Cycling in the city regions

Annex 1: Modelling the Impact of Step Changes in the Delivery of Measures to Support Cycling in PTE Areas: Technical Report

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Executive Summary

This document reports the results of a series of modelling exercises intended to estimate the potential impact and value for money of a step change in the delivery of interventions to support and promote cycling in the six English Passenger Transport Executive (PTE) areas. The purpose of this exercise is to support decision-makers in developing effective strategies aimed at increasing cycling levels in the metropolitan areas.

The present work forms part of a larger project concerned with the potential for delivering step changes in levels of cycling in the PTE areas commissioned by ***pteg*** and should be read in conjunction with the overarching policy report which gives an overview of the evidence on the impacts of, and examples of best practice in, delivering interventions to encourage changes in levels of cycling.

Evidence exists to demonstrate that when step changes are made in cycling investment, substantial changes in travel patterns can result

- The Cycling Demonstration Towns programme showed substantial positive changes in levels of cycling following significant investment in hard and soft measures.
- The Sustainable Travel Town programme showed that substantial investment in encouraging sustainable travel more generally can also have a positive impact on cycling levels.
- The areas in which Cycling Demonstration Towns and Sustainable Travel Towns interventions were delivered all bear some comparison to PTE areas in their characteristics.

Delivery of interventions similar to those implemented in the Cycling Demonstration Towns in PTE areas could yield substantial results in terms of health, decongestion and carbon benefits

- Delivery of Cycling Demonstration Towns-type interventions could result in up to 307,000 new cyclists, making 96 million trips per year, and lifting cycling mode share from 0.8% across the PTE areas to 2.4%. Benefits accrued to these new cyclists alone could total in the region of £716 million over a ten year period. Benefit to cost ratios could be as high as 3.2:1.

Delivery of large scale programmes with a broader sustainable travel focus would also have a substantial impact on travel patterns within the PTE areas

- Delivery of interventions similar to those in the Sustainable Travel Towns could generate 16 million additional cycle trips per year across the PTE areas, with cycling representing 1.9% of all trips post intervention. Replacement of up to 71.6 million car trips per year could be achieved, with an associated decongestion and carbon savings value of up to £181.4 million.

Interventions focused on specific types of journey, such as access to rail stations, schools and workplaces, could substantially increase cycling mode share for these trips.

- For instance, interventions to overcome perceived barriers to cycling to school could result in some additional 2.5 million trips to school by cycle each year, with a benefit of up to £1.4 million.
- Interventions to improve cycle access could substantially reduce the pressure on parking and local road networks at suburban and commuter stations. Interventions to encourage those who currently drive to the station but would like to cycle to do so by investing in improved facilities at suburban rail stations could replace up to 3,000 park and ride trips across the six PTE areas every day, with potential benefits in the region of £959,000 and an estimated benefit to cost ratio in the region of 12:1. A number of on-going projects, most notably by ATOC, TfL and the PTEs may shed new light on this issue over the coming year.
- Improvements to cycle routes, provision of cycling facilities in workplaces and financial incentives to cycle to work can all substantially increase cycling's mode share**.** Across the six

PTE areas, route improvements could increase cycling's mode share for work trips from 2.2% up to around 3.4%, with annual benefits valued at up to £2.6 million. The provision of indoor parking and showers alone could increase the percentage cycling to work to 2.7%, and a £1 per day incentive to cycle to work could result in 2.9% cycling mode share, with annual benefits valued at around £1 million and £1.6 million, respectively. Estimated benefit to cost ratios could be as high as 6:1 for improvements to commuting cycle routes, 5:1 for provision of cycling facilities at workplaces. However financial incentives for cycling to work alone represent modest value for money, with costs equal to total benefits.

Introduction

1.1 Context

This document reports the results of a series of modelling exercises intended to estimate the potential impact and value for money of a step change in the delivery of interventions to support and promote cycling in the six English Passenger Transport Executive (PTE) areas. The purpose of this exercise is to support decision-makers in developing effective strategies aimed at increasing cycling levels in the metropolitan areas.

The present work forms part of a larger project concerned with the potential for delivering step changes in levels of cycling in the PTE areas commissioned by ***pteg*** and should be read in conjunction with the accompanying policy report which gives an overview of the evidence on the impacts of, and examples of best practice in, delivering interventions to encourage changes in levels of cycling[1].

Although evidence of the cost-effectiveness of investment in cycling measures is not widespread, there is a growing body of evidence suggesting that schemes that support and promote cycling can represent very good value for money. For example, analysis of the Cycling Demonstration Towns project estimated a benefit to cost ratio (BCR) based on health benefits alone of 2.5:1; when a wider range of benefits were included this became as high as 3.5:1[2]. The BCR of the Sustainable Travel towns, based on congestion benefits only, was 4.5:1[3]. Analysis of investment in the London Cycle Network found a BCR of 4:1[4]. A range of other studies have estimated value for money to be even higher for more targeted, infrastructure-oriented interventions[4, 5, 6].

1.2 Concerning the evidence available to support the exercise

Monitoring cycling levels is challenging hence there is limited robust empirical evidence on the impact of cycling interventions. There are also few estimates of value for money, especially when compared with other types of transport intervention. However, the advent of guidance for appraisal of walking and cycling schemes by the Department for Transport[6] has led to a number of recent attempts at estimating the economic impact of cycling measures.

In order to undertake this exercise, the project team conducted a review of evidence available from monitoring and evaluation exercises. We sought to identify data sets, both from intervention evaluation projects and relevant academic literature, that could form the basis of modelling exercises.

The present work is comprised of two stages. The first part of this study draws on two notable examples of the impact of large scale programmes of interventions, namely monitoring and evaluation carried out for the Cycling Demonstration Town (CDT) and the Sustainable Travel Town (STT) programmes. The CDT programme took the form of a three year programme of investment in both infrastructure and soft measure interventions in six English towns and was specifically focused on cycling. The STT programme was a five year programme of investment in soft measures in three towns, with a broader, multi-modal focus. The results of these two studies are used to generate investment scenarios for PTE areas and estimate their value for money. We assume a level of investment of a similar order of magnitude on a per capita basis and a similar ratio of revenue to capital expenditure on a comparable suite of interventions to those implemented in the CDTs and STTs.

The second part of the study considers published evidence on the impact of interventions focused on specific journey types (namely commuting to work by bicycle, rail travel where the bicycle may be used as an access mode, and travel to school). We draw on a range of data sources to generate scenarios and to estimate the value for money associated with each scenario.

The difficulties in undertaking this type of modelling exercise are several. For example, the precedents for transferability are not well-established; PTE areas and local authorities for which data are available may not be comparable; and translating empirical observations into an expression of value for money often presents a further challenge. We have dealt with these difficulties by including sensitivity analyses of our results, adopting broader confidence intervals where there is greatest uncertainty, applying conservative assumptions when comparing different types of area, and applying established frameworks and conventions for economic appraisal, largely based on WebTAG. Although we acknowledge the difficulties in translating available evidence to metropolitan areas, we have sought to make clear in the report the evidence basis for the modelling, the nature of the assumptions made, and the relative applicability of the results. We believe that our work is replicable, and that the outputs and conclusions could be revisited as more appropriate data sets come to light.

The conclusions from each stage of the modelling exercise are considered to be indicative. We acknowledge that PTE areas and individual local authorities will want to review them in the context of their particular setting. We will be happy to support these exercises where our input is required.

1.3 Describing the approach taken for the study

A major part of the rationale for this work is to revisit available examples, reanalysing evidence of impact in the context of PTE areas, and expressing these impacts in terms of value for money. In this section of the report we describe the 'logical flow' of the exercise, and outline the thought process behind the approach taken and some of the key decisions made.

The overarching premise of the exercise was to test the hypothesis there is considerable potential to increase the levels of cycling in PTE areas. A rapid-review of evidence available to support modelling exercises that might serve to address this assertion was conducted. Two categories of evidence stood out: 1) data dealing with town-wide interventions, 2) data dealing with interventions focusing on specific trips, primarily because this is where the strongest evidence for the effectiveness of interventions exists; however the evidence exists only at the town-wide level, and does not disaggregate down to specific trip or destination scenarios. To look beyond the town-wide package interventions, evidence of interventions focussed on specific trip types to investigate potential impacts in that context was used; this tended to overlook the detail of the potential impact within the context of a geographical area

The first of these, the translation of evidence from large-scale interventions to promote and support cycling and to promote sustainable transport more generally, is presented in Section 2 of the report.

2 Estimating the impact of large scale cycling interventions in PTE areas

2.1 Introduction

The first part of this modelling study attempts to estimate the potential impact of substantial investment in area-wide cycling interventions (CDT scenario), or in sustainable transport modes more generally (STT model). Impacts are expressed as potential changes in numbers of cyclists, changes in numbers of trips and decongestion, carbon and health benefits.

The underlying assumption is that the same level of impact observed in CDTs and STTs can be achieved in PTE areas. Descriptions of CDT and STT interventions are given and it is assumed that both of these programmes represent sound investment, without discussion or exploration of either the counterfactual, or of other investment possibilities. The transferability of the likely impact of the intervention is considered by comparing CDT and STT areas with PTEs, using a range of socio-economic, demographic and transport variables. Investment patterns and impacts of the key comparable recipient towns are also described in more detail.

The first exercise is based on results from the CDT programme. The following parameters were estimated:

- numbers of new cyclists in PTE areas, estimated based on the proportions of new cyclists observed in the CDTs and applying the same proportion on a pro rata basis to the PTE areas
- kilometres abstracted from the road network by new cyclists, and the value of associated decongestion benefits and carbon emissions savings
- value of increased physical activity
- potential savings to Primary Care Trusts of reduced ill-health associated with overweight and obesity that is attributable to increased physical activity levels across the population where the intervention is delivered
- benefit to cost ratio based on the value of health, decongestion and carbon benefits and an estimated cost of delivering CDT-type interventions in PTE areas.

The second model uses results from the STTs. The following parameters were estimated:

- number of additional cycle trips
- reductions in the numbers of car trips and the value of the associated decongestion benefits and carbon emissions savings
- number of additional bus trips and associated operating costs and revenue benefits.

2.2 Transferring evidence to the PTE areas – scope and limitations

Monitoring and evaluation studies of both the CDTs and the STTs have found substantial positive benefits. The Cycling England report 'Making a Cycling Town'[7] notes that the towns in the programme "represent a range of regions, and topographies" and, postulates that provided that there is sustained investment over time and consistent political leadership, there is no reason why the success observed in the demonstration towns could not be replicated elsewhere. It is reasonable to speculate that similar investment in similar areas could yield the same scale of impacts.

A series of demographic and travel behaviour indicators were identified and compared for each PTE district and each CDT and STT. The most similar CDT/STT area to each PTE district is identified for each indicator. The CDT and STT most frequently identified as being similar to the local authority in question were the ones used in subsequent calculations. A second comparison was made using Corresponding Local Authorities classifications issued by the Office for National Statistics[8]. Where a local authority was identified as having a CDT or STT areas within the top five most comparable areas, then this area was used in calculations. Tables 6-1 to 6-4 in Appendix 1 summarise our analysis. Despite differences in total population and population density, the age distribution of the population and employment rates are very similar.

2.3 Cycling Demonstration Towns model

2.3.1 Evidence available from the Cycling Demonstration Towns programme

The Cycling Demonstration Town Programme was delivered in six English towns (Aylesbury, Brighton and Hove, Darlington, Derby, Exeter and Lancaster with Morecambe) between 2006 and 2008. The findings of monitoring and evaluation of the programme were published in 2010[9,10]. Key findings of the programme included:

- an increase in levels of cycling across the towns of 27% (against a 2005 baseline, based on automatic cycle counter data)
- an increase in the percentage of the adult population of local authorities with CDTs cycling for at least 30 minutes once or more per month from 11.8% in 2006 to 15.1% in 2008, whilst the percentage of adults cycling for at least 30 minutes 12 or more times per month increased from 2.6% to 3.5% over the same period of time (based on Sport England Active People Survey data)

- an increase in respondents to household surveys stating to have cycled in a typical week in the previous year from 24.3% in 2006 to 27.7% in the 2008 iteration of the survey, and a decrease in percentage of respondents classified as inactive from 26.2% in 2006 to 23.6% in 2009

Estimates of the monetary value of health benefits indicated a benefit to cost ratio of 2.5:1[11], whilst calculations including a wider range of benefits beyond health found an overall benefit to cost ratio for the programme of 2.6:1 – 3.5:1, depending on the treatment of accident and absenteeism in the calculation [2,1].

The six towns received funding equivalent to at least £10 per head of population per year from Cycling England match funded by local authorities. Aylesbury, with the smallest population of the six towns received a lower absolute level of funding, whilst the largest of the six towns targeted their investment on specific sectors of the population, and so did not receive levels of funding that reflect the overall population. In Derby, the delivery programme was focussed on children and young people (a target population of 100,000 out of a total population of 240,000) whilst Brighton and Hove targeted their investment on the western side of the town, a target population of 100,000 compared to the whole town population of 243,000. Darlington was also in receipt of Sustainable Travel Town funding during the CDT programme. In other towns, a wider range of initiatives were delivered during the programme than those directly funded by the CDT project – including additional capital investment in Aylesbury from the Community Infrastructure Fund for a new cycle and pedestrian bridge[7,9].

