic on the BIA link is travelling into the study area from the South West. In the south-west bound direction, the scheme carries mainly local traffic heading for employment opportunities in Weston-super-Mare.

As well as providing a link to the M5 for traffic to and from Nailsea, the M5 Junction 20 link scheme also offers a new route into Bristol. There is relief to the M5 between J20 and J19, and to Junction 19 itself (see Figures 6.9 and 6.10 presented earlier). Some traffic is transferred from the A38 and A370 onto the M5 between J21 and J20, although this is insufficient to have a significant impact on the performance of this section of the M5. The flow differences (see Figure 6.9) show a strong movement between Nailsea and employment opportunities in Weston-super-Mare via the new link.

Both alternatives lead to an increased flow on the A370 near Long Ashton, but this is catered for by the A370 widening included in the two schemes.
**Figure 6.29 – Difference in Flow as a Result of Implementing Airport Link Road**

<table>
<thead>
<tr>
<th>Location</th>
<th>Change in Flow (pcus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keynsham</td>
<td></td>
</tr>
<tr>
<td>Bristol</td>
<td></td>
</tr>
<tr>
<td>Yate</td>
<td></td>
</tr>
<tr>
<td>Weston-super-Mare</td>
<td></td>
</tr>
<tr>
<td>Nailsea</td>
<td></td>
</tr>
<tr>
<td>Clevedon</td>
<td></td>
</tr>
<tr>
<td>Portishead</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 6.30 – Difference in Capacity Utilisation as a Result of Implementing Airport Link Road**

- Links above 85 percent capacity in 2031
- BIA Link vs No BIA Link
- Additional links brought above capacity threshold by scheme
- Links already above capacity threshold and not affected by scheme
- Links brought below capacity threshold
6.156 Table 6.19 shows changes in morning peak journey times as a result of the two schemes. The BIA link would offer substantial journey time savings of 5-9 minutes on routes from Weston-super-Mare and Worle Parkway to the airport and central Bristol. There would also be a 5 minute saving for trips from the South West to the airport. By comparison, journey time savings with the M5 Junction 20 link are more modest.

**Table 6.19 – Key Journey Times for BIA Link and M5 Junction 20 Link Schemes (morning peak period in minutes)**

<table>
<thead>
<tr>
<th>Route</th>
<th>No Link</th>
<th>BIA Link</th>
<th>M5 Junction 20 Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weston-super-Mare to Bristol City Centre</td>
<td>62</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>BIA to Bristol City Centre</td>
<td>28</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td>Sedgemoor (Somerset) to BIA</td>
<td>42</td>
<td>37</td>
<td>41</td>
</tr>
<tr>
<td>Worle Pt Interchange to BIA</td>
<td>29</td>
<td>24</td>
<td>28</td>
</tr>
<tr>
<td>Worle Pt Interchange to Bristol City Centre</td>
<td>55</td>
<td>46</td>
<td>52</td>
</tr>
</tbody>
</table>

6.157 Table 6.20 indicates the economic performance of each scheme with the information for the M5 Junction 20 Link Road repeated from Table 6.8 given earlier. Both alternatives have a strong economic case, with a BCR of 5.4 for the BIA link and 3.1 for the M5 Junction 20 link.

6.158 With the BIA link, a large proportion of the benefits (nearly 30%) are experienced by trips travelling to and from the airport. Most of the rest of the benefits are gained by other journeys that are able to make direct use of the new link road, for instance, traffic travelling from the South West to south Bristol. Further benefits are generated by the congestion relief caused by the scheme across the wider area, bringing journey time savings for trips not making direct use of the scheme itself, for example traffic on the A370 between Nailsea and Weston-super-Mare.

6.159 With the M5 Junction 20 link, the time savings are primarily experienced by those drivers who can make direct use of the bypass, particularly those using it for local movements to and from Nailsea itself (making up around 30% of the overall benefits). The greatest benefits (typically 9 to 12 minutes per trip) are experienced by those using the bypass to travel between the Weston-super-Mare and Nailsea areas. The savings associated with these trips represent two-thirds of the benefits experienced by trips to and from Nailsea (i.e. around 20% of overall benefits).
Table 6.20 – Economic Performance of BIA and M5 Junction 20 Links

<table>
<thead>
<tr>
<th></th>
<th>BIA Link</th>
<th>M5 Junction 20 Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (2005, Q1) £mill, inc Optimism Bias</td>
<td>£128.7</td>
<td>£98.4</td>
</tr>
<tr>
<td>Cost (2005, Q1) £mill, excl Optimism Bias</td>
<td>£88.8</td>
<td>£67.9</td>
</tr>
<tr>
<td>PVC (£ mill, 2002 prices &amp; values)</td>
<td>£60.4</td>
<td>£77.7</td>
</tr>
<tr>
<td>PVB (£ mill, 2002 prices &amp; values)</td>
<td>£327.6</td>
<td>£241.8</td>
</tr>
<tr>
<td>NPV (£ mill, 2002 prices &amp; values)</td>
<td>£267.2</td>
<td>£164.1</td>
</tr>
<tr>
<td>BCR</td>
<td>5.4</td>
<td>3.1</td>
</tr>
</tbody>
</table>

6.160 The analysis presented above has demonstrated the case for a new link from the M5 to south Bristol. The BIA link scheme has a stronger case than the M5 Junction 20 link in terms of transport impacts, and does more to improve accessibility to the airport. However, both schemes have significant environmental impacts as they pass close to SSSIs and other environmental designations. The engineering difficulties of constructing the BIA link scheme could be considerable as the route encounters steep terrain at Redhill, and may require substantial revisions to limit the amount of property acquisition. For these reasons, both schemes are likely to meet with considerable levels of debate during their development. Nevertheless, the GBSTS strategy includes a new link from the M5 to south Bristol as a long term measure. The exact alignment of the route will need to be subject to further analysis and appraisal.

**Second Avon Crossing**

6.161 The M5 between Junction 18 and Junction 19 represents one of the few crossings of the River Avon within the study area and hence is a critical part of the strategic road network. Incidents on this section of the motorway network have a widespread impact across the study area and beyond. One of the factors influencing the performance of this section of the motorway is the high proportion (10%) of trips formed by local traffic travelling between Junctions 18 and 19 which, together with goods vehicles accessing the Avonmouth and Royal Portbury Docks on either bank of the River Avon, produces significant volumes of weaving traffic on the section. This, together with the relatively steep gradients necessary for the motorway to reach a sufficient height to clear the River Avon, means that the link operates at less than the full theoretical capacity for a four lane dual carriageway motorway.

6.162 The importance of the link within the national and regional strategic network, and the lack of a significant alternative route, places considerable stress on the link within the operation of the network. This is exacerbated by the additional local connections which the link provides. The dependence of the regional highway network on the continued operation of the crossing, and the threats to network resilience if the
pressures on the crossing worsen, means that particular attention needs to be placed on exploring ways of easing its critical role.

6.163 Although perhaps a long term issue, it is important to acknowledge the continuing need for maintenance of the crossing and the impact that it would have on its operation, if alternative routes are unavailable. The problem on the link between Junctions 19 and 18 is exacerbated by local constraints in the operation of Junction 19 with the combined effects of access from Portishead, Royal Portbury Dock and Easton in Gordano services.

6.164 At the same time, there is a need to enhance the public transport access for Portishead and hence, it is desirable for the crossing to include multi-modal capabilities. Furthermore, the importance of port traffic needs to be taken into account with the specific issues associated with security and customs arrangements in the movement of goods, particularly between the two areas of the port on either bank of the River Avon.

6.165 The identification of the alignment for the crossing and the design of the scheme will need to take into account a number of potentially conflicting issues, including:

♦ the allocation of capacity between general traffic and public transport including rapid transit;
♦ access to the two parts of the port, including security and customs aspects of freight movements;
♦ the form of the crossing e.g. barrage or bridge and the type of opening mechanisms; and
♦ access to the local road network and other transport infrastructure, e.g. Portway Park and Ride site.

6.166 A number of measures have been explored to relieve this section of the motorway. The most attractive option would be to provide a lower level crossing between Junctions 18 and 19. At the southern end, this would involve improvements to Junction 19 which currently experiences significant levels of congestion, especially for traffic from Portishead in the morning peak periods. It is probable that a 'dumbbell' style roundabout would be required to accommodate the additional arm. There may be scope to terminate the alignment at the existing roundabout on Royal Portbury Dock Road/Gordano Way. The preferred alignment of the link (shown in Figure 6.31) would follow the current path of the M5, starting from west of the motorway at Junction 19 and then moving between the current motorway supports and crossing over the River Avon and the Severn Beach rail line in order to link with the A4 to the east of the motorway in the vicinity of the park and ride site.

6.167 Other features of the initial design include:

♦ at this stage, the disused railway to Portishead has been treated as live for the purpose of this study and the proposed alignment therefore passes over the railway corridor on an overbridge;
♦ the route passes through two car storage areas on an embankment as it gains height to clear the railway to Portbury Dock;
• the route would cross the railway to Portbury Dock via a bridge and from this point until after the railway line on the northern bank it would continue on a structure;

• the crossing of the River Avon would need to be via some form of an opening bridge or barrage since the river is navigable beyond this point and carries, amongst other traffic, tall ships at least once a year. After discussion with the Bristol harbour authorities, the guideline used for the structure was for a clear opening of 20 metres width with a vertical clearance of 10 metres at the high water mark. Various types of structures with an open aspect (to allow for the high tidal range) could serve as a crossing. These include swing and bascule type bridges that would allow the vast majority of river traffic to pass unhindered, thereby limiting the impact caused by bridge openings on vehicular traffic;

• a barrage and lock option was not developed in detail at this stage because it could have a very significant negative environmental impact and such a solution would require all craft to pass through a lock regardless of clearance, thereby increasing delays to traffic on the crossing;

• the route would cross the Severn Beach railway line on a bridge before dropping down to tie in with the A4 on a new junction in the vicinity of the Portway park and ride site;

• there are two sets of overhead electricity transmission lines to the west of the existing M5 Avonmouth Bridge and the proposed route passes underneath one of them and, depending on the exact alignment, could affect one of the pylons. It is assumed that pylons are carrying extra high voltage cables between 22kV and 132kV. Whilst it appears that there is adequate clearance between the cables and the proposed alignment this would need to be confirmed with the electricity company;

• the Government Pipeline and Storage System, which is a high pressure oil pipeline, passes in an east-west direction underneath span number 5 of the existing M5 Avonmouth Bridge. The proposed alignment would therefore cross the pipeline to the west of the existing bridge. This section of the alignment would be on a bridge and its piers would have to be designed so as not to interfere with the pipeline or the access to it.
Figure 6.31 – The Second Avon Crossing Option
6.168 Table 6.21 shows the key effects of the Second Avon Crossing scheme. The results show that the scheme would have a relatively modest impact, reducing total vehicle delay across the study area by 0.5%.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>Impact not significant</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.1% reduction</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network (hours)</td>
<td>0.5% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>0.2% increase</td>
</tr>
</tbody>
</table>

6.169 Figures 6.32 and 6.33 show the effect of the Second Avon Crossing on highway flows and capacity utilisation.

6.170 The new crossing attracts a two-way flow of over 3000 pcus per hour in the morning peak period, and reduces the flow on the existing M5 Avonmouth Bridge by around 1300 pcus per hour northbound and 900 pcus per hour southbound (see Figure 6.32). Around two-thirds of the traffic using the second crossing is travelling entirely within the study area, indicating that the scheme is successful in removing shorter distance trips from the national strategic road network.

6.171 Re-routeing of traffic as a result of the scheme eases flows on the A369 and A370 while increasing traffic on the A4. However, there is very little impact on the motorway network outside the immediate vicinity of the scheme. The new route would allow some traffic from Portishead and Portbury to avoid the congested M5 Junction 19, but this would be counterbalanced by an increase in traffic leaving the M5 at Junction 19 to access the second crossing.

6.172 Table 6.22 indicates that the scheme has only a marginal effect on journey times.

<table>
<thead>
<tr>
<th>Route</th>
<th>Reference Case</th>
<th>Second Avon Crossing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portishead to Bristol</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>Portbury to Avonmouth</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Weston-super-Mare to Bristol</td>
<td>64</td>
<td>63</td>
</tr>
</tbody>
</table>
Figure 6.32 – Difference in Flow as a Result of the Second Avon Crossing

Figure 6.33 – Difference in Capacity Utilisation as a Result of Implementing Second Avon Crossing
6.173 Table 6.23 summarises the economic performance of the Second Avon Crossing scheme. The overall economic performance is reasonable, with a BCR estimated in the range 1.2 to 1.6, and an NPV of between £16 and £34 million. The range quoted reflects an uncertainty in the cost of the scheme – this would depend upon which of the potential structure solutions was selected.

<table>
<thead>
<tr>
<th>Table 6.23 – Economic Performance of Second Avon Crossing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Second Avon Crossing</strong></td>
</tr>
<tr>
<td>Cost (2005,Q1) £mill, inc Optimism Bias</td>
</tr>
<tr>
<td>Cost (2005,Q1) £mill, excl Optimism Bias</td>
</tr>
<tr>
<td>PVC (£ mill, 2002 prices &amp; values)</td>
</tr>
<tr>
<td>PVB (£ mill, 2002 prices &amp; values)</td>
</tr>
<tr>
<td>NPV (£ mill, 2002 prices &amp; values)</td>
</tr>
<tr>
<td>BCR</td>
</tr>
</tbody>
</table>

6.174 The time savings produced by the scheme are primarily experienced by trips between the south and north of Avonmouth (for instance between Portishead and the North Fringe). However, the savings are fairly small-scale, typically 1 to 2 minutes, because the existing crossing already provides a direct and relatively uncongested route and the new route is slightly longer and involves traversing additional junctions. It is considered that the benefits to traffic over this section are probably underestimated with the model failing to fully represent the weaving activity between Junctions 18 and 19 and therefore understanding the benefits from the relief. Furthermore, the appraisal does not take into account the benefits from significantly improved resilience of the motorway network and alternative routes that would be provided in the case of incidents on the M5.

6.175 Furthermore, the new crossing would provide the alignment for one of the proposed rapid transit routes which links Portishead with Avonmouth, central Bristol and Whitchurch. The benefits from the rapid transit route are not included in the appraisal of the crossing. There could also be the potential for private finance, with the new scheme including a toll to contribute to the capital costs.

6.176 The Second Avon Crossing is included in the GBSTS strategy as a long-term measure. The scheme would also provide improved links to Portishead, both by road and by rapid transit.

**A36-A46 Link**

6.177 The link between the A36 and A46 to the east of Bath was examined within the Bristol Bath to South Coast study which recommended that additional work should be undertaken by the local authority in order to take the scheme further. Within the GBSTS study, further work has been undertaken to assess the strategic impacts of the scheme within the GBSTS study area. The alignment of the route is shown in Figure 6.34.
6.178 Table 6.24 shows the main impacts of the A36/A46 link road scheme. The scheme has a considerable impact on congestion, reducing total vehicle delay across the modelled area by 4% and raising the average speed by 2%.

**Table 6.24 – Key Impacts of A36/A46 Link Road Scheme**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>0.2% increase</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.1% increase</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network (hours)</td>
<td>4% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>2% increase</td>
</tr>
</tbody>
</table>

6.179 Figures 6.35 and 6.36 show the impact of the A36/A46 link on the highway network, both in terms of vehicle flow and capacity utilisation. The main impact is that traffic is diverted to the A36/A46 route from the A363 through Bradford-on-Avon and the B3110 through Limpley Stoke and around the southern edge of Bath. However, the re-routeing effects are widespread, with reduced traffic flows within Bath, on the A431 and extending as far away as the A4174 Avon Ring Road.

6.180 Only 30% of the traffic using the scheme is travelling entirely within the study area, with the majority travelling to or from the West Wiltshire towns or further afield.
Figure 6.35 – Difference in Flow as a Result of A36/A46 Link Road

Figure 6.36 – Difference in Capacity Utilisation as a Result of A36/A46 Link Road

Links over 85 percent capacity in Scenario F

Bath A36/A46 Link Road

- Links brought below capacity threshold by scheme
- Links above capacity threshold and not affected by scheme
- Additional links brought above capacity threshold by scheme

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6.181 Table 6.25 shows that there are journey time savings of a few minutes for trips from the West Wiltshire towns to Bath but for longer distance journeys, the savings are potentially greater, for example, the model indicates a reduction in journey time of 18 minutes between Salisbury and South Wales.

**Table 6.25 – Key Journey Times for the A36/A46 Link Road (morning peak period, in minutes)**

<table>
<thead>
<tr>
<th>Route</th>
<th>No Link</th>
<th>A36/A46 Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bradford on Avon to Bath</td>
<td>43</td>
<td>38</td>
</tr>
<tr>
<td>Trowbridge to Bath</td>
<td>65</td>
<td>64</td>
</tr>
<tr>
<td>Chippenham to Bath</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>Salisbury to Cardiff</td>
<td>148</td>
<td>130</td>
</tr>
</tbody>
</table>

6.182 Table 6.26 summarises the economic performance of the scheme. Overall the performance is very strong, with an NPV of £700 million and BCR of 27.

**Table 6.26 – Economic Performance of the A36/A46 Link Road**

<table>
<thead>
<tr>
<th>A36/A46 Link Road</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (2005,Q1) £mill, inc Optimism Bias</td>
<td>£46</td>
</tr>
<tr>
<td>Cost (2005,Q1) £mill, excl Optimism Bias</td>
<td>£29</td>
</tr>
<tr>
<td>PVC (£ mill, 2002 prices &amp; values)</td>
<td>£27</td>
</tr>
<tr>
<td>PVB (£ mill, 2002 prices &amp; values)</td>
<td>£725</td>
</tr>
<tr>
<td>NPV (£ mill, 2002 prices &amp; values)</td>
<td>£700</td>
</tr>
<tr>
<td>BCR</td>
<td>26.6</td>
</tr>
</tbody>
</table>

6.183 The scheme’s benefits are comprised of both savings experienced by those able to make use of the new, more direct link between the A36/A46 and those benefiting from congestion relief within Bath, Bradford on Avon and Trowbridge.

6.184 There are substantial benefits within Bath, primarily as a result of the reduction in congestion on the A36 and A4 in the north east which occurs as traffic diverts to use the new link road. This congestion relief generates large time savings for trips made within Bath, particularly the north east area of the city, and those crossing between east and west Bath. Journey time reductions exceed 15 minutes in some cases and the savings within Bath represent over 25% of the total time savings brought about by the scheme.

6.185 A Major Scheme Bid is currently being assembled for a package of transport measures with Bath. These take forward recommendations from the earlier Bristol Bath to South Coast Study and include measure designed to address the traffic problems caused by goods vehicles travelling through the area. It is therefore prudent to review the impact of these measures before embarking on the new A36 to A46 link.
6.186 Bradford on Avon and Trowbridge benefit from the rerouting of traffic from the A363 to the A36 which is encouraged by the link road. This reduces traffic within their congested central areas, providing considerable journey time savings for local trips.

6.187 The A36/A46 scheme has a considerable impact on congestion within Bath and is included in the GBSTS strategy as a long term measure.

**Winterbourne and Stoke Gifford Bypasses**

6.188 Several alternative options for a Winterbourne and/or Stoke Gifford bypass were tested. The most effective scheme was an alignment linking with the B4427 to cross the M5 and connect to the Great Stoke Way, with a southern connection joining the A4174 Avon Ring Road at the Coldharbour Lane junction. The alignments of the schemes are shown in Figure 6.37.

![Figure 6.37 – Winterbourne and Stoke Gifford Bypass Alignments](image)

Note: The schemes in this diagram are conceptual and defined for appraisal purposes.

6.189 Table 6.27 shows the main impacts of the Stoke Gifford and Winterbourne Bypass schemes. Two tests were carried out: the first including both schemes; and the second with just the Stoke Gifford Bypass. With both schemes, the impact on congestion in the North Fringe area was significant, with a reduction in total vehicle delay of 1.9%. With only the Stoke Gifford Bypass in place, the reduction in total vehicle delay would be 1.7%, suggesting that the majority of the benefits are derived from this section.
Table 6.27 – Key Impacts of Stoke Gifford and Winterbourne Bypass Schemes

<table>
<thead>
<tr>
<th>Measure</th>
<th>Stoke Gifford + Winterbourne</th>
<th>Stoke Gifford</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Trips</td>
<td>0.1% increase</td>
<td>0.1% increase</td>
</tr>
<tr>
<td>Vehicle Kilometres</td>
<td>0.1% reduction</td>
<td>impact not significant</td>
</tr>
<tr>
<td>Total Vehicle Delay on highway network</td>
<td>1.9% reduction</td>
<td>1.7% reduction</td>
</tr>
<tr>
<td>Average Vehicle Speed (Highway)</td>
<td>1% increase</td>
<td>1% increase</td>
</tr>
</tbody>
</table>

6.190 Figures 6.38-6.41 show the impact of the Stoke Gifford and Winterbourne Bypasses on the road network, both in terms of vehicle flows (Figures 6.38 and 6.40) and capacity utilisation (Figures 6.39 and 6.41).

6.191 Both options would provide relief to the A38 and local roads in the North Fringe as well as some benefit to the M4 and M5. In particular, the schemes would provide relief to key junctions such as M4 J19 and M5 J16. While the Winterbourne Bypass provides additional relief to the B4058 crossing the M4 and to the A4174 Avon Ring Road, it also generates some extra traffic. This additional traffic limits the amount of congestion relief on some local roads in the North Fringe area.

Figure 6.38 – Difference in Flow as a Result of the Winterbourne and Stoke Gifford Bypasses

Portishead

Bristol

Nailsea

Keynsham
Figure 6.39 – Difference in Capacity Utilisation as a Result of the Winterbourne and Stoke Gifford Bypasses

Figure 6.40 – Difference in flow as a Result of the Stoke Gifford Bypass
In view of the traffic analysis, the economic assessment concentrated on the Stoke Gifford bypass. The economic performance of the scheme is summarised in Table 6.28. The overall economic performance of the scheme is strong, with an NPV and BCR of £258 million and 8.3 respectively, and this is despite making a substantial allowance in the capital costs for the possible grade separation of the Avon Ring Road/Coldharbour Lane junction.

The benefits are primarily time savings and over 90% of these are experienced on journeys to and from the North Fringe due to the benefits of the more direct and less congested route options offered by the scheme. Average time savings per journey are typically between 3 and 8 minutes.

<table>
<thead>
<tr>
<th>Table 6.28 – Economic Performance of Stoke Gifford Bypass</th>
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<tr>
<td><strong>Stoke Gifford Bypass</strong></td>
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<tr>
<td>Cost (2005,Q1) £mill, inc Optimism Bias</td>
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<td>Cost (2005,Q1) £mill, excl Optimism Bias</td>
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<td>PVC (£ mill, 2002 prices &amp; values)</td>
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<td>NPV (£ mill, 2002 prices &amp; values)</td>
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<td>BCR</td>
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6.194 The Stoke Gifford Bypass provides substantial relief to roads in the North Fringe including the A38 and B4057 Winterbourne Road. There would be some relief to the motorway network itself, and the scheme would also aid the movement of strategic traffic by reducing congestion at the interface of the local and strategic road networks. In addition, the scheme allows improved access to Bristol Parkway station, and would assist the introduction of the new rapid transit corridor and park-and-ride facilities discussed in Chapter 5. Further work is needed to examine alternative junction arrangements to minimise the impact on the A4174 Avon Ring Road, but nevertheless, the overall case for the scheme is strong, and it has been included in the GBSTS strategy as a long term measure. In the absence of any development north of the M4, the section of the Winterbourne Bypass north of the motorway does not add significantly to the benefits of the scheme, and is not included.

**POTENTIAL IMPLEMENTATION PROGRAMME**

6.195 An implementation programme for the highway elements of the strategy could include:

- in the short term:
  - measures to make better use of the existing highway network;
  - initial sections of the South Bristol Ring Road from the A370 to A38 (Red route) and from the A38 to Hengrove;
- in the medium term:
  - completion of the South Bristol Ring Road, with the section from Hengrove to Hicks Gate;
  - M5 J21 relocation
  - M4 widening from J19-J20; and
- in the long term:
  - second Avon crossing;
  - Stoke Gifford and Winterbourne Bypass;
  - A36/A46 Link Road;
  - new link from M5 to south Bristol.

6.196 The precise timing of the schemes will need to take into account a number of factors including the state of preparation of the scheme, the timing of residential and employment developments associated with the scheme and the necessary stages within the statutory planning process. For the larger schemes, the preparation time could be significant and hence although they are allocated to the medium or long term, work to develop the schemes may need to start at an early date. In some circumstances, it will be vital that the scheme is in place before developments can be introduced. Hence, it would be necessary to accelerate the highway scheme. Further refinement of the programme will therefore be necessary as the individual schemes are progressed.
SUMMARY

6.197 The approach adopted within the study for the development of the transport strategy concentrated on examining and promoting alternatives to the private car before considering improvements to the highway network. This was designed to ensure that highway measures are only considered after all other possibilities have been explored. Within the highway improvements themselves, the emphasis was placed on making best use of the existing infrastructure before examining the need for schemes which increase highway capacity.

6.198 The examination of highway improvements was undertaken against the background of significant growth in the demand for travel in line with a 25% rise in population and 20% growth in employment by 2031. The identification of enhancements to highway capacity took direct account of the location, scale and timing of these developments; in some cases, additional highway infrastructure is necessary to connect new developments into the existing network.

6.199 The emphasis in identifying measures to make best use of the highway network in the study area concentrated on the existing infrastructure and capacity on the motorway and major trunk roads, although many of the measures are also suitable for the local network:

- **planned maintenance** should continue to be programmed to minimise disruption by avoiding periods of peak daily and seasonal flows, including the main summer holiday periods;
- wider measures to **reduce incidents** through better driving training, increased enforcement, stricter penalties and greater use of advanced warning signs;
- continued development of **incident management** by speeding up detection, evidence collection and documentation, incident clear-up and the initiation of diversionary routes; and
- wider application of **signing, surveillance and automated systems** including active traffic management techniques.

6.200 The assessment of capacity enhancements across the study area’s highway network considered a number of potential new schemes and appraised the full range of impacts before developing a preferred package of improvements. The identification of schemes concentrated on those which would have a direct impact on the strategic highway movements across the study area. The schemes within the strategy would not be the only highway measures which would generate potential enhancements; local measures, outside the scope of GBSTS, could also have merits but would need to be progressed separately by the local authorities. Hence, the schemes identified in the strategy are concentrated on the strategic highway network in the area.

6.201 The principal schemes which the study recommended should be taken forward included:

- **South Bristol Ring Road between A4 and A38**
  South Bristol experiences severe congestion on the constrained highway network in the area together with restricted accessibility to other parts of the study area, particularly the new employment areas of the North Fringe. Accessibility would be enhanced by extension of the Avon Ring Road with an
indicative alignment from the junction with the A4 at Hicks Gate, following a new alignment south-west of Whitchurch to the A37, then running south of Hengrove before heading north to junction at Hartcliffe Way and Hengrove Way and finally, following an on-line alignment through Withywood before skirting Highridge Common to the A38. The scheme produces significant benefits through reduced delays across south Bristol, creating major new connections between south Bristol and the major employment areas. The scheme shows a strong economic performance with NPV of £950 million and BCR of 16.

♦ A38 – A370 Link
Extension of the South Bristol Ring Road from A38 through to the A370, with the study’s preferred alignment following the path of the earlier Red route. The scheme provides relief to the congestion on the B3130 through Barrow Gurney and produces a strong economic performance with NPV of £70 million and BCR of over 8.

♦ Links between south Bristol and M5
Current congestion levels on the highway network on the approaches to south Bristol from the south west would be exacerbated by planned future developments in housing and employment together with growth at BIA. The study identified alternative schemes to improve the connections to south Bristol and from the M5 motorway and the South West. The northern route would link M5 Junction 20 to the A370 near Long Ashton along an alignment to the north of the B3130 and would include bypasses for Nailsea, Tickenham and Wraxhall. The southern route would link M5 Junction 21 at Weston-super-Mare with BIA and northwards to the A370 with a bypass of Barrow Gurney. Outline alignments for the schemes have been identified for the purposes of the appraisal but considerable detailed work is necessary in order to identify potential environmental and other constraints. Both alternatives have strong transport economic case with a NPV of £270 million and a BCR of over 5 for the Junction 21 route and a NPV of £160 million and BCR of 3 for the Junction 20 option.

♦ Improvements to M5 Junction 21
Current conflict at this junction, between traffic wishing to access the M5 and through movements on the A370 between Weston-super-Mare and Congresbury/south Bristol, will worsen with future growth in traffic. The most effective approach identified by the study is to separate the two movements by constructing a replacement junction to the south of the current Junction 20 which would be accessed by a new link to the A370 in Weston-super-Mare. The existing Junction 20 would be closed for access to the M5 and would therefore be restricted to A370 traffic alone. The scheme produces a strong economic performance with a NPV of £150 million and a BCR of 3.

♦ M4 Widening between Junctions 19 and 20
The need to increase the capacity from three to four lanes in each direction on this section of the motorway was highlighted by forecast traffic flows consistently exceeding 85% of current capacity. Considerable journey time savings are achieved producing a NPV of £350 million. Due to an increase in distances travelled and a rise in vehicle operating costs, there is a growth in government indirect tax revenue which produces a negative BCR (-5). Despite this anomaly, the overall scheme performance is strong.
M5 Junctions 16 and 17 and M32 Junction 1
Problems at Junction 16 are created by a combination of high traffic levels to/from Aztec West and the North Fringe, conflicts between through traffic on the A38 and motorway access/egress and the proximity of Junction 16 with Almondsbury Interchange. Junction 17 serves the Cribbs Causeway regional shopping centre as well as other local destinations and experiences significant congestion, particularly on Saturdays. High traffic volumes through M32 Junction 1 create peak period congestion difficulties, exacerbated by the proximity to M4 Junction 19. Schemes to improve the operation of these junctions have been identified including the enhancement of the on and off slip roads and changes to the local road network and produce benefits to traffic movements. A more detailed assessment of operation of the junction is required, which is outside the scope of the study, before a full appraisal of the scheme can be completed.

Second Avon Crossing
M5 between Junction 18 and 19 is one of the few crossings of the River Avon and is a critical section of the region’s strategic road network. Incidents on this section have a widespread impact across the region and traffic levels are influenced by high levels of local traffic including movements to, from and between the two port areas on opposite banks of the river. The proposed second crossing would relieve the motorway and its junctions and improve access to Portishead and Avonmouth. The study has identified a potential low level crossing including an opening bridge or barrage which, in addition to carrying normal traffic, would also include a rapid transit link to Portishead. Because the scheme runs parallel to existing infrastructure, the journey time savings are low with a NPV of £30 million and BCR of 1.6 although this excludes the benefits from rapid transit and the improved resilience of the highway network.

A36 to A46 Link Road
The link road was recommended for further development by the earlier Bristol Bath to South Coast study. Located to the east of Bath, it produces significant benefits within Bath, through reduced congestion in the city on the A4 and A36, and traffic relief in the west Wiltshire towns of Trowbridge and Bradford-on-Avon. The overall economic performance is strong with a NPV of £700 million and BCR of 27 but there are significant environmental impacts which will need to be considered in the further development of the scheme.

Winterbourne and Stoke Gifford Bypasses
The scheme provides substantial relief to roads in the North Fringe including A38 and B4057 Winterbourne Road. The majority of the benefits occur south of the M4 and the northern section does not significantly add to the benefits and hence should not be progressed unless there are changes to developments in the area. The Stoke Gifford bypass and southern section of the scheme produces a NPV of £260 million and BCR of 8 and hence should be progressed further.

A number of additional schemes for highway capacity improvement were examined but were not included in the GBSTS strategy.

M4 to A4174 Link Road
The potential alignment for the scheme would involve close inter-relationship with M4 Junction 19 and a number of alternative designs were examined with the
most effective being the construction of a new M4 junction (18A) with access limited to motorway traffic to/from the east and closure of the east-facing slip roads at the existing Junction 18. Such a scheme in isolation recorded a NPV of £270 million and BCR of 12 but the generation of additional traffic on the M4 to the east of the new junction would create the need to add an additional lane on the M4 through to Junction 18 and hence the scheme was not recommended by the study.

♦ A4 Saltford Bypass
The scheme would relieve the congestion from traffic passing through the village but would involve high construction costs due to the terrain through which it would pass. Hence, the scheme’s economic performance, with a NPV of £17 million and BCR of 1.2, does not justify its inclusion in the strategy; although it produces some local relief, the strategic benefits are limited.

♦ A37 Whitchurch Bypass and Callington Road Link
These two schemes were identified as providing local relief to the highway network rather than having a strategic impact and hence were not included in the strategy although they produced a reasonable economic performance. Some of the benefits from the Whitchurch bypass would be achieved by the wider South Bristol Ring Road.

♦ Clutton and Temple Cloud Bypass
The construction of bypasses for the two neighbouring villages on the A37 would provide local relief but would not have a strategic impact.

♦ Banwell, Churchill and Sandford Bypasses
The three adjacent communities on the A371, A368 and A38 experience local congestion which is exacerbated by the restricted capacity through the village centres. The study examined the impact of a series of bypasses to provide relief to the villages and identified that, because the use of bypasses would increase the length of journeys, the net impact of the schemes was diminished such that the overall NPV was -£2 million with a BCR of 0.96. The scheme was therefore considered to have local rather than strategic merits and was not included in the GBSTS strategy.

♦ M49/Severnside Intermediate Junction
Projected increases in employment within the Severnside area are not sufficient to justify the potential highway improvements which include a new junction on the M49 and construction of a Spine Road through the main development area. While there are potential travel time savings for traffic to/from Severnside, the volume of traffic is small and the benefits do not justify the high scheme costs.
7. Freight

7.1 As a general strategic transport study, GBSTS was not designed to examine specific freight issues in detail. Nevertheless, there are some aspects of the study which have implications on freight operations and these are brought together in this chapter.

7.2 Many of the measures examined within GBSTS are designed to cater for general transport problems across the study area involving a wide range of transport users. For example, improvements to the capacity of the highway network will reduce the journey time and improve reliability for all users, irrespective of whether the user is driving a private car or a heavy goods vehicle. Similarly, the removal of potential blockages on the rail network by capacity enhancements will increase general capacity levels and hence improve the operational efficiency of both passenger and freight services.

7.3 Although this is true for many of the measures within the GBSTS transport strategy, there are, of course, specific measures of direct relevance to the movement of freight to, from and within the study area. At the same time, there are particular locations where freight related movements are the dominant activity (e.g. in the neighbourhood of Bristol Port) and hence changes to the form and content of developments in these locations are important to the future levels of demand for freight across the study area; these aspects were examined in Chapter 2.

7.4 Chapter 2 examined the growth in travel across the study area to 2031 and the relationship to the transport network. Compared with car trips, a much higher proportion of HGV trips have at least one trip end external to the study area. Nevertheless, around 40% of HGV trips are travelling entirely within the study area in the morning peak period. The inter-peak period has a slightly larger proportion of trips travelling outside the study area and its hinterland than in the peak period. As would be expected, the predominant freight movements are on the motorways and the local strategic network.

7.5 Over the period between 2003 and 2031, the forecast growth in HGV trips is 55%. There is a general increase in HGV vehicle-kilometres on all road types between 2003 and the 2031 Do Minimum. In built-up areas, the higher levels of congestion lead to a larger increase in HGV vehicle-hours than in other areas.

7.6 With the GBSTS strategy, there is a transfer of HGV traffic onto local strategic roads from more minor local roads. This is largely due to the improvements to the local strategic road network with the addition of new links within this category, such as the South Bristol Ring Road and the Second Avon Crossing.

7.7 In the 2031 morning peak period, there is a reduction in HGV vehicle-hours across all road types with the transport strategy compared with the Do Minimum. In the inter-
peak, increased usage of non built-up strategic roads by HGVs leads to a slight increase in total vehicle-hours on this type of road, but there are reductions in vehicle-hours on the other road types.

**Freight Consolidation**

7.8 As part of an EU project (VIVALDI), a freight consolidation scheme has been trialled in Bristol. The scheme was developed to reduce the number of delivery vehicles operating in the area, especially the city centre, and thus contribute to an improvement in air quality. The scheme started in May 2004 and makes use of a warehouse located outside the retail area at Emersons Green which acts as a consolidation and distribution point for different products intended for a range of retail outlets within the central Broadmead shopping area. The warehouse receives multiple deliveries bound for the shops and consolidates them into a single load on one vehicle which then delivers to the retail area at pre-arranged times.

7.9 The consolidation scheme is most relevant to medium sized businesses dealing in non-perishable high value goods – larger firms have their own delivery networks. It now serves more than 50 retail outlets mainly dealing in specific types of goods such as men’s and women’s fashions, shoes, mobile phones, household goods and gifts.

7.10 The scheme has cut delivery vehicle movements by 65% for participating retailers, resulting in a reduction of over 20,000 HGV kms with associated savings in environmental emissions.

7.11 A range of further developments is being explored, including:

- introducing additional value-added services for the retailers, such as remote stock rooms, storage of peak or seasonal items, and the collection and recycling of waste/packaging;
- catering for the expansion of Broadmead as a result of which there is expected to be a 40% increase in retail space over the next five years;
- introducing a charging regime for retailers so that there can be a progressively falling level of financial support by the local authority; and
- exploring a broader range of activities where the benefits of consolidation would arise.

7.12 Although the local authority would need to provide some financial support to the scheme, it is expected that the level of funding will be reduced over time.

7.13 In view of the success of the scheme in a relatively short period of time, there would be further benefits from extending it further, in particular by:

- expanding the range of outlets in the Broadmead area – this might require an extension to the type of service, for example by the use of refrigerated vehicles for use with specific perishable products;
- extend the area covered beyond Broadmead, firstly to other areas in central Bristol, and then to central Bath and local centres such as Clifton; and
although it may be difficult to involve them, examine the possibility of including
some of the major retailers which have their own distribution networks.

7.14 Although GBSTS has not been in a position to appraise these potential
developments in detail, they represent the types of enhancement which will be
necessary if the initial benefits of consolidation are to be expanded to a scale where
they have a significant impact on the movement of goods vehicles in the city centre.

**Freight Routes**

7.15 A Regional Freight Map (RFM) has been produced for the Regional Assembly setting
out the regional road-based freight network in the South West. The map gives
guidance to the haulage industry as to suitable routes, and aims to influence the
signing of routes undertaken by the Highways Agency and Department for Transport.

7.16 A revised draft ‘Policy’ RFM has been produced based on the policies and
aspirations of the different Local Highway Authorities (LHAs) in the region with inputs
of the observed volumes of HGV flows in the South West. The reclassification of
routes results in some changes in the designation of roads. The draft ‘Policy’ RFM
has had input from all of the LHAs as well as the haulage industry, and is awaiting
acceptance by the South West Regional Assembly.

7.17 The ‘Policy’ RFM defines freight routes as national, regional or county routes:

- National Freight Routes – longer distance freight routes from other parts of the
country.
- Regional Freight Routes – routes used for inter-regional travel where national
routes are not appropriate and to provide access to major distribution centres
from the national routes.
- County Freight Routes – routes used to provide access to freight facilities not
served by either national or regional routes.

7.18 A particular issue in relation to freight activity is the location of routes followed by
heavy goods vehicles particularly through sensitive areas. The activity within Bath is
especially sensitive, given the city’s status as a World Heritage Site. The Bath
Package Major Scheme Bid, being prepared by B&NES within the Local Transport
Plan process, has examined measures designed to restrict the level of through
movements by HGVs across the city. These could include the designation of specific
main roads through the city centre as lorry routes – A36, A4 and A367; all other
roads would be restricted to HGV movements apart from access. In addition,
consideration is being given to transhipment facilities on similar lines to the
Broadmead scheme in Bristol described above.

7.19 However, to be effective, there will need to be significant levels of enforcement to
ensure that HGV drivers adhere to designated routes. In the long term, the
introduction of an area-wide congestion charging scheme would help to control HGV
movements, by varying the charge payable to selected vehicle types on specific
routes so that the problems of enforcement are covered by the technical capability of
the charging system. Originally the government planned to introduce satellite-based
charging for goods vehicles by 2008. However, the delay to the government’s plans
for the national charging scheme for goods vehicles until after the medium term
means that a potentially powerful policy tool for the local area is not available. Hence, it will be necessary to await the introduction of satellite-based charging before the full benefit of the effective control of lorry routeing can be achieved.