Specific examples of capital investment made in the towns include:

- Links to key destinations – focus of investment on improving links to key destinations including schools, workplaces and key routes
- Creating advantages for cyclists and giving cyclists priority – for example, advanced stop lines, toucan crossings and contraflows
- Improving navigation – including signage and route branding
- Ensuring route continuity – filling missing links in the existing network
- Improving safety – creation of routes away from traffic, providing low traffic alternative routes to key destinations
- Making routes attractive – creation of traffic free routes through green space, authorisation for cycling through parks, improvements to canal towpaths
- Building high profile routes – development of high profile feature routes to raise local profile of cycling
- Providing cycle parking at destinations

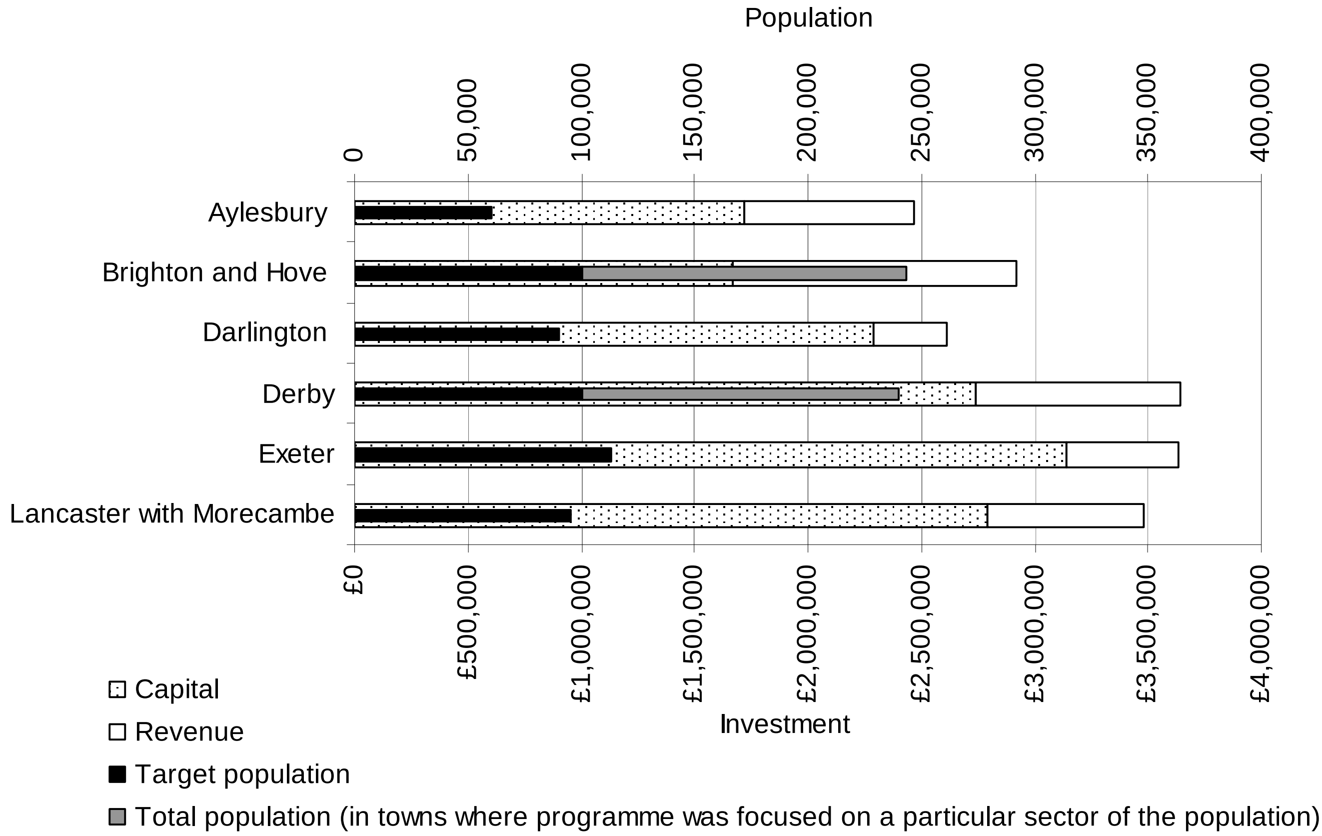
Examples of revenue investment made in the towns include:

- Cycle training
- Bike It (a programme of in-school cycling support and engagement)
- Route maps and information
- Competitions
- School travel planning
- Business bike challenges
- Workplace travel planning
- Personalised travel planning
- Events and festivals

[1] Two approaches were tested for estimating the benefits of reduced absenteeism from the programme; the first employed a threshold model in which only those employees meeting a certain level of activity attained any benefit. The second assumed a linear model, in which the benefit is adjusted proportionally to reflect the time spent cycling. Three approaches were tested in relation to accident benefits. The first assumed a relationship between increased numbers of cyclists and increased accidents as specified in Webtag guidance. The second compared accident levels in the Cycling Demonstration Town before and after the intervention. The third compared accident rates in the Cycling Demonstration Towns to those in matched towns [2].

The division of total investment between capital and revenue expenditure in each of the six towns, and the population benefiting from this investment, are presented in Chart 2.1.

Chart 2-1 : Capital and revenue investment made in the Cycling Demonstration Towns, and population benefiting from this investment[7]



Although all towns invested in cycling infrastructure and soft measures, the exact division of capital and revenue investment varied between each location. Infrastructure represented the majority of budget spend in the towns (79% of total budget). The average total spend on infrastructure was around £2.28 million per town, the majority of which was capital expenditure, totalling £2.23 million (£790,000 per year) per town. Three of the six towns (Aylesbury, Brighton and Hove, Lancaster with Morecambe), had some revenue expenditure on infrastructure, totalling £304,706. Staff investment in delivering the infrastructure strand of the work programmes in the towns averaged 1.3 FTE[7].

On average, 12% of budgets were spent on activities related to marketing and enabling cycling. Total investment in enabling cycling, including access to loaned or discounted equipment, grants for purchasing equipment, cycle training, maintenance training and led rides, averaged £37,000 (£12,000 per year). Staff investment in delivering work enabling cycling averaged 0.4 FTE. Spend on information totalled on average £128,000 (£56,000 per year) with staff investment of on average 0.7 FTE. Spending on raising awareness averaged £169,000 (£63,000 per year) with staff investment of on average 1 FTE[7].

Schools programmes received on average 8% of the total budget, with an average total capital expenditure of £155,000 (£52,000 per year) and revenue expenditure of £77,000 (£27,000 per year). Average staff investment was 1.6 FTE. Whilst Exeter and Derby had 68 and 90 schools located within the programme area, there were fewer than 40 schools within the programme areas of the other four towns. During the project more than 60% of primary and secondary schools within each town had engaged with Bikeability[2] and 16%-84% were engaged in Bike It[7, 3].

On average, 1% of budgets were spent on cycling promotion at workplaces, with total capital expenditure of £4,000 (£1,000 per year) and total revenue expenditure of £34,000 (£13,000 per year). Average staff investment was 0.5 FTE. This level of investment allowed each town to engage with approximately 16,300 employees across 16 workplaces.

2.3.2 Investment and benefits in the Cycling Demonstration Towns

The process described in section 2.2 identifies Darlington, Derby and Exeter to be most similar to individual local authorities within the PTE areas, although we note Darlington and Exeter to have lower trip lengths, and Exeter to have a higher employment rate than some local authorities within PTE areas. The division of investment between revenue and capital, the types of interventions in which investment was made[7], and the impacts of that investment[9] are summarised below and in Tables 2-1 to 2-3.

Darlington

Darlington invested approximately 86% of their budget on cycling infrastructure. Several branded radial routes were developed. These focused on the quietest, not necessarily the shortest, routes to destinations and made use of quiet streets and traffic free routes. The new routes were designed to run broadly parallel to the key road routes. In total, 22km of new cycle route was created through the programme (bringing the total for the town to 41km), as well as 13 toucan crossings, and over 100 new cycle parking spaced were installed in the town[7].

The programme delivered 1,200 cycle parking spaces in schools. Level 2 Bikeability training was taken up by 96% of primary schools in the programme area, and 100 pupils a year engaged in a bike maintenance course. Personalised travel planning was delivered to all local households. Adult cycle training, month-long bike loans for residents and workplaces were amongst the other interventions delivered during the programme[7].

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[2] Bikeability cycle training is delivered at three levels to children from Years Five and Six through to secondary school. Level One training covers basis cycle skills and is completed in a traffic free environment. Level Two equips participants with skills to cycle safely on minor roads, and Level Three covers more complex traffic environments (http://www.dft.gov.uk/bikeability/).

[3] Bike It works directly with schools, getting thousands of children on their bikes and cycling to school every day. It does this by helping schools to make the case for cycling in their school travel plans; supporting cycling champions in schools and demonstrating that cycling is a popular choice amongst children and their parents. The central aim of Bike It is to increase the levels of pupils cycling to school (http://www.sustrans.org.uk/what-we-do/bike-it).

Table 2-1 : Investment and subsequent changes in levels of cycling, Darlington[7,9]

Darlington		
Expenditure	**Capital**	**Revenue**
Infrastructure	£2,248,580	-
Enabling cycling	-	£3,400
Schools	£18,000	£55,500
Workplaces and universities	£24,000	-
Travel awareness	-	£78,400
Travel information	-	£3,000
Programme management and staffing	-	£179,500
Total	£2,290,580	£319,800
Approximate spend per head target population	£25	£4
Data source	**Change (to 2008 from 2005 baseline)**	
Automatic cycle counts	+57% against 2005 baseline	
Change in the proportion of adult residents doing any cycling in a typical week in the previous year (household surveys)	+6% (+1.2%-points from 21.3% to 22.5%)	
Change in the proportion of residents classed as inactive (household surveys)	-13% (-3.9%-point from 30.8% to 26.9%)	
Pupils usually cycling to school (PLASC)	+12% (+0.3% points from 2.6% to 2.9%)	
Pupils cycling to school on day of local authority travel survey	+408% (+4.9% points from 1.2% to 6.1%)	

Derby

Derby spent just over 50% of their total budget on cycling infrastructure, primarily improving links to schools and improving leisure cycling facilities, including the installation of competition standard BMX facilities. In total, 6.5km of new route infrastructure was developed. This included filling gaps in the existing network, improving cycle links to schools and providing links to the National Cycle Network. Three advanced stop lines and 15 toucan crossings were also installed. Reflecting the focus of Derby's programme on children and young people, nearly 30% of the budget was spent on schools. Bikeability was delivered in 60% of all schools in the programme area, and over 1,900 cycle parking spaces were installed across 67 schools. Over 1,300 pupils in 44 schools had engaged with after-schools club by late 2008[7].

Table 2-2 : Investment and subsequent changes in levels of cycling, Derby[7,9]

Derby		
Expenditure	**Capital**	**Revenue**
Infrastructure	£1,848,000	-
Schools	£892,500	£187,400
Travel awareness	-	£215,800
Travel information	-	£46,300
Programme management and staffing	-	£450,989
Total	£2,740,500	£900,489
Approximate spend per head target population	£27	£9
Data source	**Change (to 2008 from 2005 baseline)**	
Automatic cycle counts	+10% against 2005 baseline	
Counts of parked bikes	+32% (from 84 to 111, counts at 8 locations)	
Change in the proportion of adult residents doing any cycling in a typical week in the previous year (household surveys)	+29% (+5.6%-points from 19.5% to 25.1%)	
Change in the proportion of residents classed as inactive (household surveys)	-11% (-3.3%-point from 29.9% to 26.6%)	
Pupils usually cycling to school (PLASC)	+50% (+0.8% points from 1.6% to 2.4%)	
Pupils cycling regularly to school (pre and post Bike It surveys)	+167% (+24.5% points from 14.7% to 39.2%)	

Exeter

Approximately 86% of the CDT budget in Exeter was spent on cycling infrastructure. Route improvements focused on key schools and workplaces, and a total of 20km of cycle route was either created or improved during the programme. Investment was also made in cycle parking, with 250 parking spaces created at 40 locations, and improved route lighting. As well as the creation of dedicated cycle routes, Devon County Council worked to incorporate cycling infrastructure into highway schemes (including the conversion of a section of duel carriageway to single carriageway with a reduced speed limit and shared use routes to enable school access). Bikeability was delivered to 94% of schools in the target areas and Bike It engaged with 11 schools, including the 'Beauty and the Bike' scheme. Over 400 cycle parking spaces were installed across 37 schools. Workplaces were engaged through Bicycle User Groups[7].