Greater Bristol Freight Atlas

7.20 Within the Greater Bristol area, the Freight Quality Partnership was established in 2003 with the aim of bringing together representatives from both the public and private sectors with an interest in freight transport. An early output from the Partnership has been the creation of a Commercial Vehicle Drivers’ Atlas which provides guidance on the appropriate routes to be followed through the area, together with details of height, weight and access restrictions across the area.

7.21 The revised RFM has been submitted as a draft document and the consultants are currently awaiting feedback before attempting to finalise a revised copy. This stage needs to be completed so that an unambiguous position may be reached to guide vehicle hauliers, other government bodies and transportation studies in the area.

7.22 The revision of the RFM will also need to feed through to other documents such as Bristol’s Commercial Drivers’ Atlas. It is also recommended that, if possible, the Atlas be made available on-line through Bristol City Council’s own website.

7.23 With the increasing use of on-board satellite route guidance systems, the information contained within the Atlas will need to be included within the software of these systems. Commercial drivers are likely to be early adopters of this technology and failure to reflect the information and recommended routes within the satellite navigation systems will result in a dilution of the possible benefits of producing the RFM and the Atlas.

Rail Freight Facilities

7.24 The Greater Bristol area has a moderate amount of rail freight traffic with some originating traffic and passing freight over the Great Western Main Line. Rail terminals on the River Severn at Avonmouth and Royal Portbury Dock continue to generate a number of bulk train movements and there are limited movements from the specialist waste terminals in the area, though all mail traffic by rail has now ceased.

7.25 The main freight routes and key points in the Bristol area are:

- Avonmouth – Filton West Junction. Avonmouth is the principal rail freight focus for the sub-region. Traffic to and from Avonmouth is mainly imported coal for power stations.
- Bristol Parkway. As a key junction point on the rail network in the Bristol area, a number of through freight services pass Bristol Parkway each day.
- Portbury – Parson Street Junction. Royal Portbury Dock is served by a short spur off the branch of the former passenger line to Portishead. The new link was opened in 2001 and the branch refurbished for freight traffic. Traffic is mainly imported coal and automobiles.
Freight from the South West such as china clay and cement traffic from the North travels via Bristol, as does nuclear flask traffic from Bridgwater. Rail freight traffic from South Wales to London and the South East also crosses at Bristol Parkway.

Route Constraints

7.27 The loading gauge reflects the height and width restriction across the rail network taking into account line-side and overhead structures (see Figure 7.1). Most main lines through Bristol, including the line to Avonmouth from Filton, are cleared to W8 loading gauge – for inter-modal traffic, this means that most routes can accept 8’ 6” containers. The restored freight branch to Royal Portbury Dock is cleared to the larger W9 (i.e. it accepts 9’ containers). However, there are some routes which are loading gauge restricted and would require further gauge enhancement work to accept most types of inter-modal traffic (loading gauges W6 and W7 restrict the maximum container height to 8 feet). These include:

- Avonmouth via Clifton Down and the Severn Beach branch – W6;
- Tytherington Branch from Yate – W6; and
- Bathampton Junction to Trowbridge – W7.

7.28 There are no significant plans to increase rail freight facilities or activity in the Bristol area. The Great Western Main Line through Bristol and the routes to the Midlands and to South Wales will continue to be core strategic routes for rail freight traffic and thus there will be an on-going requirement for capacity to be maintained at least to current levels. As noted below, any expansion of the gauge above W9 will need to reflect the gauges throughout the region and in the neighbouring regions, taking into account the likely future markets. Such an analysis should therefore form part of national policy.

7.29 As highlighted in Chapter 2, Bristol Port is considering the construction of a new deep water container facility at Avonmouth which would increase the port’s capacity from 150,000 to 850,000 container movements a year. Although the scheme is at a very early stage, if implemented about 25% of the containers could be transported by rail to/from the rest of the country, thereby significantly increasing the level of rail freight from Avonmouth. However, it is anticipated that the capacity of the rail freight would be in a position to accommodate this level of growth.
7.30 The SWARMMS study included the following specific recommendations for inter-modal freight:

- Enhancements to loading gauges to allow containers on international rail wagons, including a W12 gauge to be provided on the Great Western Line at Avonmouth. However, GBSTS analysis indicates that there is little need to increase the loading gauge in the Avonmouth area until it has been achieved along the main lines to the South East and the Midlands, which is not likely within the medium term.

- Improved rail access to Royal Portbury Dock – this has now been implemented with the opening of the freight line.

- New road to rail Intermodal Freight Facility at Cabot Park (Avonmouth) – this would seem to have potential as a means of attracting increased transfer from road to rail, although its success may be linked to the scale of development within the Severnside area.

- Daily trains to the Cabot Park development, which will increase the volume of rail traffic through Bristol Parkway station. This could be accommodated with the proposed increase in capacity to three platforms at Bristol Parkway in the medium term and four platforms in the long term.
SUMMARY

7.31 Although the movement of freight was not identified as a major feature of the GBSTS, measures designed to relieve particular congestion locations will also generally benefit goods traffic whether on the road or rail network. Other measures with a specific freight interest have been identified within the study, although a detailed appraisal has not been undertaken:

♦ review of the consolidation trial for goods deliveries to Broadmead area, with potential expansion in terms of types of goods covered and the extent of the area served;
♦ increased publicity for freight routes within and through the area and the facilities available to HGV drivers; and
♦ accommodation of potential expansion in rail freight opportunities from Royal Portbury and Avonmouth Docks.
8. Appraisal of the Strategy

INTRODUCTION

8.1 A key aspect of the development of the GBSTS transport strategy was the appraisal of its performance against a range of key criteria. In this appraisal, the attention is concentrated on the impacts of the transport measures in the GBSTS strategy; it does not take account of the other changes underlying the transport strategy, principally the growth in population and employment and the impact of new construction necessary to achieve this.

8.2 The appraisal was carried out in accordance with the Government’s Transport Analysis Guidance (TAG), which follows the principles of the New Approach to Appraisal (NATA). The strategy has been appraised against the national criteria set out in TAG, arranged within five over-arching transport objectives:

♦ **environmental impact** – to protect the built and natural environment;
♦ **safety** – to improve safety;
♦ **economy** – to support sustainable economic activity and get good value for money;
♦ **accessibility** – to improve access to facilities for those without a car and to reduce severance; and
♦ **integration** – to ensure that all decisions are taken in the context of the Government’s integrated transport policy.

8.3 The five over-arching objectives are sub-divided into further national sub-objectives. In addition, several local objectives have been defined for GBSTS which were placed under the five over-arching criteria. The GBSTS strategy has therefore been appraised at two levels:

♦ against the Government’s national transport objectives; and
♦ against the study’s local objectives.

8.4 The objectives are set out in Table 8.1

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**Objective** | **National Sub-Objective** | **Local Sub-Objective**
--- | --- | ---
| | Protect the water environment | |
| | Encourage physical fitness | |
| | Improve journey ambience | |
| SAFETY | | |
|  | Reduce accidents | |
|  | Improve security | |
| ECONOMY | | |
|  | Minimise cost to public accounts | |
|  | Improve transport economic efficiency | |
|  | Improve reliability | |
|  | Provide beneficial wider economic impacts | |
| ACCESSIBILITY | | |
|  | Increase option values | |
|  | Reduce severance | |
|  | Improve access to the transport system | |
| INTEGRATION | | |
|  | Improve transport interchange | |
|  | Integrate transport policy with land use policy | |
|  | Integrate transport policy with other government policies | |

8.5 The GBSTS transport strategy formed the centre of the appraisal process. However, at the same time, two notable variations were appraised to explore the impact of changes to the strategy:

♦ the addition of area-wide road user charging – it was felt that the main strategy could not be based on measures that would probably require a national policy initiative and hence the introduction of area-wide charging was appraised as an addition to the core strategy; and

♦ removal of ‘Smarter Choices’ – the impact on the full strategy of excluding this package of measures was appraised to assess the importance of Smarter Choices within the overall strategy.

8.6 The appraisal of the strategy is described in the following sections dealing with each of the over-arching aspects in turn – environment, safety, economics, accessibility and integration. The overall appraisal for each of the three strategies is summarised in the Appraisal Summary Tables, Transport Economic Efficiency Tables and Public Accounts Tables in Appendix A. The assessment of site-specific factors is included in Appendix B concentrating on environment and accessibility issues.
ENVIRONMENT

8.7 This section appraises the 2031 GBSTS strategy against the Government’s environmental objectives for transport, dealing with impacts on both the built and natural environment and on people.

Noise

8.8 Transport is a key source of noise ‘annoyance’ – the feeling of displeasure evoked by noise. However, it should be recognised that, in many situations, significant changes in traffic flows are required to bring about perceptible changes in noise levels. For freely flowing traffic, a difference of about 3dB(A) is required before there is a perceptible change in the noise level. As a guide, a 25% increase or 20% decrease in traffic flow, if speed and other factors (such as the composition of traffic in terms of vehicle types) remain unaltered, only results in a 1dB(A) change in noise level.

8.9 In the appraisal process, it is the location of the noise changes, and hence the number of people affected, which is most important. The impact of noise changes on the population ‘annoyed’ by noise is given in Table 8.2. This has been calculated using DfT guidance, based on locations where changes in noise of at least 3dB(A) occur. Hence, with the strategy, in 77 of the model’s 187 zones, there is a reduction in the population annoyed by noise, while in 82 there is no change, and in 28 there is an increase in the population annoyed. Overall, taking into account the population in the vicinity of each link of the highway network, there is a net reduction of around 17,000 in the number of people annoyed by noise as a result of the strategy.

Table 8.2 – Change in Population Annoyed by Noise (based on changes > 3dB(A))

<table>
<thead>
<tr>
<th>Changes in Population Annoyed Compared with Do Minimum</th>
<th>Strategy</th>
<th>Strategy with RUC</th>
<th>Strategy without Smarter Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net change in number of people annoyed by noise</td>
<td>-16,800</td>
<td>-125,300</td>
<td>79,500</td>
</tr>
<tr>
<td>Number of zones experiencing increase in population annoyed</td>
<td>28</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>Number of zones experiencing no change in population annoyed</td>
<td>82</td>
<td>74</td>
<td>94</td>
</tr>
<tr>
<td>Number of zones experiencing decrease in population annoyed</td>
<td>77</td>
<td>84</td>
<td>63</td>
</tr>
</tbody>
</table>

8.10 Figure 8.1 shows the zones where in the number of people annoyed by noise changes as a result of the GBSTS strategy. This indicates that large increases in the population annoyed by noise are located on or near the routes of new highway links. Reductions in the population annoyed by noise are concentrated particularly within the urban areas, where the strategy achieves the highest reduction in traffic volumes. Mitigation measures will therefore need to be incorporated in the design of the new road schemes to minimise the impact of noise in adjoining areas.
8.11 Overall, there is a small reduction in the number of people across the Greater Bristol area who are annoyed by noise, and the strategy therefore has a slight beneficial effect on noise. If area-wide road user charging is included in the strategy, the impact is much greater, with 125,000 fewer people (some 10% of the total study area population in 2031) annoyed by traffic noise, as shown in Table 8.2. The strategy with road user charging therefore has a moderate beneficial effect on noise. With no Smarter Choices, more people in urban areas are affected by noise, and there is an overall net increase in the population annoyed by noise and the strategy therefore has a moderate adverse effect on noise.

Figure 8.1 – Change in Population Annoyed by Noise

8.12 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland sets Government targets for eight pollutants. Transport, especially the operation of road vehicles, is an important source of several of these pollutants, most notably oxides of nitrogen (NO\textsubscript{X}) and particulate matter (PM\textsubscript{10}), for which stringent targets have been set. The local air quality sub-objective focuses on these two pollutants.

8.13 The impact of the GBSTS strategy on emissions of PM\textsubscript{10} and NO\textsubscript{X} has been estimated following DfT guidance. Table 8.3 shows annual emissions of NO\textsubscript{X} and PM\textsubscript{10} in 2031, comparing the impact of the GBSTS strategy with the Do Minimum situation and showing variations in the impact with the addition of road user charging and exclusion of Smarter Choices.
8.14 Table 8.3 shows reductions in emissions of NO\textsubscript{X} and PM\textsubscript{10} of 45% and 53% respectively between 2003 and 2031 as a result of the increasing use of cleaner, more efficient engines and improved fuels. These are based on standard DfT projections about future changes in the characteristics of the vehicle fleet. In comparison, the GBSTS strategy in 2031 achieves a further 2% reduction in NO\textsubscript{X} emissions and a 4% reduction in PM\textsubscript{10}. Thus, the impact of the strategy is small compared with the changes already taking place between 2003 and 2031. There are some variations in the results according to whether area-wide road user charging and Smarter Choices are included in the strategy, with greater reductions with area-wide road user charging and lower reductions in the absence of Smarter Choices.

Table 8.3 – Changes in Annual Emission Levels (tonnes)

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2031 Do Minimum</th>
<th>2031 Strategy</th>
<th>2031 Strategy with RUC</th>
<th>2031 Strategy without Smarter Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO\textsubscript{X}</td>
<td>13033</td>
<td>7150</td>
<td>6980</td>
<td>6874</td>
<td>7117</td>
</tr>
<tr>
<td>PM\textsubscript{10}</td>
<td>416</td>
<td>196</td>
<td>188</td>
<td>184</td>
<td>194</td>
</tr>
</tbody>
</table>

Change from 2003 Base

<table>
<thead>
<tr>
<th></th>
<th>-5883</th>
<th>-6054</th>
<th>-6159</th>
<th>-5916</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO\textsubscript{X}</td>
<td>-45%</td>
<td>-46%</td>
<td>-47%</td>
<td>-45%</td>
</tr>
<tr>
<td>PM\textsubscript{10}</td>
<td>-220</td>
<td>-228</td>
<td>-232</td>
<td>-222</td>
</tr>
<tr>
<td></td>
<td>-53%</td>
<td>-55%</td>
<td>-56%</td>
<td>-53%</td>
</tr>
</tbody>
</table>

Change from 2031 Do Minimum

<table>
<thead>
<tr>
<th></th>
<th>-171</th>
<th>-276</th>
<th>-33</th>
<th>0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO\textsubscript{X}</td>
<td>-2%</td>
<td>-4%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>PM\textsubscript{10}</td>
<td>-8</td>
<td>-12</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-4%</td>
<td>-6%</td>
<td>-1%</td>
<td></td>
</tr>
</tbody>
</table>

8.15 The geographical spread of the changes in emissions is shown in Figures 8.2 and 8.3 for NO\textsubscript{X} and PM\textsubscript{10} respectively. These figures show that, as would be expected, the increases in emissions are focused on the new road links and on the approaches to the new links where changes in traffic levels are significant.

8.16 Overall, the strategy has a slight beneficial impact on local air quality with similar impacts for the inclusion of area-wide charging in the strategy and exclusion of Smarter Choices.

Key Pollutants in AQMAs

8.17 Large parts of Bristol, along with Bath’s London Road corridor, do not meet current national air quality targets and have been declared Air Quality Management Areas.
(AQMAs) by the appropriate unitary authority with Air Quality Action Plans setting out what measures need to be undertaken to improve the position. The AQMAs cover:

**Figure 8.2 – Location of Changes in NOx Emissions – 2031 Strategy vs Do Minimum**

**Figure 8.3 – Location of Changes in PM10 Emissions – 2031 Strategy vs Do Minimum**
the M5 corridor in Avonmouth;
♦ Bristol city centre plus most major radial routes and the M32 corridor; and
♦ the London Road corridor in Bath with a proposed extension covering Cleveland Bridge and Bathwick Street.

8.18 Table 8.4 shows the estimated changes in emissions of NO\textsubscript{X} and PM\textsubscript{10} within AQMAs between 2003 and 2031. In the Do Minimum situation, there are large reductions in emissions within the AQMAs due to the assumptions about the increasing use of cleaner vehicles. The GBSTS strategy further reduces emissions of NO\textsubscript{X}, but has less impact on emissions of PM\textsubscript{10}. Incorporating road user charging in the strategy would give further reductions within the Bristol and Bath AQMAs, while excluding Smarter Choices would mean the impact on emission levels is diminished slightly.

Table 8.4 – Changes in Emissions within AQMAs Compared with 2003

<table>
<thead>
<tr>
<th>AQMA</th>
<th>NO\textsubscript{X}</th>
<th></th>
<th>NO\textsubscript{X}</th>
<th></th>
<th>PM\textsubscript{10}</th>
<th></th>
<th>PM\textsubscript{10}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2031 Do Min</td>
<td>2031 Strategy</td>
<td>2031 Strategy with RUC</td>
<td>2031 Strategy with no Smarter Choices</td>
<td>2031 Do Min</td>
<td>2031 Strategy</td>
<td>2031 Strategy with RUC</td>
</tr>
<tr>
<td>Avonmouth</td>
<td>-40%</td>
<td>-43%</td>
<td>-43%</td>
<td>-43%</td>
<td>-52%</td>
<td>-51%</td>
<td>-52%</td>
</tr>
<tr>
<td>Bristol</td>
<td>-49%</td>
<td>-56%</td>
<td>-59%</td>
<td>-54%</td>
<td>-61%</td>
<td>-61%</td>
<td>-65%</td>
</tr>
<tr>
<td>Bath</td>
<td>-51%</td>
<td>-59%</td>
<td>-60%</td>
<td>-57%</td>
<td>-66%</td>
<td>-70%</td>
<td>-72%</td>
</tr>
</tbody>
</table>

8.19 Overall the strategy has a slight beneficial effect on air quality in AQMAs. As may be seen from Table 8.4, this impact is maintained with the introduction of area-wide road user charging and the exclusion of Smarter Choices.

Greenhouse Gases

8.20 Global warming is an important international environmental issue and transport is a major source of UK greenhouse gas emissions, in particular carbon dioxide (CO\textsubscript{2}). The UK government has committed to reducing CO\textsubscript{2} emissions as part of the international programme to stabilise global warming. The UK is currently on track to meet its Kyoto obligation to reduce overall greenhouse gas emissions by 12.5% below 1990 levels by 2008-12. In addition, the Energy White Paper stated that the UK should put itself on a path to a reduction in carbon dioxide emissions of some 60% from current levels (i.e. 2003 levels) by about 2050 with real progress by 2020.

8.21 Since 1970, total UK emissions of CO\textsubscript{2} have fallen by 22%, with significant falls in emissions from industry and power stations, but those from road transport increased by 92% and this sector now accounts for around 21% of the UK’s total CO\textsubscript{2} emissions. CO\textsubscript{2} emissions from road transport were 10% higher in 2004 than in 1990; by 2010 they are expected to be around 20% higher than in 1990. Measures to slow this increase in road transport emissions are therefore necessary.

8.22 The DfT appraisal methodology uses the change in emissions of CO\textsubscript{2} to assess the impact of transport measures upon global warming. The net change in transport
emissions of CO₂ within the study area in 2031 is shown in Table 8.5, along with changes from the current (2003) situation.

Table 8.5 – Changes in CO₂ Emissions

<table>
<thead>
<tr>
<th>Measure</th>
<th>2003</th>
<th>2031 Do Min</th>
<th>2031 Strategy</th>
<th>2031 Strategy + RUC</th>
<th>2031 No Smarter Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual CO₂ Emissions (’000 tonnes)</td>
<td>2028</td>
<td>2695</td>
<td>2559</td>
<td>2480</td>
<td>2650</td>
</tr>
<tr>
<td>% Change from 2003</td>
<td>33%</td>
<td>26%</td>
<td>22%</td>
<td>31%</td>
<td></td>
</tr>
<tr>
<td>Daily CO₂ Emission per Person (kg)</td>
<td>5.8</td>
<td>6.4</td>
<td>6.0</td>
<td>5.8</td>
<td>6.3</td>
</tr>
<tr>
<td>% Change from 2003</td>
<td>9%</td>
<td>3%</td>
<td>0%</td>
<td>7%</td>
<td></td>
</tr>
</tbody>
</table>

8.23 In the 2031 Do Minimum situation, there is a 33% increase in transport emissions of carbon dioxide within the study area between 2003 and 2031. This is due to two main factors:

- increasing wealth leading to a growth in the demand for travel, particularly for travel by car; and
- a large rise in the study area population (25%) and employment (20%) as a result of the land use changes assumed under Spatial Scenario F.

8.24 The GBSTS strategy reduces CO₂ emissions in 2031 by 6% compared with the Do Minimum situation, and by 9% if area-wide congestion-based road user charging is included. Nevertheless, even with road user charging, this still represents an increase in transport emissions of carbon dioxide of over 20% in the period from 2003 to 2031. Stripping out the effects of the population growth, the GBSTS strategy with congestion-based road user charging limits CO₂ emissions per person to 2003 levels. The results presented in Table 8.5 also show that ‘Smarter Choices’ are an essential element of the overall GBSTS strategy in terms of reducing emissions of carbon dioxide; if they are excluded, then there is a significant impact on greenhouse gas emissions.

8.25 Overall, the strategy slows the increase in emissions of carbon dioxide and hence has a slight beneficial impact on greenhouse gases.

8.26 CO₂ emissions could be reduced further by measures outside the scope of GBSTS, including the more widespread use of alternative road transport fuels and improvements to the efficiency of conventionally fuelled vehicles. In addition, it is possible that the UK government could require measures such as the use of 5% biodiesel in diesel blends which, together with any other changes in alternative fuel use, may reduce CO₂ emissions still further.

Landscape

8.27 The assessment of the impact of the GBSTS strategy on the landscape considers both the physical and cultural aspects of the land itself and the way in which these characteristics are perceived. As a consequence, the appraisal is qualitative.
8.28 In appraising the impact of the strategy on the landscape, the starting point was to identify where the principal designations are located. In line with the Strategic Environmental Appraisal approach, the location of the designations was an important input in the design of measures, although it was not necessarily possible to design measures which completely avoid all designations.

8.29 The relationships between the principal landscape designations and measures in the GBSTS transport strategy are summarised in Appendix B (Figures B.1 to B.3). The major areas of importance for landscape at a regional level are the Cotswolds to the north-east of the study area, the Mendips to the south and the Severn Estuary to the west. Within these major areas there are a number of locally designated areas, with particular attention being given to the Areas of Outstanding Natural Beauty (AONB), Woodland Grant Schemes and Countryside Character Areas. Individual tranquil areas were also included in the appraisal although these are closely related to AONB sites and are not shown separately on the maps in Appendix B.

8.30 The appraisal highlights the following major potential impacts of measures on landscape designations:

- at the western and eastern ends of the South Bristol Ring Road, there are potential landscape impacts which will need to be resolved in the detailed design of the scheme, in particular on the section between A38 and A370 and to the east of Stockwood;
- the Airport Link Road has potentially significant impacts on the landscape designations in the Wrington area – the initial alignment provides an indicative view of the potential route for the scheme and, on this basis, there are potentially significant impacts on the inclines north of Wrington which will need to be taken into account in the identification of a preferred alignment if the scheme is taken forward; and
- the A36 – A46 Link is located within an AONB and hence has a potentially significant impact on the landscape in the area, which will need to be recognised in future development of the scheme.

8.31 Given that some of the components of the strategy have a direct and significant impact on the landscape, the conclusion of the appraisal would be that the strategy has a large adverse effect, although the precise alignment of individual schemes can be designed to reduce the impact on landscape and thus the overall effect. As each scheme is included within the strategies with area-wide road user charging and without Smarter Choices, the landscape issues also occur in these strategies.

**Townscape**

8.32 Townscape is defined as the physical and social characteristics of the built and unbuilt urban environment and the way in which they are perceived. The majority of the schemes included in the strategy are located outside the urban areas, although there are some sections which lie relatively close to urban areas. The appraisal of the townscape features is essentially qualitative.

8.33 Since few of the major schemes within the strategy are located within urban areas, separate maps were not produced specifically to cover the townscape issues on their
own and the maps shown in Appendix B (Figures B.4 to B.6), which include the heritage designations, form the basis of the assessment.

8.34 Potential impacts on townscape include:

- the Second Avon Crossing has an impact on the north bank of the river at the point where the bridge would link with the existing road network (particularly the A4) but, although the precise alignment of the route and the design of the bridge have yet to be determined, given the current urban development in the area, it is unlikely that the scheme will have a major negative impact;

- the South Bristol Ring Road runs for part of its length through urban areas of south Bristol, particularly the Hartcliffe and Withywood areas of the city and, although the final path for the road will be finalised during its detailed design, it is expected that there will be some significant impact in these areas including the potential acquisition of existing residential properties, the removal of mature trees and existing green space, and increased visual intrusion for residents. These aspects will need to be taken actively into account in the consideration of the alignment and in the detailed design of the scheme. The South Bristol Ring Road will also provide relief to several areas of south Bristol through reduced traffic levels, particularly along the A4, A37 and A4174 corridors and hence would have a positive effect on the townscape in these areas;

- the Stoke Gifford Bypass includes sections of the existing highway network together with new construction within areas that are planned for development. As it currently stands, the impact of the scheme on the urban townscape will be small, although its design will need to take into account, and be planned alongside, the design of the new developments in the area, especially in Harry Stoke; and

- the A36-A46 Link Road runs outside the urban area and hence does not have a direct impact on the townscape of the area. However, the extent to which the scheme provides relief to the urban area of Bath through the diversion of traffic (especially Heavy Goods Vehicles) away from the urban area, it will have a positive impact on the townscape particularly those areas with a frontage on the major traffic routes.

8.35 Across the urban areas of Bristol and Bath, the introduction of the rapid transit system will have some localised impacts on the townscape. In general, the rapid transit services run along existing public transport, and mainly bus, corridors. However, where the rapid transit network operates along new, or segregated, alignments there will be a potential impact on townscape, for example through the harbourside area between Ashton Vale and Bristol city centre, at the junction of Coldharbour Lane and the M32, along the Severn Beach line (depending on the choice of alignment for this section of route), across the second Avon Crossing and through Portishead.

8.36 Similarly, new or expanded Park and Ride sites could potentially have impacts on the townscape in the immediate neighbourhood of the sites, with new or extended areas of hard surfacing and additional lighting.

8.37 On the other hand, the combined aspects of ‘Smarter Choices’, enhanced public transport measures and demand management/road user charging will reduce overall traffic levels and hence enhance the impact on the general townscape in the study.
area. This benefit will be further increased in areas such as central Bath where the townscape is of particular value, demonstrated by its designation as a World Heritage Site. Extended pedestrianisation schemes in the area, together with other measures designed to reduce traffic levels and especially the number of HGVs, will generate potential additional townscape benefits.

8.38 Overall, the strategy could have a moderate adverse impact on townscape and the detailed design and alignment of schemes will need to take specific potential impacts into account. To the extent that it reduces overall traffic levels in areas of townscape importance, the introduction of area-wide road user charging will have some effect in reducing the impact although not to a significant extent overall.

Heritage of Historic Resources

8.39 The man-made environment comprises buildings of architectural or historic significance (including Bath World Heritage Site), areas such as parks and other designated landscapes or public spaces, historic landscapes and architectural complexes and sites (e.g. Scheduled Ancient Monuments, places with historical associations such as battlefields, preserved evidence of human effects on the landscape, etc).

8.40 The effects of schemes on heritage designations are summarised in maps in Appendix B (Figures B.4 to B.6) which highlight the following impacts in relation to the indicative alignments of schemes in the area:

♦ the Nailsea Bypass passes close to, but does not directly impact on, one Scheduled Ancient Monument at Wraxall and a Grade II* garden at Tyntesfield;

♦ the Airport Link Road alignment passes through the Conservation Area at Wrington and runs very close to a number of Scheduled Ancient Monuments, including sites at Nye, north of Redhill on the A38 and near Felton, with burial chambers, barrows and tumuli – to avoid the impact on the sites variations in the alignment might be possible and will need to be established in the detailed development of the scheme;

♦ the South Bristol Ring Road does not have a direct impact on any Scheduled Ancient Monuments but runs through the Conservation Area in the Highridge and Withywood areas;

♦ the widening of the A370 is close to a Scheduled Ancient Monument and runs through a narrow Conservation Area to the south of Long Ashton;

♦ improvements to M32 Junction 1 could potentially have a negative impact on the Conservation Area if they are located on the north-east corner of the junction; and

♦ the A36 to A46 Link reduces traffic levels, especially goods vehicles, through the Bath World Heritage site, and hence would have a significant positive impact on the heritage characteristics of the city.

8.41 Across much of the study area, the general effect of reduced traffic levels brought about by a combination of ‘Smarter Choices’, public transport enhancements and demand management/road user charging will have positive impact on heritage features.
8.42 Overall, the strategy could have a moderate adverse impact on heritage and the detailed design and alignment of schemes will need to take specific potential impacts into account. The inclusion of area-wide road user charging and Smarter Choice would not significantly affect the appraisal.

**Biodiversity**

8.43 The examination of the transport strategy’s impact on the biodiversity and earth heritage areas in the study area covers a wide range of designations, including:

- Sites of Special Scientific Interest (SSSI);
- National Nature Reserves;
- Special Protection Areas;
- Special Areas of Conservation;
- Ramsar sites;
- Local Nature Reserves;
- Ancient Woodland (distinguishing between replanted and semi-natural);
- coastal sand dunes; and
- important bird areas.

8.44 Maps in Appendix B (Figures B.7 to B.9) summarise the impact on sites of importance for biodiversity. The main conclusions are:

- the Airport Link Road potentially affects a number of designations in that it skirts the south of the SSSI between Nye and Congresbury, it crosses the local nature reserve which runs along the disused rail line between Congresbury and Winscombe, and it runs through ancient woodlands to the north of Wrington – while a revision to the scheme’s alignment could reduce the impact on the sites, it is unlikely that it would be possible to avoid some negative effects on the biodiversity designations;
- the Nailsea Bypass skirts the northern boundary of a SSSI across Tickenham Moor – the detailed design of the scheme would need to minimise the impact on the SSSI, although there is little scope for major changes to the alignment due to the proximity of developments along the existing B3130;
- the South Bristol Ring Road and the widening of the A370 south of Long Ashton do not have an effect on specific biodiversity designations, although the section of the South Bristol Ring Road between the A38 and A370 runs close to a small ancient woodland;
- the second crossing of the River Avon runs close to an important bird area as it crosses the river and hence, if the scheme is taken forward, care will need to be taken in the choice of the alignment and the need for mitigation measures, particularly during the construction period;
- there are some areas of ancient woodland to the west of the M5 between Junctions 16 and 17 and hence any changes at these junctions or on the link between them would need to recognise the potential impacts, although it should be feasible to design schemes which do not affect the woodlands; and
the A36 to A46 Link could potentially affect a small SSSI near to the River Avon crossing which would therefore need to be reflected in the detailed design.

8.45 Overall, the strategy could have a moderate adverse impact on biodiversity and the detailed design and alignment of schemes will need to take specific impacts into account. The inclusion of area-wide road user charging and the exclusion of Smarter Choices from the strategy will not have a significant impact on this assessment.

Water Environment

8.46 The assessment of the strategy’s impact on the water environment is based on the Environment Agency’s definition as ‘the fresh, marine, surface and underground water in England and Wales’. The appraisal of these issues is summarised in maps in Appendix B (Figure B.10 to B.12) which present the following attributes in relation to the water environment:

- indicative tidal flood plain;
- indicative fluvial flood plain;
- landfill sites, distinguishing between high risk, not gassing and unknown characteristics;
- source protection zones, by category; and
- integrated pollution prevention and control site buffers.

8.47 The principal impacts of measures on the water environment in the vicinity of the schemes are summarised below:

- the Airport Link Road from the M5 at Junction 21 to the A38 and A370 crosses an area of fluvial flood plain between Nye and Congresbury and the plain of the River Yeo to the south of Wrington – the design and construction of the scheme would therefore take these features into account;
- in the neighbourhood of the airport, the Airport Link Road crosses Source Protection Zones while, north of the airport, the alignment runs close to a number of landfill sites which will therefore need to be accommodated in the design;
- the Nailsea Bypass runs through an area of fluvial flood plain for a number of streams between Tickenham and Nailsea – the design will therefore need to take this into account;
- given its proximity to the River Severn and River Avon, it is unsurprising that the scheme for the construction of a second crossing of the River Avon runs within areas of tidal flood plains which the scheme’s design would need to reflect and accommodate – at the same time, the alignment runs close to some landfill sites;
- at its western end, the South Bristol Ring Road runs close to a number of landfill sites in the section between the A38 and A370 while the widening of the A370 also potentially affects landfill sites to the south of the existing road;
- the widening of the M4 between Junctions 19 and 20 lies close to landfill sites to the north of the existing motorway, although the impact is likely to be small because the proposed scheme lies within the existing boundary of the motorway;
the M4 widening also crosses the Bradley Brook although, because the scheme is an extension of the existing road, there should not be a further impact on the stream;

- the schemes at Junctions 16 and 17 of the M5 and the section of the motorway between them do not have a significant impact on water resources, although there is a small landfill site in the vicinity of Junction 17;

- the Stoke Gifford Bypass and M32 Junction 1 cross small streams; and

- the A36 to A46 Link crosses the River Avon and has a potential impact on the river.

8.48 Overall, the strategy could have **moderate adverse** impacts on the water environment and the detailed design and alignment of schemes will need to take specific impacts into account. The inclusion of area-wide road user charging in the strategy, or the exclusion of Smarter Choices from it, would not have a significant impact on this assessment.

**Physical Fitness**

8.49 The Government has a general desire to improve the health and fitness of the nation and, in particular, it has set targets for the reduction of coronary heart disease and strokes. In connection with this, the recommended minimum level of physical activity is for 30 minutes or more, for most days of the week.

8.50 In the appraisal, the contribution that schemes make to physical fitness is measured by the extent to which the number of pedestrians or cyclists, who are active for more than 30 minutes, is increased. A further indication of improvements in physical activity is the level of mode change from private car to public transport, where the stop/station access and egress constitutes an increase in activity and hence would be beneficial to physical fitness.

8.51 In the assessment of measures within a strategic study such as GBSTS, it is not possible to quantify the number of pedestrians or cyclists and the length of their activity. However, it is reasonable to assert that the strategy would enhance the level of physical fitness because it includes the specific policy of providing additional facilities to enhance pedestrian and cycling activity. Furthermore, the overall strategy makes a significant change in the level of mode split with major increases in the proportion of travellers using public transport. The impact is further raised with the introduction of area-wide road user charging which has the effect of increasing the public transport mode share.

8.52 Hence, the overall effects of the strategy in terms of physical fitness would be **moderate beneficial**. By encouraging greater use of public transport, the inclusion of area-wide road user charging will have a **large beneficial** effect. On the other hand, the exclusion of Smarter Choices from the strategy is likely to reduce the impact to **slight beneficial**.

**Journey Ambience**

8.53 Journey Ambience is a function of the quality of facilities provided for travellers, the level of information that is disseminated to them, the cleanliness of services, the views from vehicles, and the level of overall traveller stress which includes such
factors as the safety of travel. The level of journey ambience can be directly affected (positively or negatively) by travellers themselves, and by the network providers and operators.

8.54 The GBSTS strategy may be deemed to enhance journey ambience in a number of ways although it is not possible to estimate the number of travellers that would be affected, nor to gauge the magnitude of the effect. The aspects of the strategy which would enhance journey ambience include the improvements to reliability and hence the reduction in stress as a result of the decreased congestion on the highway network. The increase in the level of information to travellers would also improve ambience; this information would be provided on the motorway network through the greater use of Variable Message Signs and on the public transport network, for example with the increased availability of real-time information for bus passengers as part of the showcase bus corridors.

8.55 The improved public transport vehicles included in the short-term enhancements to the local rail network and in the introduction of new buses as part of the Showcase bus corridors will have a positive affect on the journey ambience. In the longer term, the inauguration of rapid transit services across the study area, operated by modern vehicles, will have a significant effect on journey ambience.

8.56 Hence, the overall effects of the strategy in terms of journey ambience would be moderate beneficial. The inclusion of area-wide road user charging and the exclusion of Smarter Choices will not affect the assessment.

**SAFETY**

8.57 The appraisal against the safety objectives covers the impact of the strategy on:

♦ accidents; and
♦ security.

**Accidents**

8.58 The GBSTS strategy would result in a significant improvement in road safety through reductions in the level of road traffic, particularly within urban areas. The overall impact of the strategy on casualties is shown in Table 8.6. The derivation of the statistics on accident levels follows standard DfT guidance and is based on the change in the volume of vehicle-kms on different types of road as a result of the strategy. In this approach, new roads, designed to modern standards, would tend to have a lower accident level compared with existing roads.
Table 8.6 – Impact of GBSTS Strategy on Casualties

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fatal</th>
<th>Serious</th>
<th>Slight</th>
<th>Total</th>
<th>Total Saving Compared with Do Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>33</td>
<td>365</td>
<td>3152</td>
<td>3551</td>
<td></td>
</tr>
<tr>
<td>2031 Do Minimum</td>
<td>33</td>
<td>332</td>
<td>4022</td>
<td>4388</td>
<td></td>
</tr>
<tr>
<td>2031 Strategy</td>
<td>31</td>
<td>298</td>
<td>3597</td>
<td>3926</td>
<td>462</td>
</tr>
<tr>
<td>2031 Strategy with RUC</td>
<td>30</td>
<td>286</td>
<td>3440</td>
<td>3756</td>
<td>632</td>
</tr>
<tr>
<td>2031 no Smarter Choices</td>
<td>33</td>
<td>316</td>
<td>3804</td>
<td>4152</td>
<td>235</td>
</tr>
</tbody>
</table>

8.59 Overall, the GBSTS strategy would result in around 460 weekday casualties being avoided each year, including 34 serious injuries and 3 fatalities. Including road user charging in the strategy would result in a greater reduction in casualties, while excluding ‘Smarter Choices’ would reduce the impact of the strategy on accidents by 50%.

8.60 The Joint Local Transport Plan for the Greater Bristol area focuses on reductions in the number of the most serious road casualties with targets for cutting the number of people killed and seriously injured (KSI). The GBSTS strategy delivers a 10% reduction in KSI casualties in 2031. With the new road links, the strategy tends to transfer traffic from local roads to strategic roads, resulting in greater reductions in casualties on local roads.

8.61 Overall, the impact of the strategy on accidents is assessed as **large beneficial**. The inclusion of area-wide road user charging will have the same impact as the main strategy, although the exclusion of Smarter Choices would reduce the impact to **moderate beneficial**.

**Security**

8.62 The public transport elements of the strategy include measures to increase the personal security of travellers as an integral part of the recommendations, especially in the operation of public transport through improved facilities at bus stops and better real-time passenger information. The measures also include improvements to transport interchanges throughout the Greater Bristol area. Hence, the overall impact on security is assessed as **moderate beneficial**; this assessment would be valid for the inclusion of area-wide road user charging and the exclusion of Smarter Choices.

**ECONOMY**

8.63 The appraisal of the GBSTS strategy against the Government’s Economy objective covers the following sub-objectives:
minimise cost to public accounts;
♦ improve transport economic efficiency;
♦ improve reliability;
♦ provide beneficial wider economic impacts;
♦ improve strategic transport movements into, out of and through the study area;
♦ improve access to BIA; and
♦ reduce dependence on the car.

Transport Economic Efficiency and Public Accounts

8.64 The Transport Economic Efficiency (TEE) sub-objective refers to the economic impact of the strategy on transport users and the private sector, including travel time and vehicle operating cost savings along with changes in fares and other charges, and income and costs to the private sector. The economic impact of the strategy on the public sector, including capital and operating costs, revenue and indirect tax income is considered under the Public Accounts sub-objective. The two sub-objectives are therefore closely interrelated and need to be considered together through an assessment of the economic performance of the strategy.

8.65 The performance of the GBSTS transport strategy against the TEE and Public Accounts sub-objectives has been assessed using the DfT’s TUBA program. In summary, the assessment process involved the comparison of the total monetised benefits generated by the strategy against the total monetised costs. The costs and benefits considered fall into the following categories:

♦ **Impacts of the strategy on travel times and costs** for trips made within and through the modelled study area, together with the associated impacts on revenue and indirect tax levels. These impacts were estimated on the basis of the forecast change in travel conditions caused by the strategy compared to the Do Minimum situation. Outputs from the Greater Bristol Model (GBM) were used within TUBA to estimate traveller user benefits, revenues and indirect tax benefits over a 60 year appraisal period.

♦ **Impacts of the strategy on road accidents** in the study area. Estimates were made using the COBA 11 methodology and the changes in traffic levels and patterns forecast by the transport model.