Table 2-3 Investment and subsequent changes in levels of cycling, Exeter[7,9]

Exeter		
Expenditure	**Capital**	**Revenue**
Infrastructure	£3,142,605	-
Enabling cycling	-	£76,485
Travel awareness	-	£50,519
Travel information	-	£119,065
Programme management and staffing	-	£244,960
Total	£3,142,605	£491,029
Approximate spend per head target population	£28	£4
Data source	**Change (to 2008 from 2005 baseline)**	
Automatic cycle counts	+40% against 2005 baseline	
Change in the proportion of adult residents doing any cycling in a typical week in the previous year (household surveys)	+21% (+5.6%-points from 27.3% to 32.9%)	
Change in the proportion of residents classed as inactive (household surveys)	-10% (-2.2%-point from 22.8% to 20.6%)	
Pupils usually cycling to school (PLASC)	+19% (+0.5% points from 2.7% to 3.2%)	
Pupils cycling regularly to school (pre and post Bike It surveys)	+57% (+7.8% points from 13.8% to 21.6%)	

2.3.3 Assumptions and sensitivity testing applied in modelling the potential impacts of Cycling Demonstration Town delivery in PTE areas

In the following exercise we attempt to estimate the likely impacts following the delivery of interventions of a similar order of magnitude (on a pro rata basis) in PTE areas. We assume with this scenario that targeted packages of measures delivered in other areas could achieve the same level of impact and benefits as observed in the CDTs. Calculations reported in this section relate to the potential overall impacts of CDT-type programmes of measures delivered in PTE areas.

For each individual local authority within each PTE area, the most similar CDT area was identified following the process described above. In order to estimate the potential impact of CDT-type interventions in the PTE area, estimates of numbers of new cyclists and time spent cycling (from which an estimate of distance cycled may be estimated) are required. The impact of the CDT programme varied across the six towns in which it was delivered. In order to address this variability within the modelling the following scenarios are modelled:

- A **lower estimate** based on the 25th percentile proportion of new cyclists and time spent cycling *across all six CDTs*

- An **upper estimate** based on the 75th percentile proportion of new cyclists and time spent cycling *across all six CDTs*

In addition to estimates based on the 25th and 75th percentile of impacts across all six CDTs as described above, a third calculation was made for each individual local authority within each PTE area based on the impacts observed in the single CDT considered most similar to that local authority (Appendix table 6-4). This calculation is referred to as the 'nearest neighbour' estimate in the following sections.

2.3.4 Estimates of impacts at the PTE level and valuation of benefits

Numbers of new cyclists

The appropriate percentage population becoming 'new' cyclists (defined in the CDT monitoring study as the difference between pre and post programme studies of those doing 'some' cycling) for the lower, upper and nearest neighbour estimates defined above was applied to the adult population of each local authority area. Estimated numbers of new cyclists across the PTE areas (obtained by summing together the estimates for the component local authorities) are presented in Table 2-4. Variations between the best estimates are the result of the use of different combinations of the three CDTs considered most similar to local authorities within the PTEs to represent each area as a whole.

Table 2-4 Estimated numbers of new adult cyclists in PTE areas, new cyclists as a percentage of the adult population, and approximate cycle trips per year made by new cyclists

	Lower estimate			Upper estimate			Nearest neighbour estimate		
	New cyclists	% population	Cycle trips per year by new cyclists	New cyclists	% population	Cycle trips per year by new cyclists	New cyclists	% population	Cycle trips per year by new cyclists
SYPTE	20,729	1.9%	5,982,254	56,532	5.3%	18,226,032	32,874	3.1%	10,131,835
Metro	34,567	1.9%	9,976,146	94,275	5.3%	30,394,154	76,195	4.2%	24,531,811
GMPTE	40,339	1.9%	11,641,977	110,017	5.3%	35,469,413	87,033	4.2%	27,677,855
Centro	40,318	1.9%	11,635,694	109,957	5.3%	35,450,273	54,827	2.6%	16,613,293
Merseytravel	21,292	1.9%	6,145,008	58,070	5.3%	18,721,893	29,445	2.7%	8,940,198
Nexus	17,645	1.9%	5,092,282	48,122	5.3%	15,514,570	26,764	2.9%	8,210,599

This first stage in the calculation gives a broad estimate of potential new cyclists. The following sections consider the impact of the activities of these new cyclists.

Estimated car km abstracted from the road network

The number of days spent cycling per week and time spent cycling on each day cycled are taken from data collected in the CDTs and used to estimate km per year cycled. No data were collected through the monitoring programme to ascertain if new cycle trips were in fact replacing car trips. In the first instance, we take the broad assumption that cycle journeys up to 20 minutes duration are potentially replacing car trips. It is further assumed that 50% of these trips are actually replacing car trips. The estimated km per year abstracted from the road network are summarised in Table 2-5 for the PTEs as a whole.

Table 2-5 Estimated km per year abstracted from the road network in PTE areas

	Estimated km per year abstracted from the road network		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	3,273,919	13,637,104	7,047,137
Metro	5,459,664	22,741,552	15,427,767
GMPTE	6,371,326	26,538,969	18,617,467
Centro	6,367,888	26,524,648	11,588,647
Merseytravel	3,362,990	14,008,118	6,234,130
Nexus	2,786,863	11,608,331	5,715,298

Decongestion benefits

An estimated value for reduced decongestion as a result of the displacement of journeys from the road network can be obtained by multiplying the estimated km replaced by a standard decongestion value. The value of decongestion was taken from WebTAG guidance[12] using spreadsheets provided by the Department for Transport. The value of decongestion for 'other' roads in conurbations is 32.1p km^{-1} (based on a scheme opening year and price base of 2010). Components of this relating to carbon (local air quality, 1.2p km^{-1}, and greenhouse gases, 0.5p km^{-1}) are subtracted from this value to avoid double counting as carbon will be valued separately. Discounting to 2007 prices in line with WebTAG guidance gives a value of 28.3p km^{-1}. Values of estimated decongestion benefits in each PTE are presented in Table 2-6.

Table 2-6 Estimated annual value of decongestion benefit in PTE areas

	Estimated annual value of decongestion benefits in PTE areas (£)		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	£926,519	£3,859,301	£1,994,340
Metro	£1,545,085	£6,435,859	£4,366,058
GMPTE	£1,803,085	£7,510,528	£5,268,743
Centro	£1,802,112	£7,506,475	£3,279,587
Merseytravel	£951,726	£3,964,297	£1,764,259
Nexus	£788,682	£3,285,158	£1,617,429

Carbon benefits

Carbon emissions savings are also associated with a reduction in car km. Applying standard Defra emissions factors[13] (0.2069 kg CO_2 km^{-1}, average car, unknown fuel type), estimated reductions in carbon emissions savings are valued using the central non traded value for carbon in 2011 of £52/tonne CO_2 [14], estimated value of annual carbon emissions savings are presented in Table 2-7.

Table 2-7 Estimated annual value of carbon emissions savings in PTE areas following delivery of CDT-type interventions

	Estimated annual value of carbon emissions savings (£)		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	£35,223	£146,719	£75,819
Metro	£58,739	£244,672	£165,984
GMPTE	£68,548	£285,527	£ 200,302
Centro	£68,511	£285,373	£124,680
Merseytravel	£36,182	£150,711	£67,072
Nexus	£29,983	£124,892	£61,490

Benefits to health

Calculations of the benefit to cost ratio of the CDT programme found that benefit to health (mortality benefits) constituted a major part of the overall benefits, accounting for 70%-96% total estimated benefits over ten years[2]. The WHO HEAT tool[15] for cycling is used with estimates of numbers of new cyclists and time per week spent cycling to estimate potential health benefits in the PTE regions. It is assumed that there is a build up of uptake in cycling over three years, and a build up of benefits over five years, after which benefits remain constant for the remainder of the ten year period. The mean annual NPV of the estimated mortality benefits are presented in are presented in Table 2-8.

Table 2-8 Estimated annual mortality benefit in PTE areas

	Mean annual net present value of mortality benefit (£)		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	£3,500,000	£10,315,000	£7,072,000
Metro	£5,836,000	£17,203,000	£7,265,000
GMPTE	£8,657,000	£25,525,000	£20,701,000
Centro	£6,806,000	£20,062,000	£14,194,000
Merseytravel	£3,594,000	£10,596,000	£6,232,000
Nexus	£2,978,000	£8,781,000	£6,601,000

The calculations presented in the above sections consider a scenario in which delivery of CDT interventions in similar areas result in a similar level of uptake in cycling. Whilst this gives a very broad indication of what might be achieved, there is scope to look in greater detail at travel patterns within areas and linking potential impacts of step changes in cycling interventions to these. This will be addressed in a later section in this report.

Impacts on modal share

The calculations reported above explore the impact of CDT type interventions in the PTE areas. Car km potentially replaced by cycle trips were estimated based on high level assumptions; data pertaining specifically to the replacement of car trips by cycle were not collected during the monitoring programme. Post-intervention mode share of cycling is estimated by multiplying average trips per person per year by cycle from National Travel Survey[16] data by the population of each PTE, giving an estimated total cycle trips per year for each area. To this is added the additional cycle trips per year made by 'new cyclists' in each area (Table 2-4). The revised total cycle trips per year is then divided by the population and expressed as a percentage of total trips per person per year for Metropolitan built up areas[16]. Based on best estimate calculations of the impacts of CDT interventions in the PTE areas, the percentage mode share for cycling ranged from 2.2% to 2.7%, with an average of 2.4%. The proportion of all trips made by cycle across all PTE areas was 0.8% in the 2009 iteration of the National Travel Survey.

Potential to decrease Primary Care Trust costs from ill health associated with overweight and obesity

The final section of modelling in relation to CDT type interventions explores (using high level assumptions) the potential for reducing costs to PCTs in the PTE areas. Although levels of obesity vary across the PTE areas, the average population obese, based on 2005 data, is 25%[17]. Whilst the preceding section valued the impact of reduced mortality, we are concerned here with the annual costs to the NHS of diseases related to overweight and obesity and the impact on these of increased physical activity stimulated by cycling interventions.

Whilst evidence for physical inactivity as a factor determining obesity is limited, the relationship between physical activity and weight loss is better understood[18]. A review by Wareham (2006)[19] noted that, given the limited evidence, the amount of physical activity necessary to prevent weight gain is unknown. Citing the findings of another review, however, Wareham notes that approximately 45-60 minutes of moderate intensity activity a day is necessary to prevent transition to overweight or obese, whilst acknowledging the limitations of the evidence base. The author goes on to note the Chief Medical Officer's recommendation of moderate activity of 30 minutes at least five times a week to be rational, and that although the impact of this recommendation cannot be readily quantified, an overall increase in physical activity is likely to decrease the risk of obesity[19].

Surveys conducted during the monitoring and evaluation of the CDT programme classified respondents as inactive, moderately inactive, moderately active and active based on the EPIC methodology[20]. The percentage point change in the adult population classified as moderately active/active was +4.5% points, +1.3% points and +1.9% points for Darlington, Derby and Exeter, respectively. For the purposes of this calculation, and given the lack of evidence for the relationship between levels of physical activity and the prevention of obesity, the conservative assumption was applied that 25% of the percentage point change in population classified as moderately active/active resulted in an equivalent decrease in ill health associated with overweight and obesity (-1.13%, -0.33%, and -0.48%-points for Darlington, Derby and Exeter, respectively). Benefits were assumed to build up over the five year period after the final year of investment. Estimated costs to PCTs, broken down by local authority, from ill health related to overweight and obesity are published for 2010 and 2015[21]. Total costs in 2011 were used in the calculation, estimated from the published values assuming a linear increase over time. Benefits were assumed to accumulate from 2011 onwards (thus assuming that the final year of investment to deliver a CDT-type intervention was made in 2010).

The value of potential yearly savings to the NHS are given in Table 2-9.

Table 2-9 Potential value of saving to NHS, expressed in current prices, if the same increase in population classified as moderately active/active observed in the CDT areas occurred following CDT-type interventions in the PTE areas and a decrease in NHS costs of 25% of that percentage decrease in inactivity occurred

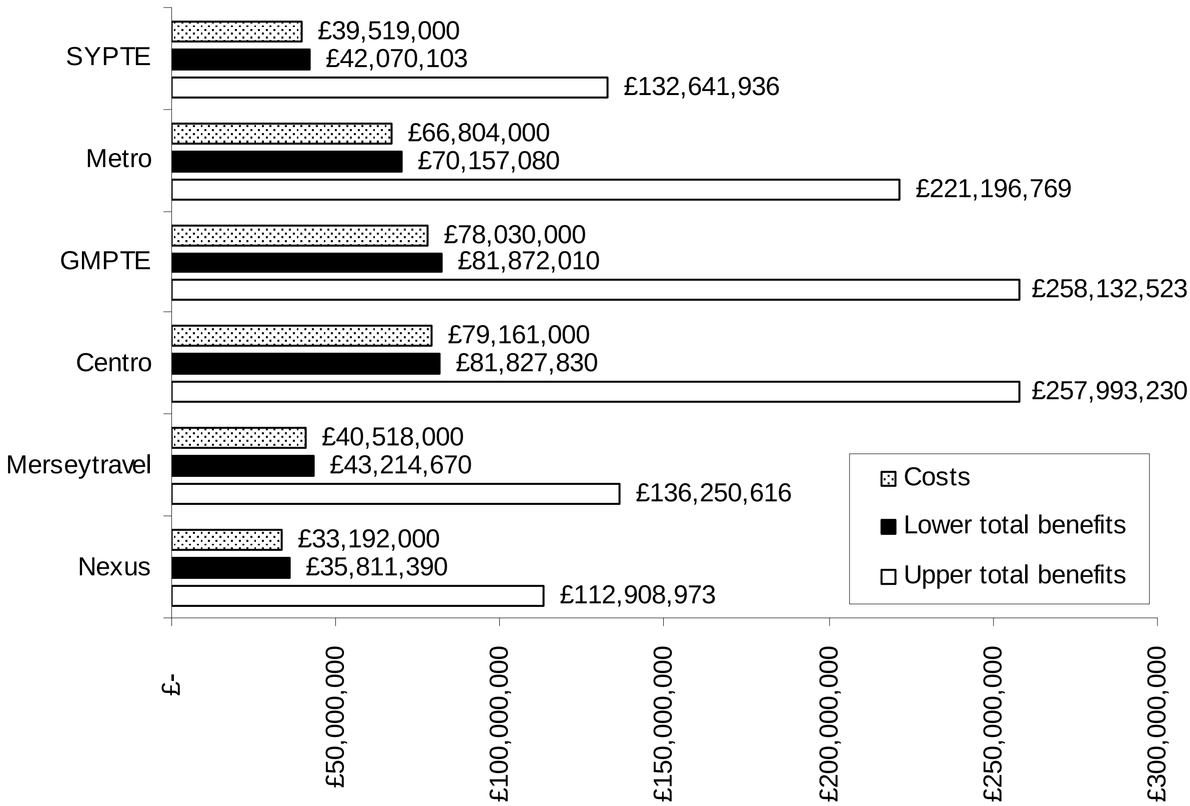
PTE area	Potential savings to NHS in PTE areas over ten years through reduced illness due to obesity/overweight (£)
SYPTE	£26,123,000
Metro	£31,935,000
GMPTE	£40,774,000
Centro	£38,407,000
Merseytravel	£35,810,000
Nexus	£22,879,000

2.3.5 Benefit cost ratio of delivering Cycling Demonstration Town – type interventions in PTE areas

Benefits to health as well as decongestion and carbon have been valued over a ten year period for a lower, upper and nearest neighbour estimate of impact in the PTE areas. Investment and the range of values of the resulting benefits from a programme of CDT type interventions delivered at the PTE level are summarised in Chart 2-2. Benefits are summed over a ten year period and adjusted to reflect a build up in benefits over the three year funding period and a discount rate of 3.5%.

Costs are estimated as population multiplied by £30 (£10 per head invested over three years). The underlying assumption is that this investment is divided between capital and revenue spend in a similar way as delivered in the CDTs. We do not have sufficient evidence to determine the exact benefits associated with each element of the work programme. Our nearest neighbour estimates of BCR values for the PTE areas reach up to 2.6:1, whilst calculations based on the 75th percentile of impacts in the CDTs indicate BCR values of up to 3.4:1.

Chart 2-2 Estimated value of costs and range of anticipated benefits following delivery of CDT type interventions in the PTE areas, based on valuation of mortality, decongestion and carbon emissions benefits only



The analysis reported herein is restricted in that it i) focuses on a limited number of benefits (mortality, decongestion, carbon) and ii) focused on the activities of new cyclists only. The full economic evaluation of the CDT programme [2] included valuation of reduced absenteeism, amenity and changes in numbers of accidents. These benefits are not included in this exercise because of the relatively intangible nature of the benefits, and the paucity of evidence in relation to the PTE areas. Total benefits of the CDT programme were estimated at up to £64 million, of which £45 million (70%) was represented by mortality benefits, and £7 million (11%) by decongestion (including carbon) benefits. Applying the high level assumption that other benefits beyond those estimated for the PTE areas were of the same order of magnitude as those found in the CDTs, then the benefit to cost ratio could be as high as 3.2:1.

The monitoring programme in the CDTs, as well as identifying new cyclists, indicated a general uplift in cycling across the programme areas. Automatic cycle count data indicated an increase in levels of cycling of on average 27% over the programme period, whilst data from manual count cordons within specific areas of the towns suggested an increase in cycling levels of 4% per year[9]. Amongst survey respondents who cycled in a usual week in the previous year, those stating that they had cycled in the last week increased significantly from 41.7% in 2006 to 49.4% in 2009 [20]. Whilst the present analysis has focused on individuals new to cycling following large scale investment in cycling interventions, such programmes will also have a positive impact on those already cycling.

2.3.6 Summary

Premise	Substantial investment in town wide packages of interventions leads to step changes in levels of cycling
Sources	Evidence from Cycling Demonstration Towns
Supported assumptions	PTE areas are readily comparable with some of the CDTs
Unsupported assumptions	Investment equivalent to that made in CDTs will yield results of a similar order of magnitude in PTE areas
Parameters	Nearest neighbour estimates are based on the most similar CDT; lower and upper estimates are based on the 25th and 75th percentiles of the CDT programme
Costs	Assumed £30 per head of population over three years invested in similar packages of measures with similar ratios of infrastructure to soft measures as delivered in the CDTs
Output values	2.6%-4.2% of the adult population become 'new cyclists' Estimated increase in cycling mode share to 2.4% Annual benefits across PTE areas of reduced congestion of up to £18.3 million, reduced carbon emissions of up to £695,300 and annual health benefits of up to £62.1 million Potential to reduce NHS costs by £196 million over ten years
Value for money	Benefit to cost ratio of up to 3.2:1
Strength of evidence	●●●●●

2.4 Sustainable Travel Towns model

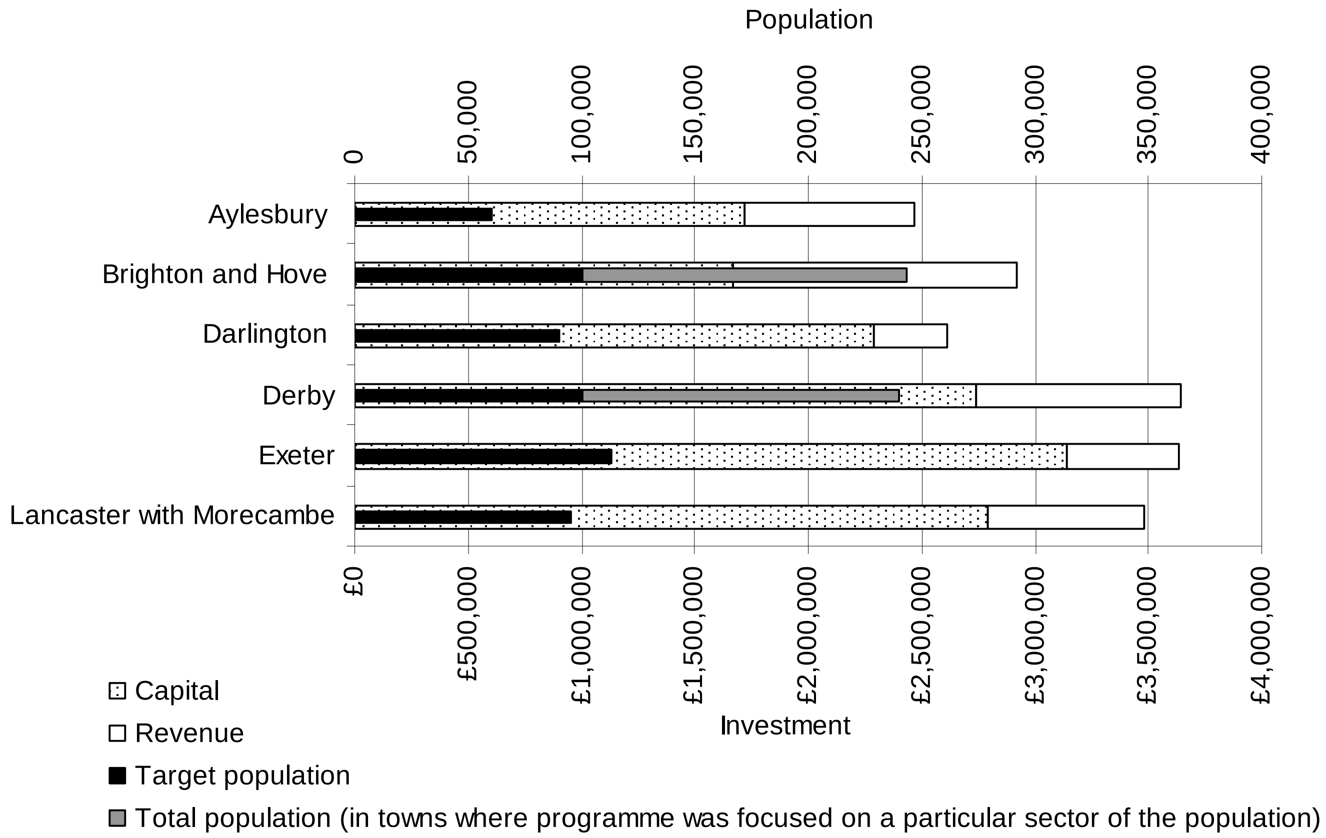
2.4.1 Evidence available from the Sustainable Travel Towns programme

The Sustainable Travel Town programme was delivered in Darlington, Peterborough and Worcester between 2004 and 2009. Over the programme period, car driver trips per resident fell by 9% whilst car driver distance reduced by 5%-7%. Bus trips per person increased by 10%-22%. Cycle trips per person increased by 26%-30%, and walking trips per person, by 10%-13%[3]. Over 4,000 respondents were surveyed in each location in 2004 and 2008.

A total of £15 million was spent across the three towns on soft measure interventions focused on reducing car use. The estimated outturn cost of the programme was £11 per person per year[3]. The exact programme of measures delivered in each town varied. Between a third and a half of the revenue spending in each location was on personal travel planning programmes; the remaining investment was made in travel awareness campaigns, schemes promoting walking and cycling, and marketing public transport. Lesser amounts were spent on workplace and school travel planning.

The division of total investment in each of the three towns, and the population benefiting from this investment, are presented in Chart 2-3[3].

Chart 2-3 : Capital and revenue investment made in the Sustainable Travel Towns, and population benefiting from this investment



The research report published on the Sustainable Travel Towns[3] notes that it was not possible to gather complete information on the detailed capital investment which may have also contributed to shifts towards more sustainable modes of travel in the STT areas. However, the report notes some specific examples. In Darlington, investment in the region of £460,000 was made in school infrastructure; £70,000 was spent on bus improvements, £1.2 million on cycling infrastructure, and £75,000 on monitoring. The STT programme in Peterborough included capital expenditure of £1.3 million on school travel infrastructure, around £800,000 on public transport information, £3.0 million on other public transport infrastructure and around £490,000 on walking and cycling infrastructure. In Worcester, the capital expenditure on school travel infrastructure was £530,000. Approximately £82,000 was spent on public transport information, £2.3 million on other public transport information and £2.6 million on walking and cycling infrastructure.

2.4.2 Investment and benefits in the Sustainable Travel Towns

All three Sustainable Travel Towns were identified as being similar based on the variables compared to at least one local authority within the PTE areas. A summary of investment and the impacts of that investment are presented in Table 2.10[3,7].

Table 2-10 Investment and impacts in the Sustainable Travel Towns

Sustainable Travel Towns	
Expenditure	**Spending over 5 year programme**
Work place travel planning	£9 - £14 per employee
School travel planning	£30-£50 per pupil capital £7 - £11 revenue
Personal travel planning	£16 per individual
Public transport information and marketing	£26-£29 per head capital (Peterborough and Worcester) £2-£3 per head revenue
Cycling and walking promotion	£14 per head (Darlington), £3-£6 per head (Peterborough and Worcester) capital (cycling) £1-£5 per head capital (walking) £3-£5 per head revenue
Travel awareness campaigns	£3-£8 per head
Data source	**Change over five year programme**
Change in car driver trips per resident	Darlington:-7%--10% Peterborough: -8%--10% Worcester: -8%--10%
Change in car driver distance per resident	Darlington:-6%--7% Peterborough: -7%--10% Worcester: -3%
Change in bus trips per person	Darlington:-6%-+11% Peterborough: +36%-+43% Worcester: +17%-+24%
Change in cycle trips per person	Darlington:+89%-+113% Peterborough: +10%-+17% Worcester: +11%-+23%
Change in walking trips per person	Darlington:+11%-+13% Peterborough: +9%-+14% Worcester: +9%-+12%

2.4.3 Assumptions and sensitivity testing applied in modelling the potential impacts of Sustainable Travel Town delivery in PTE areas

Calculations based on the STT model focus on the shift in mode use – specifically, changes in car driver trips, car driver distance and bus trips per resident. Baseline trips per resident by each mode were estimated using National Travel Survey data[16] on trips per person per year (974, metropolitan built up areas) and proportion of trips by main mode for each PTE area. Full details of these are included in Tables 7-1 to 7-15 of Appendix 2. The evaluation report for the STT programme expresses percentage change in trips per resident per mode over the whole project period. In order to gain an approximate percentage increase per year of the programme, these were divided by five.