♦ **Capital and operating costs for the strategy**. Cost estimates were made on the basis of current scheme proposals and cost rates from previous similar schemes. Appropriate allowances were made for optimism bias. As noted in Chapter 6, the capital costs exclude the costs associated with land acquisition.

8.66 The summary results of the economic assessment are presented in Table 8.7 (with definitions provided in the box below). The entries under the Present Value of Benefits (PVB) summarise the impact of the strategy on transport economic efficiency whilst the entries under the Present Value of Costs (PVC) summarise its impact on public accounts. The full TEE, Public Accounts and Summary Analysis Tables are given in Appendix A.
Table 8.7 – Summary of Economic Assessment of GBSTS Strategy

<table>
<thead>
<tr>
<th></th>
<th>Strategy</th>
<th>Strategy with RUC</th>
<th>Strategy without Smarter Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Costs in current prices (2005, Q1), £mill, inc Optimism Bias</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Cost</td>
<td>£1,156</td>
<td>£1,186</td>
<td>£1,156</td>
</tr>
<tr>
<td>Operating Costs (60 years)</td>
<td>£2,586</td>
<td>£2,586</td>
<td>£2,498</td>
</tr>
<tr>
<td>2) PVC (£ mill, 2002 prices &amp; values, 60 year appraisal period, 2016 to 2075)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Public sector capital &amp; operating costs</td>
<td>£668</td>
<td>£687</td>
<td>£643</td>
</tr>
<tr>
<td>b) Public sector revenue (indirect tax + parking &amp; road charges)</td>
<td>£435</td>
<td>-£11,028</td>
<td>£107</td>
</tr>
<tr>
<td>c) Total PVC (a+b)</td>
<td>£1,103</td>
<td>-£10,341</td>
<td>£750</td>
</tr>
<tr>
<td>3) PVB (£ mill, 2002 prices &amp; values, 60 year appraisal period, 2016 to 2075)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Travel time benefits</td>
<td>£29,248</td>
<td>£34,698</td>
<td>£22,173</td>
</tr>
<tr>
<td>e) Vehicle operating cost benefits</td>
<td>£323</td>
<td>£72</td>
<td>£188</td>
</tr>
<tr>
<td>f) User charge benefits</td>
<td>-£225</td>
<td>-£12,193</td>
<td>-£348</td>
</tr>
<tr>
<td>g) Private sector revenue</td>
<td>£5,067</td>
<td>£5,688</td>
<td>£4,026</td>
</tr>
<tr>
<td>h) Public sector operating &amp; capital costs</td>
<td>-£652</td>
<td>-£652</td>
<td>-£652</td>
</tr>
<tr>
<td>i) Accidents</td>
<td>£681</td>
<td>£923</td>
<td>£322</td>
</tr>
<tr>
<td>j) Total PVB (d+e+f+g+h+i)</td>
<td>£34,442</td>
<td>£28,534</td>
<td>£25,707</td>
</tr>
<tr>
<td>4) NPV (j-c)</td>
<td>£33,339</td>
<td>£38,876</td>
<td>£24,957</td>
</tr>
<tr>
<td>5) BCR (j/c)</td>
<td>31</td>
<td>-3</td>
<td>34</td>
</tr>
<tr>
<td>6) BKR((j-b-h)/(c-b-h))</td>
<td>26</td>
<td>30</td>
<td>20</td>
</tr>
</tbody>
</table>
Definition of Summary Statistics

<table>
<thead>
<tr>
<th>Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Present Value of Costs (PVC) (2)</td>
<td>Represents the total value of the costs of the scheme over the 60 year appraisal period, discounted to 2002 values. Costs are defined as the net impact of the scheme on the public sector.</td>
</tr>
<tr>
<td>The Present Value of Benefits (PVB) (3)</td>
<td>Represents the total value of the benefits of the scheme over the 60 year appraisal period, discounted to 2002 values. Benefits are defined as the net impact of the scheme on transport users and the private sector.</td>
</tr>
<tr>
<td>The Net Present Value (NPV) (4).</td>
<td>Represents the value of the PVB less the PVC. For most purposes this is the key figure, with a more positive NPV representing a stronger economic case for a scheme.</td>
</tr>
<tr>
<td>The Benefit Cost Ratio (BCR) (5).</td>
<td>Represents the ratio of the benefits caused by the scheme to its costs and is calculated by dividing the PVB by the PVC. As the definitions of the PVB and PVC above show, this figure effectively represents the comparison of the impact of the scheme on users and the private sector with its impact on the public sector.</td>
</tr>
<tr>
<td>The HA Benefit Cost Ratio (BKR) (6)</td>
<td>Represents the ratio of the net impact of the scheme on transport users and revenue income (public and private sector) to its total capital and operating costs. This ratio differs from the BCR in its treatment of public sector revenue (including indirect tax) and private sector capital and operating costs. The BCR includes private sector capital and operating costs with the benefits on the numerator of the ratio and the public sector revenue with the costs on the denominator of the ratio. In contrast, the BKR includes the private sector capital/operating costs with the costs (i.e. the denominator of the ratio) and the public sector revenue with the benefits (i.e. the numerator). These differences can lead to markedly different results, particularly for schemes with large scale impacts on public sector revenue.</td>
</tr>
</tbody>
</table>

8.67 The following key points arise from the economic assessment of the GBSTS strategy:

- **Economic Performance:** The economic performance of the strategy is very strong. The benefits that it generates considerably outweigh its costs over the 60 year appraisal period, resulting in an NPV of nearly £35 billion and a BCR of greater than 30.

- **Time savings:** The vast majority of the benefits generated by the strategy are time savings experienced by transport users. The implementation of the strategy would cause a step change in transport provision in the study area, alleviating congestion and providing more numerous, direct and frequent travel options. The average journey time for travel by each mode would therefore reduce considerably, generating large time savings, although, as noted below, to a large extent, the original congestion is caused by the large increase in population and employment between 2003 and 2031.

- **Revenue:** The strategy causes a marked increase in public transport patronage, resulting in a substantial increase in revenue income (a present value of over £5 billion, over the 60 year appraisal period). The revenue received comfortably
covers the ongoing costs incurred in operating the services provided. The increase is supplemented by a small increase in revenue from car drivers, raised through the workplace parking levy in the North Fringe of Bristol and increases in city centre parking charges in Bristol and Bath. The revenue impacts of the strategy are the second largest in scale (nearly 20% of the value of the time savings).

**Accident Savings:** As discussed under the safety sub-objective above, the strategy reduces the number of road accidents in the study area, leading to 10% fewer killed and seriously injured casualties than occur in the Do Minimum in 2031. The savings result from the reduction in overall traffic levels caused by the strategy and its encouragement of traffic to switch from older, lower hierarchy roads to newer and more strategic roads with higher design and safety standards. The accidents saved are worth over £620 million (present value) when considered over the full appraisal period.

**Vehicle Operating Costs:** The net impact of the strategy is a small saving in vehicle operating costs worth only a few percent of the value of total time savings. This saving comprises a larger scale decrease in costs experienced by car trips and an offsetting increase in costs experienced by goods vehicles. The two components of vehicle operating costs are the fuel used and non-fuel costs (such as general "wear and tear"). Both are dependent on travel time and distance (and the associated travel speed). Up to a threshold speed of between 60 and 75 kph (depending on vehicle type), an increased travel speed reduces average fuel consumption and acts to decrease fuel costs. For car trips in the Do Minimum, average speeds are typically 40 to 50 kph (because of the high proportion of journeys occurring on slower, congested urban roads). They are therefore well below the efficiency threshold, and hence the increased average speed produced by the strategy improves fuel efficiency and reduces vehicle operating costs. However, the average speeds of goods vehicles, in the Do Minimum, are typically higher at around 60 to 65 kph, because a greater proportion of the journeys are on less congested inter-urban roads and motorways. These speeds are therefore above the efficiency threshold for this vehicle type so that increased speeds lead to a decrease in operating efficiency and a slight increase in vehicle operating costs. The increase is relatively large in absolute terms but represents less than 2% of total goods vehicle operating costs.

**User Charge:** The strategy increases the charges paid by transport users. This is primarily the result of the workplace parking levy introduced for those working in the North Fringe and the increase in city centre parking charges in Bath and Bristol. The losses are offset, to an extent, by minor savings experienced by rail and park and ride passengers. These passengers are able to reduce the fare they pay by taking more direct and shorter routes made available by the changes in conditions and options provided by the strategy.

**Indirect Tax:** The impacts of the strategy on indirect tax levels are directly related to its effects on vehicle operating costs and revenue. Expenditure by the user on various items of transport-related costs is subject to different levels of indirect taxation. For example, fuel incurs fuel duty and VAT whilst other vehicle operating costs and some parking charges incur VAT only. In contrast, public transport fares incur no taxation. Therefore, as the strategy alters the amount of travel and expenditure on each mode, it results in changes in the levels of indirect tax received by the government. The net effect is a decrease in indirect
tax income resulting primarily from the increase in expenditure on public transport fares. The assessment takes account of the fact that, by spending more of their available income on fares, consumers would have less to spend on other, taxable items, thus leading to a reduction in indirect tax paid to the Government.

8.68 The strategy performs very strongly in economic terms, mainly due to the contribution of travel time savings which arise largely because of the high levels of congestion in the 2031 Do Minimum situation. The Do Minimum shows significant increases in population (25%) and employment (20%) with only limited improvements to the transport infrastructure. Thus, the transport system is under extreme levels of stress, which is perhaps unrealistic because there would need to be some improvement to the transport system in order to accommodate the additional population and employment. The strategy provides a significant improvement in transport supply, compared with the Do Minimum, and hence there are significant travel time savings.

8.69 The high levels of congestion in the Do Minimum situation result in the suppression of trips. The strategy provides additional transport capacity and therefore releases some of the suppressed trips. In the 2031 morning peak period, there are 2% more trips overall with the strategy than in the Do Minimum situation. The benefits from the release of suppressed trips are in addition to the benefits accrued by users of the transport system in the Do Minimum.

8.70 The economic assessment demonstrates a very strong case for the strategy, which would perform well even with lower levels of growth. In the base year (2003) situation, the transport system is already under stress, and many of the measures included in the strategy are needed to address current as well as future problems.

8.71 TUBA presents time savings generated by the strategy in terms of a Net Present Value (NPV) of the savings experienced over the 60 year appraisal period and measured in millions of pounds. To provide a sense of scale, Table 8.8 presents a summary of the average time savings experienced for journeys to and from each of the major urban areas for each mode in the morning peak in 2031. The figures show that savings experienced are significant, generally between 5 and 15 minutes and considerably greater for rapid transit in general and for bus and rail to and from Weston-super-Mare.
Table 8.8 – Average Time Saving for Trips to Urban Areas by Mode (Morning peak, 2031)

<table>
<thead>
<tr>
<th>Trips to/from/within</th>
<th>Mode</th>
<th>Average Travel Times</th>
<th>Change in Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Do Minimum</td>
<td>Strategy</td>
</tr>
<tr>
<td>Bristol</td>
<td>Bus</td>
<td>66</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>RT*</td>
<td>108</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Rail</td>
<td>79</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>34</td>
<td>25</td>
</tr>
<tr>
<td>Bath</td>
<td>Bus</td>
<td>47</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>RT*</td>
<td>134</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>Rail</td>
<td>79</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>45</td>
<td>32</td>
</tr>
<tr>
<td>Weston-super-Mare</td>
<td>Bus</td>
<td>140</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>RT</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td></td>
<td>Rail</td>
<td>98</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Car</td>
<td>40</td>
<td>29</td>
</tr>
</tbody>
</table>

*Rapid Transit Do Minimum times are the travel times that people travelling by rapid transit with the strategy in place would have faced if travelling by bus in the Do Minimum. Public transport times relate to trips within the study area only and include waiting and walking time.

8.72 The majority of trips in the study area are made by car (for example, 91% of trips in the morning peak in 2031 in the Do Minimum situation which falls to 76% with the full strategy). It therefore follows that the majority of time savings generated by the strategy are experienced by car users. Nonetheless, over 30% of the total benefits are experienced on public transport and park and ride, despite these modes accounting for less than 25% of the total trips in the GBSTS strategy (see Table 8.9).

Table 8.9 – Strategy Time Savings by Mode (full 60 year time savings)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Proportion of Total Time Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway</td>
<td>69%</td>
</tr>
<tr>
<td>Bus</td>
<td>8%</td>
</tr>
<tr>
<td>Rapid Transit</td>
<td>13%</td>
</tr>
<tr>
<td>Rail</td>
<td>5%</td>
</tr>
<tr>
<td>Park &amp; Ride</td>
<td>4%</td>
</tr>
</tbody>
</table>

8.73 The majority of trips made in the study area and the highest congestion levels occur in the weekday peak periods. Consequently, over 50% of the time savings...
generated by the strategy are experienced during this time period, despite it accounting for less than 20% of total annual hours (see Table 8.10). This pattern is the result of the larger number of trips made during this period which experience the benefits and the larger scale of the congestion alleviation impacts of the strategy in the more congested peak times.

Table 8.10 – Strategy Time Savings by Time of Day

<table>
<thead>
<tr>
<th>Mode</th>
<th>Proportion of Total Time Saving</th>
<th>Proportion of Annual Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekday Peak</td>
<td>51%</td>
<td>17%</td>
</tr>
<tr>
<td>Weekday Non Peak</td>
<td>33%</td>
<td>52%</td>
</tr>
<tr>
<td>Weekend</td>
<td>18%</td>
<td>31%</td>
</tr>
</tbody>
</table>

8.74 Trip making patterns and high congestion levels in the study area also focus on the main urban areas. Consequently, as Table 8.11 shows, a high proportion of the time savings generated by the strategy are experienced by trips to, from or within these areas.

Table 8.11 – Time Savings by Mode & Geographical Area (2031 morning peak)

<table>
<thead>
<tr>
<th>%age of Total Strategy Time Savings</th>
<th>Road</th>
<th>Bus</th>
<th>Rapid Transit</th>
<th>Rail</th>
<th>Park and Ride</th>
</tr>
</thead>
<tbody>
<tr>
<td>To &amp; From Bristol</td>
<td>46%</td>
<td>79%</td>
<td>74%</td>
<td>59%</td>
<td>66%</td>
</tr>
<tr>
<td>To &amp; From Bath</td>
<td>17%</td>
<td>7%</td>
<td>15%</td>
<td>11%</td>
<td>14%</td>
</tr>
<tr>
<td>To &amp; From Weston-super-Mare</td>
<td>11%</td>
<td>7%</td>
<td>0%</td>
<td>24%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Note: these figures include double counting as some of the journeys ‘to and from Bristol’ will be ‘from and to Bath’ etc.

Strategy with Road User Charging

8.75 The inclusion of road user charging (RUC) in the strategy alters its economic performance in a number of ways. The summary results of the assessment are shown in Table 8.7, alongside the equivalent figures for the strategy without RUC. More detailed information is provided in the TEE, Public Accounts and Summary Analysis tables in Appendix A (Tables A.5 to A.8).

8.76 A comprehensive national congestion charging scheme could not be implemented before 2021, although local measures could be put in place earlier. Therefore, the form of the road user charge included in the GBSTS strategy varies through time, with:

♦ a cordon around Bristol in the earlier part of the study period; and
♦ an area-wide congestion-based scheme covering all roads later in the study period.
While an allowance of £30 million has been made for the development of the Bristol cordon scheme, no information was available to estimate the proportion of the costs of the national scheme that would fall to the Greater Bristol area. Neither has any allowance been made for the operating and enforcement costs of either the cordon or the national scheme. Thus, the assessment below gives an optimistic view of the economic performance of the strategy with road user charging.

Using these assumptions, the inclusion of RUC increases the NPV of the strategy by over 15% to nearly £40 billion. This is accompanied by a change in the BCR from 31 to -3. This apparently counterintuitive effect is a consequence of the definition of the BCR and of the scale of public sector revenue generated by the charge. The BCR is defined as the comparison of the impacts on the private sector (‘Benefit’) against the impacts on the public sector (‘Cost’). The public sector revenue generated by RUC exceeds the costs of the strategy with RUC, so the public sector receives a net income over the appraisal period. Hence, the result is that the strategy ‘Cost’ becomes a benefit (or negative cost). This results in a negative BCR which, in this case, is not a useful indicator of the economic performance of the scheme.

The Highways Agency’s benefit cost comparison ratio (the BKR) is more useful in this context. As discussed above, it includes the public sector income as a benefit in the numerator of the ratio with only the scheme’s capital and operating costs included in the PVC in the denominator. The value of this measure is 30 for the strategy with RUC, representing a significant increase on the value of 26 for the strategy without RUC.

The increased NPV (and therefore BKR) associated with including RUC is primarily the result of two effects:

♦ increased time savings; and
♦ revenue generated from the charges.

The time savings are mainly experienced by road-based journeys (largely highway trips and, to a much lesser extent, bus trips). They are the result of congestion relief but are only experienced in the later years of the strategy period when the area-wide charging measures are introduced.

The impacts of RUC vary considerably through time as the form of the scheme alters. During the earlier years of the strategy, when RUC takes the form of an intermediate cordon around Bristol following an alignment between the Inner Ring Road and Avon Ring Road (see Figure 4.8), the scheme results in net time losses compared to the strategy without RUC in the equivalent years. Although the charge brings considerable congestion relief to central Bristol, the associated savings are more than offset by the losses that arise as drivers outside the cordon divert to avoid the charge. There are often no clear diversion routes around the cordon with the result that drivers travel considerable additional distances with associated increases in journey times. This rerouting increases congestion on roads such as the Avon Ring Road (A4174) which in turn reduces travel speeds. The result is an increase in journey times for all those using the roads, supplementing the time losses incurred by those rerouting directly to avoid the charge.

The area-wide congestion-based charge implemented later in the study period causes less rerouting. Drivers act to minimise their travel cost and a considerable
number switch modes as the widespread charge makes the comparison between public transport and car costs more favourable to public transport. The result is a 4% reduction in car trips compared to the strategy without RUC, with a consequent reduction in congestion and an increase in travel time savings of over 15% in the morning peak in 2031, compared to the strategy without RUC.

8.84 In line with the overall time savings, the majority of the increased benefits generated by RUC occur in the most congested areas, i.e. the main urban areas. For example in the 2031 morning peak, over 70% of benefits are experienced by trips to and from Bristol, Bath and Weston-super-Mare.

8.85 The total revenue generated by RUC is over £10 billion (present value) over the 60 year appraisal period. As discussed above, this results in a negative BCR using the standard definition. However, the impact on the strategy’s NPV is limited because the benefits of increased revenue are largely (90%) offset by the increase in the user charge experienced by those paying the charge.

8.86 Other, more minor, impacts from the implementation of RUC include increased vehicle operating cost savings generated by improved journey speeds and the additional incentive to reduce journey lengths. The traffic reduction effect of RUC also results in a 50% increase in the accident savings created by the strategy, bringing the value to more than £900 million (present value) over the appraisal period. Finally, slight rail disbenefits arise as rail travellers experience additional crowding due to the increase in mode switching encouraged by the road user charge.

**The Impact of ‘Smarter Choices’**

8.87 The ‘Smarter Choices’ component of the strategy has an important impact on the strategy's overall economic performance. Table 8.7 presents the summary economic assessment results of a sensitivity test undertaken to exclude the Smarter Choices component from the strategy. Further information is provided in the TEE, Public Accounts and Summary Analysis tables in Appendix A (Tables A.9 to A.12).

8.88 The exclusion of ‘Smarter Choices’ reduces the NPV for the strategy by around 25% or £8 billion. The associated change in BCR is an increase from 31 to nearly 34.

8.89 The increase in NPV is mainly the consequence of reduced road travel time savings. The impacts of ‘Smarter Choices’ are focussed on congested urban areas and these measures are therefore very effective at alleviating highway congestion and reducing highway travel times. If ‘Smarter Choices’ are excluded from the strategy, average highway time savings decrease markedly, reducing the value of highway time saving benefits by over 30%.

8.90 A second important impact of the exclusion of ‘Smarter Choices’ measures is an increase in the revenue received from drivers. The measures focus on broadly the same trips that are targeted by the parking strategy (i.e. those to central urban areas and to work). The success of ‘Smarter Choices’ in removing these trips therefore reduces the revenue received by the public sector. When the ‘Smarter Choices’ are excluded, the revenue received increases by over £1.5 billion (present value) over the 60 year appraisal period.
8.91 The impact of this change on NPV is limited by the offsetting increase in user charges. However, it is this change, along with the reduction in the Government’s indirect tax losses (resulting from the reduction in vehicle operating cost savings), that causes the BCR to increase when ‘Smarter Choices’ are removed. As both parking revenue and indirect tax represent public sector income, they offset the strategy costs in the BCR. The increase in revenue caused by excluding ‘Smarter Choices’ reduces the effective cost to the public sector by over 35%, a larger proportion than the 25% reduction in benefits for the numerator of the BCR (due to time saving reductions, etc). The net result is therefore an increase in the BCR.

8.92 As discussed above, the BKR measure excludes the complicating effect of public sector income (which acts to offset scheme costs) and compares all user and revenue impacts of the strategy with its capital and operating costs. The BKR measure reduces from 26 to 20 when ‘Smarter Choices’ are excluded following a pattern more consistent with the change in NPV.

8.93 Other more minor impacts of the exclusion of ‘Smarter Choices’ include a drop in public transport patronage (and therefore revenue), and reductions in the vehicle operating savings (due to the reduced improvements in average travel speed and therefore vehicle fuel efficiency). The decrease in traffic reduction also halves the accident savings caused by the strategy.

Improve Strategic Transport Movements into, out of and through the Study Area

8.94 One of the main aims of the study was to improve strategic transport movements into, out of and through the study area. Clearly, the key to achieving this objective is to improve the operation of the motorway network in the Greater Bristol area. To achieve this, it is important to consider the interface between the local and strategic networks as well as the motorway network itself, because problems on the local network can often cause knock-on impacts on strategic routes. The GBSTS strategy includes a number of measures intended to meet this objective:

- measures designed to make better use of the existing motorway network, including Active Traffic Management;
- providing better alternatives to the car by a step change in the provision of local public transport, including a new rapid transit system;
- actively encouraging people to use alternatives to the car by means of Smarter Choices and parking restraint;
- improvements to the local strategic transport network to take some pressure off the motorway network, including South Bristol Ring Road, Second Avon Crossing, Airport Link Road and Stoke Gifford Bypass; and
- improvements to the motorway network itself, including relocating M5 Junction 21, widening the M4 to four lanes between Junctions 19 and 20, and improvements to M5 Junctions 16 and 17 and to M32 Junction 1.

8.95 Table 8.12 summarises the impact of the different elements of the GBSTS strategy on the motorway network. In the table, the following colour coding is used for the links:

- Green – capacity utilisation less than 85%;
Orange – capacity utilisation between 85% and 90%; and
Red – capacity utilisation greater than 90%.

For the junctions, the colour coding is:

- Green – capacity utilisation less than 85%;
- Orange – capacity utilisation greater than 85% for some links; and
- Red – capacity utilisation greater than 85% for all or most links.

Table 8.12 – Impact of the Strategy on the Motorway Network (Morning Peak Period)

<table>
<thead>
<tr>
<th>Location</th>
<th>2003 Base</th>
<th>2031 Do Minimum</th>
<th>Public Transport Measures</th>
<th>Public Transport plus Smarter Choices</th>
<th>Public Transport, Smarter Choices and Parking</th>
<th>Strategy (no RUC)</th>
<th>Strategy with RUC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motorway Links</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J21-J20 NB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J20-J19 NB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J19-J18 NB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J18-J17 NB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J17-J16 NB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4 J20-J19 EB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4 J19-J18 EB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4 J18-J17 EB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Motorway Junctions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J18/J18A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J17*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M5 J16*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4 J19*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M32 J1*</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Some of the measures proposed in the GBSTS strategy, such as junction improvements at M5 Junctions 16 and 17 and at M32 Junction 1 involve detailed changes to operations and slip road arrangements. It did not prove possible to represent such schemes in the Greater Bristol Model which, as a strategic model, is not suitable for analysis of such detailed proposals. Consequently, the expected benefits from these measures are not reflected in the model output, or in any further analysis derived from the model results.

Table 8.12 shows that there is a marked deterioration in the performance of the motorway network between 2003 and 2031 in the Do Minimum situation. With only limited improvements in place (the climbing lanes), the network cannot cope with the large increases in traffic volumes created as a result of the developments in Spatial Scenario F and the associated growth of 25% in population and 20% in employment across the study area.

The non-highway elements of the strategy (such as public transport measures and Smarter Choices) reduce the flows on the motorway network considerably, bringing most motorway links below the 85% capacity threshold. The exception is the M4 between Junctions 19 and 20, for which capacity utilisation remains above 90% despite the introduction of such measures. It is only with widening to four lanes that this section is brought below the 85% capacity threshold.

Problems at the motorway junctions are much harder to solve, and reductions in the general level of traffic brought about by the non-highway elements of the strategy are not sufficient to reduce congestion. The GBSTS strategy therefore includes specific measures to tackle problems at key motorway junctions.

The public transport elements of the strategy improve strategic transport movements into and out of the study area by improving access to inter-regional rail services. Specific measures include:

- Worle public transport interchange, with an increase in the number of inter-regional rail services stopping at the station and improved connections by car, bus and coach;
- improved interchange at Bristol Parkway; and
- improved connections to main rail stations (such as Bristol Temple Meads, Bath Spa, Bristol Parkway and Worle) via higher frequency local rail services, rapid transit and enhanced bus services.

Overall, the impact of the strategy on improving strategic transport movements into, out of and through the study area is judged to be large beneficial. The assessment is maintained with the inclusion of area-wide road user charging and the exclusion of Smarter Choices.

Reliability

The assessment of reliability has considered the changes in route stress (congestion) in the 2031 morning peak period as this represents the period of greatest congestion. Reliability is difficult to quantify directly, but a useful measure is the extent of the highway network below, approaching, at, and over capacity. The greater the proportion of the network below capacity, the less risk of network instability leading to
delay and unreliable journey times. Table 8.13 presents the proportion of vehicle-kilometres in each category in the morning peak period in 2031, with the equivalent 2003 figures shown for comparison. The results indicate a considerable worsening of reliability between 2003 and 2031 in the Do Minimum situation, with the proportion of links comfortably below capacity falling from 91% to 69%. The strategy brings this measure back up to 86% and, when road user charging is included, it is returned to 2003 levels. If Smarter Choices are excluded, the impact of the strategy on reliability is muted.

### Table 8.13 – Proportion of Vehicle-kilometres on Congested Links (2031, morning peak)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Below capacity</td>
<td>91%</td>
<td>69%</td>
<td>86%</td>
<td>91%</td>
<td>76%</td>
</tr>
<tr>
<td>Approaching capacity</td>
<td>4%</td>
<td>14%</td>
<td>5%</td>
<td>3%</td>
<td>12%</td>
</tr>
<tr>
<td>At capacity</td>
<td>3%</td>
<td>8%</td>
<td>6%</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Significantly over</td>
<td>3%</td>
<td>9%</td>
<td>3%</td>
<td>2%</td>
<td>6%</td>
</tr>
</tbody>
</table>

8.104 Measures included in the strategy to make best use of the existing motorway network, including Active Traffic Management, will also contribute to improved reliability, reinforcing the effects of reductions in congestion.

8.105 The GBSTS strategy provides significant improvements to reliability when compared to the Do Minimum case, and is judged to have a large beneficial impact overall. This assessment is strengthened with the inclusion of area-wide road user charging. If Smarter Choices were to be excluded from the strategy, the overall impact would be moderate beneficial.

### Wider Economic Impacts

8.106 The assessment of potential wider economic benefits provides an estimate of the scheme, area specific and cumulative wider impacts of the transport proposals in the strategy. The analysis shows that, overall, the wider economic impacts of the proposed GBSTS strategy are significant:

- The strategy improves current and future accessibility of residential populations to workplaces in the region. Schemes which make a particular contribution include the South Bristol Ring Road, cross-Bristol rail services and rapid transit measures. These enable the transfer of working populations in predominantly residential locations to employment centres such as the North Fringe, and central Bristol and Bath.
The impact of the transport proposals on the nature and form of business activity varies by scheme and the sectors affected. A literature review showed that, generally, it is the manufacturing, retail and office based sectors that are most greatly impacted by transport scheme improvements. Bus and rail schemes assist primarily in widening customer and labour catchments with little impact on supplier relationships with business. Road-based schemes can improve the relationships of business with suppliers, customers and workforce. The GBSTS strategy, in providing for a range of public transport and highways based improvements, will have a positive overall impact on the business activity as relationships with customers, suppliers and workforce are assisted.

Overall, proposals contained within the GBSTS transport strategy have an impact on the Greater Bristol area as a whole with the main effects on sub-areas in the central and south Bristol, with lesser impacts on parts of the North Fringe, Weston-super-Mare and central Bath. Several of the proposals (e.g. motorway measures, the second Avon crossing) have a greater impact on the effective operation of the motorway network rather than other local roads within the sub-region and therefore have a less noticeable local impact.

The impact of the transport proposals on areas of unemployment and deprivation varies. Several of the proposals (e.g. motorway measures, second Avon crossing, Stoke Gifford bypass, Nailsea bypass, A36-A46 link) do not impact on sub-areas in the Greater Bristol sub-region with current unemployment and deprivation problems. Generally, unemployment and deprivation in the sub-region is found in central and south Bristol, Weston-super-Mare and, to a limited degree, central Bath. The proposals for Junction 21 of the M5, South Bristol Ring Road, rapid transit and cross-Bristol rail services are best located to have a positive impact on existing pockets of deprivation and unemployment. This is possible via improved customer/workforce links to centres of major employment (i.e. from south to central Bristol, from existing locations to new development sites in Weston-super-Mare). It is also possible as new sites become accessed and developable as a result of transport improvements, for example those in close proximity to the alignment of the South Bristol Ring Road, in central Bristol or in Weston-super-Mare. However, the literature review suggests that a positive impact on existing levels of unemployment and deprivation is only possible via a comprehensive policy response that includes, but is not exclusive to, improvements in transport infrastructure.

The GBSTS strategy will have an overall positive impact on inward investment in the Greater Bristol area. The impacts will be higher where they are associated with those schemes which facilitate better strategic road movements (motorway measures, etc) and access to Bristol International Airport. However, it should be noted that demand from inward investors is likely to remain in the north of Greater Bristol (e.g. North Fringe) and that the potential for this area in the long term is unclear given limited additional site availability.

Overall, the assessment estimates that the GBSTS strategy has the potential to encourage the development of a range of employment sites which together provide for about 20,000 jobs, of which approximately 2,000 are not redistributed or displaced jobs. This is in addition to the assistance the strategy provides in enabling improved accessibility for sites earmarked for major mixed use development.
The GBSTS strategy will have a positive wider economic impact on the South West region as a whole. This would be achieved in three main ways:

- it will improve economic activity in the sub-region and therefore will improve the overall economic prosperity of the South West region as a whole;
- it will improve inward investment opportunities for the Greater Bristol sub-region, which in turn will have a positive impact on overall wealth of the South West region; and
- by improving the capacity for the motorway network and relieving traffic congestion, it will improve accessibility to other parts of the South West region with potential positive economic impacts for businesses elsewhere in the region.

Thus, overall the transport strategy is considered to have a moderate beneficial effect on the wider economic benefits across the Greater Bristol area. This assessment is maintained with the inclusion of area-wide road user charging and the exclusion of ‘Smarter Choices’.

### Improve Access to BIA

The strategy includes a number of specific measures which contribute to improving access to Bristol International Airport (BIA):

- Bristol Airport Link Road connecting BIA with both Weston-super-Mare and south Bristol, with improved onward connections via the South Bristol Ring Road and the relocated M5 J21;
- improved and expanded Flyer express bus services to BIA, with direct links from Bristol Parkway, Worle transport interchange and Bath as well as increased frequencies from central Bristol;
- improved onward connections by public transport, via the rapid transit system and improved rail services, with the possibility of extending some services on the Ashton Vale rapid transit route through to BIA; and
- demand responsive public transport services for airport employees.

In addition, general congestion relief throughout the highway network as a result of the strategy improves journey times to BIA by car. The strategy therefore has a significant impact on journey times compared with the Do Minimum, increasing the population within half an hour of BIA by car by 500,000, and increasing the population within an hour of BIA by public transport by 60,000. Further details and journey time contours are given in the section on accessibility below.

Overall the strategy is judged to have a large beneficial impact on access to BIA. This assessment is unchanged with the inclusion of area-wide road user charging or the exclusion of Smarter Choices.

### Reduce Dependence on the Car

The strategy has a considerable impact on reducing dependence on the car within the Greater Bristol area, with a step change in the frequency, coverage and quality of public transport services (see the section on accessibility below). This is reflected in a large reduction in car mode share, from 91% in the Do Minimum to 76% with the
strategy in the morning peak period and from 94% to 85% in the inter-peak period (see Table 8.14).

8.112 As well as providing improvements to public transport infrastructure, it is important to give people incentives to reduce their dependence on the car. The measures included within ‘Smarter Choices’ are a key component of the strategy – without these, even with the improved public transport services in place, the morning peak car mode share would be 80%, compared with 76% with the complete strategy. Area-wide road user charging would provide a further incentive against the use of the car and reduce the morning peak car mode share to 74%.

8.113 Overall, the impact of the strategy on changing dependence on the car is assessed as large beneficial.

Table 8.14 – Impact of Strategy on Mode Share

<table>
<thead>
<tr>
<th>Mode</th>
<th>2003 Base</th>
<th>2031 Do Minimum</th>
<th>2031 Strategy</th>
<th>2031 Strategy with RUC</th>
<th>2031 Strategy no Smarter Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Morning Peak (average hour)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car</td>
<td>88.8%</td>
<td>90.8%</td>
<td>76.2%</td>
<td>74.2%</td>
<td>79.9%</td>
</tr>
<tr>
<td>Bus</td>
<td>7.8%</td>
<td>5.7%</td>
<td>6.1%</td>
<td>7.3%</td>
<td>4.9%</td>
</tr>
<tr>
<td>Rail</td>
<td>2.5%</td>
<td>2.7%</td>
<td>3.7%</td>
<td>4.0%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Rapid Transit</td>
<td>0.0%</td>
<td>0.0%</td>
<td>9.6%</td>
<td>10.2%</td>
<td>8.7%</td>
</tr>
<tr>
<td>Park &amp; Ride</td>
<td>0.9%</td>
<td>0.9%</td>
<td>4.3%</td>
<td>4.2%</td>
<td>3.7%</td>
</tr>
<tr>
<td><strong>Inter Peak (average hour)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car</td>
<td>92.4%</td>
<td>93.8%</td>
<td>85.2%</td>
<td>84.0%</td>
<td>86.3%</td>
</tr>
<tr>
<td>Bus</td>
<td>6.2%</td>
<td>4.6%</td>
<td>5.1%</td>
<td>6.0%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Rail</td>
<td>1.2%</td>
<td>1.3%</td>
<td>1.7%</td>
<td>1.8%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Rapid Transit</td>
<td>0.0%</td>
<td>0.0%</td>
<td>7.2%</td>
<td>7.4%</td>
<td>6.9%</td>
</tr>
<tr>
<td>Park &amp; Ride</td>
<td>0.2%</td>
<td>0.2%</td>
<td>0.8%</td>
<td>0.8%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

ACCESSIBILITY

8.114 The appraisal of the strategy against the Government’s accessibility objective includes the following sub-objectives:

♦ increase option values – i.e. provide a greater choice of the means of travel;
♦ reduce severance;
♦ improve access to the transport system; and
♦ facilitate easier local, national and international travel.
Option Values

8.115 The principle underlying option values can be explained using the example of the proposed rapid transit system. Even if a particular individual living along the route of the rapid transit does not intend to use the service with any regularity, he/she may still value having the option to use the service if and when they choose. For example, a car-owner may value the ability to use the service when, for whatever reason, they cannot drive or the car is unavailable. A non-car-owning resident who generally does not travel far may value the knowledge that, should they need to reach the city centre, the facilities exist for them to do so, at acceptable cost and with a reasonable level of convenience.

8.116 The GBSTS strategy includes a number of major public transport enhancements, which would provide additional options to residents of the Greater Bristol area:

♦ the rapid transit network, covering the Bristol and Bath urban areas, and extending out to Portishead and Avonmouth;
♦ cross-Bristol rail services, giving a good level of service for journeys that were previously difficult by rail, i.e. Weston-super-Mare and Bath to the North Fringe and Yate.
♦ new park and ride sites at Lambridge, Whitchurch, Emmer Green, Hambrook and Nibley.

8.117 Table 8.15 demonstrates the increases in public transport and park and ride capacity provided by the strategy, compared with the Do Minimum situation. There is a doubling in the capacity of bus/rapid transit (measured by the number of seat-kms), largely due to the new rapid transit network. In 2031, around 160,000 Greater Bristol residents (13% of the total) would be within 250 metres of the rapid transit network. In addition, the new park and ride sites and extensions to existing sites provide a doubling in capacity compared with the existing park and ride network.

<table>
<thead>
<tr>
<th>Mode</th>
<th>% Change in Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail (increase in seat-km)</td>
<td>20%</td>
</tr>
<tr>
<td>Bus and rapid transit (increase in seat-km)</td>
<td>102%</td>
</tr>
<tr>
<td>Park and ride (parking spaces)</td>
<td>109%</td>
</tr>
</tbody>
</table>

8.118 Overall, it is considered that the GBSTS strategy will have a large beneficial impact on option values. There is no change in this assessment through the addition of area-wide road user charging or the exclusion of Smarter Choices.

Severance

8.119 The introduction of new transport infrastructure has the potential to create increased severance by the introduction of new or additional barriers to movement. The classic situation is the construction of a new road which breaks an existing travel movement (whether by walking, cycling, public transport or car) and hence creates a potential hindrance to travel. The design of the scheme can, and should, of course, include
measures which mitigate against the potential severance, through the inclusion of footbridges, underpasses and other facilities designed to accommodate existing movement patterns as far as possible.

8.120 However, it is likely that there will be some increases in severance with major transport schemes. In view of the nature of the strategic study, it is not appropriate to include the detailed design of schemes, and hence identify the measures designed to mitigate against potential severance. However, it is possible to highlight potential sources of increased severance for individual schemes:

♦ South Bristol Ring Road – potential for increased severance along the route particularly on the urban sections through Hartcliffe and Withywood where the number of crossing points may be reduced, but also in terms of access in the rural areas where it will be necessary to replicate, as far as possible, the current footpaths, bridleways, etc;

♦ relocation of M5 Junction 21 – small change to severance, probably limited to the alignment of the link between the new junction and the A370;

♦ new crossing of River Avon – on the one hand, the scheme reduces the level of severance created by the River Avon by providing a more accessible link between the two banks of the river while, on the other hand, potentially worsening severance through the sections of new construction on either side of the river, although the impact of this is likely to be small;

♦ new link between A370 and M5 Junction 20 (Nailsea Bypass) – the scheme runs along a new alignment, south of the existing B3130 and there is therefore the potential for the severance of existing local movements – although the major movements would be accommodated in the construction of replacement measures, it may not be feasible to include all current movements;

♦ new link between A370 and M5 Junction 21 (Airport Link Road) – the scheme broadly involves a new alignment with limited on-line improvements to the existing highway network and, as with similar schemes, it would be expected that major current links would be included in the design to reduce problems of severance although there may be some minor movements which cannot be accommodated and hence severance would increase;

♦ Stoke Gifford bypass – the scheme involves a combination of new alignment and improvement to existing alignments and it is likely that there will therefore be some impact on severance, although much of the development along the alignment has yet to be designed and hence the scheme can be taken into consideration from the outset;

♦ the A36 to A46 could have a negative impact on local severance in the immediate vicinity of the scheme, where it cuts existing movements, although by providing a new crossing of the River Avon to the east of Bath, there is the potential for improved connections and hence reduced severance, for travellers wishing to cross the river, for example between Bathampton and Bailbrook;

♦ measures such as Smarter Choices and road user charging which reduce overall traffic levels across the highway network will therefore reduce severance by making it easier for pedestrians, cyclists, etc to move around the network; and

♦ the rapid transit network of lines includes a number of segregated sections which could potentially sever existing movements, for example through the harbourside
area between Ashton Vale and Bristol city centre, and in the connection between M32 and Coldharbour Lane, although the impact on severance is likely to be small.

8.121 As noted above, it is difficult to assess the net impact on severance without the detailed design of the major schemes. However, on the basis that the design will include reasonable features to counter any potential increases in severance, and taking into account the positive effects of Smarter Choices and road user charging, it is estimated that the net impact would be slight adverse.