For each individual local authority within each PTE area, the most similar STT area was identified following the process described above. The impact of the STT programme varied across the three towns in which it was delivered. In order to address this variability within the modelling the following scenarios are modelled:

- A **lower estimate** based on the smallest change in mode share reported across all three STTs, taking the mid point of each range of change reported for each town and selecting the lowest of these values
- An **upper estimate** based on the greatest change in mode share reported across all three STTs, taking the mid point of each range of change reported for each town and selecting the largest of these values

In addition to estimates based on lower and upper estimates of impacts across all three STTs as described above, a third calculation was made for each individual local authority within each PTE area based on the impacts observed in the single STT considered most similar to that local authority (Appendix table 6-4). This calculation is referred to as the 'nearest neighbour' estimate in the following sections.

2.4.4 Estimates of impacts at the PTE level and valuation of benefits

Cycle trips

Although the STTs did not have a specific focus on cycling, there were substantial increases in cycling trips over the course of the programme. Estimated additional cycle trips per year, presented in Table 2-11, were estimated by multiplying additional cycle trips per person per year by the population.

Table 2-11 Estimated additional cycle trips per year following delivery of STT type interventions in PTE areas

	Estimated additional cycle trips per year		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	411,889	2,447,106	2,447,106
Metro	520,467	3,092,185	3,092,185
GMPTE	563,199	3,346,065	1,233,884
Centro	467,066	2,774,923	2,509,804
Merseytravel	565,360	3,358,904	3,358,904
Nexus	615,757	3,658,322	3,658,322

Car driver trips and distance

Estimated annual decreases in car trips were calculated by applying to the baseline car driver trips per person the appropriate percentage change in car driver trips per resident. An estimate of car km saved per resident was made using local authority level trip length distributions for trips to work. Values per resident were multiplied by local authority populations in order to obtain total savings.

Values for local authorities were summed to give totals for each PTE, as presented in Table 2-12. The potential value of the decongestion benefits of the reduction in car driver trips are presented in Table 2-13, and carbon emissions savings in Table 2-14.

Table 2-12 Estimated car km saved per year following STT type interventions in the PTE areas

	Estimated annual car km saved		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	79,098,043	83,750,869	79,098,043
Metro	131,781,070	139,532,898	131,781,070
GMPTE	144,270,465	152,756,963	150,738,136
Centro	129,840,132	137,477,787	130,568,716
Merseytravel	73,112,058	77,412,767	73,112,058
Nexus	52,321,955	55,399,717	52,321,955

Table 2-13 Estimated decongestion value per year of reduced car driver trips following the delivery of STT type interventions in the PTE areas

	Estimated annual decongestion benefit per year (£)		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	£22,384,746	£23,701,496	£22,384,746
Metro	£37,294,043	£39,487,810	£37,294,043
GMPTE	£40,828,542	£43,230,221	£42,658,892
Centro	£36,744,757	£38,906,214	£36,950,946
Merseytravel	£20,690,712	£21,907,813	£20,690,712
Nexus	£14,807,113	£15,678,120	£14,807,113

Table 2-14 Estimated value of carbon emissions savings per year in PTE area following delivery of STT type interventions in the PTE areas

PTE area	Estimated annual carbon emissions savings (£)		
	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	£851,000	£901,059	£851,000
Metro	£1,417,806	£1,501,207	£1,417,806
GMPTE	£1,552,177	£1,643,482	£1,621,761
Centro	£1,396,924	£1,479,096	£1,404,763
Merseytravel	£786,598	£832,868	£786,598
Nexus	£562,921	£596,034	£562,921

Bus trips

Department for Transport bus statistics, which include values for annual bus trips per head in the PTE areas, were used as a baseline[22].Additional bus trips in the PTE areas were estimated by multiplying additional bus trips per resident by the total population. The bus operating costs and revenues associated with these additional trips were estimated by multiplying the total number of additional trips by a value per trip obtained from Department for Transport data. The bus operating cost per trip used in the calculations was £1.05[23], whilst the revenue per trip was £1.20[24]. Additional bus trips, operating costs and revenue are presented in Tables 2-15, 2-16 and 2-17.

Table 2-15 Estimated additional bus trips per year, operating costs and revenue following delivery of STT type interventions in the PTE areas

PTE area	Additional bus trips per year		
	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	17,894	282,724	17,894
Metro	22,269	351,848	22,269
GMPTE	28,625	452,270	226,981
Centro	29,290	462,782	77,096
Merseytravel	16,587	262,071	16,587
Nexus	14,158	223,690	14,158

Table 2-16 Estimated additional operating costs following delivery of STT type interventions in the PTE areas

PTE area	Additional operating costs per year (£)		
	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	£18,789	£296,860	£18,789
Metro	£23,382	£369,441	£23,382
GMPTE	£30,056	£474,884	£238,330
Centro	£30,755	£485,921	£80,951
Merseytravel	£17,416	£275,175	£17,416
Nexus	£14,865	£234,874	£14,865

Table 2-17 Estimated additional operating revenue following delivery of STT type interventions in the PTE areas

PTE area	Additional operating revenue per year (£)		
	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	£21,473	£339,269	£21,473
Metro	£26,723	£422,218	£26,723
GMPTE	£34,350	£542,724	£272,377
Centro	£35,148	£555,339	£92,515
Merseytravel	£19,904	£314,485	£19,904
Nexus	£16,989	£268,427	£16,989

Impacts on modal share

The calculations reported above explore the impact of STT type interventions in the PTE areas. Estimated changes in cycle trips and car use were based on monitoring of the STT programme which expressed impacts as percentage change in trips per resident by each mode. The mode share of cycling and car as driver trips post intervention are estimated by applying the percentage increase in trips by each of these modes to a base number of trips per person by cycle and car as driver. These base trips per person were estimated by multiplying total trips per person in Metropolitan built up areas[16] by the percentage of all trips made by each mode in each PTE. The additional trips per person per year in the with intervention scenario were added to this base number of trips then expressed as a percentage of total trips per person per year. Estimated post intervention mode share of cycling ranged from 0.9% to 3.4%, with an average of 1.9%. The proportion of all trips made by cycle in the 2009 iteration of the National Travel Survey was 0.8%. Estimated post intervention mode share of car as driver trips ranged from 31% to 37%, with an average of 35%. The proportion of all trips made by car as driver in the 2009 iteration of the National Travel Survey was 38%.

2.4.5 Comparing the costs to the potential benefits of Sustainable Travel Towns – type interventions delivered in PTE areas

Whilst we hold information from surveys about the number of respondents taking up cycling over the course of the CDT programme, we are less certain on the basis of the available data as to the proportion of the additional cycle trips observed in the STT areas being undertaken by those who are new to cycling, a necessary input for the estimation of the value of health benefits from interventions. Published information on the Sustainable Travel Towns note a benefit to cost ratio based on decongestion benefits alone of 4.5:1[3].

2.4.6 Summary

Premise	Substantial investment in town wide packages focused more generally on sustainable travel can also have a substantial impact on levels of cycling
Sources	Evidence from Sustainable Travel Towns
Supported assumptions	PTE areas are readily comparable with some of the STTs
Unsupported assumptions	Investment of a similar level in the PTE areas as made in the Sustainable Travel Towns spent on a comparable range of measures will yield results of a similar order of magnitude as delivered in the programme areas
Parameters	Nearest neighbour estimates are based on the most similar STT; lower and upper estimates are based on the 25^{th} and 75^{th} percentiles of the STT programme
Costs	Assumed investment of the order of £11 per head of population over five years invested in similar packages of measures as delivered in the STTs
Output values	Up to 16 million additional cycle trips per year Estimated increase of cycling mode share to 1.9% Reduction in car km of up to 617.6 million Decongestion benefit valued at up to £174.8 million Annual benefits of reduced carbon emissions savings of up to £6.6 million Up to 375,000 additional bus trips per year
Value for money	Benefit to cost ratios not calculated due to more limited information on the potential impacts on health than available for the CDT model. Published estimates of value for money for the Sustainable Travel Towns based on decongestion benefits only are 4.5:1
Strength of evidence	●●●●●

3 Impact of interventions targeted at specific journey types

3.1 Introduction

The first part of the modelling study estimated the potential impacts of large scale packages of cycling interventions delivered across the PTE areas. Whilst the evidence base is strong for the impact of such interventions as a whole, it is not possible from the existing evidence to readily establish the individual impact of specific interventions when delivered as part of a wider package. This chapter seeks to estimate the impact of investment in specific types of intervention at a much more disaggregate level.

Relevant evidence is identified for the purposes of estimating the impact of investment in cycling on cycle access to railway stations, cycle mode share on the trip to work, and on the trip to school.

For rail station access, two user response scenarios are presented focusing on provision of secure cycle parking at stations. A third scenario compares cycle access mode share in Holland and the UK.

For the trip to school two scenarios are presented focusing firstly on theorised behaviour change impacts of smarter choices measures, and secondly the impact of interventions to overcome barriers to cycling to school. The first scenario is derived from modelling undertaken for the Greater Manchester TIF bid. The second scenario is based on data from a survey conducted for the recent Travelling to School Initiatives report. Car kilometre reductions and carbon emission savings are calculated and valued.

For travel to work, a series of scenarios is presented with regard to different typologies of intervention, derived from academic research into the propensity to cycle. This information is combined with commuter trip length data derived from the Census. The typologies are changes in infrastructure, provision of cycling facilities at work places, and financial incentives for cycling to work. In each case the value of decongestion benefits and carbon emissions savings benefits are calculated.

3.2 Impact of interventions to support cycle access to railway stations

This scenario explores the potential impacts from increasing cycling trips to railway stations, particularly the potential to transfer trips from car to cycle. In order to model the potential impact of interventions encouraging cycling to railway stations, the following information is required:

- levels of rail patronage, estimated from station usage statistics for 2008-09[25]. Two subsets of this data set were used in the calculations. For each PTE, station entries for stations within 5km of mainline stations (denoted ‘inner city’ stations), and station entries for stations within the boundary of the PTE area but situated more than 5km from mainline stations (denoted ‘suburban’ stations).
- proportions of rail users currently accessing stations by car and by cycle, estimated from data collected in the PTE areas on mode of access to stations.
- proportions of rails users currently accessing stations by car making journeys of a distance that is readily cyclable, estimated from data collected in PTE areas on distance travelled to stations
- proportions of rail users accessing stations by car who would like to cycle
- proportions of rail users accessing stations by car who may be encouraged to transfer to cycle

The latter two items are obtained from various surveys of rail users.

3.2.1 Impact of improvements to cycle parking provision at stations

Estimate of impacts

The first scenario is based on the findings of an online survey of rail users (planning a journey or buying tickets online)[26]. This survey found that of 61% survey respondents who owned a bike, 35% would not consider cycling to the station. Between 30 and 35% of these identified lack of secure parking as a reason for this. This equates 6.4% of rail users taking part in the survey – the same proportion of station entries was taken to represent the subset of journeys for which mode shift to cycling might reasonably occur following the delivery of improved cycling facilities. In this calculation, it is assumed that the modal split of 6.4% of rail users who could be encourage to cycle is currently the same as the modal split for access to the station of rail commuters as a whole.

Based on station surveys by Centro[27], GMPTE[28] and Metro[29], the average percentage rail users accessing stations by cycle was 1.65%, whilst the average percentage driving to stations was 23.7% and the average percentage being dropped at the station was 12.7%. The proportion of trips currently made to the station by car that could potentially be replaced by cycle trips was based on data on trip distance by mode collected by Metro[29] indicating that 28.5% of drive and park trips were <2km, and 39.8% were 2-5km. Car trips (either driving or drop off) under 2km were considered the most likely to be actually replaced by cycle.

Potential car km replaced were calculated assuming that following the provision of infrastructure to address this perceived barrier, 100% and 50% and those currently driving <2km to the station and stating the lack of secure parking as a barrier began to cycle to the station. Calculations were performed for car driver and car drop off trips, for inner city and suburban stations, as described above. Existing cycle trips to the station per day, estimated additional cycle trips replacing car trips, and car km replaced are presented in Table 3-1. The estimated value of these car km replaced in terms of decongestion and carbon emissions savings, are presented in Table 3-2 to Table 3-4.

Table 3-1 Estimated cycle trips to stations per day and estimated car trips replaced following increased cycling to inner city and suburban railway stations if 100% and 50% of the 6.4% of rail commuters who stated that lack of secure parking was a barrier to their cycling to the station actually cycled in place of travelling by car (as-driver and as-passenger) following the delivery of interventions to address this barrier

	Inner city stations			Suburban stations		
Car-as-driver	Current trips per day to stations by cycle*	Additional cycle trips per day generated (car trips replaced)*		Current trips per day to stations by cycle*	Additional cycle trips per day generated (car trips replaced)*	
		100%	50%		100%	50%
SYPTE	4	1	0	146	38	19
Metro	42	11	6	628	165	82
GMPTE	161	42	21	534	140	70
Centro	310	81	41	772	202	101
Merseytravel	474	124	62	991	260	130
Nexus	9	2	1	9	2	1
	Inner city stations			Suburban stations		
Car-as-passenger	Current trips per day to stations by cycle*	Additional cycle trips per day generated (car trips replaced)*		Current trips per day to stations by cycle*	Additional cycle trips per day generated (car trips replaced)*	
		100%	50%		100%	50%
SYPTE	4	1	0	146	21	10
Metro	42	6	3	628	88	44
GMPTE	161	23	11	534	75	38
Centro	310	44	22	772	109	54
Merseytravel	474	67	33	991	139	70
Nexus	9	1	1	9	1	1

*The sometimes modest trip numbers reported in Table 3-1 reflect the fact that main line, and therefore amongst the busiest, railway stations are excluded from this analysis

Table 3-2 Estimated car km replaced per year following increased cycling to inner city and suburban railway stations if 100% and 50% of the 6.4% of rail commuters who stated that lack of secure parking was a barrier to their cycling to the station actually cycled in place of travelling by car (as-driver and as-passenger) following the delivery of interventions to address this barrier

Car-as-driver	Inner city stations		Suburban stations	
	Car km replaced per year			
	100%	50%	100%	50%
SYPTE	1,083	541	41,966	20,983
Metro	12,092	6,046	180,461	90,230
GMPTE	46,249	23,124	153,282	76,641
Centro	89,116	44,558	221,722	110,861
Merseytravel	136,111	68,056	284,706	142,353
Nexus	2,621	1,311	2,442	1,221
Car-as-passenger	Inner city stations		Suburban stations	
	Car km replaced per year			
	100%	50%	100%	50%
SYPTE	581	290	22,509	11,254
Metro	6,486	3,243	96,791	48,395
GMPTE	24,806	12,403	82,214	41,107
Centro	47,798	23,899	118,922	59,461
Merseytravel	73,004	36,502	152,703	76,352
Nexus	1,406	703	1,310	655

Table 3-3 Estimated decongestion value (current prices) per year of car km replaced following increased cycling to inner city and suburban railway stations if 100 and 50% of the 6.4% of rail commuters who stated that lack of secure parking was a barrier to their cycling to the station actually cycled in place of travelling by car (as-driver and as-passenger) following the delivery of interventions to address this barrier

Car-as-driver	Inner city stations		Suburban stations	
	Estimated decongestion value per year (£)			
	100%	50%	100%	50%
SYPTE	£306	£153	£11,876	£5,938
Metro	£3,422	£1,711	£51,070	£25,535
GMPTE	£13,088	£6,544	£43,379	£21,689
Centro	£25,220	£12,610	£62,747	£31,374
Merseytravel	£38,520	£19,260	£80,572	£40,286
Nexus	£742	£371	£691	£346
Car-as-passenger	Inner city stations		Suburban stations	
	Estimated decongestion value per year (£)			
	100%	50%	100%	50%
SYPTE	£164	£82	£6,370	£3,185
Metro	£1,835	£918	£27,392	£13,696
GMPTE	£7,020	£3,510	£23,266	£11,633
Centro	£13,527	£6,763	£33,655	£16,827
Merseytravel	£20,660	£10,330	£43,215	£21,608
Nexus	£398	£199	£371	£185

Table 3-4 Estimated carbon emissions savings (current prices) per year of car km replaced following increased cycling to inner city and suburban railway stations if 100% and 50% of the 6.4% of rail commuters who stated that lack of secure parking was a barrier to their cycling to the station actually cycled in place of travelling by car (as-driver and as-passenger) following the delivery of interventions to address this barrier

Car-as-driver	Inner city stations		Suburban stations	
	Estimated carbon emissions savings per year (£)			
	100%	50%	100%	50%
SYPTE	£12	£ 6	£452	£226
Metro	£130	£65	£1,942	£971
GMPTE	£498	£249	£1,649	£ 825
Centro	£959	£479	£2,385	£1,193
Merseytravel	£1,464	£732	£3,063	£1,532
Nexus	£28	£14	£26	£13
Car-as-passenger	Inner city stations		Suburban stations	
	Estimated carbon emissions savings per year (£)			
	100%	50%	100%	50%
SYPTE	£6	£3	£242	£121
Metro	£70	£35	£1,041	£521
GMPTE	£267	£133	£885	£442
Centro	£514	£257	£1,279	£640
Merseytravel	£785	£393	£1,643	£821
Nexus	£15	£8	£14	£7

The estimates presented in this scenario show potential for notable savings in car kilometres. The associated benefit values far outweigh the necessary cost of investment in basic parking facilities. Investment in more sophisticated and more expensive arrangements, such as the Leeds Cycle Point facility, would presumably have benefits above and beyond those of solely cycle parking, and could therefore stimulate more substantial changes in levels of cycle access to stations, with attendant higher benefit values assigned.

Impacts on modal share

The calculations reported above explore the impact of improvements to cycle parking facilities on levels of cycling to stations. Estimated car km saved through such interventions are based on high level assumptions, and not on data relating specifically to the impact such interventions may have on car use. Estimated mode share of cycling to stations is estimated by calculating cycle trips to stations without the intervention, adding to this the additional trips estimated with the intervention and expressing the resulting value as a percentage of all trips to stations. The estimated proportion of all trips to stations made by cycle following improvements to cycle parking facilities increases by approximately 40%, to 2.3% compared to 1.65% in the assumed pre-intervention scenario.

Estimate of value for money

The approximate value for money of provision of secure cycle parking at railways stations in the scenario described above can be estimated from known average unit costs of installation and maintenance of cycle parking facilities. The following is an illustrative estimate made using a number of high level assumptions, listed below:

- The number of additional cycle parking spaces required is based on the estimated number of additional cycle trips to the station across PTE areas (Table 3-1). In practice it may be necessary to provide some additional spare capacity but we have not attempted to explicitly estimate that figure.
- The cost of secure indoor cycle parking is estimated to be £200 per cycle parking space, with operating costs of £10 per year
- 10% of cycle stands are assumed to be replaced after five years
- Benefits and annual operating costs are discounted over a ten year period at 3.5% per year

Using these assumptions, the cost for indoor cycle parking spaces to accommodate the estimated additional number of cyclists per day is £498,460 over ten years. Discounted decongestion and carbon emissions benefits over ten years total £4.4 million.

The estimated benefit to cost ratio using the assumptions described above could be as high as 8.8:1, based on decongestion and carbon benefits alone. Accounting for mortality benefits and savings to the NHS based on the impact per new cyclist estimated earlier, the benefit cost ratio could exceed 11:1. However, it should be understood that this scenario excludes any expenditure in complementary soft measures aimed at maximising take up of available facilities.

3.2.2 Impact of cycle parking provision and improved access to stations

The second, distinct, modelling scenario for travel to stations considers the provision of improved routes for accessing stations, as well as cycle parking provision. The inferred shift in access to railway stations is based on station surveys of rail users. The final report on the National Station Improvement Programme[30] noted that of the 47% of respondents who drove to the station, 9% would like to cycle. These proportions were used with rail patronage data for inner city and suburban stations (as defined in the previous section) to estimate the number of journeys being made to the station by car by rail users who would like to cycle. We assume that shorter journeys (<2km) made by car are the most likely to be replaced by cycle (28.5%). Estimates of potential numbers of car trips and car km replaced, decongestion value and carbon emissions savings assuming 100% and 50% of those who would like to cycle actually stated to do so are presented in Tables 3-5 to 3-8.

Table 3-5 Estimated cycle trips to stations per day and estimated car trips replaced following increased cycling to inner city and suburban railway stations if 100% and 50% of the 9% of rail commuters currently driving to the station who would like to cycle actually cycled in place of travelling by car following the delivery of interventions to address barriers

	Inner city stations			Suburban stations		
Car-as-driver	Current trips per day to stations by cycle*	Additional cycle trips per day generated (car trips replaced)*		Current trips per day to stations by cycle*	Additional cycle trips per day generated (car trips replaced)*	
		100%	50%		100%	50%
SYPTE	4	3	1	146	107	53
Metro	42	31	15	628	459	230
GMPTE	161	118	59	534	390	195
Centro	310	227	113	772	564	282
Merseytravel	474	346	173	991	724	362
Nexus	9	7	3	9	6	3

*Modest trip numbers reported in Table 3-5 reflect the fact that main line, and therefore amongst the busiest, railway stations are excluded from this analysis

Table 3-6 Estimated car km per year replaced per year following increased cycling to inner city and suburban railway stations if 100% and 50% of the 9% of rail commuters travelling to stations by car but who stated a desire to cycle to the station started to cycle

Car-as-driver	Inner city stations		Suburban stations	
	Car km replaced per year			
	100%	50%	100%	50%
SYPTE	3,016	1,508	116,911	58,456
Metro	33,686	16,843	502,732	251,366
GMPTE	128,841	64,421	427,018	213,509
Centro	248,261	124,131	617,680	308,840
Merseytravel	379,183	189,591	793,142	396,571
Nexus	7,302	3,651	6,802	3,401

Table 3-7 Estimated decongestion value (current prices) per year of car km replaced following increased cycling to inner city and suburban railway stations if 100%, 50% and 20% of the 9% of rail commuters travelling to stations by car but who stated a desire to cycle to the station started to cycle

Car-as-driver	Inner city stations		Suburban stations	
	Decongestion value per year (£)			
	100%	50%	100%	50%
SYPTE	£853	£427	£33,086	£16,543
Metro	£9,533	£4,767	£142,273	£71,137
GMPTE	£36,462	£18,231	£120,846	£60,423
Centro	£70,258	£35,129	£174,803	£87,402
Merseytravel	£107,309	£53,654	£224,459	£112,230
Nexus	£2,067	£1,033	£1,925	£963

Table 3-8 Estimated carbon emissions savings (current prices) of car km replaced following increased cycling to inner city and suburban railway stations if 100% and 50% of the 9% of rail commuters travelling to stations by car but who stated a desire to cycle to the station started to cycle

Car-as-driver	Inner city stations		Suburban stations	
	Carbon emissions savings per year (£)			
	100%	50%	100%	50%
SYPTE	£32	£16	£1,258	£629
Metro	£362	£181	£5,409	£2,704
GMPTE	£1,386	£693	£4,594	£2,297
Centro	£2,671	£1,335	£6,645	£3,323
Merseytravel	£4,080	£2,040	£8,533	£4,267
Nexus	£79	£39	£73	£37

This scenario shows that benefit values for improved access to stations and parking, derived from very simple expressions of user intent, show a value that over a relatively short period of time would present a benefit well in excess of the level of investment.

Impacts on modal share

The calculations reported above explore the impact of improvements to cycle parking provision and improved cycle access on levels of cycling to stations. Estimated car km saved through such interventions are based on high level assumptions, and not on data relating specifically to the impact such interventions may have on car use. Estimated mode share of cycling to stations is estimated by calculating cycle trips to stations without the intervention, adding to this the additional trips estimated with the intervention and expressing the resulting value as a percentage of all trips to stations. The estimated proportion of all trips to stations made by cycle following improvements to cycle parking facilities and cycle access is 2.9% compared to 1.65% in the assumed pre-intervention scenario.

Estimate of value for money

The approximate value for money of provision of secure cycle parking at railways stations in the scenario described above can be estimated from costs of installation and maintenance of cycle parking facilities. Below is an example estimate made using a series of high level assumptions:

- The number of additional cycle parking spaces required is based on the estimated number of additional cycle trips to the station across PTE areas (Table 3-1)
- The cost of secure indoor cycle parking is estimated to be £200 per cycle parking space, with operating costs of £10 per year
- 10% of cycle stands are assumed to be replaced after five years
- Benefits and annual operating costs are discounted over a ten year period at 3.5% per year.

Based on these assumptions, the cost for indoor cycle parking spaces to accommodate the estimated additional number of cyclists per day is £903,843 over ten years. Discounted decongestion and carbon emissions savings benefits over ten years total nearly £8 million.

Using these estimates, the benefit to cost ratio could be as high as 8.8:1, based on decongestion and carbon benefits alone. Accounting for mortality benefits and savings to the NHS based on the impact per new cyclist estimated earlier, the benefit cost ratio would exceed 12:1. However, it should be understood that this scenario excludes any expenditure in complementary soft measures aimed at maximising take up of available facilities.

3.2.3 Modelling levels of cycling to stations in the PTEs similar to those in Holland

The first two scenarios presented in this section examine modest levels of shift in mode of access to stations from car to cycle alone. In the following calculations we explore the potential impacts should levels of cycling to railway stations in PTE areas were comparable to those found elsewhere in Europe. In Holland, nearly 40% of rail passengers arrive at the station by cycle[31], more than 20 times the level of access to stations by cycle in the UK. Although this is highly aspirational, we assume that levels of accessing stations by cycle in Holland can be replicated in PTE areas. Trips to inner city and suburban stations by cycle are calculated assuming that 100%, 50% and 20% of levels of cycling to station in Holland are achieved across the PTE areas, presented in Table 3-9.