Access to Transport

8.122 The national sub-objective “Access to Transport” focuses on access to the public transport system for those with no car available.

8.123 The GBSTS strategy provides a substantial improvement in public transport provision throughout the study area, particularly in urban areas. This will significantly increase the opportunity for people to access the public transport network, and will provide the means for a much wider range of journeys to be made conveniently by public transport.

8.124 The improvements to the public transport system would have a particular impact on local travel within the Greater Bristol area, but would also improve public transport connections to mainline rail stations such as Bristol Temple Meads, Bristol Parkway and Bath Spa, which facilitates inter-regional travel. Worle Parkway will provide a more convenient hub for passengers from the south of the study area wishing to access inter-regional rail and coach services, and enhanced links to BIA will make international travel easier for those without access to a car.

8.125 The diagrams in Appendix B (Figures B.13 to B.22) show changes in morning peak journey times for trips by public transport, comparing the GBSTS strategy with the Do Minimum situation in 2031.

8.126 Table 8.16 shows the change in population within an hour of the key destinations by public transport as a result of the GBSTS strategy, compared with the Do Minimum.

Table 8.16 – Change in Population within an Hour by Public Transport

<table>
<thead>
<tr>
<th>Destination</th>
<th>Additional Population within an hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strategy</td>
</tr>
<tr>
<td>Bristol city centre</td>
<td>515,000</td>
</tr>
<tr>
<td>Bath city centre</td>
<td>56,000</td>
</tr>
<tr>
<td>Weston-super-Mare</td>
<td>53,000</td>
</tr>
<tr>
<td>Aztec West</td>
<td>61,000</td>
</tr>
<tr>
<td>Bristol International Airport</td>
<td>62,000</td>
</tr>
</tbody>
</table>
8.127 The key points that can be drawn from the analysis of public transport journey times are:

- the strategy leads to a considerable improvement in journey times to Bristol city centre. With the strategy in place, an additional 500,000 people are within an hour of the city centre, including residents of the Bristol urban area, Keynsham, Bath, Portishead, Nailsea and Yate, together with users of BIA;
- the rapid transit service to Portishead gives a vast improvement in its accessibility by public transport, reducing the total journey time to Bristol city centre from over two hours to under an hour. In addition, the improved interchange possibilities mean that journey times from Portishead to Aztec West and BIA are also improved significantly;
- the main improvements in public transport journey times to Bath are focussed on the rail and rapid transit corridors - in particular, with increased rail frequencies, there is improved accessibility to Bath from Yate and stations in North Somerset;
- from Weston-super-Mare, a much greater proportion of the Bristol urban area can be reached within an hour and a half. Areas covered by the cross-Bristol rail services, such as Bath, Yate and the North Fringe, are also more accessible from Weston-super-Mare;
- the accessibility of the Aztec West area of the North Fringe by public transport is also enhanced, with an additional 60,000 people able to reach it within an hour – there are particular improvements along the rail corridors and within the Bristol urban area;
- journey times to BIA by public transport are improved, with an additional 60,000 people being able to reach it within an hour – the most significant improvements are from south Bristol and from the Worle public transport interchange; and
- there is a marked improvement in the accessibility of south Bristol – with the strategy in place, south Bristol residents are within an hour of central Bristol, and within an hour and a half of the North Fringe and BIA.

8.128 Overall, the strategy is judged to have a large beneficial impact on access to public transport. This assessment is unchanged with the addition of area-wide road user charging or the exclusion of Smarter Choices.

Easier Local, National and International Travel

8.129 The improved opportunities for travel by public transport as a result of the GBSTS strategy are discussed in the previous section.

8.130 The local road schemes included in the strategy, particularly the South Bristol Ring Road, Second Avon Crossing and Airport Link Road, improve the accessibility of key locations for travellers by car, making local travel easier. The motorway schemes in the strategy, namely M4 widening from Junction 19 to 20, and improvements to M5 Junctions 16, 17 and 21, improve access to the South West and to the rest of the UK. The Airport Link Road improves access to BIA, facilitating international travel, while the Second Avon Crossing improves access to Bristol Port.

8.131 Furthermore, reduced congestion on the highway network, brought about by the whole package of measures included in the GBSTS strategy, cuts journey times and
improves journey time reliability, making travel easier at the local, national, and international levels.

8.132 The diagrams in Appendix B (Figures B.23 to B.32) show the changes in journey times for trips by car in the morning peak period in 2031.

8.133 Changes in the population within half an hour of the key destinations by car in the morning peak period in 2031 are shown in Table 8.17.

Table 8.17 – Change in Population within 30 Minutes by Car

<table>
<thead>
<tr>
<th>Destination</th>
<th>Additional Population within 30 mins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strategy</td>
</tr>
<tr>
<td>Bristol city centre</td>
<td>623,000</td>
</tr>
<tr>
<td>Bath city centre</td>
<td>21,000</td>
</tr>
<tr>
<td>Weston-super-Mare</td>
<td>60,000</td>
</tr>
<tr>
<td>Aztec West</td>
<td>210,000</td>
</tr>
<tr>
<td>Bristol International Airport</td>
<td>533,000</td>
</tr>
</tbody>
</table>

8.134 The results show that the GBSTS strategy makes travel by road in the Greater Bristol area considerably easier. This is due not only to the highway infrastructure improvements, but also, to a large extent, to the other elements of the strategy, such as public transport improvements and the expansion of Smarter Choices which encourage changes in mode split and hence ease congestion on the highway network.

8.135 With the strategy in place, a large part of the study area is within half an hour of Bristol city centre, the North Fringe (Aztec West) and BIA, by car. This amounts to a considerable improvement in accessibility compared with the Do Minimum, with an additional 600,000 people living within 30 minutes drive of Bristol city centre and a further 500,000 living within 30 minutes of BIA. There are also improvements in the accessibility of Weston-super-Mare and Bath.

8.136 If road user charging is added to the strategy, this has a particular impact on accessibility in Bath, increasing the population within half an hour of the centre by almost 300,000. The strategy includes several measures which reduce car travel within central Bath, including the rapid transit system, Smarter Choices, and the A36/A46 link road, but despite this, congestion levels in Bath remain high. The congestion-based road user charging scheme targets the highest levels of charge at the most congested locations, thus discouraging car travel to areas such as central Bath. With the reduction in delays this brings within Bath, a large area around the city is brought within the 30 minute catchment area.
8.137 Excluding Smarter Choices from the strategy significantly reduces the impact in tackling congestion, and there is less improvement in car journey times. In particular, the workplace travel plans included in Smarter Choices lead to a substantial reduction in congestion around workplaces in the North Fringe area, and thus excluding Smarter Choices limits the improvements in journey times to Aztec West considerably.

8.138 Overall, the strategy is assessed as having a large beneficial impact on ease of local, national and international travel. The inclusion of area-wide road user charging and the exclusion of Smarter Choices do not affect the assessment.

INTEGRATION

8.139 The consideration of the impact of the GBSTS strategy on integration within the study area concentrates on the following aspects:

♦ the effects on the integration between transport modes;
♦ the integration of the strategy with land use policy; and
♦ the integration with other government policies.

8.140 Each of these aspects is covered separately in the sections below.

Transport Interchange

8.141 The strategy contains a number of measures designed to improve the ease and quality of interchange between transport modes across the study area. Some of the specific measures include:

♦ the creation of a new multi-modal interchange at Worle, with combined activities of rail, local bus, regional bus and coach services (including airport access) with park and ride at a single site;
♦ the expansion of interchange facilities at Bristol Parkway (bus and rail) and University of the West of England (bus);
♦ increased parking facilities at Nailsea and Backwell rail station;
♦ improved passenger waiting facilities at stops including real-time passenger information, within the Showcase bus corridor measures;
♦ increased frequency on local rail services to provide ‘turn up and go’ style of operation for passengers on the local rail network;
♦ creation of a network of rapid transit services on corridors extending from central Bristol with common sections within Bristol city centre to facilitate interchange between lines;
♦ expansion of existing park and ride sites and creation of new sites to enhance integration between private car and public transport; and
♦ improved facilities for cyclists at rail stations, public transport interchanges, etc.

8.142 An additional form of integration between modes occurs through the inclusion of public transport aspects within highway schemes, for example the potential use of South Bristol Ring Road for new public transport services and the improved access to Bristol Parkway provided by Stoke Gifford bypass.
The overall impact of the package of measures would be a significant enhancement in the level of integration between modes and within public transport sub-modes.

Thus the transport strategy may be considered to be large beneficial in terms of the provision of physical interchange measures. The inclusion of area-wide road user charging in the strategy and the exclusion of Smarter Choices from the strategy would not have a significant impact on this assessment.

### Land Use Policy

The development of the GBSTS transport strategy has been closely linked with the parallel development, by the West of England Partnership, of the sub-regional spatial strategy (SRSS) for the Greater Bristol area. The level of growth to 2031 implied by the SRSS, with a 25% increase in population and 20% rise in employment, dictated that the transport strategy needed to closely reflect the location of the new developments in developing the measures in the strategy. At a number of key points within the study process, the study has taken direct account of the inter-relationship between transport and land use impacts including:

- the impact of five spatial development scenarios was tested to identify the effect of each different distribution of population and employment on the transport network;
- an initial series of generic transport measures, representing a range of potential improvements to the transport system, were tested with each of the spatial development scenarios to establish both the suitability of transport measures to accommodate the growth in demand and the impact on the transport system of developments at specific locations;
- the two preceding stages contributed to the identification, by the WoEP, of the spatial scenario (Scenario F) which formed the basis for the development of the SRSS and the GBSTS transport strategy; and
- the transport strategy which has formed the basis of the appraisal in this report was therefore linked directly with the land use in Spatial Scenario F, which was closely associated with the SRSS prepared by the WoEP.

Thus, there have been close links throughout the study between the transport elements of the GBSTS strategy and spatial development components of the SRSS.

The transport strategy took direct account of the needs of specific developments within the spatial strategy. In addition, there were significant developments within the existing urban areas across the study area, together with specific growth at BIA. The transport measures in the GBSTS strategy were designed specifically to cater for the spatial developments and the timing of the implementation programme for the transport measures was tailored to the anticipated spatial development programme. As an example, the rapid transit network was designed to serve a number of the new development sites, including Ashton Vale, Emersons Green, Whitchurch, Harry Stoke, Portishead, Keynsham and Cribbs Causeway. Other improvements to the highway network were also designed to cater for the additional demands caused by the developments, for example the South Bristol Ring Road, link road between M5 Junction 21 and South Bristol, Second Avon Crossing and Stoke Gifford Bypass.
8.148 Hence, the GBSTS strategy shows strong beneficial impacts in terms of the integration with land use developments. The inclusion of area-wide road user charging and the exclusion of Smarter Choices do not affect this assessment.

**Other Government Policies**

8.149 The sub-objective seeks to identify how the strategy affects other relevant government policies across the range of government departments.

8.150 In July 2002, the Government and the Local Government Association agreed upon a set of seven shared priorities, which were:

- raising standards across schools;
- promoting healthier communities and narrowing health inequalities;
- creating safer and stronger communities;
- transforming the local environment;
- improving the quality of life of older people and children, young people and families at risk;
- meeting local transport needs more effectively; and
- promoting the economic vitality of localities.

8.151 A number of these wider priorities are directly relevant to the contents and objectives of the transport strategy. In this context, the Department for Transport’s ‘Shared Priority Delivery Plan’ contains the following four key outcomes:

- tackling congestion;
- delivery accessibility;
- safer roads; and
- better air quality.

8.152 Further DfT policy objectives include these specific outcomes, supplemented by further related items:

- improving the quality of life; and
- reducing social exclusion.

8.153 The other elements of the strategy appraisal highlight how the combined elements of the transport strategy contribute to satisfying the outcomes.

8.154 Other government departments have related policy objectives which are relevant to the aims and contents of the transport strategy, including:

- Department for Health
  - improve access to health facilities,
  - encouraging walking and cycling
- Department for Education and Skills
  - increasing opportunities for access to education
- Department for the Environment, Food and Rural Affairs
The contents of the transport strategy and the appraisal, described elsewhere in this report, make a significant contribution to the achievement of these policies. Hence, the GBSTS strategy shows a strong beneficial impact in terms of integration with other Government policies. The inclusion of area-wide road user charging and the exclusion of Smarter Choices do not alter this assessment.

**SUMMARY**

The preceding sections have examined the impacts of the GBSTS strategy under the key headings of environment, safety, economy, accessibility and integration. At the same time, a comparison has been made with the changes to the appraisal resulting from variations to the strategy by adding area-wide road user charging and excluding ‘Smarter Choices’.

The detailed appraisals outlined in the previous sections are summarised in the Appraisal Summary Tables:

- Table 8.18 – central GBSTS transport strategy;
- Table 8.19 – GBSTS strategy with area-wide road user charging; and
- Table 8.20 – GBSTS strategy excluding ‘Smarter Choices’.

The tables highlight the key features in the appraisal of each strategy.
<table>
<thead>
<tr>
<th>GBSTS Strategy</th>
<th>Problems: congested road network with lack of high quality public transport options</th>
<th>Present Value of Costs to Public Accounts £1,103M</th>
<th>ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environment</strong></td>
<td><strong>Qualitative Impacts</strong></td>
<td><strong>Quantitative Assessment</strong></td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>Small net decrease in the number of people annoyed by noise (based on perceptible changes in noise levels). Increase in noise levels along new highway links on strategic road network. Decreases in noise spread across the study area network. The appraisal excludes the potential impacts attributable to the use of low noise surfacing and noise barriers in new schemes, which would further reduce levels of noise pollution.</td>
<td>Number of zones improving noise levels:</td>
<td>Net decrease in estimated population annoyed of 16,800.</td>
</tr>
<tr>
<td>Local Air Quality</td>
<td>Reduction in emission levels of NOx and PM10 between 2003 and 2031 through increasing use of cleaner, more efficient engines and improved fuels. Further moderate improvements achieved in 2031 for both NOx (2%) and PM10 (4%) compared with Do Minimum. Within the local air quality Management Areas, there are reductions in emissions compared with 2031 Do Minimum. For NOx reductions are 3% (Avonmouth), 7% (Bristol) and 8% (Bath) and for PM10 a 4% drop in Bath and no change in Avonmouth and Bristol. The appraisal excludes impacts attributable to possible supporting measures such as roadside emissions testing, low emission zones and the further development of low emissions technologies.</td>
<td>Total annual emissions (tonnes) – NOx:</td>
<td>Changes in:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Base (2003) – 13033</td>
<td>CO2:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do Minimum (2031) – 7150</td>
<td>-170 tonnes pa (-2.4% change)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategy (2031) – 6980</td>
<td>PM10:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Base (2003) – 416</td>
<td>-8 tonnes pa (-4.1% change)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do Minimum (2031) – 196</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategy (2031) – 158</td>
<td></td>
</tr>
<tr>
<td>Greenhouse Gases</td>
<td>A moderate (5%) reduction in CO2 emissions in 2031 making a contribution towards meeting the UK Government's obligations under the Kyoto agreement on tackling climate change. Due to growth in development between 2003 and 2031, the level of CO2 emissions increases by 33% between 2003 and 2031 Do Minimum.</td>
<td>Total annual emissions (tonnes) – CO2:</td>
<td>Changes in:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Base (2003) – 2027705</td>
<td>CO2:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do Minimum (2031) – 2954531</td>
<td>-13203 tonnes pa (-5.0% change)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strategy (2031) – 2559328</td>
<td></td>
</tr>
<tr>
<td>Landscape</td>
<td>Impacts of specific strategy measures on individual landscape designations:</td>
<td>N/A</td>
<td>Potentially large adverse impact</td>
</tr>
<tr>
<td></td>
<td>- South Bristol Ring Road – potential impacts at western and eastern ends of the route;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Airport Link Road – potentially significant impacts on landscape in the Wrington area;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- M5 Junction 17 – possible impact on local landscape designations to west of existing junction; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- A36 – A46 Link Road – potentially significant impact on AGCB.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remedial measures may need to be included within the design as schemes are developed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
</tr>
<tr>
<td>Towercage</td>
<td>Impacts of specific strategy measures on individual towercage designations:</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- South Bristol Ring Road – parts of the urban sections of the route (Shapton Ave, Hawfield Rd, Hengrove Way, Cader Rd, Link, King George's Rd, Higgnadie Grn) could have potential landscape impacts; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Stoke Gifford Bypass – potential local impacts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remedial measures may need to be included within the design as schemes are developed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heritage of Historic Resources</td>
<td>Impacts of specific strategy measures on individual heritage designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
</tr>
<tr>
<td></td>
<td>- South Bristol Ring Road – runs through Avon Conservation Area in Highbridge and Withywood area;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Airport Link Road – runs very close to Scheduled Ancient Monuments at Nye, Redhill and Fenton;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Nailsea By-pass – passes close to, but does not directly impact on, a Scheduled Ancient Monument at Wivral and listed garden of Tyntefield;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Widening of A370 – lies close to a Scheduled Ancient Monument and runs through a narrow band of Avon Conservation Area;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Improvements to M22 Junction 1 – could potentially impact on Avon Conservation Area to the north-east of the junction; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- A36 – A46 Link Road – runs close to Avon Conservation Area.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remedial measures may need to be included within the design as schemes are developed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Impacts of specific strategy measures on individual biodiversity designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
</tr>
<tr>
<td></td>
<td>- South Bristol Ring Road – runs close to small ancient woodland at western end;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Airport Link Road – skirts SSSI between Nye and Congresbury, crosses Local Nature Reserve along disused rail line between Congresbury and Winscombe, runs through ancient woodland north of Wrington;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Nailsea By-pass – skirts northern boundary of SSSI across Tickenham Moor;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Second Avon Crossing – runs close to important bird area when it crosses River Avon;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Improvements to M5 Junctions 16 &amp; 17 – close proximity to areas of ancient woodland; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- A36 – A46 Link Road – passes close to small SSSI.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remedial measures may need to be included within the design as schemes are developed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Environment</td>
<td>Impacts of specific strategy measures on individual water environment designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
</tr>
<tr>
<td></td>
<td>- South Bristol Ring Road – runs close to a number of landfill sites at western end;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Airport Link Road – crosses flood plain between Nye and Congresbury, crosses the flood plain of River Yeo to the south of Wrington, crosses Source Protection Zones near to BIA and runs close to landfill sites north of BIA;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Nailsea By-pass – runs through flood plain between Tickenham and Nailsea;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Second Avon Crossing – runs within flood plain of River Avon and at southern end near to landfill sites;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Widening of A370 – runs close to landfill sites;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Widening of M4 between Junctions 19 and 20 – lies close to landfill sites and crosses Bradley Brook.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Stoke Gifford Bypass – crosses small streams;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Improvements to M5 Junctions 16 &amp; 17 – close proximity to landfill sites near Junction 17; and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- A36 – A46 Link Road – crosses River Avon.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Remedial measures may need to be included within the design as schemes are developed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBJECTIVE</td>
<td>SUB-OBJECTIVE</td>
<td>QUALITATIVE IMPACTS</td>
<td>QUANTITATIVE ASSESSMENT</td>
</tr>
<tr>
<td>----------------------------</td>
<td>--------------------------------</td>
<td>---------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Physical Fitness</td>
<td>Promotion of walking and cycling measures and reduced car use through transfer to public transport would increase physical activity and fitness.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Journey Ambience</td>
<td>Various measures potentially reduce stress for drivers (through improved journey reliability, e.g. Variable Message signs, reduced congestion and public transport passengers (improved journey times, real-time passenger information).</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Safety</td>
<td>Transfer of traffic onto new higher standard roads reduces overall accident levels.</td>
<td>Annual weekday casualty levels: 2003 – 398 KSI 2031 (Do Minimum) – 365 2031 (Strategy) – 339</td>
<td>PVB £881M</td>
</tr>
<tr>
<td>Security</td>
<td>Improved public transport security through better facilities at stops, real-time passenger information.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Economic Public Accounts</td>
<td>Significant public sector expenditure, particularly on public transport and highway schemes.</td>
<td>Central Government PVC: £703M, Local Government PVC: £399M</td>
<td>PVC £1,103M</td>
</tr>
<tr>
<td>Transport Economic Efficiency: Consumers</td>
<td>Large travel time savings, especially for height, with smaller vehicle operating cost savings. Significant time savings for public transport operators.</td>
<td>Users PVB: £13,743M, Transport Providers PVB: £4,414M, Other PVB: £0M</td>
<td>PVB: £18,158M</td>
</tr>
<tr>
<td>Reliability</td>
<td>Additional highway capacity will reduce congestion and improve reliability. Extended use of Variable Message Signs will improve reliability on the motorway network.</td>
<td>Proportion of vehicle-kms below capacity: Base – 91% Do Minimum – 69% Strategy – 96%</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Wider Economic Impacts</td>
<td>Current and future population have improved accessibility to work particularly in south Bristol.</td>
<td></td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Accessibility Option Values</td>
<td>Significant increase in level of public transport provision through bus, rapid transit and park and ride improvements.</td>
<td>Increase in public transport capacity between Do Minimum and Strategy: Rail – 20% Bus and rapid transit – 102% Park and Ride – 109%</td>
<td>Large beneficial impact</td>
</tr>
<tr>
<td>Severance</td>
<td>Individual highway schemes will increase local severance although detailed scheme design should include mitigation measures to maintain current links.</td>
<td>N/A</td>
<td>Slight adverse impact</td>
</tr>
<tr>
<td>Access to Transport</td>
<td>Improved accessibility to main city/town centres, North Fringe and BIA for both public transport and highways.</td>
<td>Extra population within 60 mins – public transport Bristol city centre – 515,000 Bath city centre – 56,000 Weston-super-Mare – 53,000 North Fringe – 61,000 BIA – 62,000 Extra population within 30 mins – highways Bristol city centre – 63,000 Bath city centre – 21,000 Weston-super-Mare – 60,000 North Fringe – 210,000 BIA – 533,000</td>
<td>Large beneficial impact</td>
</tr>
<tr>
<td>Accessibility for the Disabled</td>
<td>Introduction of new vehicles on bus, rapid transit and rail services with low floor access and designated areas for disabled.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Integration</td>
<td>Improved interchange through developments including expansion of interchanges (at Wrake, Bristol Parkway and UWE), enhanced network of rapid transit and rail services, increased provision of park and ride, improved real-time information for passengers.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Land-Use Policy</td>
<td>Spatial development policies have been key input to strategy development process. Close liaison with West of England Partnership in preparation of Sub-Regional Spatial Strategy.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Other Government Policies</td>
<td>Strategy uses other Government policies (e.g. sustainability and social inclusion) through improvements to public transport services and changes in mode split.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
</tbody>
</table>
**GBSTS Strategy with Road User Charging**

### Objective

**Environmental**
- **Objective**: Efficiency: Transport Economic Providers
  - **Sub-objective**: Reducing emissions of NOx and PM10 between 2003 and 2031 through increasing use of cleaner, more efficient engines and improved fuels. Further moderate improvements achieved in 2031 by the strategy with RUC. For both NOx and PM10, 8% compared with Do Minimum.

**Sub-objective**: Greenhouse Gases
- A moderate (8%) reduction in CO2 emissions in 2031 making a contribution towards meeting the UK Government’s obligations under the Kyoto agreement on tackling climate change.

### Impacts

#### Water Environment Impacts
- **Impacts**: Total annual emissions (tonnes) – NOx:
  - Base (2003) – 13033
  - Do Minimum (2031) – 7155
  - Strategy with RUC (2031) – 6874
  - Changes in NOx: -276 tonnes pa (-3.9% change)

- **Impacts**: Total annual emissions (tonnes) – PM10:
  - Do Minimum (2031) – 196
  - Strategy with RUC (2031) – 164
  - Changes in PM10: -12 tonnes pa (-6.1% change)

#### Landscape Impacts
- **Impacts**: Total annual emissions (tonnes) – CO2:
  - Base (2003) – 2027705
  - Do Minimum (2031) – 2694351
  - Strategy with RUC (2031) – 2479879
  - Changes in CO2: -214552 tonnes pa (-8.0% change)

#### Heritage of Historic Resources Impacts
- **Impacts**: Greenhouse Gases
  - N/A

#### Biodiversity Impacts
- **Impacts**: Water Environment
  - N/A

#### Physical Fitness Impacts
- **Impacts**: Safety
  - N/A

#### Journey Ambiance Impacts
- **Impacts**: Safety
  - N/A

#### Security Impacts
- **Impacts**: Economy
  - N/A

#### Reliability Impacts
- **Impacts**: Economy
  - N/A

#### Wider Economic Impacts
- **Impacts**: GBSTS Strategy with Road User Charging
  - N/A

### Key Figures

#### Emissions Reductions
- **Total annual emissions (tonnes) – NOx**:
  - Base (2003) – 13033
  - Do Minimum (2031) – 7155
  - Strategy with RUC (2031) – 6874
  - Changes in NOx: -276 tonnes pa (-3.9% change)

- **Total annual emissions (tonnes) – PM10**:
  - Do Minimum (2031) – 196
  - Strategy with RUC (2031) – 164
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  - Strategy with RUC (2031) – 2479879
  - Changes in CO2: -214552 tonnes pa (-8.0% change)
<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>SUB-OBJECTIVE</th>
<th>QUALITATIVE IMPACTS</th>
<th>QUANTITATIVE ASSESSMENT</th>
<th>Present Value of Costs to Public Accounts £10.341M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>Option Values</td>
<td>Significant increase in level of public transport provision through bus, rapid transit park and ride and rail improvements.</td>
<td>Increase in public transport capacity between Do Minimum and Strategy: Rail – 20%, Bus and rapid transit – 102%, Park and Ride – 109%.</td>
<td>Large beneficial impact</td>
</tr>
<tr>
<td>Severance</td>
<td>Individual highway schemes will increase local severance although detailed scheme design should include mitigation measures to maintain current links.</td>
<td>N/A</td>
<td>Slight adverse impact</td>
<td></td>
</tr>
<tr>
<td>Access to Transport</td>
<td>Improved accessibility to main city/town centres, North Fringe and BIA for both public transport and highways.</td>
<td>Extra population within 60 mins – public transport Bristol city centre – 524,000 Bath city centre – 58,000 Weston-super-Mare – 53,000 North Fringe – 73,000 BIA – 73,000 Extra population within 30 mins – highways Bristol city centre – 653,000 Bath city centre – 712,000 Weston-super-Mare – 74,000 North Fringe – 296,000 BIA – 659,000</td>
<td>Large beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Accessibility for the Disabled</td>
<td>Introduction of new vehicles on bus, rapid transit and rail services with low floor access and designated areas for disabled.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td>Transport Interchange</td>
<td>Improved interchange through developments including expansion of interchanges (at Wrax, Bristol Parkway and UWE), enhanced network of rapid transit and rail services, increased provision of park and ride, improved real-time information for passengers.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Land-Use Policy</td>
<td>Spatial development forecasts have been key input to strategy development process. Close liaison with West of England Partnership in preparation of Sub-Regional Spatial Strategy.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Other Government Policies</td>
<td>Strategy assists other Government policies (e.g. sustainability and social inclusion) through improvements to public transport services and changes in mode split.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
</tbody>
</table>
Table 8.20 – Appraisal Summary Table for GBSTS Strategy without Smarter Choices

<table>
<thead>
<tr>
<th>Environment</th>
<th>Objective</th>
<th>Sub-Objective</th>
<th>Qualitative Impacts</th>
<th>Present Value of Costs to Public Accounts £750M</th>
<th>Quantitative Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>GBSTS Strategy without Smarter Choices</td>
<td>Slight beneficial impact</td>
<td>Reduce in the number of people annoyed by perceptible change in noise levels. Increase in noise levels along new highway links on strategic road network. Decreases in noise spread across the study area network.</td>
<td>N/A</td>
<td>Potentially large adverse impact</td>
</tr>
<tr>
<td>Landscape</td>
<td>Impacts of specific strategy measures on individual landscape designations:</td>
<td>N/A</td>
<td>Various measures potentially reduce stress for drivers (through improved journey reliability, e.g. Variable Efficient: Business)</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Heritage of Historic Resources</td>
<td>Impacts of specific strategy measures on individual heritage designations:</td>
<td>N/A</td>
<td>A36 – A46 Link Road – runs close to Avon Conservation Area.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Impacts of specific strategy measures on individual biodiversity designations:</td>
<td>N/A</td>
<td>- A36 – A46 Link Road – runs close to small ancient woodland at eastern end; and</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Water Environment</td>
<td>Impacts of specific strategy measures on individual water environment designations:</td>
<td>N/A</td>
<td>- Airport Link Road – runs close to landfill sites</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Physical Fitness</td>
<td>Promotion of walking and cycling measures and reduced car use through transfer to public transport would increase physical activity and fitness</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Journey Ambience</td>
<td>Various measures potentially reduce areas for drivers (through improved journey reliability, e.g. Variable Message signs, reduced congestion) and public transport passengers (improved journey times, real-time passenger information)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Wider Economic Impacts</td>
<td>Current and future population have improved accessibility to work, particularly in south Bristol.</td>
<td>N/A</td>
<td>Present Value of Costs to Public Accounts £750M</td>
<td>Present Value of Costs to Public Accounts £750M</td>
<td>Present Value of Costs to Public Accounts £750M</td>
</tr>
</tbody>
</table>
## GBSTS Strategy without Smarter Choices

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>SUB-OBJECTIVE</th>
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<th>QUANTITATIVE ASSESSMENT</th>
<th>Present Value of Costs to Public Accounts (£750M)</th>
</tr>
</thead>
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<tr>
<td>Access to Transport</td>
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<td>Extra population within 60 mins – public transport: Bristol city centre – 476,000 Bath city centre – 58,000 Weston-super-Mare – 50,000 North Fringe – 52,000 BIA – 62,000 Extra population within 30 mins – highways: Bristol city centre – 587,000 Bath city centre – 9,000 Weston-super-Mare – 9,200 North Fringe – 220,000 BIA – 471,000</td>
<td>Large beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Accessibility for the Disabled</td>
<td>Introduction of new vehicles on bus, rapid transit and rail services with low floor access and designated areas for disabled.</td>
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<td>N/A</td>
<td></td>
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</tr>
</tbody>
</table>
9. Funding and Next Steps

9.1 Ultimately, the greatest challenge to developing any transport strategy or scheme is the ability to pay for it. This section reviews the potential sources of funding for transport schemes in the context of the GBSTS. The transport strategy comprises a series of individual elements, with different characteristics in terms of the balance between ownership of the assets, construction or capital cost, operating cost, level of revenue and variety of benefits. At the same time, these characteristics lend themselves to different possible sources of funding.

**NEW DEVELOPMENTS AFFECTING FUNDING**

9.2 Government spending is usually categorised as ‘capital’ or ‘revenue’ expenditure, with different sources and funding rules for each. Typically, for local transport, revenue spending comes from the Block Grant from ODPM and capital spending from the Integrated Transport Block and Structural Maintenance Block of the LTP settlement. Many local authorities claim that, while there are many opportunities to obtain capital resources, they can rarely obtain sufficient revenue funding.

**Main Mechanisms for Capital Investment**

9.3 Four main mechanisms of government capital spending on transport schemes can be identified:

- programme spending by national government agencies or bodies such as Network Rail and the Highways Agency;
- the Regional Funding Allocation (with funding from central government) for schemes with an identified regional importance;
- Local Transport Plan (LTP) spending by local authorities (funded partially by central government); and
- smaller grants and locally-raised finance, primarily for smaller schemes.

9.4 The current arrangements for the financing of major local transport capital projects provide a range of options for local authorities:

- The most common are projects financed through a mixture of credit approvals and specific government grants.
- Other existing mechanisms include procurement through the Private Finance Initiative (PFI) or through specific public-private partnerships such as those established for the procurement of large light rail schemes. These involve a mix of funding sources: credit approvals and grants during the construction phase, and PFI credits to support availability payments during the operations phase.
- Funding for transport improvements can also be secured through agreements under Section 106 of the Town and Country Planning Act 1990, which provides the opportunity for authorities to facilitate transport improvements through the development process.
9.5 The process for agreeing LTPs is the main route for delivering local transport capital investment as well as driving much current expenditure. The LTP2 process is more targeted and robust than the first round and is based on four principles:

- setting transport in a wider local context, integrating it with planning for other functions, such as housing, regeneration, health and land use;
- setting locally relevant targets with identified outcome objectives;
- getting value for money by making the best use of existing infrastructure or capacity before implementing any new investment, along with robust assessments of major schemes at an early stage; and
- establishing new monitoring plans with indicators and trajectories.

9.6 The mainstream LTP2 funding (consisting of the Integrated Transport Block and the Maintenance Block) is likely to be based increasingly on a ‘formula approach’. The ‘Planning Guideline’ approach gives additional money for ‘good’ LTPs and less money for ‘poor’ LTPs. The Maintenance Block allocation for the Greater Bristol area in 2006/7 is £12.694 million, with an additional amount for Exceptional Maintenance for the A4174 of £3.950 million. For the Integrated Transport Block, the 2006/7 allocation is £11.281 million. Planning guidelines show the allocation rising to £12.765 million for the Integrated Transport Block in 2010/11.

9.7 The LTP ‘major scheme’ funding will continue to be additional to the mainstream LTP funding and is designed for schemes with an estimated cost greater than £5 million. However, the new guidance underlines that schemes will now have to be much better specified and costed at an earlier stage in development. The local authorities in the Greater Bristol area have submitted a Major Scheme Bid for £42 million for the Showcase bus services in the Greater Bristol Bus Network. A second bid for the Bath Package of transport measures is being prepared. The prioritisation of such schemes against other competing alternatives across the region is undertaken through the Regional Funding Allocation process, outlined below.

**Regional Funding Allocations**

9.8 The Regional Funding Allocations (RFA) are set out for transport, housing and economic development over a three year period with indicative amounts based on projecting forward long term planning assumptions (currently up to 2015/16). The spending included within each of these sectors is as follows:

- **Transport:**
  - LTP major scheme capital funding;
  - Highways Agency major scheme (>£5 million) funding on roads of a regional significance;
- **Housing:**
  - Regional housing pot;
  - Housing market renewal pathfinder;
- **Economic development:**
  - RDA single budget.
9.9 Total RFA for the South West region in 2005/6 is £374 million, of which transport element amounts to £84 million. This is set to rise to £455 million by 2007/8 with the transport portion up to £88 million. Although not committed, based on planning assumptions the South West RFA could reach £535 million by 2015/16 with transport accounting for £105 million of the total.

9.10 The RFA process recognises the difficulties of delivering large projects which require significant and guaranteed funding levels in certain years. Thus, to accommodate this ‘lumpiness’ in funding requirements regions are able to:
- defer expenditure from one year to a later year (but not bring it forward);
- adjust the distribution of funding between the sectors of transport, housing and economic development; and
- agree with another region a process by which the two regions together meet their allocations.

9.11 The RFA process extends to cover the funding of some schemes in the trunk road network managed by the Highways Agency. The trunk road network is divided between two main categories:
- Routes of Strategic National Importance – funded from the HA national transport budget; and
- Other National Routes – funded by the RFA.

9.12 As far as the study area is concerned, the designation of the trunk road network is:
- Routes of Strategic National Importance – M4 and M5; and
- Other National Routes – M48 east of M4 Junction 21 and M49 between M5 Junction 18 and M4 Junction 22.

9.13 The Regional Funding Allocation process will be continuously updated as the information about the content, design and performance of schemes changes as they are developed. The South West Regional Assembly undertook the initial RFA in January 2006 in which it allocated potential schemes under a number of headings covering the period to 2016 including:
- schemes already in progress or firmly planned;
- other schemes where the region concluded that there is a strong case;
- schemes which require further work and analysis; and
- schemes which may well prove to be longer term priorities but which are not sufficiently developed or focussed on top level priorities.

9.14 While no schemes within the study area have been allocated to the first category, there are a significant number of entries in the remaining categories. This highlights the work undertaken by the authorities within the Greater Bristol sub-region to bring forward schemes with sufficient merit and evidence. The individual schemes being advanced within the RFA process are outlined later in the chapter.
The Private Finance Initiative

9.15 The PFI approach allows investment to be brought forward by using private capital, through a committed stream of ‘revenue’ payments by local (and central) government. Some risk is also transferred to the private sector. Currently, the PFI approach appears to be the only method by which a major light rail project, for example, can be procured.

Section 106 Developer Contributions

9.16 Current Government policy requires fair, open and reasonable negotiation of planning obligations, so that the obligations enhance the quality of development and enable proposals to go ahead which might otherwise be refused.

9.17 New clauses in the Planning and Compulsory Purchase Act 2004 introduce an alternative means for developers to make contributions towards services and facilities without the need to negotiate with the Local Planning Authority (LPA). Those undertaking development may agree to pay to a LPA an amount set out in a document, drawn up by the LPA, as an alternative to the negotiated agreements which are currently made.

Local Authority ‘Prudential’ Borrowing

9.18 Local councils receive the bulk of their revenue funding from the government through the Formula Grant. This includes a Revenue Support Grant (RSG) based on an assessment of each council’s needs and a proportion of the National Non Domestic Rate (NNDR), collected from businesses.

9.19 From 2004/05 government support for capital investment is described as either Supported Capital Expenditure (Revenue), known as SCE(R), or Supported Capital Expenditure (Capital Grant), known as SCE(C). Supported Capital Expenditure (Revenue) is the amount of expenditure towards which revenue grant will be paid to a local authority on the costs of borrowing.

Tolls and Road User Charging

9.20 The Transport Act 2000 allows local and municipal authorities to charge road users on a limited scale. In addition, a local traffic authority can impose a levy or licence charge on road users, or for keeping vehicles on roads.

9.21 This funding method involves charging road users for the use of road space. This may be through passing a ‘cordon’ (as currently in operation in London), or based on congestion levels in operation when using the road.

9.22 One of the key political issues associated with a local charging scheme is that the transport improvements may need to be in place in advance of the charging regime. However, it is difficult for a local authority to develop and procure transport projects in advance of the introduction of a charging scheme, when the funding for those projects is dependent on the successful implementation of the charging scheme.
Workplace Parking Charges

9.23 The Transport Act 2000 also made provision for local authorities to implement workplace parking levies. The availability of convenient, free or relatively cheap parking provided by employers encourages car use, particularly for commuting, even when alternative modes are available. By imposing a charge on the level of parking attached to a development, the objective is to influence the level of car use by employees at the site. As with road user charging, the revenues received from workplace charges must be used to improve transport in the charged area.

Transport Innovation Fund

9.24 The recently introduced Transport Innovation Fund (TIF) has three key aims:

♦ to support innovative local transport packages e.g. those that combine road pricing with enhanced public transport, especially buses;
♦ to support innovative mechanisms to raise new funds; and
♦ to support schemes which are beneficial to national productivity.

9.25 A TIF bid should include demand management measures that go beyond those referred to as ‘soft measures’ or ‘Smarter Choices’ and preference would be given to bids that include road pricing over workplace parking levies, and schemes that cover a wide geographical area and/or a large population base. Although the guidance does not explicitly state as much, it is generally assumed that TIF schemes are likely to be pilot versions of a national road pricing system.

9.26 The first TIF allocations are expected in 2008/9 – nationally this is likely to amount to £290 million. The guidance indicates the fund growing to £2,550 million by 2014/15.

9.27 In addition to the general TIF allocation, a separate fund exists to ‘pump prime’ scheme developments. A separate process exists for authorities to win funds for this stage and pump priming will not be available for all successful TIF bidders. The aim of the pump priming fund is to ensure the development of packages for a range of circumstances. In November 2005, the local authorities in Greater Bristol were successful in receiving an award of £1.495 million from the TIF pump priming fund to develop their congestion charging scheme.

Land Value Taxation

9.28 The Treasury is examining the possibility of using the land value gains that can result from the development of transport infrastructure. Changing the tax base towards land could have other positive implications such as preventing unsustainable housing booms.

Local Authority Business Grant Incentive (LABGI)

9.29 This is a newly proposed funding method, based on the US system of Tax Increment Financing which has been in operation for over 20 years in America. Essentially, local authorities can carry out improvements to attract businesses, without raising taxes. Funds are derived from the growth in property tax revenues – the tax increment.
Business Improvement Districts (BIDs)

9.30 BIDs are a partnership between a local authority and the local business community to develop and take forward projects and services that benefit the trading environment and the public realm. They are designed to support the long-term sustainability of town and city centres. The BID is funded by non-domestic rate payers through a supplement to the rates bill.