Table 3-9 Total trips per day to stations by cycle if levels of cycling to the station were encouraged to the same, 50% and 20% of levels seen in Holland, compared to existing levels of cycling to stations in the UK

	Trips per day to stations by cycle, levels as seen in Holland*					
	Inner city stations			Suburban stations		
	100%	50%	20%	100%	50%	20%
SYPTE	91	46	18	3,543	1,771	709
Metro	1,021	510	204	15,233	7,617	3,047
GMPTE	3,904	1,952	781	12,939	6,470	2,588
Centro	7,523	3,761	1,505	18,716	9,358	3,743
Merseytravel	11,490	5,745	2,298	24,033	12,017	4,807
Nexus	221	111	44	206	103	41

*Modest trip numbers reported in Table 3-9 reflect the fact that main line, and therefore amongst the busiest, railway stations are excluded from this analysis

3.2.4 Summary

Premise	Investment in interventions to overcome perceived barriers to cycling to railway station can increase levels of access to station by cycle
Sources	Evidence from surveys of rail users
Supported assumptions	There is a desire amongst commuters currently using other modes to access stations by cycle
Unsupported assumptions	If interventions are put in places to address the barriers identified by those currently not cycling to the station, then a proportion of those commuters will start to cycle to the station
Parameters	Additional cycle trips to stations estimated from annual station entries in the PTE areas Existing levels of cycling to stations estimated from averages across surveys performed in PTE areas Trips in scope for transfer to cycle are car as driver or car as passenger trips of 2km or less A fraction of those who stated barriers to cycling began to cycle regularly to the station following interventions to overcome those barriers
Costs	Assumed costs of £200 per indoor cycle parking racks, annual maintenance costs of £10 per parking rack and replacement of 10% of parking racks after five year
Output values	Up to 3,000 additional cycle accesses to stations of each day Cycle mode share to journeys to access train stations of up to 2.9% Decongestion benefits valued at up to £924,000 per year Carbon emission savings values at up to £35,000 per year
Value for money	Based on cost assumptions described above, and decongestion and carbon emissions savings benefits discounted over ten years, the estimated benefit to cost ratios is 12:1
Strength of evidence	●●○○○

3.3 Cycling to school

3.3.1 Introduction

This scenario looks at the potential for mode shift for the trip to school, based on Pupil Level Annual School Census (PLASC) data, and incorporating trip distance information to identify replaceable car trips. Stated barriers for cycling to school will be investigated in the same way as for trips to the railway station, assuming that by removing the barrier a proportion of those who stated that perceived barrier to cycling will start to cycle to school.

Baseline information on the usual mode of travel to school is obtained from the 2009 PLASC survey, summing together data for local authorities within each PTE area, giving the total number pupils 'usually' travelling to school by each mode in each PTE. A figure for total trips by car is obtained as the sum of those travelling by car and by car share.

National Travel Survey data[32] on the percentage of trips to school by mode and distance is also used. An estimate of the number of school trips falling in each distance category is obtained by expressing the unweighted sample size for each distance category as a percentage of the total number of trips samples. Together these are used to estimate the total number of car trips to school under 2 miles – these are considered to be car trips potentially 'replaceable' by cycle trips. This is used in further calculations to estimate the impact of various shifts in levels of cycling to school as a result of targeted interventions. The distance by car replaced by cycle trips is estimated assuming the same trip length distribution as for car trips (30% of trips 0-1 miles, assume 0.5 miles (0.8km); 70% of trips 1-2 miles, assume 1.5 miles (2.4km).

3.3.2 Theorised travel behaviour change impacts of smarter choices measures

The first scenario is based on a reduction in education car trips of 5.4%, as cited in the 2008 GMPTE TIF bid for their Travel Behaviour Change Strategy[33]. This paper works through a series of demand forecasts for public transport and active travel as a result of smarter choices interventions in different scenarios. Later the work discusses the costs and benefits of interventions, including both user benefits and external benefits following WebTAG guidance. A NATA based economic appraisal of the interventions is also detailed. A baseline for travel modal share in the GMPTE region is established, with impacts of the Travel Behaviour Change Strategy modelled against this. The impact of the elements of the TIF bid focused on schools is forecast based on responses to school travel plans and funding support across 331 schools.

Calculations are performed assuming that 50% of the schools in the PTE areas were affected and 50% of the 5.4% reduction in car trips is achieved. An estimate of total car km savings per year is made by multiplying the number of pupils estimated to be replacing car trips by 114 (assuming that there are 190 days in the school year and trips are replaced on three out of five days) and multiplying by two to include the return journey distance. Cycling trips, car km replaced, decongestion and carbon emission savings are presented in Table 3-10.

Table 3-10 Estimated additional cycle trips per year, car km saved, decongestion value and carbon emissions savings (current prices) following a reduction in car trips to primary and secondary schools of 5.4%

PTE area	Number of additional cycling trips	Car km saved	Decongestion value (£)	Carbon emissions saving (£)
SYPTE	80,369	154,308	£43,669	£1,660
Metro	147,169	282,564	£79,966	£3,040
GMPTE	166,841	320,335	£90,655	£3,446
Centro	183,133	351,616	£99,507	£3,783
Merseytravel	83,478	160,278	£45,359	£1,724
Nexus	63,216	121,375	£34,349	£1,306

This exercise does not describe the impact of a specific programme of interventions; rather it illustrates the potential values of relatively modest levels of change.

Impacts on modal share

The calculations reported above explore the potential impact of smarter choices measures on reductions in levels of car travel. Estimated additional cycle trips are based on high level assumptions, and not on data relating specifically to the impact such interventions may have on transfer between modes for the journey to school. Including all the assumptions outlined above, the mode share for trip to school by car is 25.4%.

3.3.3 Impact of interventions to overcome barriers to cycling to school

One potential intervention that could yield an even greater degree of benefit is the delivery of interventions to overcome barriers to cycling to school. In a study evaluating the 'Travelling to School Initiative' programme[34], 37% of respondents to a school survey stated that the main barrier to encouraging pupils to cycle to school was the perception of local roads being unsafe, and a lack of safe cycle routes and crossing points. Other factors were: parental attitudes (reluctance to let children travel independently due to perceived safety/security issues, 27%) and difficulty in changing parental routines (26%).

Barriers concerning safety improvements linked to the provision of quality routes linking to schools and improved crossing facilities could be overcome with investment in infrastructure. In this scenario, we assume that lack of safe routes and crossings is a barrier to 37% of half of the pupils in the PTEs and that these pupils might otherwise cycle or walk to school. It is assumed that, with a suitable intervention in place, 25% of those currently discouraged from walking or cycling to school are encouraged to do so, and 50% of those cycle. The distance by car replaced by cycle trips was estimated assuming the same trip length distribution as for car trips (30% of trips 0-1 miles, assume 0.5 miles (0.8km); 70% of trips 1-2 miles, assume 1.5 miles (2.4km)). Distance replaced per year was estimated assuming that children cycle to school on three out of five days a week and that there are 190 days in a school year. Decongestion benefits and carbon emissions savings were valued as previously described and presented in Table 3-11.

Table 3-11 Estimated additional cycle trips, car km saved, decongestion value and carbon emissions savings (current prices) per year following an increase in cycle trips to school linked to interventions to improve cycle routes to school and crossings

PTE area	Number of additional cycling trips	Car km saved	Decongestion value (£)	Carbon emissions savings (£)
SYPTE	275,337	528,646	£149,607	£5,688
Metro	504,189	968,042	£273,956	£10,415
GMPTE	571,556	1,097,444	£310,577	£11,807
Centro	627,401	1,204,610	£340,905	£12,960
Merseytravel	285,991	549,102	£155,396	£5,908
Nexus	216,574	415,823	£117,678	£4,474

Impacts on modal share

The calculations reported above explore the potential impact of interventions to address barriers to cycling to school. Estimated car km saved are based on high level assumptions, and not on data relating specifically to the impact such interventions may have on transfer between modes for the journey to school. The estimated proportion of trips to school by cycle is calculated taking a base level of cycling to school, adding to this the estimated additional cycle trips to school and expressing the resulting value as a percentage of the total number of trips to school. In the with intervention scenario, the proportion of trips to school by cycle ranged from 1.2% to 1.9% with an average of 1.6%, compared to an average of 0.8% in the assumed without intervention scenario.

Estimate of value for money

The scenario reported above explores the potential impact should barriers to cycling to school be overcome. Typical costs for infrastructure interventions which may address such barriers range from about £50,000 for toucan crossings up to £300,000 for the creation of new shared use paths[35] , whilst the delivery of Bikeability cycle training costs vary between local authorities[36], with an average delivery cost of around £45 per pupil[37].

However, it has not been possible in the time available to work up estimates of the delivery of this range of measures across individual PTE areas due to lack of detailed information on the most appropriate interventions at individual schools. We would be happy to work with PTEs in the future to develop more detailed estimates of the cost and likely impact of this type of intervention in specific areas.

On the benefits side, tools currently available for estimating the impact of interventions focused on encouraging children to cycle are somewhat limited. Whilst the impact of increased physical activity through cycling is anticipated to be substantial, this cannot be readily valued using the research and tools available at the present time.

Sustrans recently compiled benefit to cost ratios for several Links to Schools schemes using Department for Transport guidance and found, based on the benefits to adult pedestrians and cyclists alone who also benefited from these improved local links, an average benefit to cost ratio of around 4:1[38]. This illustrative figure indicates that, even when benefits to children are not valued directly (most notably health benefits), interventions improving cycle access to school deliver good value for money.

3.3.4 Summary

Premise	Delivery of interventions to address barriers to cycling to school can increase levels of cycling for the school commute
Sources	Evidence from studies estimating reduction in car trips for education following smarter choices interventions and surveys identifying barriers to encouraging children to walk and cycle to school
Supported assumptions	There are barriers to levels of cycling to school which can be overcome through deliverable interventions
Unsupported assumptions	If interventions are put in places to address the barriers identified by those currently not cycling to school, then a proportion of those children will start to cycle to school
Parameters	Existing cycle trips to school are estimated from PLASC data for the relevant area Trips in scope for transfer to cycle are those of 2 miles or less A fraction of those currently not cycling to school begin to do so following interventions to overcome barriers
Costs	Delivery of cycle training to school children costs approximately £45 per pupil[37] Infrastructure interventions may cost from £50,000 - £300,000[35]
Output values	Up to 2.5 million additional cycle accesses to school each year Cycle mode share to journeys to access schools of up to 1.6% Decongestion benefits valued at up to £1.3 million Carbon emission savings values at up to £51,000
Value for money	Uncertain for cited examples; estimated benefit cost ratios for infrastructure interventions to improve cycle access to school are in the region of 4:1[38]
Strength of evidence	●●○○○

3.4 Cycling to work

3.4.1 Introduction

Local authority data from cordon counts suggests somewhere in the region of 1,000-3,000 cycle trips per day are made to city centres. This series of scenarios looks at the potential for mode shift for the commute to work to city centres, based on distance from the work place and current mode of travel to work. For the first three scenarios we adapt work by Wardman et al.[39]. The authors used a combination of revealed preference surveys together with National Travel Survey data, and stated preference surveys to understand the impacts of different factors – including route facilities, at destination cycling facilities and financial incentives to encourage cycling to work. We use each of these three focal points as the basis for the following sections of this report. The model to forecast the impact of various combinations of these interventions on proportions travelling to work uses as a point of reference Census data for travel to work by each of the main modes - by car (driver and passenger), bus, train, by foot and cycle for trip distance <7.5 miles.

3.4.2 Modelling impact of changes in infrastructure

The impact of changes to cycle infrastructure provision on the proportion of commuters cycling to work forecast by Wardman et al.[39] are summarised in Table 3-12. The base percentage cycling to work was derived from 1997 National Travel Survey data and reflects commuting mode share by cycle for journeys of 7.5 miles or less.

Table 3-12 Impact of infrastructure changes on forecast mode share of cycling to work as reported in Wardman et al[39]

Scenario	% cycling	Index
Base	5.8%	100
Half existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	6.6%	114
Half existing major and minor roads with no cycling facilities change to segregated on road cycle lane	6.9%	119
Half existing major and minor roads with no cycling facilities change to segregated off road cycle lane	7.0%	121
All existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	7.7%	133
All existing major and minor roads with no cycling facilities change to segregated on road cycle lane	8.5%	147
All existing major and minor roads with no cycling facilities change to segregated off road cycle lane	8.7%	150
All existing major and minor roads with no cycling facilities and non-segregated on road cycle lane change to segregated on road cycle lane	8.8%	152
All existing major and minor roads with no cycling facilities, non-segregated on road cycle lane and segregated on road cycle lane change to segregated off road cycle lane	9.0%	155

For the modelling exercises, the base percentage of trips to work made by cycle is for trips under 10km (surrogate for trips under 7.5 miles estimated from Census data) for each PTE area. The same percentage change in levels of cycling to work reported by Wardman et al.[39] are applied to this base level of cycling for the different infrastructure changes included in the analysis.

Additional trips by cycle are calculated by subtracting trips currently made by cycle from the total number of trips to work by cycle in the with intervention scenario. Potential car km replaced were estimated assuming that 60% of additional trips by cycle were replacing trips by car, and assuming that trip length distribution of these cycling trips was the same as existing cycle trips to work (based on census data; 36% <2km, assume 1.5km; 44% 2-5km, assume 3.5km, and 20% 5-10km, assume 7.5km).

Trip distance was adjusted for return trips and multiplied by an annualisation factor to obtain an estimate of car km saved per year (assuming 220 days worked per year and cycling to work on three out of five days per week). The estimated percentage of commuters travelling to work by cycle for each infrastructure scenario and the estimated number of trips are summarised in Table 3-13. The estimated car km replaced, decongestion and carbon emissions savings for each scenario are presented in Tables 3-14. In all cases the ranges reported are those calculated across all scenarios described in Table 3-12. Complete tables reporting values individually for each scenario are included in the appendix to this report.