Summary

9.31 There are clearly several significant developments that will shape the way transport schemes are funded in the future. However, it is likely that the bulk of investment will continue to be funded in a similar way as is done today, with some modifications.

FUNDING ROAD AND ROAD TRAFFIC SCHEMES

Road Schemes and the LTP Process

9.32 Most road schemes proposed by the study for the local strategic road network will need to be included within the Regional Funding Allocation process outlined above. Hence, for these schemes will be considered at the regional level, in competition with other schemes across the region.

Highways Agency Programme Investment

9.33 The Highways Agency (HA) has a substantial annual budget for highway maintenance and renewal. Few new roads are planned, although the programme includes road widening and junction capacity improvements. Proposed new roads will need to be included in the Regional Transport Strategy in order to be considered for HA funding and will be subject to the Regional Funding Allocation process outlined earlier.

9.34 The biggest Highways Agency road projects fall into one of the following categories:

- Targeted Programme of Improvements – major road projects costing more than £5 million;
- Country-Wide Projects – national initiatives being carried out by the Agency;
- Design, Build, Finance & Operate (DBFO) – a PFI for parts of the motorway and trunk road network. The Highways Agency pay DBFO companies an amount, which is based on the number and type of vehicles using the road, with adjustments made for lane closure and safety performance; and
- Route Management Strategies – a strategic approach to the maintenance, operation and improvement of the network, involving regional stakeholders and the public in the decision-making process (e.g. M5 between Juncions 9 and 15).

9.35 The HA expects that around 25% (by value) of current and new major schemes will be procured using PFI contracts, including DBFO. The HA is also developing new procurement approaches for maintenance so as to introduce long-term maintenance contracts on DBFO lines.
Developer Contributions

9.36 There are many examples of developer contributions being used to fund access roads to developments. However these investments are almost always relatively small-scale and directed at providing access to the particular development in question. Recently the trend has been to look for schemes integrated with public transport improvements. Proposals for changes to the assessment procedure are currently out for consultation. If the changes are implemented as proposed, they could link developments more directly to required contributions.

Toll Roads

9.37 The new M6 Toll was designed, built and is run by a private consortium. The tolls are paid by the road users and vary by the type and size of vehicle, and the time of day. Although traffic levels and toll revenues are reported to be lower than expected, the DfT has announced that it considers the scheme to be a success and is willing to support new similar schemes.

Area-Wide Road Charging Schemes

9.38 It seems likely that any area-wide charging scheme would have to be part of an integrated transport strategy that includes public transport provision. Any resources obtained through charging road users would have to be shared between road infrastructure development and public transport improvements. Use of the funds raised for any major road scheme is unlikely to fit in with the philosophy of ‘better use of existing road space’.

FUNDING HEAVY RAIL SCHEMES

Network Rail Investment Programme

9.39 Network Rail currently undertakes the following types of enhancement projects:

♦ construction or completion of committed ‘legacy’ projects;
♦ schemes arising from the Safety and Environment Plan;
♦ schemes costing less than £5 million for which there would be benefits through operational efficiency and reliability gains may be funded through the recently announced Network Rail Discretionary Fund with a total value of £400 million to 2008/9 with half contributed by DfT and half from Network Rail’s own funds;
♦ schemes sponsored by the DfT, particularly where the opportunity for the enhancement is as a result of a planned signalling renewal; and
♦ schemes sponsored and funded by other parties, principally PTEs, local authorities and train operators.

9.40 In future, most major enhancements will be delivered by third parties, either directly, or by way of a Special Purpose Vehicle company, such as is happening for the North London Line. Thus, despite being intimately involved in the national rail infrastructure, Network Rail will not be a major source for funding for local rail schemes, although it will be a necessary partner in any development.
Infrastructure Grants

9.41 Following the abolition of the SRA, infrastructure development schemes that were being developed are being taken over by Network Rail and the DfT. Most of the grants previously applicable for the development of rail schemes – such as the Rail Passenger Partnership Fund or the Freight Facility Grant – are currently not available.

Business Case and Affordability

9.42 If a project has a positive business case then it can be considered for DfT funding. All projects with positive business cases are weighed against other calls on the budgets to determine an appropriate funding allocation. However, the pressure on finance means that it will be difficult to obtain funding for any strategic schemes that are not already in the Network Rail Business Plan.

LTP Funding of Rail Schemes

9.43 With funding sources such as the Rail Passenger Partnership Fund available, the LTP process generally excluded rail enhancement projects. Since the demise of this fund, the DfT has noted that it is prepared to consider supporting rail projects within LTP2.

Community Railways

9.44 Community Rail routes may now be designated separately from the conventional and high speed rail networks, as happens elsewhere in Europe. Separate designation of Community Railways will allow a fresh approach in the way these lines are managed, marketed and supported as well as to the way they are maintained and renewed.

Local Authority Borrowing

9.45 Prudential borrowing by local authorities can be used to fund heavy rail schemes – the Mayor of London has done this to pay for the extension of the East London Line. Any borrowing will, of course, have to be underpinned by future revenue stream of some sort.

Funding Light Rail Schemes

9.46 Since 1980, seven new LRT systems have been built in England at a cost of £2.3 billion, of which more than £1 billion was contributed by central government as a Section 56 grant. Five of the seven systems were designed, constructed, operated and maintained by private sector companies. The Sheffield Supertram was built and originally run by the local PTE but later run and maintained by a private sector company. The Tyne and Wear Metro was built, and is still run, by the local PTE.

9.47 After the Nottingham LRT Section 56 grant, the ‘message’ from the Government was that further LRTs were unlikely. Subsequently, the National Audit Office produced a generally critical report on LRT development and the Secretary of State has rejected requests for funding for four LRT schemes (Manchester, South Hampshire, Leeds and Liverpool).
There are now a number of requirements that future LRT proposals will have to meet:

- no operating subsidy will be available;
- users should pay through the fare-box for all the benefits they derive and only non-user benefits can be counted in the social cost-benefit analysis;
- the cost-benefit analysis must give a high enough positive NPV – this is difficult to achieve as the principal benefits of a public transport system (e.g. time value of passengers not at work) are not included, even though they are included in assessments of new road projects;
- the project's risks must be largely transferred to the private sector;
- the maximum contribution possible to the capital cost must be obtained from the private sector;
- cautious estimating of ridership must be verified by techniques such as stated preference surveys; and
- rigorous analysis must demonstrate that there is not an alternative mode or solution which is more cost-effective (e.g. bus based).

Local Authority Borrowing

In line with heavy rail schemes outlined above, prudential borrowing can be used by local authorities to fund light rail schemes, e.g. extensions of the Docklands Light Railways.

Road Pricing and LRT

The development of an LRT scheme could be funded in part by revenue from a local road pricing scheme. However, road pricing is politically more palatable after improvements have been made to public transport. This implies that the capital costs of the LRT would have to be borne initially by a PPP private-sector partner. The current approach to LRT funding would still apply, although a proportion of the 'PFI credit' payments to the PPP would come from road pricing.

The Transport Innovation Fund aims to support and encourage strategies to tackle congestion in towns and cities. These particularly include linking demand management techniques such as road pricing with enhanced public transport. The emphasis is, however, on bus based public transport schemes.

Pre-LRT Schemes

Given the high cost of implementing rail-based LRT, and the current uncertainty for the private sector, it may be appropriate to consider a staged approach, introducing a bus-based scheme initially. This could then be up-graded to a rail-based LRT if the scheme is successful in attracting patronage.
FUNDING BUS SCHEMES

The LTP Process

9.53 Since deregulation, few local authorities operate bus services directly and they must issue tenders for any subsidised services that they wish to provide. Nevertheless, they can propose a wide range of measures that will make bus operations more effective and user-friendly, including bus lanes, junction signal priorities, improved bus stops, publicity etc.

Quality Bus Partnerships

9.54 Apart from funding bus services considered socially necessary, the main mechanism for implementing bus schemes has been the Quality Bus Partnership (QBP) (or similar approaches such as the Bus Showcase) where investment by the local authority in infrastructure is combined with investment by a bus operator in vehicles or other enhancements.

9.55 The DfT provides funding to English local authorities for bus priority measures such as quality bus corridors. Funding provided in 2003–04 was forecast to deliver over 1,300 kilometres of improved bus routes.

DfT Grants

9.56 The TIF is now available to authorities pursuing innovative schemes to link demand management with enhanced public transport. The emphasis is on bus based public transport enhancements indicating that this new source of finance is particularly appropriate to funding bus schemes.

9.57 Over the last few years, the DfT has arranged ‘Challenge’ funding for rural and urban bus schemes, although these funds have now been closed.

9.58 Improvements to bus services often have a significant ‘revenue’ component, for which a contribution may be available from Bus Services Operators Grant or Rural Bus Subsidy Grant.

Section 106 developer contributions

9.59 The changes affecting Section 106 contributions are described earlier in this chapter. With more attention being directed at ensuring that new developments have adequate public transport provision, the flexibility of bus transport allows cost-effective connection of new developments to the local public transport network.

EU Funding

9.60 EU funding is available for the implementation of new technology in public transport, in particular the use of environmentally-friendly fuels and new vehicle technology. However, these are usually only for ‘demonstration’ pilot projects, rather than regular, ‘mainstream’ funding.
The Countryside Agency

9.61 The Countryside Agency has in the past offered a ‘Parish Transport Grant’ and a ‘Rural Transport Partnership Fund’. However, both of the funds are currently over-committed and the Agency appears to prefer ‘mainstream’ funding of bus schemes.

FUNDING OF OTHER SCHEMES

Cycling

9.62 The main source of funds for enhancements to the cycling environment is the LTP.

9.63 In the 1999 budget the Government introduced a package of seven tax measures to encourage employers to establish green transport plans and help employees travel to work without using their own cars. There is now no tax on workplace parking for bicycles, or bicycles and cycling safety equipment made available for employees to travel between home and work.

9.64 Employers are also able to pay their employees up to 20p per mile tax free for using their own cycles on business travel, and employees are able to claim tax relief on 12p per business mile if their employer pays less than 12p.

Walking

9.65 Improvements to facilities for walking usually form part of road development and other urban regeneration schemes. The usual funding source is through the LTP process. Other potential sources of funding include urban regeneration programmes, contributions from developers and congestion charging and the workplace parking levy.

Travel Plans

9.66 The cost of developing travel plans can be shared with other organisations and businesses. Local bus companies may be willing to provide support and incentives in the form of discounted travel.

School Travel Plans (STPs)

9.67 DfES will give a grant to an English state school that implements a STP to help fund measures such as cycle parking, lockers, and bus bays. Details are available from local authority school travel advisers.

9.68 Other sources of finance possible for promoting STP initiatives are:

- ‘Safe and Sound’ – a challenge scheme open to all schools in England which submit proposals for increasing the number of children who walk or cycle to school;
- sponsorship from local business; and
- National Lottery Grants – support of transport initiatives is recognised as an application criterion.
Intelligent Transport Systems & Travel Information

9.69 Such schemes are usually financed through the LTP. EU research funding is also possible for innovative schemes, for example, the VIVALDI Programme.

Park & Ride

9.70 The main source of funding for Park & Ride schemes is likely to remain the LTP process. Partnership is possible with local bus companies to introduce bus corridor improvements as well as improvements in vehicle quality.

SUMMARY OF SOURCES OF FUNDING

9.71 The main sources of finance are:

♦ programme investment by the main transport agencies (e.g. Highways Agency, Network Rail);
♦ the LTP process and Regional Funding Allocation;
♦ Section 106 Developer Contributions; and
♦ new sources of funding, such as local authority borrowing, area-wide road charging, and the Transport Innovation Fund.

PROGRAMME AND FUNDING OF THE GBSTS STRATEGY

9.72 In this section, we bring together the cost estimates for the individual elements of the strategy outlined with the preceding sections of the report and present an indicative profile of implementation and expenditure over the period to 2031.

9.73 Figure 9.1 presents an indicative timetable for the implementation of schemes through to 2031. The timing of schemes takes into account a number of factors including the time and resources necessary to develop, design and implement the scheme; the likely duration of the planning and approval process, including statutory consultation procedures; the funding process. The timetable shown in Figure 9.1 will evolve and develop as the contents of the strategy are developed.

9.74 Figure 9.2 summarises the anticipated costs for the components of the central GBSTS strategy, i.e. including Smarter Choices but excluding the area-wide road user charging and the associated costs and revenues. The projected expenditure of £1155 million, spread over the likely 25 year implementation programme, represents an annual expenditure of about £46 million. This compares with the current Integrated Transport Block received by the unitary authorities in 2006/7 of around £11.3 million.

9.75 Finally, Figure 9.3 summarises the possible profile of expenditure over the 25 year period to 2031. As it currently stands there are some significant variations between peaks and troughs in the profile and further work will be required to adjust the profile to smooth out the annual expenditure.
WHAT HAPPENS NEXT

9.76 The recommendations from the study outlined in this report will be presented to the partner group comprising officers from the following organisations:

♦ Department for Transport (DfT)/Government Office for the South West (GOSW);
♦ South West Regional Development Agency (SWRDA);
♦ Highways Agency (HA);
♦ Bath & North East Somerset Council (B&NES);
♦ Bristol City Council (BCC);
♦ North Somerset Council (NSC); and
♦ South Gloucestershire Council (SGC).

9.77 Having reviewed the outcomes from the study, the officers will develop recommendations on which schemes and measures should be taken forward by their organisations, identifying a potential timetable for implementation.

9.78 The Secretary of State for Transport and elected members of the unitary authorities will then consider which schemes and measures should be taken forward. Once decisions have been made, further work will be undertaken on the schemes and measures to enable them to be entered into the appropriate programmes of the Department for Transport, the Highways Agency and the unitary authorities. The schemes and measures will then be subject to the normal statutory planning processes.

9.79 The Secretary of State for Transport has asked the South West region to advise him on its priorities for transport investment in the next ten years or so. The recommendations from GBSTS will assist the region to understand the benefits of the schemes and measures, in terms of supporting future prosperity in Greater Bristol by investing in transport, compared with other areas in the South West. The advice to the Secretary of State will be based on evidence from GBSTS.

9.80 The study has been progressed in an open and consultative manner and the possible options have been discussed publicly. Many of the proposals are at a very early stage in the planning process and, if the recommendations are accepted, considerable further work will be required to prepare and consult on detailed designs for the schemes, including specific route alignments.
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</table>

**Key**

- **Planning**: Unknown
- **Capital Cost Expenditure**: Unknown
- **Revenue Cost Expenditure**: Unknown
Figure 9.2 – GBSTS Final Strategy Costs

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Description</th>
<th>Estimated Capital Cost (£M)</th>
<th>Estimated Revenue Cost p.a. (£M)</th>
<th>Notes</th>
</tr>
</thead>
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<tr>
<td>Smarter Choices</td>
<td>Smarter Choices - Workplace Travel Plans</td>
<td>0.0</td>
<td>0.8</td>
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<tr>
<td>Smarter Choices</td>
<td>Smarter Choices - School Travel Plans</td>
<td>0.0</td>
<td>0.6</td>
<td>Estimated cost p.a. by 2031</td>
</tr>
<tr>
<td>Public Transport</td>
<td>Showcase Bus Corridors</td>
<td>56.5</td>
<td>0.4</td>
<td>75% of bus operating costs assumed to be covered by revenue</td>
</tr>
<tr>
<td></td>
<td>Improved interchange facilities at UWE</td>
<td>0.5</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Express inter-urban buses (including Worle and Bath to BIA)</td>
<td>0.0</td>
<td>1.0</td>
<td>60% of bus operating costs assumed to be covered by revenue</td>
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<tr>
<td></td>
<td>Extending Airport Flyer service to North Fringe</td>
<td>0.0</td>
<td>0.0</td>
<td>100% of operating costs assumed to be covered by revenue</td>
</tr>
<tr>
<td></td>
<td>Park and Ride site extensions</td>
<td>20.3</td>
<td>0.2</td>
<td>Includes new park-and-ride bus service to Bristol Parkway extension</td>
</tr>
<tr>
<td></td>
<td>Bath Package (including new Lambridge P&amp;R site, Bath Rapid Transit, P&amp;R site extensions at Newbridge, Lansdown and Odd Down)</td>
<td>47.5</td>
<td>0.2</td>
<td>75% of park and ride bus operating costs assumed to be covered by revenue</td>
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<td></td>
<td>New Park and Ride sites</td>
<td>23.0</td>
<td>0.5</td>
<td>75% of park and ride bus operating costs assumed to be covered by revenue</td>
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<tr>
<td></td>
<td>Worle public transport interchange</td>
<td>12.6</td>
<td>0.0</td>
<td>Includes car park extension, lengthening platforms</td>
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<tr>
<td></td>
<td>Rapid Transit - Henrove to North Fringe</td>
<td>55.4</td>
<td>0.0</td>
<td>100% of operating costs assumed to be covered by revenue</td>
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<tr>
<td></td>
<td>Rapid Transit - Ashton Vale to Emersons Green</td>
<td>25.5</td>
<td>0.0</td>
<td>100% of operating costs assumed to be covered by revenue</td>
</tr>
<tr>
<td></td>
<td>Rapid Transit - Whitchurch to Avonmouth/Portishead</td>
<td>30.2</td>
<td>0.0</td>
<td>100% of operating costs assumed to be covered by revenue</td>
</tr>
<tr>
<td></td>
<td>Rapid Transit Newbridge to Cribbs Causeway</td>
<td>41.0</td>
<td>0.0</td>
<td>100% of operating costs assumed to be covered by revenue</td>
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<tr>
<td></td>
<td>Rail infrastructure improvements</td>
<td>20.2</td>
<td>0.0</td>
<td>Includes turn-back at Yate, extra platforms at Weston-super-mare and Bristol Parkway</td>
</tr>
<tr>
<td></td>
<td>Train lengthening</td>
<td>0.0</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Highway</td>
<td>Cross-Bristol rail services</td>
<td>0.0</td>
<td>5.0</td>
<td>67% of rail operating costs assumed to be covered by revenue</td>
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<tr>
<td></td>
<td>A38-A370 Red Route</td>
<td>15.6</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A38-A370 Orange Route</td>
<td>13.4</td>
<td>0.0</td>
<td>Associated with BIA link road scheme</td>
</tr>
<tr>
<td></td>
<td>South Bristol Ring Road Hicks Gate to Whitchurch section</td>
<td>64.0</td>
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<tr>
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<td></td>
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<tr>
<td></td>
<td>South Bristol Ring Road Henrove to A38 section</td>
<td>21.9</td>
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<td></td>
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<tr>
<td></td>
<td>M5 J21 Junction Relocation</td>
<td>62.5</td>
<td>0.0</td>
<td>Includes cost of associated road improvements on A370 PDR and B3440</td>
</tr>
<tr>
<td></td>
<td>Second Avon Crossing</td>
<td>141.7</td>
<td>0.0</td>
<td>Includes cost of associated M5 J19 improvements</td>
</tr>
<tr>
<td></td>
<td>BIA Link road</td>
<td>75.0</td>
<td>0.0</td>
<td></td>
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<tr>
<td></td>
<td>A36-A46 Link Road</td>
<td>46.2</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stoke Gifford Bypass</td>
<td>43.1</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M5 Junction improvements J16-17</td>
<td>91.3</td>
<td>0.0</td>
<td></td>
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<td></td>
<td>M52 J1 improvements</td>
<td>10.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M4 J20 - J19 Widening</td>
<td>55.3</td>
<td>0.0</td>
<td></td>
</tr>
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<td></td>
<td>Junction improvements on A4174 ARR</td>
<td>10.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long Ashton bypass widening (A370)</td>
<td>45.9</td>
<td>0.0</td>
<td>Associated with BIA link road scheme</td>
</tr>
<tr>
<td></td>
<td>A38 Widening</td>
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<td>0.0</td>
<td>Associated with BIA link road scheme</td>
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<tr>
<td></td>
<td>Avon and Somerset Tactical Information System</td>
<td>50.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wiltshire Information and Signal Enhancement</td>
<td>7.5</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>1155.7</td>
<td>15.7</td>
<td></td>
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Figure 9.3 – GBSTS Emerging Cost Profile

- Privately Funded Scheme
- Rail Scheme
- Highways Agency (national scheme)
- LTP Transport Innovation Fund
- LTP Schemes*
- LTP Major Scheme Bids
# Greater Bristol Strategic Transport Study

Report on Consultation: Strategy Options Draft

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<th>DOC REF: GBSTS Phase B Consultation Report - first draft - final on web.doc</th>
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| Revision | Purpose Description |
|----------|---------------------|---|---|---|---|---|

*ATKINS*
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<td>5-1</td>
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<tr>
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1. Introduction

BACKGROUND

1.1 The Government Office for the South West (GOSW) has commissioned Atkins to undertake the Greater Bristol Strategic Transport Study (GBSTS) to address the current and future transport needs of the Greater Bristol area. The study will develop recommendations for a range of practical measures aimed at addressing transport problems and realising Greater Bristol's potential for economic growth. The output from the study is likely to have a significant impact on local planning and transport strategies in the area.

1.2 In common with other major population centres in the United Kingdom, Greater Bristol has experienced notable levels of economic growth over a number of years. Growth has brought with it rising levels of congestion on the main transport networks and across the urban areas which in turn has led to the need for this strategic transport study.

1.3 The study area is principally Bristol's journey to work catchment area, and includes Bath, Weston-super-Mare, Trowbridge and Chippenham. It includes the major routes within the area bounded by:

- Junction 14 on the M5 to the north;
- Junction 18 on the M4 to the east;
- The Second Severn Crossing and the Severn Bridge to the west including the M49, M48 and A4 trunk road in the Avonmouth area;
- M5 Junction 22 and Midsomer Norton on the A37 to the south; and
- Beckington on the A36 to the south east.

1.4 Since strategic movements on the motorway and rail networks that pass through the Greater Bristol area are a major issue, the study is also taking into account the attributes of trips that start and end outside the journey to work catchment area. Figure 1.1 shows the study area.

1.5 The study follows from the earlier South West Area Multi Modal Study (SWARMMS) which, because of its wide coverage, was unable to examine the Greater Bristol area in adequate detail. GBSTS follows from SWARMMS but is not constrained by its conclusions and recommendations.

1.6 The study is being guided by the government guidelines on improving transport, as detailed below:

- "integration - ensuring that all decisions are taken in the context of the integrated transport policy
- safety - to improve safety for all transport users
- economy - supporting sustainable economic activity in appropriate locations and getting good value for money
AIMS AND OBJECTIVES

1.7 The primary objectives of GBSTS are:

- To investigate the potential for transferring to local transport means, trips that start or end within the study area and use national strategic routes;
- Having identified the potential for change, to look into the more detailed needs of the national and local strategic networks to deal with residual problems on these routes; and
- To support, validate and inform the development of the Regional Transport Strategy and future development scenarios.

1.8 The overall aims of the study are to:

- Develop a series of integrated, multi-modal transport strategies over time for the study area identifying, analysing and appraising solutions to problems on the national strategic transport networks, on the local strategic transport networks and at the interface between them, so as to improve strategic transport movements into, out of and through the study area;
♦ Develop transport strategies that support existing economic activity, continue sustainable development and assist economic regeneration of urban areas and the wider process of urban renewal within the study area; and
♦ Reduce the impact of transport on the environment.

**CONSULTATION**

1.9 A range of consultation methods have been used to ensure that both local and strategic interests are fairly represented. The overall consultation process comprises the following stages:
♦ Problems and Issues;
♦ Strategy Options; and
♦ Draft Recommendations.

1.10 During the summer of 2004, consultation was undertaken with a wide range of stakeholders with interests in the area (the “Wider Reference Group”) and members of the public to understand their views on the problems and issues associated with the existing transport systems in the area. The detailed findings from this process are presented in the Report on Problems and Issues Consultation.

1.11 Following the process of consultation with the Wider Reference Group and general public on problems and issues, a further “interim” phase of consultation took place with the steering group for the study. This examined the issues in formulating potential transport strategies, a process which led to the definition of the strategy options.

1.12 The process of consultation on strategy options took place between November 2004 and January 2005, and this report sets out the findings from this process.

**WHAT ELSE IS HAPPENING?**

1.13 At the same time as GBSTS, the four local authorities are in the process of developing the new Joint Local Transport Plan (LTP) for Greater Bristol.

1.14 In addition, the West of England Partnership is drawing up a new strategy to guide future development in and around Bristol, Bath, Weston-super-Mare and their surrounding towns, villages and countryside.

1.15 The responses to the GBSTS and the West of England Partnership consultations will be brought together in developing an integrated transport and land use strategy for the area.

**STRUCTURE OF THIS REPORT**

1.16 Following this introductory chapter, Chapter 2 sets out the methodology adopted during this phase of consultation. The remainder of the report presents the results of the consultation under the following themes:
1.17 In each of the above chapters, the range of opinions expressed by each group of consultees is discussed. The concluding chapter sets out how the views of stakeholders and the general public should be taken into account in developing the preferred transport strategy for the Greater Bristol area.
2. Methodology

OBJECTIVE OF THE CONSULTATION PROCESS

2.1 The main purpose of this phase of consultation was to present key stakeholders and members of the public with the characteristics and impacts of three very distinct transport strategies, in order to raise awareness of the challenges faced, and to promote debate about the potential roles of different policy measures in catering for the future travel needs of the Greater Bristol sub-region. It was also designed to raise the profile of the study and to ensure the continued engagement of both stakeholders and the general public.

APPROACH TO CONSULTATION

2.2 The approach used towards consulting the different groups is set out below.

Wider Reference Group

2.3 A combined stakeholder event, to consider both the options for transport and the long-term spatial strategy, was jointly organised by the GBSTS team and the West of England Partnership. The event took place in Bristol on 8th December 2004, and benefited from the attendance of stakeholders with interests in the development of the long-term vision for the sub-region, its spatial strategy and the transport strategy being developed through GBSTS. This gave stakeholders the opportunity to consider the long-term future of Greater Bristol in an integrated way, ensuring that transport issues were taken into account in debating how development should be promoted in the sub-region. Furthermore, the event raised the profile of GBSTS, and the importance of the long-term transport strategy, to a very wide range of stakeholders in the sub-region.

2.4 In total, there were 152 attendees comprising:

♦ Local Authorities (the four unitary authorities and adjacent counties);
♦ Government Agencies;
♦ The Business Community;
♦ Environment & Sustainability groupings;
♦ Education providers;
♦ The voluntary sector; and
♦ Transport providers (rail, bus, coach, airport).

2.5 The event comprised a series of presentations, on both the spatial strategy and GBSTS, followed by facilitated discussions, and an opportunity to circulate around a series of display boards, which provided various sources of contextual information. Display boards were presented by:

♦ GBSTS;
♦ The spatial strategy (by the West of England Partnership);
♦ The Joint Local Transport Plan;
♦ GOSW;
♦ Bristol City Council;
♦ South Gloucestershire Council;
♦ North Somerset Council; and
♦ The Forest of Avon.

2.6 Stakeholders were divided into 14 groups and each group was asked to address a key question. These were drawn from the WOEP’s vision for the area: “Directions for Change” and GBSTS. The aim was not just to answer the question, but also to consider how members of the group might enable others to consider the question during the period of public consultation. The feedback from these discussions will be presented in the subsequent chapters.

General Public

2.7 Atkins worked with the Government News Network (GNN) to publicise the study to members of the public. A media briefing took place on 24th November 2004, at which consultation was launched for both GBSTS and the spatial strategy. This resulted in extensive coverage in both the local and regional print and broadcast media. Three-minute features were included in the evening news bulletins on ITV West and BBC Points West, and major features were included in the Bristol Evening Post and Western Daily Press.

2.8 Our approach was to place leaflets (simultaneously, for both GBSTS and the spatial strategy) in public places across the sub-region, including council offices, community centres, libraries and leisure centres. The media articles provided information on how to obtain copies of the leaflets, and also gave contact details of the study team and the address of the GBSTS website, www.gbsts.com.

2.9 In order to reach as wide an audience as possible, the website (www.gbsts.com) incorporated copies of the leaflet and an interactive questionnaire. Copies of reports were also made available online.

2.10 A copy of the leaflet is attached in Appendix A.

Survey

2.11 A questionnaire was devised allowing members of the public to provide input to the study. The questionnaire was designed to establish the opinions of respondents on various themes being proposed that could be taken forward for further development. This was useful in assisting to build understanding of public attitudes in comparison to the discussions held with key stakeholders. The comments received will assist in the development of the preferred transport strategy for the sub-region.

2.12 Copies of the questionnaire were available via both the leaflet and the website. In total, we received 621 replies: 357 via the leaflet (57%) and 264 via the web (43%).
### Characteristics of Survey Respondents

2.13 Although a variety of mechanisms have been used to engage with the public, it must be noted that the very nature of self-completion surveys encourages self-selection and a disproportionate number of responses are usually received from specific groups, for example older people or from those with an interest in a particular issue. Responses are more likely to come from people who wish to raise a particular issue than those who do not. It is therefore important to analyse the demographic characteristics of those people who did respond to the survey.

#### Gender

2.14 The tables below illustrate the characteristics of all respondents. It is interesting to note that over two thirds of respondents (71%) were male (self completion surveys usually attract a greater proportion of female respondents).

**Table 2.1 – Gender of Survey Respondents**

<table>
<thead>
<tr>
<th>Survey</th>
<th>Male Frequency</th>
<th>Male %</th>
<th>Female Frequency</th>
<th>Female %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web</td>
<td>176</td>
<td>67</td>
<td>85</td>
<td>33</td>
</tr>
<tr>
<td>Postal</td>
<td>254</td>
<td>74</td>
<td>89</td>
<td>26</td>
</tr>
<tr>
<td>Total (All respondents)</td>
<td>430</td>
<td>71</td>
<td>174</td>
<td>29</td>
</tr>
</tbody>
</table>

*Base: all respondents who gave their gender (604)*

2.15 Just over two thirds of respondents to the postal survey were male (74% of responses compared to 26% from females). The web survey attracted a slightly lower proportion of males to females (67% compared to 33%).

2.16 This demonstrates that there was strong bias in the survey towards responses from males: Table 2.2 illustrates the balance of genders (according to the 2001 Census) for the four Unitary Authorities in the study area.

**Table 2.2 – Gender (2001 Census Data)**

<table>
<thead>
<tr>
<th>District</th>
<th>Total Population</th>
<th>Male %</th>
<th>Female %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol</td>
<td>380615</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>Bath &amp; NE Somerset</td>
<td>169040</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>North Somerset</td>
<td>188564</td>
<td>49</td>
<td>51</td>
</tr>
<tr>
<td>South Gloucestershire</td>
<td>245641</td>
<td>49</td>
<td>51</td>
</tr>
</tbody>
</table>

2.17 The disproportionately high level of response from males (in comparison with the general population) may be attributed to a number of factors, including variations in the level of interest in transport issues, differences in the use of the internet and,
possibly, the male acting as “head of household” in completing the questionnaire on behalf of the whole household.

2.18 Typically for a self completion survey, few responses were received from younger people, as shown in Table 2.3 below. Overall, 1% of responses came from people aged under 16 (with three responses). Respondents aged 16-34 represented a further 18% of total responses. Two fifths of responses were received from persons aged 35-54. The remaining 42% of respondents were aged over 55.

Table 2.3 – Age of Survey Respondents

<table>
<thead>
<tr>
<th>Survey</th>
<th>Age Under 16</th>
<th>Age 16-34</th>
<th>Age 35-54</th>
<th>Age 55-64</th>
<th>Age 65+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>Web</td>
<td>0</td>
<td>0</td>
<td>80</td>
<td>32</td>
<td>114</td>
</tr>
<tr>
<td>Postal</td>
<td>3</td>
<td>1</td>
<td>25</td>
<td>7</td>
<td>126</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>1</td>
<td>105</td>
<td>18</td>
<td>240</td>
</tr>
</tbody>
</table>

Table 2.3 – Age of Survey Respondents

Base: all respondents who gave their age (597)

2.19 The higher level of responses from younger people in the web survey confirms the need for different consultation methods and media engagement.

2.20 Table 2.4 illustrates the distribution of population between age groups (according to the 2001 Census) for the four Unitary Authorities in the study area.

Table 2.4 – Age (2001 Census Data)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Under 16</th>
<th>16 to 19</th>
<th>20 to 29</th>
<th>30 to 59</th>
<th>60 to 74</th>
<th>75 &amp; over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol</td>
<td>19.1</td>
<td>5.4</td>
<td>17.6</td>
<td>38.9</td>
<td>11.4</td>
<td>7.6</td>
</tr>
<tr>
<td>Bath &amp; NE Somerset</td>
<td>18.2</td>
<td>5.4</td>
<td>13</td>
<td>40.6</td>
<td>13.8</td>
<td>8.9</td>
</tr>
<tr>
<td>North Somerset</td>
<td>19</td>
<td>4.4</td>
<td>9.1</td>
<td>42.6</td>
<td>14.9</td>
<td>9.9</td>
</tr>
<tr>
<td>South Gloucestershire</td>
<td>20.8</td>
<td>4.6</td>
<td>11.4</td>
<td>43.9</td>
<td>13</td>
<td>6.3</td>
</tr>
<tr>
<td>England and Wales</td>
<td>20.2</td>
<td>4.9</td>
<td>12.6</td>
<td>41.5</td>
<td>13.3</td>
<td>7.6</td>
</tr>
</tbody>
</table>

2.21 The most apparent issue in the survey responses is an under-representation of under-16s, which represent 20% of the population, but from which less than 1% of the responses were received. The low level of response from young people might be as expected, given their dependence upon others on travel choices, with little influence over their journey choices.

2.22 The largest group of survey responses (40%) was from the 35 to 54 age group. There appears to be some evidence that this is high in comparison with the population as whole. In the case of the surveys, 40% of responses were from a group spanning a 20-year age interval (35-54), compared with only 42% of people
aged 30-59 (a 30-year interval), across the population as a whole. It is also evident that there was a disproportionately high level of response from people in the 55-64 age group, compared with the population as a whole.

**Access to Private Car**

2.23 Greater Bristol's high level of car use and dependency is evident from Figure 2.1. Over 90% of respondents have access to a car for shopping and leisure trips. Eighty six per cent of respondents have access to a car to travel to work, and just over two thirds (67%) stated that they have access to a car to travel to school/college.

![Figure 2.1 – Access to Car amongst Survey Respondents](image)

**Employment Status**

2.24 As illustrated in Figure 2.2, just under three quarters of survey respondents are currently engaged in employment. The majority are in full time employment (60%) and 12% work part time. 20% of respondents are retired and the remaining 7% are house persons (2%), students (2%), and ‘others’ (3%).
Figure 2.2 – Working Status of Survey Respondents

Table 2.5 – Employment Status (2001 Census Data)

<table>
<thead>
<tr>
<th></th>
<th>Bath &amp; NE Somerset</th>
<th>Bristol City</th>
<th>North Somerset</th>
<th>South Glouce</th>
<th>Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed</td>
<td>62%</td>
<td>60%</td>
<td>64%</td>
<td>69%</td>
<td>72%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Retired</td>
<td>14%</td>
<td>11%</td>
<td>16%</td>
<td>13%</td>
<td>20%</td>
</tr>
<tr>
<td>Students</td>
<td>11%</td>
<td>12%</td>
<td>5%</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>Looking after home/family</td>
<td>5%</td>
<td>6%</td>
<td>6%</td>
<td>5%</td>
<td>2%</td>
</tr>
</tbody>
</table>

2.25 Table 2.5 illustrates the distribution of employment status across the study area according to the 2001 Census.

2.26 Comparisons to the survey data demonstrate similar representations for employed and unemployed people. The survey, however, appears to under-represent students (census = 8%, survey = 2%) although this is most likely due to the survey being carried out during the Christmas/New Year vacation period. It also shows a slight over-representation of retired people, reflecting the distribution of ages of those people responding, as already discussed.
Area of Residence

2.27 Respondents were asked to give their home postcodes in order to allow the analysis of responses by each of the four main districts contained within the GBSTS area. Figure 2.3 illustrates the distribution of responses to the postal survey and Figure 2.4 illustrates the responses for the web survey. Both maps clearly demonstrate that there was a broad representation from all four districts contained within the study area.

Figure 2.3 – Home Postcodes of Postal Respondents

2.28 A total of 357 people responded to the postal survey, with 306 (86%) of respondents providing a postcode for analysis. Figure 2.3 illustrates that responses came from Bristol City (30%), North Somerset (29%), South Gloucestershire (19%), and Bath & North East Somerset (14%). A very small number of responses came from outside of the four unitary authorities (8%).
A total of 264 people responded to the website survey, with 227 (86%) of respondents providing a postcode for analysis. Figure 2.4 also shows that the majority of respondents were drawn from within the four unitary authorities, and a very small number of responses came from outside the main study area. Table 2.6 below illustrates the actual distribution of responses from the two surveys.

Table 2.6 – Comparison of Locations of Responses to Web and Postal Surveys

<table>
<thead>
<tr>
<th>District</th>
<th>Postal Surveys</th>
<th>Website Surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath &amp; North East Somerset</td>
<td>44</td>
<td>20</td>
</tr>
<tr>
<td>Bristol City</td>
<td>90</td>
<td>66</td>
</tr>
<tr>
<td>North Somerset</td>
<td>89</td>
<td>65</td>
</tr>
<tr>
<td>South Gloucestershire</td>
<td>57</td>
<td>53</td>
</tr>
<tr>
<td>Elsewhere</td>
<td>26</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>306</td>
<td>227</td>
</tr>
</tbody>
</table>

%
2.30 As illustrated in Table 2.6, the distribution of responses in the postal survey is broadly similar to that of the web survey. It is interesting to compare the distribution of responses in Table 2.6 with the populations of the four unitary authorities, shown in Table 2.2. In the case of Bristol, which has the largest population, with 381,000, it might be expected that it would have the largest number of responses. However, the number of responses is equal to North Somerset, which has a population of only 189,000. South Gloucestershire, with a population of 245,000, actually generated fewer responses than North Somerset, which has a smaller population. Bath & North East Somerset, although it has a smaller population of 169,000, attracted a relatively low number of responses.

2.31 In conclusion, it would appear that the numbers of responses from North Somerset were higher than might be expected, and lower than expected in Bristol City and, in particular, Bath & North East Somerset. It would therefore appear that people in North Somerset have been, in particular, motivated to respond to the questionnaire, potentially in response to the proposals set out in the consultation material.

Summary

2.32 As highlighted in this chapter, the responses to both postal and website surveys lean towards males, and those in older age groups. These characteristics must be noted when interpreting the data described in subsequent chapters of this report, as they are likely to have a significant impact upon the attitudes explored here. For this reason, this report will also examine the differences in response between different groups, such as younger people and older people, males and females.
3. Theme 1: Better Public Transport

DESCRIPTION OF THE PROPOSALS

3.1 The objective of presenting this theme was to explore the potential level of support for a strategy which would be focused on major improvements to the public transport network, including major improvements to the bus network, upgrading and expanding rail services, and the introduction of a three-line rapid transit system serving the Bristol area.

3.2 Groups at the stakeholder workshop considered specific questions relating to the public transport proposals, and the general public were asked to consider the importance and effectiveness of specific elements of the public transport package.

STAKEHOLDERS

3.3 Stakeholders were asked two questions directly relating to public transport, and the feedback from the discussions is presented below.

3.4 The group of stakeholders presented with this question raised a number of general comments about public transport, as well as wider issues in relation to transport, before considering specific types of measure. The notes below present the full range of issues discussed.

Question 1: What public transport improvements (road, rail and rapid transit) will be most needed?

3.5 Stakeholders were asked to identify any questions that they thought had been omitted in the information presented and to agree on the information needed to answer the above question. The following key points / questions were raised:

- What (public) transport improvements are needed to deal with the existing situation? This needs to be answered before moving to discussion of further development.
- The documents do not mention any costs: how will funding be obtained? What road improvements are already envisaged and how much money has been set aside for them? What alternatives are being considered if we can’t afford large scale investment?¹
- Make developments (transport as well as buildings) an exemplar / selling point, so that others want what we’ve got. Turn negatives into positives and change attitudes, reputations and living patterns. For example, make public transport a positive option, not a fall back.
- In addition, how can such developments be made truly ‘sustainable’? What does ‘sustainability’ really mean, and how do we achieve it?

¹ It is noted that this part of the discussion referred to road investment, as opposed to road-based public transport (ie buses), but is included here for completeness.
How can we reduce the impact of travel? We need to look at real life patterns of where people are travelling to and from and build plans around these patterns. The questions are too global – not all transport forms and areas are the same: different areas (rural, suburbia, urban) have different requirements.

Are administrative boundaries realistic? We need to look at cross-border issues. The GBSTS in particular is very Bristol centric. What about the possibility of a rapid transit link between Bath and Bristol?

3.6 After visiting the stands, respondents identified a number of outstanding questions and issues:

- Two assumptions that seemed to underlie much of the vision / planning / transport work are:
  - Buses are the magic solution to all obstacles.
  - The boundaries of the area are limited to the administrative area; there seems to be little discussion with neighbouring authorities.

- One group member reported that Bristol – B&NES transport would (in the plans) be improved through use of existing heavy rail. A group member from Network Rail argued that this was neither planned, nor possible.

- Plans should focus on linking up those areas with few existing public transport options, by better use of existing facilities. A key example would be to use the rail lines (or other infrastructure) in place for Portishead, Clevedon, Thornbury and Norton Radstock. In addition, improvements should be used to kick-start growth in areas such as South Bristol – the absence of the ring road in this area is a barrier to private sector investment and employment.

- Any new developments must incorporate high quality public transport corridors from the outset.

- Public transport options will have to pay for themselves, so need to have a high capacity – buses are inadequate for this. Can we learn from the principle of low cost airlines? (e.g. book early for lower prices).

- More competition is needed to lower prices: current public transport services are too expensive.

- Deliver one success to improve the image of public transport and set a benchmark.

- Rail links:
  - Is a long-term rail network strategy needed, and how should it be put together? Need to link up areas without connections and to improve rail capacity / flow on the existing system.
  - Are there problems with rail signals that need resolving to make the railways flow better?
  - Are improvements affordable? Heavy rail is an expensive option.
  - Some improvements to ‘pinch points’ are already planned – or have already been made.
  - Central government is responsible for service specifications and would need to give the instructions if we are to improve existing services.
Road links:
- The key prerequisite for improved road links is a joined up, clear approach through better partnership;
- Choose appropriate modes of transport for each corridor, improve planning coordination and use Section 106 agreements better;
- What cost assessments have been made?;
- How can new roads be used to enhance public transport? E.g. through guided buses or other innovative and attractive solutions. There is a need to choose imaginative solutions that will overcome and improve the poor image of public transport (and improve the comfort, frequency, directness and cost of services so that there is substance behind the image);
- Capacity issues need to be resolved;
- Non-central areas need to be better linked – public transport planning needs to have a spatial dimension and include interchanges;
- A Park & Ride at Bedminster Down is needed;
- Not all routes are suitable for buses, but, if planned right, they can free space for public transport elsewhere. However, new routes could increase the volume of traffic – demand management may be needed.

Rapid transit:
- Even if an LRT is not on the horizon at present, we must keep the land and facilities available in case it becomes possible later on: don’t build houses on the route: protect it and be ambitious for the future;
- Is an LRT the most needed public transport improvement?;
- Bus corridors may be a more immediate solution for the near future than a tram;
- Is Bristol’s topography too difficult for trams? One group member argued that this was not so: trams can climb a gradient of up to 10%;
- A concept vehicle that could travel on both road and rail would be better than a straightforward tram;
- Technology may provide a better solution to inner city transport problems than anything we are thinking about at present.

Summary of significant issues / arguments:

- Transport options should be appropriate to each area’s needs.
- Significant improvements could be made by linking areas with few public transport options to the network, perhaps using existing rail lines.
- The poor image of public transport is a major problem that needs to be overcome if we are to increase the volume of passengers.
- The most important unanswered question was that of cost: where is the money coming from, and are the given options unrealistic?

Question 2: What measures (e.g. interchanges/park-and-ride, fare structures and delivery arrangements) are most needed to integrate transport improvements?

3.7 Stakeholders raised a number of key issues:
♦ Challenge assumption that we need to provide for people’s travel needs rather than influencing where they need to travel (not unanimous – most thought must do both);

♦ Discussion around how to make public transport (and interchanges) more convenient, clean, efficient, fairly priced, better timed in terms of serving whole day and in making connections. Promoting use of underused transport (e.g. Park & Ride buses in middle of the day), and address perception of public transport;

♦ Need to address peak time travel and look at ways of staggering journeys;

♦ Need to look at economic impact of congestion charging, workplace charging etc;

♦ Fundamental question around who provides public transport – privatisation has not produced effective competition & so much is disjointed;

♦ Delivery arrangements for transport – need to work sub regionally (and with neighbouring sub regions) on this. WoE Partnership is a good place to start;

♦ Predict and provide is the approach for housing, why not for transport?

♦ What’s the role of legislation? Hypothecated? There is a need to look at other local authority areas affected;

♦ Pump priming investment upfront needed to pay for complementary measures to allow alternatives. (Use growth coming in); and

♦ Some stakeholders thought that wider sustainability issues were not addressed, but this was not unanimous.

Conclusions

♦ Need to consider whether we should follow and cater for market forces or work to influence travel patterns. Consensus was that we needed to do both; and

♦ Need to work on supply of sustainable travel options at the same time as reducing demand for travel.

SURVEYS

Importance of Individual Measures

3.8 Respondents were asked to rate the importance of a number of different potential public transport measures. The overall results are ranked in Figure 3.1 and described in further detail below.
Figure 3.1 – Importance of Public Transport Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Very Important</th>
<th>Quite Important</th>
<th>Neutral</th>
<th>Not Very Important</th>
<th>Not Important at all</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid transit: Ashton Vale to Emersons Green</td>
<td>20</td>
<td>17</td>
<td>38</td>
<td>8</td>
<td>15</td>
<td>77</td>
</tr>
<tr>
<td>Park and ride: new sites serving Weston</td>
<td>24</td>
<td>11</td>
<td>32</td>
<td>15</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>High speed coach services</td>
<td>15</td>
<td>34</td>
<td>33</td>
<td>10</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Rapid transit: Cribbs Causeway to South Bristol</td>
<td>27</td>
<td>27</td>
<td>31</td>
<td>18</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>Rapid transit: Severn Beach line</td>
<td>27</td>
<td>27</td>
<td>31</td>
<td>18</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>Park and ride: new sites serving Bath</td>
<td>27</td>
<td>27</td>
<td>30</td>
<td>15</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>Easier ticketing for buses</td>
<td>31</td>
<td>31</td>
<td>25</td>
<td>17</td>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>Park and ride: new sites serving Bristol</td>
<td>33</td>
<td>32</td>
<td>27</td>
<td>14</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Rail services: cross Bristol services</td>
<td>46</td>
<td>32</td>
<td>14</td>
<td>16</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Rail services: increased frequencies</td>
<td>50</td>
<td>29</td>
<td>25</td>
<td>14</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Rail services: re-opening of railway lines</td>
<td>60</td>
<td>23</td>
<td>30</td>
<td>14</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>More reliable buses with bus priority</td>
<td>59</td>
<td>25</td>
<td>29</td>
<td>9</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>More frequent and better buses</td>
<td>55</td>
<td>32</td>
<td>32</td>
<td>9</td>
<td>17</td>
<td>5</td>
</tr>
</tbody>
</table>

**Bus and Coach**

3.9 Figure 3.1 above illustrates the importance to respondents of improved bus services: more frequent, better and more reliable bus services are the highest-ranking public transport measures in terms of importance to respondents.
3.10 Figure 3.2 presents the responses relating to improved bus and coach services.

**Figure 3.2 – Importance of Bus and Coach Measures**

![Bar chart showing the importance of various bus and coach measures](chart_image)

- More reliable buses with bus priority: 59% very important, 25% quite important, 10% neutral, 14% not very important, 9% not important at all, 0% don't know.
- More frequent and better buses: 55% very important, 31% quite important, 7% neutral, 10% not very important, 3% not important at all, 0% don't know.
- Easier ticketing for buses: 31% very important, 25% quite important, 14% neutral, 7% not very important, 10% not important at all, 0% don't know.
- High speed coach services: 34% very important, 34% quite important, 9% neutral, 14% not very important, 10% not important at all, 0% don't know.

**Base:** all respondents who answered question related to bus and coach measures

3.11 This demonstrates that over four fifths of respondents stated that more reliable buses with bus priority; and more frequent and better buses were very important (59% and 55%) or quite important (25% and 31%) measures. Just under one third (31%) of respondents felt that easier ticketing was very important, although only 14% stated that high speed coach services would be very important.

3.12 Further analysis shows that females were more likely to agree with the importance of bus and coach measures compared to males. For example, 95% of females agreed that frequent and better buses, and more reliable buses with priority, were important/very important, compared to only 83% and 78% (respectively) of males.

3.13 In terms of age, there were also significant differences. For example, younger respondents were much less likely to agree with the importance of high speed coach services (38%) than those aged over 65 (59%). This was also the case for easier ticketing for buses, with only 57% of those aged between 16-34 stating it was important/very important, compared to 61% of those aged 35-54, 68% of those aged 55-64 and 65% of those aged 65 and over.

3.14 In considering differences between postal responses and website responses, over half of respondents (53%) for the postal questionnaire agreed that high speed coach services were very important/important, compared to only 43% of website respondents. This reflects the differing demographics of the two groups, with the younger respondents in the web survey less likely to consider this to be a priority.
**Rapid Transit**

3.15 Respondents were subsequently asked to state the importance of rapid transit measures, and the results are presented in Figure 3.3.

**Figure 3.3 – Importance of Rapid Transit Measures**

Base: all respondents who answered question related to rapid transit

3.16 Only half of the respondents felt that Rapid transit along the Severn Beach line (50%) and from Cribbs Causeway to South Bristol (49%) was very important or quite important. Even fewer (37%) stated this to be the case for rapid transit along the Severn Beach line. For all three rapid transit measures, approximately 10% of respondents felt that they were not very important or not important at all. The remaining respondents remained neutral or stated that they did not know.

3.17 Females were more likely than males to consider rapid transit from Cribbs Causeway to south Bristol to be important (56% compared to 46%) and from Ashton Vale to Emersons Green (38% compared to 37%). Conversely, only 46% of female respondents agreed that rapid transit along the Severn Beach line was important/very important, compared to 52% of males.

3.18 No significant differences were noted when analysing responses by age.
**Rail Services**

3.19 The importance attached to improvements to the rail network is presented in Figure 3.4.

![Figure 3.4 – Importance of Improved Rail Services](image)

*Base: all respondents who answered the question related to rail services*

3.20 The re-opening of railway lines appears to be considered to be most important, with over four fifths of respondents stating that it is very important (60%) or quite important (23%). Similarly high numbers of respondents (78%) felt this to be the case for increasing the frequencies of trains and the introduction of cross-Bristol services. Less than 6% of respondents stated that these measures were not very important or not important at all.

3.21 Female respondents were more likely to agree/strongly agree with all of the measures compared to males. For example, 93% of females felt the re-opening of railway lines was important/very important, compared to 80% of males.

3.22 Respondents over the age of 65 were less likely than other age groups to consider cross-Bristol rail services to be important (69% compared to ~80%). This was also the case for increased frequencies (68% compared to ~79%).
**Park & Ride**

3.23 Respondents were asked to consider the importance of new Park & Ride sites in the study area, to serve Bristol, Bath and Weston, as summarised in Figure 3.5.

**Figure 3.5 – Importance of Park and Ride Measures**

<table>
<thead>
<tr>
<th>New sites serving Bristol</th>
<th>New site serving Bath</th>
<th>New sites serving Weston-s-Mare</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>32</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>21</td>
<td>27</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>0%</td>
<td>10%</td>
<td>20%</td>
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<td>10%</td>
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<td>30%</td>
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<td>70%</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>80%</td>
<td>90%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Base: all respondents who answered the question related to Park & Ride

3.24 Two thirds of respondents felt that new sites serving Bristol were either very important (34%) or quite important (32%), with just over one fifth of respondents (21%) remaining neutral. Just over half of respondents (51%) felt that a new site serving Bath was important, 30% remained neutral and the remaining 19% felt it was not important, not important at all, or did not know. Fewer respondents (43%) felt that new sites serving Weston were very important or quite important; one third remained neutral, 16% felt it was unimportant and the remaining 8% stated that they did not know.

3.25 Male respondents were slightly more likely than females to consider as important new sites serving Bath (53% compared to 47%), although such differences could not be considered to be statistically significant. No significant differences were noted for new sites serving Bristol and Weston.

3.26 There were also differences between different age groups. Older people were consistently more likely than young people to identify as being important new sites to serve Bristol, Bath and Weston. For example, in the case of Bristol, respondents aged 16-34 were less likely than any other age group to consider this to be important (only 58% compared to at least 65% for all other age groups). In the case of Bath, respondents over the age of 65 were more likely than any other age group to state that a new Park and Ride site was important/very important (63% compared to <50%
for all other age groups), which was also mirrored for Weston (57% compared to <42%).

3.27 There were differences between the postal and web surveys. Only three fifths of website responses agreed that park and ride serving Bristol was important compared to 72% for postal responses. Similarly, only 41% of website responses (59% for postal responses) agreed with new sites serving Bath and just under a third for Weston (compared to 51% for postal responses).

Conclusions

3.28 Of all the public transport measures described above, respondents clearly agreed that bus and rail were the most important (>80% agreed that they were important/very important). Conversely, rapid transit was seen as the least important measure (<50% agreed that it was important/very important).

Potential for Mode Shift

3.29 Respondents were subsequently asked how effective the measures outlined above would be in encouraging car drivers to use public transport. The results are detailed in Figure 3.6.

Figure 3.6 – Effectiveness of measures to encourage mode shift

<table>
<thead>
<tr>
<th>Measure</th>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
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Base: All respondents (621)

3.30 The measures in Figure 3.6 have been listed in the same order as that shown in Figure 3.1, which ranked the importance attached to each measure. Importantly,
Figure 3.6 shows that there is a broad correlation between the perceived importance of measures and their perceived effectiveness in encouraging mode shift.

**Bus and Coach**

3.31 The perceived effectiveness of improved bus and coach services in encouraging mode shift away from the private car is presented in Figure 3.7.

**Figure 3.7 – Effectiveness of bus and coach measures in encouraging mode shift**

![Bar chart showing effectiveness of bus and coach measures](image)

*Base: all respondents who answered the question related to Bus and Coach Measures*

3.32 The vast majority (>80%) of respondents agreed that more frequent and better buses (83%) and more reliable buses with bus priority (82%) would be effective in encouraging car users to use public transport, with around half of these stating that these measures would be “highly effective”. Fewer but still significant numbers of respondents (57%) felt that easier ticketing for buses would be effective in encouraging mode shift, with 26% offering a neutral response.

3.33 Half of respondents (50%) agreed that high speed coach services would be effective in encouraging car users to use public transport, 28% remained neutral, 18% stated that it would be ineffective and the remaining 4% did not know. Unsurprisingly, younger respondents were less likely to agree with this measure than the older age groups. For example 45% of those aged 16-34 agreed/strongly agreed, compared to 48% of those aged 35-54, 55% of those aged 55-64 and 55% of those aged over 65.
3.34 Female respondents were more likely than males to highlight the effectiveness of all of the bus and coach measures detailed above. For example, 94% of females felt that more frequent and better buses would be effective/very effective, compared to 72% of males, 94% stated more reliable buses with bus priority would be effective/very effective in encouraging mode shift, compared to 77% of males; and 66% of females stated high speed coach services compared to 47% of males.

3.35 There were, in general, no significant differences between the web and postal surveys, although fewer respondents to the web survey considered that high speed coach services would be effective (43%, compared to 56% of postal responses).

Rapid Transit

3.36 The responses for rapid transit are presented in Figure 3.8.

**Figure 3.8 – Effectiveness of rapid transit in encouraging mode shift**

Base: all respondents who answered the question related to Rapid Transit.

3.37 Respondents felt that rapid transit on the Severn Beach line and from Cribbs Causeway to south Bristol would be most effective in encouraging car users to use public transport, with over half (57% and 56%) of respondents stating that it would be either highly effective or effective. Fewer respondents (47%) felt this to be the case for rapid transit from Ashton Vale to Emersons Green, with just under one third (31%) remaining neutral.

3.38 Further analysis shows that respondents aged 16-34 were more likely than any other age group to state that rapid transit would be effective in encouraging mode shift. For example, 70% felt rapid transit from Cribbs Causeway to south Bristol would be effective/very effective (compared to <53% for all other age groups). Similarly, 64% of respondents aged between 16-34 felt this to be the case for rapid transit along the
Severn Beach line (compared to <58% for all other age groups); and 59% felt rapid transit from Ashton Vale to Emersons Green would be effective/very effective (compared to <46% for all other age groups).

3.39 Female respondents were slightly more likely than males to consider rapid transit from Cribbs Causeway to south Bristol to be effective/highly effective (67% compared to 52%) in encouraging mode car drivers to use public transport. However, no significant differences were noted for the other rapid transit measures.

**Rail**

3.40 Respondents were subsequently asked how effective they thought improved rail services would be in encouraging mode shift: the results are shown in Figure 3.9.

**Figure 3.9 – Effectiveness of rail measures in encouraging mode shift**

![Figure 3.9 – Effectiveness of rail measures in encouraging mode shift]

Base: all respondents who answered the question related to Rail Services

3.41 At least three quarters of respondents felt that all three listed measures would either be highly effective or effective. The re-opening of railway lines was deemed to be the most effective: 81% stated it would be either highly effective (52%) or effective (29%). Increased frequencies were also seen as being effective, with 80% stating that these would be highly effective (46%) or effective (34%). Slightly fewer but still significant numbers of respondents (75%) stated that cross-Bristol rail services would be effective in encouraging car drivers to use public transport.

3.42 Female respondents were more likely than males to agree with the effectiveness of rail service measures to encourage mode shift (~87% of females stated that all measures were effective/highly effective compared to ~75% of males).
3.43 Respondents aged between 16-34 were more likely than any other age group to agree that increased rail frequencies would be effective/highly effective (88% compared to <78% for all other age groups). This was also the case for the effectiveness of cross-Bristol services rail frequencies (86% compared to ~73% for all other age groups).

**Park & Ride**

3.44 The responses for Park & Ride are presented in Figure 3.10.

**Figure 3.10 – Effectiveness of park & ride in encouraging mode shift**

![Graph showing effectiveness of Park & Ride sites]

Base: all respondents who answered the question related to Park & Ride

3.45 Respondents considered that sites serving Bristol would be the most effective in encouraging car users to use Public Transport. Just under three quarters of respondents (71%) stated that it would be highly effective (33%) or effective (38%).

3.46 Just under two thirds of respondents (60%) felt that Park & Ride serving Bath would be effective in encouraging car drivers to use public transport, with a further 23% of respondents remaining neutral. Just over half of respondents (53%) stated that a Park & Ride site serving Weston would be effective in encouraging mode shift, and 25% of respondents remained neutral.

3.47 Male respondents were more likely than females to consider to be effective the Park & Ride sites serving Bristol (72% compared to 68%) and Bath (61% compared to 55%) in encouraging mode shift, although no statistical significance can be attached.
to these observed differences. No significant differences were noted for sites serving Weston.

3.48 Respondents over the age of 65 were more likely to agree with the effectiveness of Park & Ride measures to encourage mode shift than any other age group. For example, 80% of respondents over 65 felt that new sites serving Bristol would be effective/highly effective, compared to 72% for those aged 16-34, and 69% for those aged 35-54 and 55-64.

3.49 Similar trends were noted for new sites serving Bath: 71% of respondents over 65 stated that it would be effective/highly effective, compared to 63% of those aged 16-34, 57% of those aged 35-54 and 54% of respondents aged 55-64.

3.50 Less but still significant differences were noted for new sites serving Weston: 63% of those aged over 65 stated that it would be effective/highly effective in encouraging mode shift, compared to ~50% for all other age groups.

3.51 There were notable differences between postal and website responses, with consistently lower proportions of web responses considering that Park & Ride would be effective. This would appear to reflect the differences in age profiles of the two survey channels, with higher proportions of people aged over 65 responding to the postal survey.

CONCLUSIONS

3.52 The feedback from both key stakeholders and the general public has demonstrated the importance of public transport as a central element of the future transport strategy for Greater Bristol, and in supporting the long-term spatial strategy for the sub-region.

3.53 From the discussions with stakeholders, it was evident that there is a need for much better co-ordination of land use and transport planning, with the location of development being used to reduce the need for travel, and high quality public transport being provided in new developments from the outset. There was unanimous agreement that public transport is currently inadequate (mirroring feedback in the problems and issues consultation), and consensus that improved bus services are the essential first step, with consideration to be given to network coverage and connectivity, frequency, reliability, quality and price.

3.54 There was rather less consensus about the future role of rail and rapid transit in catering for travel needs. Some stakeholders considered that rail and rapid transit must play a role: whilst it was the general view that the priority must be to improve bus services, it was considered by some that an upgraded bus network would not be sufficient to meet long-term needs, and provision would be needed for rapid transit.

3.55 The views of stakeholders would appear to be mirrored by the general public, with the highest level of importance being given to improvements to the bus network, including improved frequencies, reliability and ticketing arrangements. A high priority was also given to improved rail services (including line re-openings, increased
frequencies and cross-city services), with much lower priority for Park & Ride and rapid transit.

3.56 The discussions above have shown that there are distinct differences in the responses between demographic groups, and these will need to be taken into account when reviewing the acceptability of specific proposals as they are developed.
4. Theme 2: Better Public Transport and Control on the Use of the Private Car

DESCRIPTION OF THE PROPOSALS

4.1 The objective of presenting this theme was to explore the potential level of support for a strategy which would include the major improvements to public transport in Theme 1, in tandem with demand management measures, such as additional parking controls, workplace parking charges or various forms of road user charging.

4.2 Groups at the stakeholder workshop considered specific questions relating to potential demand management measures, and the general public were asked to consider if they would support alternative demand management measures, as well as the effectiveness of these measures in encouraging mode shift.

STAKEHOLDERS

4.3 Stakeholders were asked the following question directly relating to controlling the use of the private car:

Question: What measures (e.g. through parking controls, road user charging and land use planning) will be most needed to reduce the demand for travel?

4.4 The major issues in relation to demand management were:

- Need to accept that people will continue to need/want to travel;
- Not so concerned about reducing demand as long as negative impacts of increase in travel are addressed;
- Examples of measures in the question are all about deterrence – need carrots as well as sticks;
- Stakeholders raised a concern whether any of the GBSTS proposed options, or mix of options, will reduce the demand for travel; and
- Need to explore use of new technology to reduce demand for travel – ICT, broadband.

4.5 Stakeholders in this group also raised a number of additional issues not directly related to demand management but which are included here for completeness:

Employment

- What sorts of jobs are envisaged for the sub-region? Key issues around matching jobs to skills (e.g. south Bristol: distinctive jobs profile – skilled trades, construction, social service, health).
- Currently little evidence of explicit consideration of need to link people with jobs, bring jobs to communities, etc – this issue needs to be closely integrated with transport planning.
Need to balance land use from a sub-regional perspective, e.g. North Fringe and South Bristol. South Bristol needs viable, accessible employment sites (need for office development?).

**Environmental issues**

- Important to encourage forestation. This is about access to the countryside and tree cover in *urban* environments. Seems to be no consideration of question of reducing demand for travel in terms of, for example, trees in urban areas.
- Green belts: important to city as well as country.
- Footpath links?
- Environmental impact of airport expansion: CO₂ emissions will increase substantially if planned expansion takes place. Raises important questions around land use: will need heavy tree planting if this level of emission is to be offset. This issue has not been addressed in the debates so far.
- Is JSPTU undertaking a strategic environmental assessment (SEA) as part of the spatial planning work?
- Fully support WofE aspiration for a carbon-neutral sub-regional economy, but need to begin to think *now* about how to achieve this. What are the implications of a carbon-neutral sub-regional economy for inter-regional economic growth/competitiveness (i.e., if other regions are not pursuing this goal, will the WofE/SW lose out)? How is the sub-region planning to deal with the substantial increase in emission levels that expansion of the airport will bring?
- Need greater sub-regional focus on waste issues, including focus on infrastructure, and solutions for disposing of more waste within the sub-region (much is currently being transported out of the sub-region for reprocessing). Need to think of waste as a sub-regional resource: consider potential future sourcing of electricity/water supply/marketable composts. Future planning around waste disposal must proceed on the principles of proximity and self-sufficiency. This is a key issue for the West of England Partnership.

**SURVEYS**

4.6 Respondents were asked whether they agreed with a number of possible measures to control the use of the private car. The results are presented in Figure 4.1 and described in further detail below.
4.7 Interestingly, less than half of respondents agreed with any of the measures to control the use of the private car. However, respondents were most likely to agree with increased parking charges in town centres. Just under half of respondents strongly agreed (26%) or agreed (22%) with these measures, although a similar number disagreed (18%) or strongly disagreed (23%). The remaining 11% remained neutral or did not know.

4.8 Similar numbers of respondents (48%) agreed with road tolls in Bristol and Bath city centres (36% disagreed, 15% remained neutral, and 1% did not know). Respondents over the age of 65 were less likely to agree/strongly agree with road tolls in Bristol and Bath city centres compared to all the other age groups (42% compared to 47% of those aged 35-54, 50% of those aged 55-64, and 55% of respondents aged between 16-34).

4.9 Although 41% of respondents agreed/strongly agreed with less parking in town centres, a similar number of respondents (43%) disagreed/strongly disagreed. Of the remaining responses, 15% remained neutral, and 1% stated that they did not know.

4.10 Similarly, although over one third of respondents (40%) agreed/strongly agreed with workplace charging, an equal number disagreed/strongly disagreed with this measure. 19% of respondents remained neutral and 1% stated that they did not know. Although there were no significant differences between age groups in terms of their agreement with workplace charging, respondents over the age of 65 were far less likely to disagree with this measure (28% compared to > 39%).

4.11 Less than one third of respondents (32%) agreed/strongly agreed with motorway tolls whereas 43% disagreed/strongly disagreed. The remaining 25% remained neutral (24%) or stated that they did not know.
4.12 Of all the proposed measures, respondents were least likely to agree with distance based charging. Only 30% agreed/strongly agreed with distance based charging in urban areas (43% disagreed/strongly disagreed); and less than a quarter of respondents (24%) agreed/strongly agreed with distance based charging across the whole study area (just under half of respondents (48%) disagreed/strongly disagreed).

4.13 For all of the above measures, female respondents were more likely to agree/strongly agree than males. For example, 37% of females agreed/strongly agreed with motorway tolls compared with 30% of males.

Scope for Mode Shift

4.14 Respondents were subsequently asked how effective the measures described above would be in encouraging car drivers to use public transport, walk or cycle. The results are detailed in Figure 4.2.

Figure 4.2 – Effectiveness of measures to control the use of the private car in encouraging mode shift

Base: All respondents (621)

4.15 Unsurprisingly, given the results described in the previous section, of all the measures presented, respondents felt that increased parking charges in town centres would be most effective in encouraging car drivers to use alternative modes of transport. Over half of respondents (58%) felt that they would be highly effective (21%) or effective (37%). Just under one third (31%) felt that they would be ineffective or not very effective and the remaining 11% remained neutral or did not know.
4.16 A similar number of respondents felt that road tolls in Bristol and Bath city centres (56%) and less parking in town centres (55%) would be highly effective/effective in encouraging mode shift. Just over one quarter of respondents (27% and 30% respectively) felt that it would be ineffective / not very effective and the remaining respondents either remained neutral (15% and 13%) or did not know (2%).

4.17 Just under half of respondents (49%) felt that workplace charging would be an effective/highly effective measure (it is worth noting that only 40% agreed with this measure in Figure 4.1), and 32% felt it would not be effective. Respondents aged 16-34 and over 65 were less likely to agree than other age groups that workplace parking charges would be effective in encouraging mode shift (~29% compared to ~38%).

4.18 Interestingly, although few respondents agreed with distance-based charging (it was the least popular measure as detailed in Figure 4.1), significantly higher proportions felt that it would be effective in encouraging car drivers to use alternative modes. Over one third of respondents (40%) felt that distance-based charging in urban areas would be highly effective/effective (compared to 30% who agreed in Figure 4.1); and just under one third (34%) stated this to be the case for distance-based charging covering the whole study area (compared to 24% who agreed in Figure 4.1). Respondents aged 16-34 were most likely to agree that urban charging would be effective in encouraging mode shift (50% compared to an average of 38% for all other age groups).

4.19 Of all the measures presented, respondents felt that motorway tolls would be the least effective in encouraging mode shift. Only 34% stated that it would be highly effective/effective, and 42% felt such tolls would be ineffective or not very effective.

4.20 Female respondents were slightly more likely than males to state that all of the above measures to control the use of the private car would be effective in encouraging mode shift. For example, 60% of females stated that road tolls in Bath and Bristol city centres would be effective/highly effective compared to 55% of males. Similarly, 43% of females stated that distance-based charging would be an effective/highly effective measure, compared to 40% of males, although this is not statistically significant.

Demand Management and Public Transport Improvements

4.21 Respondents were asked to what extent they would agree with measures to reduce the use of the private car:

- if no improvements were made to public transport; and
- if the money raised was used to pay for the public transport improvements detailed in the leaflet (as discussed in Chapter 3).

4.22 The responses to the two questions are presented in Figure 4.3.
Figure 4.3 – Agreement with measures to reduce the use of the private car

Base: All respondents (621)

4.23 Figure 4.3 demonstrates dramatic differences in the responses to the two questions. It is clear that the majority of respondents (77%) would only agree/strongly agree with measures to reduce the use of the private car if the money raised was used to pay for public transport improvements. Only 22% of respondents stated that they would agree with such measures if no improvements were made to public transport.

4.24 Further analysis shows that respondents aged 16-34 were more likely than any other age group to disagree or strongly disagree with measures to reduce the private car if no improvements were made to public transport (78% compared to ~66%). In addition, male respondents were slightly more likely to disagree with this statement than females (70% compared to 65%).

CONCLUSIONS

4.25 The feedback from both key stakeholders and the general public indicates that a pre-requisite for the successful introduction of demand management measures will be improvements to the transport alternatives. As shown in Figure 4.3, there is a dramatic increase in the level of support for demand management, as a concept, if significant improvements to public transport are also provided.

4.26 The levels of support for specific measures vary, with greater support for targeted demand management (particularly town centres) than for area-wide measures. This could reflect the relatively good levels of accessibility to urban centres by alternative modes, but poor levels of accessibility across the network as a whole. Evidently, demand management tools that charge for using the whole network will require dramatic improvements in travel choice, to enable people making a diverse range of journeys to consider alternatives to the private car.
5. Theme 3: Better Roads

DESCRIPTION OF THE PROPOSALS

5.1 The objective of presenting this theme was to explore the potential level of support for a strategy which would include the major improvements to the road network.

5.2 Groups at the stakeholder workshop were asked to consider where improvements to the highway network would be most needed. The general public were asked to identify their level of support for specific highway proposals.

STAKEHOLDERS

5.3 Stakeholders were asked the following question directly relating to better roads:

Question: What road improvements or new roads will be most needed?

Summary of discussions:

♦ Proposed road improvements outside of the Study area may have an impact on the West of England – such as the improvements to the A358, which could provide a second strategic route to the South West;

♦ Completion of the “Ring Road” around / through South Bristol is fundamental. This would have implications for access to the Bristol International Airport and implications for a wider area. It would provide an alternative to M5 / River Avon Bridge in event of motorway closure;

♦ A new low level crossing of the River Avon needs to be considered – possibly in the form of a barrage, which would have recreational benefits. But provision of roads is not the only solution to the problem. Growth in the form of development should be used to mitigate the problems and enable solutions;

♦ Congestion in Bristol is a key issue. Public transport provision is not as effective as it needs to be. Improvements could include additional “Showcase” routes and park and ride facilities (such as in South Bristol, Lambridge in Bath, and capacity improvements in the existing park and ride sites). There was a suggestion that congestion charging should not be introduced in central Bristol until the Ring Road is complete – to provide a choice, and that congestion charging may be required in North Bristol;

♦ Determining a route through / around South Bristol will be a challenge. Dundry Hill is a natural barrier; the Chew Valley is a valued landscape area; there is high quality agricultural land; Green Belt issues; SSSIs; social and economic impacts etc to balance against the benefits of completing the Ring Road;

♦ Bristol International Airport is not part of the “congestion” problem. Access to it needs to be improved – from Bristol, Weston-Super-Mare and Bath;

♦ Road improvements / enhancements should be seen in a wider context. Urban expansion in South West Bristol would provide new uses for land that has been tipped on; development could provide a zero-waste / carbon neutral community;
and help relieve housing shortage. Green Belt designation in South West Bristol should be reviewed to enable the better use of land; and

- Transport issues in Bath should not be over-looked, but would road improvements affect the World Heritage Site status of the City?

Conclusions:

- New roads and road improvements, supported by enhanced public transport and road charging in central Bristol, aimed at providing better access to and from South Bristol; and
- Access improvements should not be seen in isolation, but as part of an integrated strategy designed to enhance economic activity and social inclusion to provide better access to jobs and health facilities such as a major new hospital and local health centres. A package of measures would be required to address the downside of new roads in terms of their impact on the existing communities of South Bristol, open countryside and Green Belt, and improve the quality of life in the area.

SURVEYS

5.4 Respondents were asked to consider the extent to which they agreed with a number of ideas for improved strategic road corridors. The results are detailed in Figure 5.1 and described in further detail below.

Figure 5.1 – Agreement with ideas for improved strategic road corridors

Base: All respondents (621)
5.5 Of all the ideas for improved strategic road corridors, respondents were most likely to agree/strongly agree with **improved links to the M4** (57%) and **links from the M5 to south of Bristol** (54%). Approximately one quarter of respondents (25% and 24%) disagreed/strongly disagreed with these measures and the remaining 22% stated that they did not know or remained neutral.

5.6 Respondents aged 16-34 were less likely to agree with these measures than any other age group. For example, 45% agreed/strongly agreed with improved road links to the M4 compared to >54% for all other age groups. Similarly, only 43% of respondents aged 16-34 agreed/strongly agreed with improved links to the M5 south of Bristol, compared to 50% for those aged 25-54 and >60% for those aged over 55.

5.7 Male respondents were significantly more likely to agree with these measures than females: 61% compared to 44% agreed/strongly agreed with improved links to the M4; and 58% compared to 42% agreed/strongly agreed with improved links to the M5 south of Bristol.

5.8 In general, the postal survey showed higher levels of agreement with the road schemes than the web survey. Website respondents were less likely to agree with for both improvements to the M5 south of Bristol (46%) and improved links to the M4 (45%) compared to 60% and 65% for postal responses.

5.9 Half of respondents (50%) agreed/strongly agreed with improved **links to the M5** (in South Gloucestershire) and **improvements south of Bristol** (Avon Ring Road). Again, around one quarter of respondents (26% and 23%) disagreed/strongly disagreed with these measures and the remaining respondents remained neutral or did not know. Respondents aged 55-64 or over 65 were more likely to agree/strongly agree with this measure than any other age group (55% and 58%, compared to 48% of those aged 35-54, and 41% of those aged under 35). Again, male respondents were more likely to agree with these measures than females: 55% agreed/strongly agreed with improved links to the M5 (compared to 40% of females) and improvements south of Bristol (compared to 36% of females).

5.10 Only 41% of website respondents agreed with improved links to the M5 compared to just under three fifths of postal responses (58%). Similarly, only 45% of web respondents agreed / strongly agreed with improvements south of Bristol, compared to 54% of postal respondents.

5.11 Fewer, but still significant numbers of respondents agreed/strongly agreed with the idea of new **north-south road links in south Bristol** (47%) and the **A4 Bristol-Bath Corridor** (46%). Similar proportions of respondents disagreed/strongly disagreed (27% and 23%) and remained neutral (24% and 25%); and the remaining respondents stated that they did not know.

5.12 Respondents aged over 65 were most likely to agree/strongly agree with improvements to the A4 Bristol-Bath corridor than any other age group (57% compared to ~45%). This was also the case for new north-south road links in South Bristol (53% compared to ~44%). In addition, just over half of males agreed/strongly agreed with new north-south links in South Bristol compared to only 34% of females. Similar proportions agreed/strongly agreed improvements to the A4 Bristol-Bath Corridor (52% of males compared to 34% of females).
5.13 Just over two fifths of respondents (43%) agreed/strongly agreed with improvements from **Weston-super-Mare to Bristol**, just under one quarter of respondents disagreed/strongly disagreed (24%), and the remaining respondents remained neutral (25%) or did not know (8%).

5.14 Respondents over 65 were more likely to agree/strongly agree with these improvements than any other age group (59% compared to under <42%). In addition, just under half of male respondents (46%) agreed/strongly agreed with improvements from Weston compared to just over one third (34%) of females.

5.15 Only 34% of web respondents strongly agreed/agreed with improvements from Weston to Bristol compared to just under half (49%) of respondents to the postal survey.

5.16 Just under two fifths of respondents agreed/strongly agreed with improvements on the **A37 south of Bristol** (40%) and a **new Avon Crossing** (37%). However, relatively significant proportions of respondents also disagreed or strongly disagreed (24% and 29%). The remaining respondents remained neutral (27% and 23%) or did not know (9% and 11%). Almost twice as many male respondents agreed/strongly agreed with both measures compared to females (45% compared to 27% for the A37 and 40% compared to 24% for the new Avon Crossing).

5.17 Only 35% of website respondents strongly agreed/agreed with improvements on the A37 south of Bristol, compared to 44% for postal responses, and for a new Avon Crossing, only 30% of website replies agreed compared to 42% for postal responses.

5.18 Just over one third of respondents agreed or strongly agreed with improved **North-South links in South Gloucestershire** (36%) and the **A36/A46 link east of Bath** (35%). However, a greater proportion of respondents remained neutral or did not know (39% and 44%) and the remaining respondents disagreed/strongly disagreed with these measures (25% and 21%).

5.19 Respondents aged between the ages of 16 and 34 were less likely to agree with these measures than any other age group. For example, only 28% agreed/strongly agreed with improved North-South links in South Gloucestershire compared to 35% of people aged 35-54, 40% of those aged 55-64 and 39% of those aged over 65. Even fewer (22%) agreed/strongly agreed with improvements to the A36/A46 link east of Bath compared to >40% for respondents over 35. In addition, significantly more males agreed with both measures compared to females (39% compared to 28% for North-South links in South Gloucestershire); and 42% compared to 25% for the A36/A46 east of Bath).

5.20 Again, there was a higher level of support in the postal survey for these improvements. Only 28% of web respondents strongly agreed/agreed with north–south links in South Gloucestershire (compared with 43% of postal respondents) and 29% for the A36/A46 link east of Bath (40% of postal respondents).

5.21 Of all the ideas presented, respondents were least likely to agree with the idea of improvements to the **Severnside Spine Road**. Only 30% agreed/strongly agreed with this measure, 32% remained neutral, 25% disagreed/strongly disagreed and the remaining 13% of respondents stated that they did not know. Again, respondents
under 34 were less likely to agree than those in the older age groups (27% compared to 29% of those aged 35-54, 33% of those aged 55-64 and 35% of those aged over 65).

5.22 Female respondents were less likely (20%) than males (34%) to agree/strongly agree with the improvements. Respondents over the age of 65 were less likely to disagree with this measure than any other age group (18% compared to ~27%). Only 22% of web respondents strongly agreed or agreed with the improvements, compared with 37% of postal respondents.

CONCLUSIONS

5.23 The feedback from both key stakeholders and the general public would suggest that road building alone would not be sufficient to meet the future needs of the sub-region.

5.24 Stakeholders indicated that certain improvements would be important, including improving accessibility around south Bristol, to complement tackling congestion in central Bristol. Road construction should, however, only form one part of a package of improvements to improve accessibility. The constraints imposed by the high quality environment to the south of Bristol were also noted, and would need to be taken into account in developing proposals in the area.

5.25 The responses from the surveys also demonstrate that the general public have particular priorities for road improvements. The highest level of support is given to improved links to the M4 (at Emersons Green), improved links to the M5 (both south of Bristol and in South Gloucestershire) and improved access around the south of Bristol (in the form of the Avon Ring Road).

5.26 Again, the responses show widespread differences in the level of support between different groups, with males and older people consistently more likely to be supportive of the different highway improvements identified. It will therefore be necessary to take into account the views of different social groups if ideas are to be further developed.
6. Emphasis on Preferred Strategy

SURVEYS

6.1 Respondents were asked to state what emphasis should be placed on a number of themes in the preferred strategy. The results are detailed in Figure 6.1 and described in further detail below.

Figure 6.1 – Level of support for transport elements in preferred strategy

6.2 As illustrated in Figure 6.1, respondents agreed that the strongest emphasis in the preferred strategy should be on public transport. Rail measures were felt to be slightly more important than bus measures: 89% of respondents agreed/strongly agreed that emphasis should be placed on rail, compared to 87% for bus).

6.3 No significant differences were noted when analysing respondents by age, although female respondents were slightly more likely to agree with bus and rail measures than males (97% compared to 82% for bus and 94% compared to 85% for rail).

6.4 Interestingly, given the results presented in Chapter 3 (Figure 3.1), just under three quarters of respondents (74%) agreed/strongly agreed that the preferred strategy should include rapid transit. Of the remaining 26%, 17% gave a neutral response, and 8% disagreed/strongly disagreed.
6.5 No significant differences were noted when analysing responses by age, although females were slightly more likely than males to agree that emphasis should be placed on rapid transit measures (80% compared to 72%).

**Better Roads**

6.6 Just over half of respondents (52%) felt that emphasis should be placed on better roads to the south of Bristol, although over one quarter (28%) disagreed/strongly disagreed with this measure, and 18% remained neutral; and 2% did not know. Male respondents were significantly more likely than females to agree or strongly agree with this measure (57% compared to 37%). Respondents over the age of 55 were more likely to agree than those in the younger age groups: 59% of those aged 55-64 and 60% of those aged over 65 agreed/strongly agreed, compared to <47% for the younger age groups. In addition, reflecting the younger age profile of respondents to the web survey, only 44% of website respondents agreed or strongly agreed, compared to 57% of postal responses.

6.7 Respondents felt that less emphasis should be placed on better roads to the north of Bristol. Only 42% agreed/strongly agreed, one quarter (25%) of respondents remained neutral, and just less than one third (29%) disagreed/strongly disagreed. Further analysis by age and gender shows similar trends to those described above. For example, respondents over 55 were more likely to agree with this measure than other age groups (~46% compared to <39%). Again, male respondents were more likely to agree with this measure than females (46% compared to 31%).

**Managing Demand**

6.8 Approximately half of respondents agreed that emphasis should be placed on controlling demand for travel by car. Parking controls elicited slightly higher levels of support than road user charging. For example, 51% agreed/strongly agreed with parking controls compared to 44% for road user charging. Approximately one third of respondents disagreed/strongly disagreed with both measures (30% and 34%) and the remaining respondents remained neutral or stated that they did not know.

6.9 No significant differences were noted when analysing responses by age and gender.
7. Other Travel Issues

SURVEYS

7.1 At the end of the survey questionnaire, respondents were given the opportunity to express additional comments and opinions.

7.2 The responses were separated into web and postal comments, and then subdivided into the following subject areas for analysis:

- Roads;
- Rail;
- Bus;
- Cycling;
- Public Transport generally;
- Rapid Transit / Tram;
- Parking;
- Road user / congestion charging;
- The environment; and
- Other.

7.3 The results are illustrated in Figure 7.1 and described in further detail below.

Figure 7.1 – Evaluation of Additional Comments

Comparison of Responses - Numbers

7.4 Overall, the number of responses was split evenly across all of the subject areas, with one exception. The study team received multiple copies of a letter forwarded by cycling groups to their members via our website (www.gbsts.com). It is likely that
many of the members also completed the on-line questionnaire and, as a result, comments relating to cycling comprised 11% of the website comments, compared to only 5% of the postal totals. Overall, this related to 8% of the combined responses (web and postal), which called for consideration to be given to the role of cycling within the transport strategy to be developed by GBSTS.

7.5 The largest number of comments received (17%) related to local and strategic roads. Further analysis reveals the following three major themes:

♦ Completion of the Avon Ring Road;
♦ Road building will result in more traffic and congestion; and
♦ Improved access to Bristol International Airport.

7.6 Other concerns related to local bypass schemes, such as Banwell, and the desire to stop HGVs travelling through villages.

7.7 Fourteen per cent (14%) of responses related to public transport in general, with an additional 23% relating specifically to bus (12%) and rail (11%). Respondents called for an improved public transport network, with cheaper fares, more integration and wider network coverage.

7.8 A large proportion of respondents commented on the fact that many of the buses in the study area are expensive to use, unreliable, dirty and unwelcoming. Several people called for First to be abolished, or for a rival operator to be introduced to provide competition. Comments relating to rail focused on improved and more frequent services and the re-opening of the Portishead Branch Line.

7.9 Seven per cent of the total number of comments related to Road User Charging, which is surprisingly low given the attention given in the leaflet and the fact that it is considered to be a potentially contentious issue. There was a 50/50 split between those who supported the concept and those who were against. Concerns were raised that this could affect the poorest members of society the most and that any funds raised must be ring fenced and used for improvements to the transport infrastructure. Several people called for an improvement in public transport before any charging is introduced, thereby allowing people to make a proper modal choice.

7.10 Similar numbers of comments related to Park and Ride, the majority of which remained largely supportive of new sites serving Bristol, Bath and Weston-super-Mare. Several people said that they would welcome more sites or an extension of operating hours for existing sites. It was noted, however, that town centre parking must continue to be provided, especially for short trips or those with restricted mobility.

7.11 Only 4% of comments specifically related to Rapid Transit or Trams. All but one of these called for the introduction of a modern tram system, and possible conversion of some suburban heavy rail lines (e.g. Severn beach). One respondent wished for the plan to be scrapped, although no reasons were provided.
7.12 Another 4% of comments related to environmental issues. These were evenly split between the need to protect the green belt, and a general concern that global warming and the Kyoto protocols are not being considered by the study.

7.13 In addition to the categories outlined above, a number of additional comments were received, which generally focused on individual opinions on the performance of the local authorities, the difficulty in accessing travel information and the need to consider transport and new development in parallel. A selection of these comments is illustrated below:

- “Be radical – stop talking and start doing"
- “Lift share schemes? Possibly encouraged by priority on the roads e.g. the right to drive in certain lanes if you have more than one passenger or use alternative signalling at junctions"
- “Anti-car is politically motivated foolishness"
- “2026 vision is good - let’s get on with it!”
- “Bristol is full up - the government should send everyone north!”
- “Make reliability a top priority - biggest problem presently”
- “Land use regeneration and local job provision is vital for reducing the need for trips. - JOINED UP THINKING"
- “Encourage High Street shopping - low rents, and discourage supermarkets and retail outlets.”
- “Improve north/south links in Bristol”

**WEBSITE EMAILS**

7.14 A total of 158 emails were received via our website email address (info@gbsts.com). A large proportion of these were general requests for information, all of which were logged and responded to, as appropriate, by members of the study team.

7.15 All other comments were subdivided into the categories used for the web/postal questionnaire analysis, and the results are detailed in Figure 7.2.
7.16 As previously discussed, just under half (74) of the emails received were copies of a letter forwarded by cycling groups to their members. This would indicate the importance given by the cycling community to this consultation process, and the need for the preferred strategy to give proper consideration to the role of cycling (and walking) in the long-term travel needs of the sub-region.
Executive Summary

Background to the Study

The Greater Bristol Strategic Transport Study (GBSTS), undertaken by the consultant team led by Atkins, developed a series of transport strategies for the Greater Bristol sub-region covering the period to 2031, with intermediate years of 2011, 2016 and 2021. This report outlines the development and appraisal of the transport strategies.

GBSTS has its origins in the London to South West and South Wales Multi-Modal Study (SWARMMS) which explored the needs to 2016 of the main east-west transport corridors between London/South East and the South West. Within SWARMMS, insufficient time was available to deal in detail with the complex issues of the Greater Bristol sub-region. GBSTS followed on from SWARMMS, with the objective of fulfilling this requirement, building and drawing on the work undertaken by SWARMMS, but not constrained by it.

The principal partners for the study included:

♦ Department for Transport/Government Office for the South West;
♦ South West Regional Development Agency;
♦ Highways Agency;
♦ Bath & North East Somerset Council;
♦ Bristol City Council;
♦ North Somerset Council; and
♦ South Gloucestershire Council.

The study has been guided by a Key Stakeholder Advisory Group (KSAG) drawn from representative organisations with an interest in transport planning and operations in the study area. In addition to the study partners listed above, the KSAG included:

♦ South West Regional Assembly;
♦ Business West;
♦ Joint Strategic Planning and Transportation Unit;
♦ Strategic Rail Authority (until June 2005); and
♦ Sustainability South West.

In brief specified that GBSTS should:

♦ develop a series of integrated multi-modal transport strategies over time (detailed strategies for 2011 and 2016 and broader, high level, strategies for 2021 and 2031) for the study area identifying, analysing and appraising solutions on the national strategic transport networks, on the local strategic transport networks and at the interface between them, so as to improve strategic transport movements into, out of and through the study area;
♦ develop transport strategies that support existing economic activity, continue sustainable development and assist economic regeneration of urban areas and the wider process of urban renewal within the study area; and
♦ reduce the impact of transport on the environment.

Furthermore, in developing and appraising the strategies, the study was required to ‘make focused and realistic recommendations on transport policy and infrastructure provision across all modes and networks, focusing on the period to 2016 and taking full account of potential funding and deliverability constraints’. Hence, the strategies that are developed need to be both affordable and implementable.

**Growth in the Demand for Travel**

The development of the GBSTS transport strategy up to 2031 was based on significantly increased demand for travel, of which a key factor was the projected growth in population and employment within the Greater Bristol area, with the associated rise in freight movements. Working with the West of England Partnership, GBSTS prepared travel forecasts for 2031 based on 138,000 extra dwellings in the study area, equivalent to population growth of 245,000 from the existing 990,000. For employment, the forecast increase was 95,000 jobs in addition to the current workforce of about 500,000.

The additional dwellings were split between 78,000 on brownfield sites in existing built-up areas and 60,000 on greenfield sites formed by extensions to the principal urban areas, particularly Bristol and Weston-super-Mare. Further travel would be generated by growth in activity at BIA with air passenger numbers rising from the current 4 mppa to 12 mppa by 2031 with an associated increase in employee levels.

The growth in travel demand resulting from the increased population and employment would be significant. However, the growth is constrained by the limited capacity on the transport system which results in the suppression of some journeys. Nevertheless, even with some suppression, the additional demand creates severe problems for the operation of the transport network. By 2031, the study forecast a 34% rise in the number of vehicle trips on the road system in the morning peak but the limited capacity results in a 35% drop in average speeds from 44 km/hour to 28 km/hour and an increase in delay of 230%, indicating a large-scale growth in congestion. The rise in traffic occurs particularly on the motorway network, with a further 3000 passenger car units in the peak between 2003 and 2031 across the M5 Avonmouth Bridge and between Junctions 19 and 20 of the M4. Bus operators experience the impact of increased congestion on the road network with bus speeds dropping between 20% and 40%. Consequently the car mode share rises from 88.8% in 2003 to 90.8% in 2031. The decline in bus use is offset to a limited extent by an increase in rail patronage, although the restricted coverage and capacity on the rail system constrains the growth in passenger levels with a significant rise in crowding on trains.
The series of transport measures designed to cater for and accommodate the projected growth in demand for travel are outlined below and summarised on the attached diagram. The measures are considered in the following sequence which reflects the strategy development and appraisal process:

- encouraging the use of alternative modes;
- management of travel demand;
- public transport improvements; and
- highway measures.

**Measures to Encourage the Use of Other Modes**

Before embarking on measures that are potentially costly in resources or finance, in developing the transport strategy it was important to explore measures which are designed to influence the decision to make a journey to a particular destination or to encourage the use of alternative modes.

The transport strategy has been prepared against a background of significant developments in population and employment. The design and implementation of the new developments should be planned so as to reduce the total volume of travel and encourage the use of alternative modes to the car. Such policies should include the concentration of developments within transport corridors easily served by public transport; the creation of a mix of developments so that more activities are easily reached by walking or cycling; and an increase in the density of development such that there is a choice of facilities within a reasonable distance. Furthermore, the design of developments (especially major residential schemes), should pay particular attention to their operation in the most sustainable way.

Although detailed schemes to enhance walking and cycling are outside the scope of a strategic study like GBSTS, there are nevertheless benefits to be achieved from providing attractive schemes and facilities to encourage greater levels of these activities. At the same time, other policies, such as demand management or ‘Smarter Choices’ will encourage the use of alternative modes in general and hence will stimulate walking and cycling, if the supplementary measures are in place.

The expansion of initiatives under the heading of ‘Smarter Choices’ can have a positive impact on the overall volume of travel and the level of car use. Some of the policies contained in ‘Smarter Choices’ are within the responsibility of the public sector including workplace travel plans, school travel plans, car sharing schemes and car clubs. The unitary authorities within the Greater Bristol area already actively pursue these measures, and it is vital that renewed and enhanced efforts are made to expand their coverage. This will require a continuous application of resources to maintain the impetus and continue the level of benefits. The impact of ‘Smarter Choices’ would be strengthened and supported by other policy measures such as demand management which would provide further encouragement for the use of alternative modes. It is estimated that a comprehensive policy of ‘Smarter Choices’ combined with other complementary measures could reduce person trips in the study area by car by around 10%. Other elements of ‘Smarter Choices’ could include teleworking, tele-conferencing and home shopping; while these features would contribute to the use of alternative modes, much of the initiative behind them would come from market forces,
with the savings and benefits obtained by the private sector. Hence, because they are generally outside the control or influence of local authorities, their promotion is not included in the GBSTS transport strategy.

It will be important to develop the full potential of the range of approaches to encourage alternative modes before embarking on major infrastructure developments. However, there needs to be awareness that continued promotion of the measures is necessary if the full impact is to be achieved and maintained and therefore resources must continue to be allocated to ‘Smarter Choices’ in the future.

**Demand Management**

Within the transport strategy, it is important to include measures designed to control or manage the level of demand for travel by car across the study area. A number of measures to manage demand are available for implementation now and concentrate on varying the availability and cost of parking. The policies need to be adjusted and refined in order to reflect the growth in car traffic, by increasing charges, controlling the number and availability of spaces, raising enforcement, introducing controlled parking zones, exploring ways of controlling parking at Cribbs Causeway and introducing stringent parking standards. The expansion and variation of parking policy measures also need to take into account the potential impact on economic activity, especially within city and neighbourhood centres, in order to ensure that the prosperity of the centres is maintained.

The range of additional policy instruments to manage traffic demand includes workplace parking charges. Although there are potential limitations to the impact that such measures may have, it remains a possible tool for introduction in areas outside the scope of existing parking policy, e.g. the North Fringe, and hence should be examined further. The introduction of workplace parking charges would strengthen the operation of workplace travel plans.

However, the most effective additional form of demand management is likely to be some type of road user charging. The study has identified a number of potential charging mechanisms, including bridge tolls, cordon charging, motorway tolls, supplementary licences, congestion charging and distanced-based charging. In the longer-term, the study believes that the most effective form of demand management would be an area-wide charge. However, it is unlikely that such an approach would be feasible until later in the study’s horizon and hence it is important to explore charging systems that provide the opportunity for more immediate implementation. A cordon-based charge would be the most appropriate technique and the initiative by unitary authorities within the Transport Innovation Fund should be taken forward as quickly as possible.

The study does not believe that the introduction of tolls on the motorway network would produce overall benefits with the likelihood that such a system would encourage the diversion of traffic onto the uncharged local roads, generally unsuitable for the traffic volumes, and with only a small change in the overall level of traffic across the study area. For many of these journeys, there is a lack of an attractive public transport alternative. Hence, an area-wide road user charging system would be the most suitable long-term approach. We have examined alternative forms for the area-wide road user charging scheme and believe that the most appropriate is one in which the charge varies with the
level of congestion. As highlighted earlier, the benefits from charging are greater where the congestion is more severe. By varying the charge in line with the level of congestion, it is therefore possible to optimise the level of benefits. It is estimated that, with such a variable charge in 2031, it would be possible to reduce total vehicle delay across the study area by 20% and increase vehicle speeds by 9% for a lower average charge (14p/mile) than with a simple distance based charge of 50p/mile on all roads in the study area.

Public Transport Improvements

The study has examined a wide range of potential improvements to the public transport system in order to cater for the general growth in the demand for travel across Greater Bristol. The particular components of the public transport measures within the transport strategy range from improvements to the local bus services through to an expansion of the rail network.

Improvements to urban bus services would be a main focus in the strategy for enhancing the public transport system in the short to medium term. The Showcase bus corridors which form the Greater Bristol Bus Network are the subject of a Major Scheme Bid within the Local Transport Plan process and include a package of measures with junction improvements providing priorities for buses, new bus lanes, improved bus shelters, real-time passenger information and new low-floor buses. It is important that the Greater Bristol Bus Network is introduced as soon as practical.

Extensions to the park and ride system would involve expansion at the existing sites in Bristol and Bath to increase the capacity and improve the facilities. New sites are also identified in the strategy at Emersons Green, Hambrook, Whitchurch, Nibley and Lambridge.

The detailed consideration of inter-urban bus services is outside the main scope of GBSTS. Nevertheless, it is possible to identify new connections that would be necessary following the new population and employment developments across the study area. In addition, extensions to the highway network will provide the opportunity to offer service improvements such as journey time cuts and reliability gains on existing routes or through a re-routeing of services. The network of services will need to be reviewed in association with the priority measures in the Greater Bristol Bus Network together with the introduction of rapid transit routes and improvements to rail services.

Extensions to the coach services in the strategy would be a combination of enhanced operations through the use of priority measures within the Greater Bristol Bus Network together with potential new stopping locations outside city centres at the new Worle Parkway Interchange, Lambridge Park and Ride and in north Bristol at Parkway/UWE/Hambrook.

A particular growth area of future travel is BIA and public transport access to the airport must be enhanced to accommodate the growth in both air passengers and workers at the airport. The strategy identifies the current Flyer service as the foundation for future expansion, with increased frequency on the existing route together with expansion to serve north Bristol (Parkway) and Worle Interchange (for both Weston-super-Mare and the wider South West region). To cater particularly for the airport workers, a demand-responsive or shared taxi operation would be the most appropriate means of serving the widespread destinations.
The strategy identifies a number of public transport interchanges which should be developed outside town or city centres to serve local developments, including Worle Parkway (with multi-modal activity), UWE (serving the North Fringe), Yate and Filton Abbey Wood rail stations.

A major area of new development for the public transport system involves the network of rapid transit lines which would build on the priority measures within the Greater Bristol Bus Network to produce a system with further priorities including segregation from general traffic wherever possible. The lines would be designed to serve many of the new residential and employment developments, with the initial plans comprising:

- Ashton Vale – Emersons Green;
- Hengrove – North Fringe/Cribbs Causeway;
- Bath – Cribbs Causeway; and
- Whitchurch – Avonmouth/Portishead.

An early element of the rapid transit network would operate in Bath between Lambridge and Newbridge as part of the Major Scheme Bid which is being prepared within the JLTP process.

Further work is required to identify the type of vehicle used to operate the service but modern, low-floor, articulated buses are likely to be the most appropriate, flexible and cost effective vehicles to satisfy the requirements of the service. Further work is also necessary to specify the precise routes, taking into account the desire for significant levels of segregated operation.

The rail network within Greater Bristol represents a potential resource capable of wider and more intensive use although there are limitations brought about by the number and location of existing rail lines. The restricted penetration of the rail network into the city centres of Bristol, Bath and Weston-super-Mare and the poor links to the North Fringe contribute to low levels of current rail use, with just 2% of journeys in the morning peak period.

A range of measures has been identified to improve and expand the rail network, taking into account the availability of resources within the industry:

- improved rolling stock providing increased capacity and speed enhancements on the local rail services;
- additional facilities at Bristol Parkway with initially three and ultimately four platforms to increase capacity and improve reliability;
- expanded facilities at Worle station to create a major interchange location, including platform lengthening and an expansion of services;
- new turn-back facilities to enable more trains to operate to/from Weston-super-Mare and Yate; and
- increased services across Bristol linking Weston-super-Mare, Yate and Bath Spa – in view of the restrictions in turning trains at Bath Spa, it may be necessary to extend the local services to Westbury to provide better connections between the west Wiltshire towns of Trowbridge and Bradford-on-Avon and the employment centres of Bath and Bristol.
Although some of the improvements could be introduced in the short-medium term, the full extent of service increases would be dependent on the re-signalling of the Bristol area which is likely to be completed by 2018.

**Highway Measures**

The approach adopted within the study for the development of the transport strategy concentrated on examining and promoting alternatives to the private car before considering improvements to the highway network. This was designed to ensure that highway measures are only considered after all other possibilities have been explored. Within the highway improvements themselves, the emphasis was placed on making best use of the existing infrastructure before examining the need for schemes which increase highway capacity.

The examination of highway improvements was undertaken against the background of significant growth in the demand for travel in line with a 25% rise in population and 20% growth in employment by 2031. The identification of enhancements to highway capacity took direct account of the location, scale and timing of these developments; in some cases, additional highway infrastructure is necessary to connect new developments into the existing network.

The emphasis in identifying measures to make best use of the highway network in the study area concentrated on the existing infrastructure and capacity on the motorway and major trunk roads, although many of the measures are also suitable for the local network:

- **planned maintenance** should continue to be programmed to minimise disruption by avoiding periods of peak daily and seasonal flows, including the main summer holiday periods;
- wider measures to **reduce incidents** through better driving training, increased enforcement, stricter penalties and greater use of advanced warning signs;
- continued development of **incident management** by speeding up detection, evidence collection and documentation, incident clear-up and the initiation of diversionary routes; and
- wider application of **signing, surveillance and automated systems** including active traffic management techniques.

The assessment of capacity enhancements across the study area's highway network considered a number of potential new schemes and appraised the full range of impacts before developing a preferred package of improvements. The identification of schemes concentrated on those which would have a direct impact on the strategic highway movements across the study area. The schemes within the strategy would not be the only highway measures which would generate potential enhancements; local measures, outside the scope of GBSTS, could also have merits but would need to be progressed separately by the local authorities. Hence, the schemes identified in the strategy are concentrated on the strategic highway network in the area.

The principal schemes which the study recommended should be taken forward included:
South Bristol experiences severe congestion on the constrained highway network in the area together with restricted accessibility to other parts of the study area, particularly the new employment areas of the North Fringe. Accessibility would be enhanced by extension of the Avon Ring Road with an indicative alignment from the junction with the A4 at Hicks Gate, following a new alignment south-west of Whitchurch to the A37, then running south of Hengrove before heading north to junction at Hartcliffe Way and Hengrove Way and finally, following an on-line alignment through Withywood before skirting Highridge Common to the A38. The scheme produces significant benefits through reduced delays across south Bristol, creating major new connections between south Bristol and the major employment areas. The scheme shows a strong economic performance with NPV of £950 million and BCR of 16.

A38 – A370 Link
Extension of the South Bristol Ring Road from A38 through to the A370, with the study’s preferred alignment following the path of the earlier Red route. The scheme provides relief to the congestion on the B3130 through Barrow Gurney and produces a strong economic performance with NPV of £70 million and BCR of over 8.

Links between south Bristol and M5
Current congestion levels on the highway network on the approaches to south Bristol from the south west would be exacerbated by planned future developments in housing and employment together with growth at BIA. The study identified alternative schemes to improve the connections to south Bristol and from the M5 motorway and the South West. The northern route would link M5 Junction 20 to the A370 near Long Ashton along an alignment to the north of the B3130 and would include bypasses for Nailsea, Tickenham and Wraxhall. The southern route would link M5 Junction 21 at Weston-super-Mare with BIA and northwards to the A370 with a bypass of Barrow Gurney. Outline alignments for the schemes have been identified for the purposes of the appraisal but considerable detailed work is necessary in order to identify potential environmental and other constraints. Both alternatives have strong transport economic case with a NPV of £270 million and a BCR of over 5 for the Junction 21 route and a NPV of £160 million and BCR of 3 for the Junction 20 option.

Improvements to M5 Junction 21
Current conflict at this junction, between traffic wishing to access the M5 and through movements on the A370 between Weston-super-Mare and Congresbury/south Bristol, will worsen with future growth in traffic. The most effective approach identified by the study is to separate the two movements by constructing a replacement junction to the south of the current Junction 20 which would be accessed by a new link to the A370 in Weston-super-Mare. The existing Junction 20 would be closed for access to the M5 and would therefore be restricted to A370 traffic alone. The scheme produces a strong economic performance with a NPV of £150 million and a BCR of 3.

M4 Widening between Junctions 19 and 20
The need to increase the capacity from three to four lanes in each direction on this section of the motorway was highlighted by forecast traffic flows consistently exceeding 85% of current capacity. Considerable journey time savings are achieved producing a NPV of £350 million. Due to an increase in distances travelled and a rise in vehicle operating costs, there is a growth in government indirect tax revenue which produces a negative BCR (-5). Despite this anomaly, the overall scheme performance is strong.
♦ M5 Juncions 16 and 17 and M32 Junction 1
Problems at Junction 16 are created by a combination of high traffic levels to/from Aztec West and the North Fringe, conflicts between through traffic on the A38 and motorway access/egress and the proximity of Junction 16 with Almondsbury Interchange. Junction 17 serves the Cribbs Causeway regional shopping centre as well as other local destinations and experiences significant congestion, particularly on Saturdays. High traffic volumes through M32 Junction 1 create peak period congestion difficulties, exacerbated by the proximity to M4 Junction 19. Schemes to improve the operation of these junctions have been identified including the enhancement of the on and off slip roads and changes to the local road network and produce benefits to traffic movements. A more detailed assessment of operation of the junction is required, which is outside the scope of the study, before a full appraisal of the scheme can be completed.

♦ Second Avon Crossing
M5 between Junction 18 and 19 is one of the few crossings of the River Avon and is a critical section of the region’s strategic road network. Incidents on this section have a widespread impact across the region and traffic levels are influenced by high levels of local traffic including movements to, from and between the two port areas on opposite banks of the river. The proposed second crossing would relieve the motorway and its junctions and improve access to Portishead and Avonmouth. The study has identified a potential low level crossing including an opening bridge or barrage which, in addition to carrying normal traffic, would also include a rapid transit link to Portishead. Because the scheme runs parallel to existing infrastructure, the journey time savings are low with a NPV of £30 million and BCR of 1.6 although this excludes the benefits from rapid transit and the improved resilience of the highway network.

♦ A36 to A46 Link Road
The link road was recommended for further development by the earlier Bristol Bath to South Coast study. Located to the east of Bath, it produces significant benefits within Bath, through reduced congestion in the city on the A4 and A36, and traffic relief in the west Wiltshire towns of Trowbridge and Bradford-on-Avon. The overall economic performance is strong with a NPV of £700 million and BCR of 27 but there are significant environmental impacts which will need to be considered in the further development of the scheme.

♦ Winterbourne and Stoke Gifford Bypasses
The scheme provides substantial relief to roads in the North Fringe including A38 and B4057 Winterbourne Road. The majority of the benefits occur south of the M4 and the northern section does not significantly add to the benefits and hence should not be progressed unless there are changes to developments in the area. The Stoke Gifford bypass and southern section of the scheme produces a NPV of £260 million and BCR of 8 and hence should be progressed further.

A number of additional schemes for highway capacity improvement were examined but were not included in the GBSTS strategy.

♦ M4 to A4174 Link Road
The potential alignment for the scheme would involve close inter-relationship with M4 Junction 19 and a number of alternative designs were examined with the most effective being the construction of a new M4 junction (18A) with access limited to motorway traffic to/from the east and closure of the east-facing slip roads at the existing Junction 18.
Such a scheme in isolation recorded a NPV of £270 million and BCR of 12 but the generation of additional traffic on the M4 to the east of the new junction would create the need to add an additional lane on the M4 through to Junction 18 and hence the scheme was not recommended by the study.

- **A4 Saltford Bypass**
  The scheme would relieve the congestion from traffic passing through the village but would involve high construction costs due to the terrain through which it would pass. Hence, the scheme’s economic performance, with a NPV of £17 million and BCR of 1.2, does not justify its inclusion in the strategy; although it produces some local relief, the strategic benefits are limited.

- **A37 Whitchurch Bypass and Callington Road Link**
  These two schemes were identified as providing local relief to the highway network rather than having a strategic impact and hence were not included in the strategy although they produced a reasonable economic performance. Some of the benefits from the Whitchurch bypass would be achieved by the wider South Bristol Ring Road.

- **Clutton and Temple Cloud Bypass**
  The construction of bypasses for the two neighbouring villages on the A37 would provide local relief but would not have a strategic impact.

- **Banwell, Churchill and Sandford Bypasses**
  The three adjacent communities on the A371, A368 and A38 experience local congestion which is exacerbated by the restricted capacity through the village centres. The study examined the impact of a series of bypasses to provide relief to the villages and identified that, because the use of bypasses would increase the length of journeys, the net impact of the schemes was diminished such that the overall NPV was -£2 million with a BCR of 0.96. The scheme was therefore considered to have local rather than strategic merits and was not included in the GBSTS strategy.

- **M49/Severnside Intermediate Junction**
  Projected increases in employment within the Severnside area are not sufficient to justify the potential highway improvements which include a new junction on the M49 and construction of a Spine Road through the main development area. While there are potential travel time savings for traffic to/from Severnside, the volume of traffic is small and the benefits do not justify the high scheme costs.

### Freight Aspects

Although the movement of freight was not identified as a major feature of the GBSTS, measures designed to relieve particular congestion locations will also generally benefit goods traffic whether on the road or rail network. Other measures with a specific freight interest have been identified within the study, although a detailed appraisal has not been undertaken:

- review of the consolidation trial for goods deliveries to Broadmead area, with potential expansion in terms of types of goods covered and the extent of the area served;
- increased publicity for freight routes within and through the area and the facilities available to HGV drivers; and
accommodation of potential expansion in rail freight opportunities from Royal Portbury and Avonmouth Docks.

**Appraisal of the Strategy**

The contents of the GBSTS strategy and their impacts have been appraised under the key headings of environment, safety, economy, accessibility and integration. The detailed appraisals are summarised in the Appraisal Summary Table for the strategy shown in the attached table which highlights the key features in the appraisal of the strategy.

**The Next Steps**

The recommendations from the study outlined in this report will be presented to the partner group comprising officers from the organisations listed earlier. Having reviewed the outcomes from the study, the officers will develop recommendations on which schemes and measures should be taken forward by their organisations, identifying a potential timetable for implementation.

The Secretary of State for Transport and elected members of the unitary authorities will then consider which schemes and measures should be taken forward. Once decisions have been made, further work will be undertaken on the schemes and measures to enable them to be entered into the appropriate programmes of the Department for Transport, the Highways Agency and the unitary authorities. The schemes and measures will then be subject to the normal statutory planning processes.

One of the key aspects will be the potential sources of funding for individual schemes. These will depend upon the characteristics of the scheme, but will include Local Transport Plan, Regional Funding Allocation, Highways Agency and Network Rail budgets together with potential contributions from local developers and possible revenues from road user charging and other demand management measures. The development and appraisal of the schemes will need to make particular reference to the requirement of the appropriate funding processes.

The Secretary of State for Transport has asked the South West region to advise him on its priorities for transport investment in the next ten years or so. The recommendations from GBSTS will assist the region to understand the benefits of the schemes and measures, in terms of supporting future prosperity in Greater Bristol by investing in transport, compared with other areas in the South West. The advice to the Secretary of State will be based on evidence from GBSTS.

The study has been progressed in an open and consultative manner and the possible options have been discussed publicly. Many of the proposals are at a very early stage in the planning process and, if the recommendations are accepted, considerable further work will be required to prepare and consult on detailed designs for the schemes, including specific route alignments.
GBSTS Final report v11

GBSTS Strategy Problems: congested road network with lack of high quality public transport options Present Value of Costs to Public Accounts £1.103M ASSESSMENT

OBJECTIVE | SUB-OBJECTIVE | QUALITATIVE IMPACTS | QUANTITATIVE ASSESSMENT | ASSESSMENT
--- | --- | --- | --- | ---
Environment | Noise | Small net decrease in the number of people annoyed by noise (based on perceptible changes in noise levels). Increase in noise levels along new highways links on strategic road network. Decreases in noise spread across the study area network. The appraisal excludes the potential impacts attributable to the use of low noise surfacing and noise barriers in new schemes which would further reduce levels of noise pollution. | Number of zones experiencing noise impact: - Increase in population annoyed – 26 zones - No change in population annoyed – 82 zones - Decrease in population annoyed – 77 zones | Net decrease in estimated population annoyed of 16,803

Local Air Quality | Gases | Reduction in emission levels of NOx and PM10 between 2003 and 2031 through increasing use of cleaner, more efficient engines and improved fuels. Further moderate improvements anticipated in 2031 by the strategy for both NOx (2%) and PM10 (4%) compared with Do Minimum. Within the local Air Quality Management Areas, there are reductions in emissions compared with 2031 Do Minimum. For NOx, reductions are 3% (Avonmouth), 7% (Bristol) and 8% (Bath) and for PM10 a 4% drop in Bath and no change in Avonmouth and Bristol. The appraisal excludes impacts attributable to possible supporting measures such as roadside emissions testing, low emission zones and the further development of low emissions technologies. | - Total annual emissions (tonnes) – NOx: - Base (2003) – 13033 - Do Minimum (2031) – 7150 - Strategy (2031) – 6880 - Total annual emissions (tonnes) – PM10: - Base (2003) – 416 - Do Minimum (2031) – 196 - Strategy (2031) – 188 | Changes in: NOx: -170 tonnes pa (-2.4% change) PM10: -8 tonnes pa (-4.1% change)

Greenhouse | Gases | A 40% (20%) reduction in CO2 emissions in 2031 making a contribution towards meeting the UK Government’s obligations under the Kyoto agreement on tackling climate change. Due to growth in development between 2003 and 2031, the level of CO2 emissions increases by 33% between 2003 and 2031 Do Minimum. | Total annual emissions (tonnes) – CO2: - Base (2003) – 2027705 - Do Minimum (2031) – 2894531 - Strategy (2031) – 2599328 | Changes in: CO2: -132503 tonnes pa (-5.0% change)

Landscape | Impacts of specific strategy measures on individual landscape designations: | N/A | Potentially large adverse impact

Townscape | Impacts of specific strategy measures on individual townscape designations: | N/A | Potentially moderate adverse impact

Heritage | Impacts of specific strategy measures on individual heritage designations: | N/A | Potentially moderate adverse impact

Biodiversity | Impacts of specific strategy measures on individual biodiversity designations: | N/A | Potentially moderate adverse impact

Water Environment | Impacts of specific strategy measures on individual water environment designations: | N/A | Potentially moderate adverse impact

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Other Government Policies

Strategy assists other Government objectives (e.g. sustainability and social inclusion) through improvements to public transport services and changes in mode split.

N/A Moderate beneficial impact
APPENDIX A

Appraisal Tables
A. Appraisal Summary Tables (ASTs), Transport Economic Efficiency Tables

A.1 This Appendix contains the detailed (TEE), Public Accounts and Summary Analysis Tables for:

- GBSTS strategy (Tables A.1 to A.4);
- GBSTS strategy with road user charging (Tables A.5 to A.8); and
- GBSTS strategy without Smarter Choices (Tables A.9 to A.12).

A.2 The values in each table refer to costs and benefits experienced over the full appraisal period (2016 to 2075) and are quoted in thousands of pounds in 2002 prices and values.
**Table A.1 – Appraisal Summary Table for GBSTS Strategy**

<table>
<thead>
<tr>
<th>GBSTS Strategy Problems: connected road network with lack of high quality public transport options</th>
<th>Present Value of Costs to Public Accounts £1,103m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OBJECTIVE</strong></td>
<td><strong>SUB-OBJECTIVE</strong></td>
</tr>
<tr>
<td>Environment</td>
<td>Noise</td>
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<td>Heritage of Historic Resources</td>
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</tbody>
</table>
## GBSTS Strategy

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>SUB-OBJECTIVE</th>
<th>QUALITATIVE IMPACTS</th>
<th>QUANTITATIVE ASSESSMENT</th>
<th>Present Value of Costs to Public Accounts £1,103M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Fitness</td>
<td>Promotion of walking and cycling measures and reduced car use through transfer to public transport would increase physical activity and fitness.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Journey Ambiance</td>
<td>Various measures potentially reduce stress for drivers (through improved journey reliability, e.g. Variable Message signs, reduced congestion) and public transport passengers (improved journey times, real-time passenger information).</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Transfer of traffic onto new higher standard roads reduces overall accident levels.</td>
<td>Annual weekday casualty levels: 2003 – 398 KSI 2031 (Do Minimum) – 385 2031 (Strategy) – 329</td>
<td>PVB £681M</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td>Improved public transport security through better facilities at stops, real-time passenger information.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Economy</td>
<td>Significant public sector expenditure, particularly on public transport and highway schemes.</td>
<td>Central Government PVC: £719M, Local Government PVC: £389M</td>
<td>PVC £1,103M</td>
<td></td>
</tr>
<tr>
<td>Transport Economic Efficiency: Business Users and Transport Providers</td>
<td>Large travel time savings, especially for freight, with smaller vehicle operating cost savings. Significant time savings for public transport operators.</td>
<td>Users PVB: £13,743M, Transport Providers PVB: £4,414M, Other PVB: £0M</td>
<td>PVB: £18,158M</td>
<td></td>
</tr>
<tr>
<td>Reliability</td>
<td>Additional highway capacity will reduce congestion and improve reliability. Extended use of Variable Message Signs will improve reliability on the motorway network.</td>
<td>Proportion of vehicle-kms below capacity: Base – 91% Do Minimum – 69% Strategy – 86%</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Wider Economic Impacts</td>
<td>Current and future population have improved accessibility to work particularly in south Bristol.</td>
<td></td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Accessibility</td>
<td>Option Values</td>
<td>Significant increase in level of public transport provision through bus, rapid transit, park and ride and rail improvements.</td>
<td>Increase in public transport capacity between Do Minimum and Strategy Rail – 20% Bus and rapid transit – 102% Park and Ride – 109%</td>
<td>Large beneficial impact</td>
</tr>
<tr>
<td>Severance</td>
<td>Individual highway schemes will increase local severance although detailed scheme design should include mitigation measures to maintain current links.</td>
<td>N/A</td>
<td>Slight adverse impact</td>
<td></td>
</tr>
<tr>
<td>Access to Transport</td>
<td>Improvement in public transport accessibility to main city/town centres. North Fringe and BIA for both public transport and highways.</td>
<td>Extra population within 60 mins – public transport Bristol city centre – 515,000 Bath city centre – 56,000 Weston-super-Mare – 53,000 North Fringe – 61,000 BIA – 62,000 Extra population within 30 mins – highways Bristol city centre – 623,000 Bath city centre – 21,000 Weston-super-Mare – 86,000 North Fringe – 210,000 BIA – 533,000</td>
<td>Large beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Accessibility for the Disabled</td>
<td>Introduction of new vehicles on bus, rapid transit and rail services with low floor access and designated areas for disabled.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td>Improved interchange through developments including expansion of interchanges (at Bristol, Bristol Parkway and UWE), enhanced network of rapid transit and rail services, increased provision of park and ride. Improved real-time information for passengers.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Land-Use Policy</td>
<td>Spatial development forecasts have been key input to strategy development process. Close liaison with West of England Partnership in preparation of Sub-Regional Spatial Strategy.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Other Government Policies</td>
<td>Strategy wastes other Government policies (e.g. sustainability and social inclusion) through improvements to public transport services and changes in mode split.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
</tbody>
</table>
# Table A.2 – Transport Economic Efficiency Table for GBSTS Strategy

(60 year appraisal period, 2016 - 2075. Figures in £,000s, 2002 prices and values. Positive values represent benefits, negative values represent costs.)

<table>
<thead>
<tr>
<th></th>
<th>ALL MODES</th>
<th>ROAD</th>
<th>BUS</th>
<th>RAPID TRANSIT</th>
<th>RAIL</th>
<th>PARK &amp; RIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONSUMER USER BENEFITS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Travel time</td>
<td>15,229,783</td>
<td>8,694,003</td>
<td>1,811,441</td>
<td>2,935,120</td>
<td>716,088</td>
<td>1,073,131</td>
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<tr>
<td>Vehicle Operating costs</td>
<td>524,213</td>
<td>587,164</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-62,952</td>
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<tr>
<td>User charges</td>
<td>-150,850</td>
<td>-447,540</td>
<td>0</td>
<td>0</td>
<td>87,872</td>
<td>208,818</td>
</tr>
<tr>
<td><strong>Net Consumer Benefits</strong></td>
<td>15,603,145</td>
<td>8,833,627</td>
<td>1,811,441</td>
<td>2,935,120</td>
<td>803,960</td>
<td>1,218,998</td>
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<tr>
<td><strong>BUSINESS USER BENEFITS</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel time</td>
<td>14,018,543</td>
<td>8,082,270</td>
<td>4,097,896</td>
<td>325,154</td>
<td>1,017,565</td>
<td>495,657</td>
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<tr>
<td>Vehicle Operating costs</td>
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<td>183,815</td>
<td>-385,005</td>
<td>0</td>
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<td>1,060</td>
<td>0</td>
<td>0</td>
<td>16,279</td>
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<tr>
<td><strong>Net Business User Benefits</strong></td>
<td>13,743,300</td>
<td>8,174,692</td>
<td>3,713,952</td>
<td>325,154</td>
<td>1,017,565</td>
<td>511,936</td>
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<td><strong>PRIVATE SECTOR PROVIDER IMPACTS</strong></td>
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<tr>
<td>Revenue</td>
<td>5,066,796</td>
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<td>0</td>
<td>668,847</td>
<td>2,761,569</td>
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<td>Operating costs</td>
<td>-652,322</td>
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<td>-76,236</td>
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<td>Investment costs</td>
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<tr>
<td>Grant/subsidy</td>
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<tr>
<td><strong>Net Private Sector Provider Benefits</strong></td>
<td>4,414,474</td>
<td>0</td>
<td>0</td>
<td>592,610</td>
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<td><strong>Net Business Impact</strong></td>
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<td><strong>PV OF TEE BENEFITS (PVB)</strong></td>
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</table>
Table A.3 – Public Accounts Table for GBSTS Strategy
(60 year appraisal period, 2016 - 2075. Figures in £,000s, 2002 prices and values. Positive values represent costs, negative values represent benefits.)

<table>
<thead>
<tr>
<th></th>
<th>ALL MODES</th>
<th>ROAD</th>
<th>BUS</th>
<th>RAPID TRANSIT</th>
<th>RAIL</th>
<th>PARK &amp; RIDE</th>
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<tbody>
<tr>
<td><strong>LOCAL GOVERNMENT FUNDING</strong></td>
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<td>Revenue</td>
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<td>-268,312</td>
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<td>Operating Costs</td>
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<tr>
<td>Investment Costs</td>
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<td>43,104</td>
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<tr>
<td><strong>Net Impact</strong></td>
<td>399,418</td>
<td>188,232</td>
<td>43,104</td>
<td>100,322</td>
<td>11,620</td>
<td>56,140</td>
</tr>
</tbody>
</table>

| **CENTRAL GOVERNMENT FUNDING** |           |           |           |               |            |             |
| Revenue                    | 0         | 0         | 0         | 0             | 0          | 0           |
| Operating Costs            | 0         | 0         | 0         | 0             | 0          | 0           |
| Investment Costs           | 0         | 0         | 0         | 0             | 0          | 0           |
| Developer Contributions    | 0         | 0         | 0         | 0             | 0          | 0           |
| Grant/Subsidy Payments     | 0         | 0         | 0         | 0             | 0          | 0           |
| Indirect Tax Revenues      | 703,417   | -35,652   | 108,216   | 453,137       | 158,915    | 18,802      |
| **Net Impact**             | 703,417   | -35,652   | 108,216   | 453,137       | 158,915    | 18,802      |

<table>
<thead>
<tr>
<th><strong>TOTAL PRESENT VALUE OF COSTS</strong> (PVC)</th>
<th>1,102,835</th>
</tr>
</thead>
</table>

GBSTS Final Report v4 APPENDICES
Table A.4 – Public Accounts Table for GBSTS Strategy
(60 year appraisal period, 2016 - 2075. Figures in £,000s, 2002 prices and values.

<table>
<thead>
<tr>
<th>ANALYSIS OF MONETISED COSTS AND BENEFITS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Exchequer Impacts</td>
</tr>
<tr>
<td></td>
<td>Consumer User Benefits</td>
</tr>
<tr>
<td></td>
<td>Business User Benefits</td>
</tr>
<tr>
<td></td>
<td>Private Sector Provider Impacts</td>
</tr>
<tr>
<td></td>
<td>Other Business Impacts</td>
</tr>
<tr>
<td></td>
<td><strong>Accident Benefits</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Net Present Value of Benefits (PVB)</strong></td>
</tr>
<tr>
<td></td>
<td>Local Government Funding</td>
</tr>
<tr>
<td></td>
<td>Central Government Funding</td>
</tr>
<tr>
<td></td>
<td><strong>Net present Value Costs (PVC)</strong></td>
</tr>
<tr>
<td></td>
<td>Overall Impact</td>
</tr>
<tr>
<td></td>
<td><strong>Net present Value (NPV)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Benefit to Cost Ratio (BCR)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>HA Benefit to Cost Ratio (BKR)</strong></td>
</tr>
</tbody>
</table>
GBSTS Strategy with Road User Charging

OBJECTIVE

GBSTS Final Report v4 APPENDICES
GREATER BRISTOL STRATEGIC TRANSPORT STUDY
Final Report

Economy

Safetyst

GBSTS Strategy with Road User Charging

TABLE A.5 – APPRAISAL SUMMARY TABLE FOR GBSTS STRATEGY WITH ROAD USER CHARGING

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>SUB-OBJECTIVE</th>
<th>QUALITATIVE IMPACTS</th>
<th>PROBLEMS: COMPETITIVE ROAD NETWORK WITH LACK OF HIGH QUALITY PUBLIC TRANSPORT OPTIONS</th>
<th>PRESENT VALUE OF COSTS TO PUBLIC ACCOUNTS £10.341M</th>
<th>QUANTITATIVE ASSESSMENT</th>
</tr>
</thead>
</table>
| Environment | Noise | Small net decrease in the number of people annoyed by perceivable change in noise levels. Increase in noise levels along new highway links on strategic road network. Decreases in noise spread across the study area network. The appraisal excludes the potential impacts attributable to the use of low noise surfacing and noise barriers in new schemes which would further reduce levels of noise pollution. | Number of zones experiencing noise impact: 
- Increase in population annoyed = 29 zones 
- No change in population annoyed = 74 zones 
- Decrease in population annoyed = 84 zones | Net decrease in estimated population annoyed of 125,300. |
| Local Air Quality | Reduction in emissions of NOx and PM10 between 2003 and 2031 through increasing use of cleaner, more efficient engines and improved fuels. Further moderate improvements achieved in 2031 by the strategy with RUC for both NOx (4%) and PM10 (3%) compared with Do Minimum. Local air quality improvement measures are limited by emissions from road transport. Local air quality assessments indicate that impacts have been reduced in areas with significant emissions. The appraisal excludes impacts attributable to possible supporting measures such as roadside emissions testing, low emission zones and the further development of low emissions technologies. | Total annual emissions (tonnes) – NOx: 
- Base (2003) – 13033 
- Do Minimum (2031) – 7150 
- Strategy with RUC (2031) – 6874 | Changes in PM10: 
- Do Minimum (2031) – 196 
- Strategy with RUC (2031) – 164 | Changes in PM10: 
- 12 tonnes pa (-6.1% change) |
| Greenhouse Gases | A moderate (8%) reduction in CO2 emissions in 2031 making a contribution towards meeting the UK Government’s obligations under the Kyoto agreement on tackling climate change. Due to growth in vehicle miles and road transport investments in other parts of the region, the level of CO2 emissions increases by 33% from 2003 and 2031 Do Minimum. | Total annual emissions (tonnes) – CO2: 
- Base (2003) – 2027705 
- Do Minimum (2031) – 2694531 
- Strategy with RUC (2031) – 2478979 | Changes in CO2: 
- 21652 tonnes pa (-8.0% change) |
| Landscape | Impacts of specific strategy measures on individual landscape designations: 
- South Bristol Ring Road – potential impacts at eastern and western ends of the route; 
- Airport Link Road – potentially significant impacts on landscape in the Avon gorge; 
- M5 Junction 17 – possible impact on local landscape designations to west of existing junction; and 
- A36 – A46 Link Road – potentially significant impact on ACNB. Remedial measures may need to be included within the design as schemes are developed. | N/A | Potentially large adverse impact |
| Townscape | Impacts of specific strategy measures on individual townscape designations: 
- South Bristol Ring Road – parts of the urban sections of the route (Bathport Ave, Hawkfield Rd, Hengrove Way, Cather Rd Link, King George’s Rd, Highridge Grn) could have potential townscape impacts; and 
- Stoke Gifford Bypass – potential local impacts. Remedial measures may need to be included within the design as schemes are developed. | N/A | Potentially moderate adverse impact |
| Heritage of Historic Resources | Impacts of specific strategy measures on individual heritage designations: 
- South Bristol Ring Road – runs through Avon Conservation Area in Higherwick and Withywood area; 
- Airport Link Road – runs very close to Scheduled Ancient Monuments at Nye, Radhill and Felton; 
- Nailsea Bypass – passes close to, but does not directly impact on, a Scheduled Ancient Monument at Withywood and listed garden at Yatefield; 
- Widening of A30 – lies close to a Scheduled Ancient Monument and runs through a narrow band of Avon Conservation Area; 
- Improvements to M5 Junction 16 & 17 – close proximity to areas of ancient woodland; and 
- A36 – A46 Link Road – runs close to Avon Conservation Area. Remedial measures may need to be included within the design as schemes are developed. | N/A | Potentially moderate adverse impact |
| Biodiversity | Impacts of specific strategy measures on individual biodiversity designations: 
- South Bristol Ring Road – runs close to small ancient woodland at eastern end; 
- Airport Link Road – skies SSSI between Nye and Congresbury; crosses Local Nature Reserve along disused rail line between Congresbury and Wincisome, runs through ancient woodland north of Wingorton; 
- Nailsea Bypass – skirts northern boundary of SSSI across Tickernham Moor; 
- Second Avon Crossing – runs close to important bird area when it crosses River Avon; 
- Improvements to M5 Junction 16 & 17 – close proximity to areas of ancient woodland; and 
- A36 – A46 Link Road – passes close to small SSSI. Remedial measures may need to be included within the design as schemes are developed. | N/A | Potentially moderate adverse impact |
| Water Environment | Impacts of specific strategy measures on individual water environment designations: 
- South Bristol Ring Road – runs close to a number of landfill sites at western end; 
- Airport Link Road – passes SSSI between Nye and Congresbury, crosses the flood plain of River Yeo to the south of Wingorton, crosses Source Protection Zones near to BIA and runs close to landfill site north of BIA; 
- Nailsea Bypass – runs through flood plain between Tickernham and Nailsea; 
- Second Avon Crossing – runs within flood plain of River Avon and at southern end near to landfill sites; 
- Widening of A30 – runs close to landfill sites; 
- Widening of M4 between Junctions 19 and 20 – lies close to landfill sites and crosses Bradley Brook; 
- Stoke Gifford Bypass – crosses small streams; 
- Improvements to M5 Junction 16 & 17 – close proximity to landfill site near Junction 17; and 
- A36 – A46 Link Road – crosses River Avon. Remedial measures may need to be included within the design as schemes are developed. | N/A | Potentially moderate adverse impact |
| Physical Fitness | Promotion of walking and cycling measures and reduced use through transfer to public transport would increase physical activity and fitness. | N/A | Large beneficial impact |
| Journey Ambience | Various measures potentially reduce stress for drivers (through improved journey reliability, e.g. Variable Message Signs, reduced congestion) and public transport passengers (improved journey times, real-time passenger information). | N/A | Moderate beneficial impact |
| Safety | Transfer of traffic onto new higher standard roads reduces overall accident levels. | N/A | PVB £923M |
| Security | Improved public transport security through better facilities at stops, real-time passenger information. | N/A | PVB £923M |
| Economy | Large revenues accruing to local authority through road user charging which offsets government expenditure. Large travel time savings, especially for freight, with smaller vehicle operating cost savings. Significant time savings for public transport operators. | Total annual emissions (tonnes) – CO2: 
- Base (2003) – 2027705 
- Do Minimum (2031) – 2694531 
- Strategy with RUC (2031) – 2478979 | Changes in CO2: 
- 21652 tonnes pa (-8.0% change) |
| Transport Economic Efficiency – Business Users and Transport Providers | Large travel time savings, especially for freight, with smaller vehicle operating cost savings. Significant time savings for public transport operators. | Users PVB: £12,845M, Other PVB £4,034M | PVB: £17,875M |
| Transport Economic Efficiency – Consumers | Large travel time savings for users but offset by suppressed trips through road user charging. | Users PVB: £6,738M | PVB: £6,738M |
| Reliability | Additional highway capacity will reduce congestion and improve reliability. Extended use of Variable Message Signs will improve reliability on the motorway network. | Proportion of vehicle-kms below capacity: 
- Base – 91% 
- Do Minimum – 69% 
- Strategy with RUC – 91% | Large beneficial impact |
| Wider Economic Impacts | Current and future population have improved accessibility to work particularly in south Bristol. | N/A | Moderate beneficial impact |
### GBSTS Strategy with Road User Charging

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>SUB-OBJECTIVE</th>
<th>QUALITATIVE IMPACTS</th>
<th>PROBLEMS: Congested road network with lack of high quality public transport options</th>
<th>PRESENT VALUE OF COSTS TO PUBLIC ACCOUNTS £ 10,341M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>Option Values</td>
<td>Significant increase in level of public transport provision through bus, rapid transit, park and ride and rail improvements.</td>
<td>Increase in public transport capacity between Do Minimum and Strategy: Rail – 20%, Bus and rapid transit – 102%, Park and Ride – 109%.</td>
<td>Large beneficial impact</td>
</tr>
<tr>
<td>Separation</td>
<td>Individually highway schemes will increase local separation although detailed scheme design should include mitigation measures to maintain current links.</td>
<td>N/A</td>
<td>Slight adverse impact</td>
<td></td>
</tr>
<tr>
<td>Access to Transport</td>
<td>Improved accessibility to main city/town centres, North Fringe and BIA for both public transport and highways.</td>
<td>Extra population within 60 mins – public transport: Bristol city centre – 524,000, Bath city centre – 58,000, Weston-super-Mare – 53,000, North Fringe – 73,000, BIA – 659,000. Extra population within 30 mins – Highways: Bristol city centre – 653,000, Bath city centre – 12,000, Weston-super-Mare – 74,000, North Fringe – 296,000, BIA – 659,000.</td>
<td>Large beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Accessibility for the Disabled</td>
<td>Introduction of new vehicles on bus, rapid transit and rail services with low floor access and designated areas for disabled.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td>Transport Interchange</td>
<td>Improved interchange through developments including expansion of interchanges at Worle, Bristol Parkway and UWE, enhanced network of rapid transit and rail services, increased provision of park and ride. Improved real-time information for passengers.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td>Land-Use Policy</td>
<td>Spatial development forecasts have been key input to strategy development process. Close liaison with West of England Partnership in preparation of Sub-Regional Spatial Strategy.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Other Government Policies</td>
<td>Strategy assists other Government policies (e.g. sustainability and social inclusion) through improvements to public transport services and changes in mode split.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
</tbody>
</table>
Table A.6 – Transport Economic Efficiency Table for GBSTS Strategy with RUC
(60 year appraisal period, 2016 - 2075. Figures in £000s, 2002 prices and values.
Positive values represent benefits, negative values represent costs.)

<table>
<thead>
<tr>
<th>CONSUMER USER BENEFITS</th>
<th>ALL MODES</th>
<th>ROAD</th>
<th>BUS</th>
<th>RAPID TRANSIT</th>
<th>RAIL</th>
<th>PARK &amp; RIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel time</td>
<td>17,502,481</td>
<td>10,431,287</td>
<td>2,189,329</td>
<td>3,092,315</td>
<td>709,724</td>
<td>1,079,826</td>
</tr>
<tr>
<td>Vehicle Operating costs</td>
<td>628,481</td>
<td>698,446</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-69,965</td>
</tr>
<tr>
<td>User charges</td>
<td>-8,394,965</td>
<td>-8,576,874</td>
<td>0</td>
<td>0</td>
<td>90,756</td>
<td>91,153</td>
</tr>
<tr>
<td>Net Consumer Benefits</td>
<td>9,735,997</td>
<td>2,552,859</td>
<td>2,189,329</td>
<td>3,092,315</td>
<td>800,480</td>
<td>1,101,014</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BUSINESS USER BENEFITS</th>
<th>Cars</th>
<th>GV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel time</td>
<td>17,195,076</td>
<td>10,077,585</td>
</tr>
<tr>
<td>Vehicle Operating costs</td>
<td>-556,978</td>
<td>201,718</td>
</tr>
<tr>
<td>User charges</td>
<td>-3,798,366</td>
<td>-1,604,085</td>
</tr>
<tr>
<td>Net Business User Benefits</td>
<td>12,839,732</td>
<td>8,675,218</td>
</tr>
</tbody>
</table>

| PRIVATE SECTOR PROVIDER IMPACTS | | | | |
| Revenue | 5,687,856 | 0 | 0 | 1,054,465 | 2,841,805 | 1,144,584 | 647,002 |
| Operating costs | -652,322 | 0 | 0 | -76,236 | -181,196 | -337,639 | -57,251 |
| Investment costs | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grant/subsidy | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Net Private Sector Provider Benefits | 5,035,534 | 0 | 0 | 978,229 | 2,660,608 | 806,945 | 589,751 |

| Net Business Impact | 17,875,265 |

| PV OF TEE BENEFITS (PVB) | 27,611,262 |
Table A.7 – Public Accounts Table for GBSTS Strategy with RUC
(60 year appraisal period, 2016 - 2075. Figures in £,000s, 2002 prices and values.
Positive values represent costs, negative values represent benefits.)

<table>
<thead>
<tr>
<th></th>
<th>ALL MODES</th>
<th>ROAD</th>
<th>BUS</th>
<th>RAPID TRANSIT</th>
<th>RAIL</th>
<th>PARK &amp; RIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOCAL GOVERNMENT FUNDING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue</td>
<td>-13,257,972</td>
<td>-13,487,844</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>229,872</td>
</tr>
<tr>
<td>Operating Costs</td>
<td>24,246</td>
<td>24,246</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Investment Costs</td>
<td>662,839</td>
<td>451,687</td>
<td>43,104</td>
<td>100,322</td>
<td>11,620</td>
<td>56,107</td>
</tr>
<tr>
<td>Developer Contributions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Grant/Subsidy Payments</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Net Impact</strong></td>
<td>-12,570,887</td>
<td>-13,011,911</td>
<td>43,104</td>
<td>100,322</td>
<td>11,620</td>
<td>285,979</td>
</tr>
<tr>
<td><strong>CENTRAL GOVERNMENT FUNDING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Operating Costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Investment Costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Developer Contributions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Grant/Subsidy Payments</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Indirect Tax Revenues</td>
<td>2,229,567</td>
<td>1,353,460</td>
<td>172,197</td>
<td>467,547</td>
<td>185,989</td>
<td>50,375</td>
</tr>
<tr>
<td><strong>Net Impact</strong></td>
<td>2,229,567</td>
<td>1,353,460</td>
<td>172,197</td>
<td>467,547</td>
<td>185,989</td>
<td>50,375</td>
</tr>
<tr>
<td><strong>TOTAL PRESENT VALUE OF COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(PVC)</td>
<td>-10,341,319</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table A.8 – Public Accounts Table for GBSTS Strategy with RUC
(60 year appraisal period, 2016 - 2075. Figures in £,000s, 2002 prices and values.

<table>
<thead>
<tr>
<th>Non-Exchequer Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer User Benefits</td>
</tr>
<tr>
<td>Business User Benefits</td>
</tr>
<tr>
<td>Private Sector Provider Impacts</td>
</tr>
<tr>
<td>Other Business Impacts</td>
</tr>
<tr>
<td><strong>Accident Benefits</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Net Present Value of Benefits (PVB)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local Government Funding</strong></td>
</tr>
<tr>
<td><strong>Central Government Funding</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Net present Value Costs (PVC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net present Value (NPV)</strong></td>
</tr>
<tr>
<td><strong>Benefit to Cost Ratio (BCR)</strong></td>
</tr>
<tr>
<td><strong>HA Benefit to Cost Ratio (BKR)</strong></td>
</tr>
</tbody>
</table>
Reliability
Additional highway capacity will reduce congestion and improve reliability. Extended use of Variable Message Signs will improve reliability on the motorway network.

Proportion of vehicle-kms below capacity:
- Base: 91%
- Do Minimum: 69%
- Strategy without Smarter Choices: 78%

Slight beneficial impact

Wider Economic Impacts
Current and future population have improved accessibility to work, particularly in south Bristol.

Moderate beneficial impact

Table A.9 – Appraisal Summary Table for GBSTS Strategy without Smarter Choices

<table>
<thead>
<tr>
<th>Environment</th>
<th>Objective</th>
<th>Qualitative Impacts</th>
<th>Problems: Congestion of network with lack of high quality public transport options</th>
<th>Present Value of Costs to Public Accountants £750m Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>Small net decrease in the number of people annoyed by perceptible change in noise levels. Increase in noise levels along new highway links on strategic road network. Decreases in noise spread across the study area network.</td>
<td>Number of zones experiencing noise impact:</td>
<td>Net increases in estimated population annoyed of 79,500.</td>
<td></td>
</tr>
<tr>
<td>Local Air Quality</td>
<td>Reduction in emission levels of NOx and PM10 between 2003 and 2031 through increasing use of cleaner, more efficient engines and improved fuels. Further small improvements achieved in 2031 by the strategy for both NOx (negligible %) and PM10 (1%) compared with Do Minimum. Within the local Air Quality Management Areas, there are reductions in emissions compared with 2031 Do Minimum. For NOx, reductions are 3% (Avonmouth), 5% (Bristol) and 6% (Bath) and for PM10 a 3% drop in Bath and no change in Avonmouth and Bristol. The appraisal excludes impacts attributable to possible supporting measures such as roadside emissions (e.g. low emission zones and the further development of low emissions technologies).</td>
<td>Total annual emissions (tonnes)</td>
<td>Changes in NOx: -33 tonnes pa (-0.5% change) PM10: -2 tonnes pa (-1.0% change)</td>
<td></td>
</tr>
<tr>
<td>Greenhouse Gases</td>
<td>A small (5%) reduction in CO2 emissions in 2031 making a contribution towards meeting the UK Government’s obligations under the Kyoto agreement on tackling climate change. Due to growth in development between 2003 and 2031, the level of CO2 emissions increases by 33% between 2003 and 2031 Do Minimum.</td>
<td>Total annual emissions (tonnes)</td>
<td>Changes in CO2: -4781 tonnes pa (-1.7% change)</td>
<td></td>
</tr>
<tr>
<td>Landscape</td>
<td>Impacts of specific strategy measures on individual landscape designations:</td>
<td>N/A</td>
<td>Potentially large adverse impact</td>
<td></td>
</tr>
<tr>
<td>Townscape</td>
<td>Impacts of specific strategy measures on individual landscape designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
<td></td>
</tr>
<tr>
<td>Heritage of Natural Resources</td>
<td>Impacts of specific strategy measures on individual heritage designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
<td></td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Impacts of specific strategy measures on individual biodiversity designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
<td></td>
</tr>
<tr>
<td>Water Environment</td>
<td>Impacts of specific strategy measures on individual water environment designations:</td>
<td>N/A</td>
<td>Potentially moderate adverse impact</td>
<td></td>
</tr>
<tr>
<td>Physical Fitness</td>
<td>Promotion of walking and cycling measures and reduced car use through transfer to public transport would increase physical activity and fitness.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Journey Ambiance</td>
<td>Various measures potentially reduce areas for delays through improved journey reliability, e.g. Variable Message Signs, reduced congestion and public transport passengers (improved journey times, real-time passenger information).</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td>Safety</td>
<td>Transfer of traffic onto new higher standard roads reduces overall accident levels.</td>
<td>N/A</td>
<td>FV£ 322M</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td>Improved public transport security through better facilities at stops, real-time passenger information.</td>
<td>N/A</td>
<td>FV£ 370M</td>
<td></td>
</tr>
<tr>
<td>Economy</td>
<td>Significant public sector expenditure, particularly on public transport and highway schemes.</td>
<td>N/A</td>
<td>FV£ 750M</td>
<td></td>
</tr>
<tr>
<td>Transport Economic Efficiency: Consumers</td>
<td>Large travel time savings for transport users, with smaller operating cost savings.</td>
<td>Users: P/V £12.21BM</td>
<td>FV£ 12.21BM</td>
<td></td>
</tr>
<tr>
<td>GBSTS Final Report APPENDICES</td>
<td>GREATER BRISTOL STRATEGIC TRANSPORT STUDY Final Report</td>
<td></td>
<td></td>
<td></td>
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</table>
### GBSTS Strategy without Smarter Choices

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>SUB-OBJECTIVE</th>
<th>QUALITATIVE IMPACTS</th>
<th>QUANTITATIVE ASSESSMENT</th>
<th>Present Value of Costs to Public Accounts £750M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accessibility</strong></td>
<td>Option Values</td>
<td>Significant increase in level of public transport provision through bus, rapid transit, park and ride and rail improvements.</td>
<td>Increase in public transport capacity between Do Minimum and Strategy: Rail – 20% Bus and rapid transit – 102% Park and Ride – 109%</td>
<td>Large beneficial impact</td>
</tr>
<tr>
<td><strong>Severance</strong></td>
<td></td>
<td>Individual highway schemes will increase local severance although detailed scheme design should include mitigation measures to maintain current links.</td>
<td>N/A</td>
<td>Slight adverse impact</td>
</tr>
<tr>
<td><strong>Access to Transport</strong></td>
<td></td>
<td>Improved accessibility to main city/town centres, North Fringe and BIA for both public transport and highways.</td>
<td>Extra population within 60 mins – public transport Bristol city centre – 476,000 Bath city centre – 58,000 Weston-super-Mare – 50,000 North Fringe – 52,000 BIA – 62,000 Extra population within 30 mins – highways Bristol city centre – 587,000 Bath city centre – 9,000 Weston-super-Mare – 9,200 North Fringe – 220,000 BIA – 471,000</td>
<td>Large beneficial impact</td>
</tr>
<tr>
<td><strong>Accessibility for the Disabled</strong></td>
<td></td>
<td>Introduction of new vehicles on bus, rapid transit and rail services with low floor access and designated areas for disabled.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td><strong>Integration</strong></td>
<td>Transport Interchange</td>
<td>Improved interchange through developments including expansion of interchanges (at Worle, Bristol Parkway and UWE), enhanced network of rapid transit and rail services, increased provision of park and ride, improved real-time information for passengers.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
</tr>
<tr>
<td><strong>Land-Use Policy</strong></td>
<td>Spatial development forecasts have been key input to strategy development process. Close liaison with West of England Partnership in preparation of Sub-Regional Spatial Strategy.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
<tr>
<td><strong>Other Government Policies</strong></td>
<td>Strategy assists other Government policies (e.g. sustainability and social inclusion) through improvements to public transport services and changes in mode split.</td>
<td>N/A</td>
<td>Moderate beneficial impact</td>
<td></td>
</tr>
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</table>
Table A.10 – Transport Economic Efficiency Table for GBSTS Strategy without ‘Smarter Choices’
(60 year appraisal period, 2016 - 2075. Figures in £000s, 2002 prices and values.
Positive values represent benefits, negative values represent costs.)

<table>
<thead>
<tr>
<th></th>
<th>ALL MODES</th>
<th>ROAD</th>
<th>BUS</th>
<th>RAPID TRANSIT</th>
<th>RAIL</th>
<th>PARK &amp; RIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONSUMER USER BENEFITS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel time</td>
<td>12,276,058</td>
<td>6,156,285</td>
<td>1,597,521</td>
<td>2,823,309</td>
<td>740,782</td>
<td>958,161</td>
</tr>
<tr>
<td>Vehicle Operating costs</td>
<td>204,735</td>
<td>254,066</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-49,331</td>
</tr>
<tr>
<td>User charges</td>
<td>-268,237</td>
<td>-515,222</td>
<td>0</td>
<td>0</td>
<td>69,400</td>
<td>177,585</td>
</tr>
<tr>
<td><strong>Net Consumer Benefits</strong></td>
<td>12,212,556</td>
<td>5,895,129</td>
<td>1,597,521</td>
<td>2,823,309</td>
<td>810,182</td>
<td>1,086,416</td>
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<tr>
<td><strong>BUSINESS USER BENEFITS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel time</td>
<td>9,896,700</td>
<td>5,351,674</td>
<td>2,746,796</td>
<td>298,464</td>
<td>1,013,070</td>
<td>486,695</td>
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<tr>
<td>Vehicle Operating costs</td>
<td>-17,144</td>
<td>121,864</td>
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<tr>
<td>User charges</td>
<td>-79,834</td>
<td>-94,501</td>
<td>859</td>
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<td>13,808</td>
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<tr>
<td><strong>Net Business User Benefits</strong></td>
<td>9,799,722</td>
<td>5,379,037</td>
<td>2,608,647</td>
<td>298,464</td>
<td>1,013,070</td>
<td>500,503</td>
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<tr>
<td><strong>PRIVATE SECTOR PROVIDER IMPACTS</strong></td>
<td></td>
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<tr>
<td>Revenue</td>
<td>4,025,577</td>
<td>0</td>
<td>0</td>
<td>423,818</td>
<td>2,655,681</td>
<td>496,583</td>
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<tr>
<td>Operating costs</td>
<td>-652,322</td>
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<td>0</td>
<td>-76,236</td>
<td>-181,196</td>
<td>-337,639</td>
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<tr>
<td>Grant/subsidy</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Net Private Sector Provider Benefits</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Net Business Impact</strong></td>
<td>13,172,977</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>PV OF TEE BENEFITS (PVB)</strong></td>
<td>25,385,534</td>
<td></td>
<td></td>
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Table A.11 – Public Accounts Table for GBSTS Strategy without ‘Smarter Choices’
(60 year appraisal period, 2016 - 2075. Figures in £000s, 2002 prices and values. Positive values represent costs, negative values represent benefits.)

<table>
<thead>
<tr>
<th></th>
<th>ALL MODES</th>
<th>ROAD</th>
<th>BUS</th>
<th>RAPID TRANSIT</th>
<th>RAIL</th>
<th>PARK &amp; RIDE</th>
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<tbody>
<tr>
<td><strong>LOCAL GOVERNMENT FUNDING</strong></td>
<td></td>
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<tr>
<td>Revenue</td>
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<td>72</td>
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<td>Operating Costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Investment Costs</td>
<td>643,450</td>
<td>432,298</td>
<td>43,104</td>
<td>100,322</td>
<td>11,620</td>
<td>56,107</td>
</tr>
<tr>
<td>Developer Contributions</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td><strong>Net Impact</strong></td>
<td>199,479</td>
<td>-11,745</td>
<td>43,104</td>
<td>100,322</td>
<td>11,620</td>
<td>56,179</td>
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<tr>
<td><strong>CENTRAL GOVERNMENT FUNDING</strong></td>
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</tr>
<tr>
<td>Revenue</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Operating Costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Investment Costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Developer Contributions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Grant/Subsidy Payments</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Indirect Tax Revenues</td>
<td>550,901</td>
<td>-23,992</td>
<td>65,858</td>
<td>434,832</td>
<td>73,164</td>
<td>1,039</td>
</tr>
<tr>
<td><strong>Net Impact</strong></td>
<td>550,901</td>
<td>-23,992</td>
<td>65,858</td>
<td>434,832</td>
<td>73,164</td>
<td>1,039</td>
</tr>
<tr>
<td><strong>TOTAL PRESENT VALUE OF COSTS (PVC)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>750,380</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>
Table A.12 – Public Accounts Table for GBSTS Strategy without ‘Smarter Choices’
(60 year appraisal period, 2016 - 2075. Figures in £000s, 2002 prices and values.)

<table>
<thead>
<tr>
<th>ANALYSIS OF MONETISED COSTS AND BENEFITS</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Exchequer Impacts</strong></td>
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</tr>
<tr>
<td>Consumer User Benefits</td>
<td>12,212,556</td>
</tr>
<tr>
<td>Business User Benefits</td>
<td>9,799,722</td>
</tr>
<tr>
<td>Private Sector Provider Impacts</td>
<td>3,373,255</td>
</tr>
<tr>
<td>Other Business Impacts</td>
<td>0</td>
</tr>
<tr>
<td><strong>Accident Benefits</strong></td>
<td>321,805</td>
</tr>
<tr>
<td><strong>Net Present Value of Benefits (PVB)</strong></td>
<td>25,707,339</td>
</tr>
<tr>
<td><strong>Local Government Funding</strong></td>
<td>199,479</td>
</tr>
<tr>
<td><strong>Central Government Funding</strong></td>
<td>550,901</td>
</tr>
<tr>
<td><strong>Net present Value Costs (PVC)</strong></td>
<td>750,380</td>
</tr>
<tr>
<td><strong>Overall Impact</strong></td>
<td></td>
</tr>
<tr>
<td>Net present Value (NPV)</td>
<td>24,956,959</td>
</tr>
<tr>
<td>Benefit to Cost Ratio (BCR)</td>
<td>34</td>
</tr>
<tr>
<td>HA Benefit to Cost Ratio (BKR)</td>
<td>20</td>
</tr>
</tbody>
</table>
APPENDIX C

Abbreviations
### C. Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AID</td>
<td>Automatic Incident Detection</td>
</tr>
<tr>
<td>AONB</td>
<td>Areas of Outstanding Natural Beauty</td>
</tr>
<tr>
<td>AQMA</td>
<td>Air Quality Management Areas</td>
</tr>
<tr>
<td>ARR</td>
<td>Avon Ring Road</td>
</tr>
<tr>
<td>ARR(S)</td>
<td>Avon Ring Road Southern Section</td>
</tr>
<tr>
<td>AST</td>
<td>Appraisal Summary Table</td>
</tr>
<tr>
<td>ATM</td>
<td>Active Traffic Management</td>
</tr>
<tr>
<td>B&amp;NES</td>
<td>Bath &amp; North East Somerset Council</td>
</tr>
<tr>
<td>BCC</td>
<td>Bristol City Council</td>
</tr>
<tr>
<td>BCR</td>
<td>Benefit Cost Ratio</td>
</tr>
<tr>
<td>BIA</td>
<td>Bristol International Airport</td>
</tr>
<tr>
<td>BIDs</td>
<td>Business Improvement Districts</td>
</tr>
<tr>
<td>BKR</td>
<td>HA Benefit Cost Ratio</td>
</tr>
<tr>
<td>BPC</td>
<td>Bristol Port Company</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed circuit television</td>
</tr>
<tr>
<td>CfIT</td>
<td>Commission for Integrated Transport</td>
</tr>
<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>DBFO</td>
<td>Design, Build, Finance &amp; Operate</td>
</tr>
<tr>
<td>DfT</td>
<td>Department for Transport</td>
</tr>
<tr>
<td>dwt</td>
<td>dead weight tonne</td>
</tr>
<tr>
<td>FQP</td>
<td>Freight Quality Partnership</td>
</tr>
<tr>
<td>GBM</td>
<td>Greater Bristol Model</td>
</tr>
<tr>
<td>GBSTS</td>
<td>Greater Bristol Strategic Transport Study</td>
</tr>
<tr>
<td>GOSW</td>
<td>Government Office for the South West</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HA</td>
<td>Highways Agency</td>
</tr>
<tr>
<td>HGV</td>
<td>Heavy Goods Vehicle</td>
</tr>
<tr>
<td>HOV</td>
<td>High Occupancy vehicle</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transport Systems</td>
</tr>
<tr>
<td>JLTP</td>
<td>Joint Local Transport Plan</td>
</tr>
<tr>
<td>JSPTU</td>
<td>Joint Strategic Planning and Transportation Unit</td>
</tr>
<tr>
<td>KSAG</td>
<td>Key Stakeholder Advisory Group</td>
</tr>
<tr>
<td>KSI</td>
<td>killed and seriously injured</td>
</tr>
<tr>
<td>LHA</td>
<td>Local Highway Authority</td>
</tr>
<tr>
<td>LPA</td>
<td>Local Planning Authority</td>
</tr>
<tr>
<td>LRT</td>
<td>Light Rapid/Rail Transit</td>
</tr>
<tr>
<td>LTP</td>
<td>Local Transport Plan</td>
</tr>
<tr>
<td>MIDAS</td>
<td>Motorway Incident Detection and Automatic Signalisation</td>
</tr>
<tr>
<td>MMS</td>
<td>multi-modal study</td>
</tr>
<tr>
<td>MOVA</td>
<td>Microprocessor Optimised Vehicle Actuation</td>
</tr>
<tr>
<td>mppa</td>
<td>million passengers per annum</td>
</tr>
<tr>
<td>NAO</td>
<td>National Audit Office</td>
</tr>
<tr>
<td>NATA</td>
<td>New Approach to Appraisal</td>
</tr>
<tr>
<td>NNDR</td>
<td>National Non Domestic Rate</td>
</tr>
<tr>
<td>NOₓ</td>
<td>oxides of nitrogen</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>NRDF</td>
<td>Network Rail Discretionary Fund</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>NSC</td>
<td>North Somerset Council</td>
</tr>
<tr>
<td>ODPM</td>
<td>Office of the Deputy Prime Minister</td>
</tr>
<tr>
<td>PDR</td>
<td>primary distributor road</td>
</tr>
<tr>
<td>PFI</td>
<td>Private Finance Initiative</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>particulate matter</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Private Partnership</td>
</tr>
<tr>
<td>PTE</td>
<td>Passenger Transport Executive</td>
</tr>
<tr>
<td>PUA</td>
<td>Principal Urban Area</td>
</tr>
<tr>
<td>PVC</td>
<td>Present Value of Costs</td>
</tr>
<tr>
<td>QBP</td>
<td>Quality Bus Partnership</td>
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<td>RDA</td>
<td>Regional Development Agency</td>
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<tr>
<td>RFA</td>
<td>Regional Funding Allocations</td>
</tr>
<tr>
<td>RFM</td>
<td>Regional Freight Map</td>
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<tr>
<td>RPD</td>
<td>Royal Portbury Dock</td>
</tr>
<tr>
<td>RPG</td>
<td>Regional Planning Guidance</td>
</tr>
<tr>
<td>RSG</td>
<td>Revenue Support Grant</td>
</tr>
<tr>
<td>RUC</td>
<td>road user charging</td>
</tr>
<tr>
<td>RUS</td>
<td>Route Utilisation Strategy</td>
</tr>
<tr>
<td>SBRR</td>
<td>South Bristol Ring Road</td>
</tr>
<tr>
<td>SCE(C)</td>
<td>Supported Capital Expenditure (Capital Grant)</td>
</tr>
<tr>
<td>SCE(R)</td>
<td>Supported Capital Expenditure (Revenue)</td>
</tr>
<tr>
<td>SGC</td>
<td>South Gloucestershire Council</td>
</tr>
<tr>
<td>SPV</td>
<td>Special Purpose Vehicle</td>
</tr>
<tr>
<td>SRA</td>
<td>Strategic Rail Authority</td>
</tr>
<tr>
<td>SRSS</td>
<td>Sub-Regional Spatial Strategy</td>
</tr>
<tr>
<td>SSSI</td>
<td>Sites of Special Scientific Interest</td>
</tr>
<tr>
<td>STP</td>
<td>School travel plan</td>
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<tr>
<td>SWARMMS</td>
<td>London to South West and South Wales Multi-Modal Study</td>
</tr>
<tr>
<td>SWRA</td>
<td>South West Regional Assembly</td>
</tr>
<tr>
<td>SWRDA</td>
<td>South West Regional Development Agency</td>
</tr>
<tr>
<td>TAG</td>
<td>Transport Analysis Guidance</td>
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<tr>
<td>TEE</td>
<td>Transport Economic Efficiency</td>
</tr>
<tr>
<td>TIF</td>
<td>Transport Innovation Fund</td>
</tr>
<tr>
<td>TPI</td>
<td>Targeted Programme of Improvements</td>
</tr>
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<td>TUBA</td>
<td>Transport Users Benefit Appraisal</td>
</tr>
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<td>UTC</td>
<td>Urban Traffic Control</td>
</tr>
<tr>
<td>UWE</td>
<td>University of the West of England</td>
</tr>
<tr>
<td>V/C</td>
<td>volume to capacity ratio</td>
</tr>
<tr>
<td>VAT</td>
<td>Value Added Tax</td>
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<td>VMS</td>
<td>variable message signs</td>
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<tr>
<td>WoEP</td>
<td>West of England Partnership</td>
</tr>
<tr>
<td>WTP</td>
<td>Workplace travel plan</td>
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