Table 3-13 Percentage commuters travelling to work by cycle and estimated number of cycle trips per year following improvements to cycle routes

PTE area	Base % cycling to work	% cycling to work following cycle route improvements	Additional numbers cycling to work
SYPTE	2.0%	2.2%-3.0%	929-3,715
Metro	1.5%	1.7%-2.4%	1,254-5,014
GMPTE	2.6%	3.0%-4.1%	2,581-10,322
Centro	2.4%	2.7%-3.7%	2,401-9,605
Merseytravel	2.7%	3.1%-4.2%	1,288-5,153
Nexus	2.1%	2.4%-3.2%	875-3,502

Table 3-14 Estimated car km saved, decongestion value and carbon emissions savings (current prices) following improvements to cycle routes

PTE area	Estimated annual car km replaced	Estimated annual decongestion value (£)	Estimated annual carbon emissions savings (£)
SYPTE	221,816-887,263	£62,774-£251,095	£2,386-£9,546
Metro	299,400-1,197,600	£84,730-£338,921	£3,221-£12,885
GMPTE	616,393-2,465,570	£174,439-£697,756	£6,632-£26,527
Centro	573,532-2,294,127	£162,309-£649,238	£6,171-£24,682
Merseytravel	307,702-1,230,808	£87,080-£348,319	£3,311-£13,242
Nexus	209,099-836,396	£59,175-£236,700	£2,250-£8,999

The values generated relate solely to infrastructure provision and offer a clear insight into the potential value of savings associated with such interventions.

Impacts on modal share

The calculations reported in the above sections model the impacts of cycle route improvements on levels of cycling to work based on forecasts from academic research[39]. Depending on the degree of route improvement, average mode share of cycling to work for journeys of 7.5 miles or less across the PTE areas could range from 2.5% to 3.4% compared to an average base value of 2.2%.

Estimate of value for money

The approximate value for money of improvements to cycle routes described above can be estimated from costs of installation and maintenance of cycle routes. The following is an illustrative estimate based on the scenario that half existing major and minor roads with no cycling facilities change to segregated off road cycle lane. The following high level assumptions are applied:

- The length of additional cycle route installed/improved is estimated assuming four key commuting corridors per PTE area and that installation of 2km of new or improved cycle route on each of these corridors reflects the scenario described above
- The cost of installing segregated off road cycle lane is assumed to be £150,000[38] per mile (£93,168 per km) and maintenance cost is assumed to be £500 per km per year
- Benefits and annual operating costs are discounted over a ten year period at 3.5% per year.

Based on these assumptions, the cost for additional cycle routes in this scenario (including installation and maintenance) is £4.7 million over ten years. Discounted decongestion and carbon emissions savings benefits over ten years total £8.2 million.

Using these estimates, the benefit to cost ratio could be in the region of 2:1, based on decongestion and carbon benefits alone. Accounting for mortality benefits and savings to the NHS based on the impact per new cyclist estimated earlier for the CDTs, the benefit cost ratio would exceed 6:1. However, it should be understood that this scenario excludes any expenditure in comparatively cheap complementary soft measures at workplaces which could increase the take up of available facilities. Our results also exclude any benefits to non-commuters or those using new facilities but not travelling into city centres.

3.4.3 Modelling impact of improvements to cycling facilities at work places

The impact of changes in cycling facilities at work places derived from Wardman et al.[39] are summarised in Table 3-18.

Table 3-15 Impact of changes in cycling facilities in workplaces on forecast mode share of cycling to work

Scenario	% cycling	Index
Base	5.8%	100
Outdoor parking provided	6.3%	109
Indoor parking provided	6.6%	114
Showers and indoor parking provided	7.1%	122

Additional cycling trips and estimated changes in car km were calculated as described above for route infrastructure changes. The estimated percentage of commuters travelling to work by cycle for each infrastructure scenario and the estimated number of trips are summarised in Table 3-16. The estimated car km replaced, decongestion and carbon emissions savings for each scenario are presented in Tables 3-17. In all cases the ranges reported are those calculated across all scenarios described in Table 3-15. Complete tables reporting values individually for each scenario are included in the appendix to this report.

Table 3-16 Percentage commuters travelling to work by cycle and estimated number of cycle trips per year following improvements to work place cycle facilities

PTE area	Base % cycling to work	% cycling to work following improvements to work place cycle facilities	Additional numbers cycling to work
SYPTE	2.0%	2.1%-2.4%	580-1,509
Metro	1.5%	1.7%-1.9%	783-2,037
GMPTE	2.6%	2.9%-3.2%	1,613-4,194
Centro	2.4%	2.6%-2.9%	1,501-3,902
Merseytravel	2.7%	2.9%-3.3%	805-2,093
Nexus	2.1%	2.3%-2.6%	547-1,423

Table 3-17 Estimated car km saved, decongestion value and carbon emissions savings (current prices) following improvements to work place cycle facilities

PTE area	Estimated annual car km replaced	Estimated annual decongestion value (£)	Estimated annual carbon emissions savings (£)
SYPTE	138,635-360,450	£39,234-£102,007	£1,492-£3,878
Metro	187,125-486,525	£52,956-£137,687	£2,013-£5,234
GMPTE	385,245-1,001,638	£109,024-£283,464	£4,145-£10,776
Centro	358,457-931,989	£101,443-£263,753	£3,857-£10,027
Merseytravel	192,134-500,016	£54,425-£141,505	£2,069-£5,380
Nexus	130,687-339,786	£36,984-£96,159	£1,406-£3,656

This exercise addresses only changes at the workplace to support people travelling by cycle, but still shows that a notable degree of impact, in car kilometre reduction and benefit value terms, is quite possible.

Impacts on modal share

The calculations reported in the above sections model the impacts of cycle facilities at work places on levels of cycling to work based on forecasts from academic research[39]. Average mode share of cycling to work for journeys of 7.5 miles or less across the PTE areas could range from 2.4% (following provision of outdoor parking) to 2.7% (following provision of indoor parking and showers) compared to an average base of 2.2%.

Estimate of value for money

An approximate value for money of improvements to workplace cycling facilities can be generated using costs of installation and maintenance of facilities. The following is an illustrative estimate based on the scenario of installation of additional cycle parking at workplaces, and is made applying the following high level assumptions:

- the number of additional cycle parking spaces required is based on the estimated number of additional cycle trips to work across PTE areas (Table 3-16)
- the cost of secure indoor cycle parking is estimated to be £200 per cycle parking space, with operating costs of £10 per year
- 10% of cycle stands are assumed to be replaced after five years
- benefits and annual operating costs are discounted over a ten year period at 3.5% per year

Using these assumptions, the cost for indoor cycle parking spaces to accommodate the estimated additional number of cyclists per day is £2.8 million over ten years. Discounted decongestion and carbon emissions savings benefits over ten years total £5.4 million.

Based on these estimates, the benefit to cost ratio could be around 2:1, based on decongestion and carbon benefits alone. This estimate ratio is lower than that estimated for installation of cycle parking at railway stations due to variation in assumptions applied regarding distance travelled and replacement of car trips by cycle trips. Accounting for mortality benefits and savings to the NHS based on the impact per new cyclist estimated earlier, the benefit cost ratio would exceed 5:1.

3.4.4 Modelling impact of financial incentives to cycle to work

The impact of financial incentives on levels of cycling to work places[39] is presented in Table 3-24. In the simplest terms, a financial reward is provided for every occasion that an employee elects to cycle to work

Table 3-18 Impact of financial incentives on forecast mode share of cycling to work

Scenario	% cycling	Index
Base	5.8%	100
£0.50 per day payment	6.6%	114
£1.00 per day payment	7.7%	133
£1.50 per day payment	9.1%	157
£2.00 per day payment	10.9%	188
£3.00 per day payment	15.5%	267
£4.00 per day payment	21.8%	376
£5.00 per day payment	28.0%	483

Additional cycling trips and estimated changes in car km were calculated as described above for route infrastructure changes. The estimated percentage of commuters travelling to work by cycle for each incentive scenario and the estimated number of trips are summarised in Table 3-19. The estimated car km replaced, decongestion and carbon emissions savings for each scenario are presented in Tables 3-20. In all cases the ranges reported are those calculated across all scenarios described in Table 3-18. Complete tables reporting values individually for each scenario are included in the appendix to this report.

Table 3-19 Percentage commuters travelling to work by cycle and estimated number of cycle trips per year following financial incentives to cycle to work

PTE area	Base % cycling to work	% cycling to work following financial incentives to do so	Additional numbers cycling to work
SYPTE	2.0%	2.2%-9.4%	928-25,771
Metro	1.5%	1.7%-7.3%	1,254-34,785
GMPTE	2.6%	3.0%-12.7%	2,581-71,614
Centro	2.4%	2.7%-11.6%	2,401-66,634
Merseytravel	2.7%	3.1%-13.0%	1,288-35,750
Nexus	2.1%	2.4%-10.1%	875-24,294

Table 3-20 Estimated car km saved, decongestion value and carbon emissions savings (current prices) following financial incentives to cycle to work

PTE area	Estimated annual car km replaced	Estimated annual decongestion value (£)	Estimated annual carbon emissions savings (£)
SYPTE	221,816-6,155,385	£62,744-£1,741,974	£2,386-£6,625
Metro	299,400-83,08,352	£84,730-£2,351,264	£3,221-£89,388
GMPTE	616,393-17,104,894	£174,439-£4,840,685	£6,632-£184,028
Centro	573,532-15,915,505	£162,309-£4,504,088	£6171-£171,232
Merseytravel	307,702-8,538,734	£87,080-£2,416,462	£3,311-£91,867
Nexus	209,099-5,802,499	£591,75-£1,642,107	£2,250-£62,428

Impacts on modal share

The calculations reported in the above sections model the impacts of financial incentives on levels of cycling to work based on forecasts from academic research[39]. Average mode share of cycling to work for journeys of 7.5 miles or less across the PTE areas could range from 2.5% (following a financial incentive of £0.50 per day) to 10.7% (following a financial incentive of £5.00 per day) compared to an average base of 2.2%.

Estimate of value for money

The approximate value for money of financial incentives to encourage cycling to work can be estimated from costs of providing such incentives. The following is an illustrative estimate based on the scenario of a £3 per day incentive to cycle to work, and is made applying the following high level assumptions:

- the initial cost of providing the financial incentive to cycle is estimated by multiplying the number of additional cyclists (Table 3-19) by the incentive (£3) and the number of days cycled to work (132, assuming 220 working days per year and cycling to work on three out of five day)
- it is assumed that in each year of the ten year period, 10% of those cycling in the previous year continue to do so without the financial incentive
- benefits and annual operating costs are discounted over a ten year period at 3.5% per year

Using these assumptions, the cost of delivering the financial incentive over ten year s is £215.4 million. Discounted decongestion and carbon emissions savings benefits over ten years total nearly £66 million.

Based on these estimates, the benefit to cost ratio could be around 0.3:1, based on decongestion and carbon benefits alone, suggesting within the bounds of the current scenario, financial incentives to cycle to work represent very poor value for money compared to other interventions. Even after adding in potential health benefits and NHS savings costs would only match the benefits.

The scenarios explored above relate to separate interventions. Wardman et al also forecast the impact of combinations of these interventions. The conversion of half of major and minor roads without cycling facilities to non-segregated on road cycle lane, the provision of outdoor parking, indoor parking and showers, together with a £1 per day incentive to cycle is forecast to yield a 103% increase in cycle mode share for commuting to work (from a reported base of 5.8% to 11.8%). The conversion of half of major and minor roads without cycling facilities to segregated on road cycle lane, together with indoor and outdoor parking, showers and a £5 per day financial incentive is forecast to yield a 508% increase in cycling to work[39].

3.4.5 Modelling potential town wide interventions on journeys to work

The calculations reported above relate to the potential impact of various interventions in relation to levels of cycling to work. Earlier in this report we explored the potential impact of town wide packages on levels of cycling in general. In the following calculations, we revisit the CDT model in the context of cycling to work, the rationale for doing so being that commuting trips over short distances are amongst the most promising for transfer to cycling.

Data are available at a local authority level on distance travelled and mode of travel to work. These data used together with data on employment rate and time and frequency of cycling by the estimated numbers of new cyclists in PTE areas (based on evidence from CDTs) give an estimate of potential numbers of car trips replaced if interventions were put in place to encourage a shift towards cycling for everyday journeys, specifically the commute to work.

Trips considered ‘in scope’ for replacement by cycling are those of up to 5km distance. The adult population making ‘in scope’ trips was calculated using the employment rate for each local authority together with the percentage of trips to work of 5km or less. Estimated ‘new’ cyclists amongst this subset of the population are calculated for the lower, upper and nearest neighbour estimate scenario as previously defined. This estimation assumes that the potential for individuals to become new cyclists is the same amongst the employed population travelling 5km or less to get to work as for the adult population as a whole. The proportion of trips to work currently made by car (driver) was calculated from local authority level data on mode of travel to work by distance, and applied to the population of new cyclists who are employed and assumed to have the same commuting travel pattern as the local authority population as a whole. Annual trips displaced were estimated assuming 220 working days per year and assuming that 50% of ‘in scope’ trips by car to work made by new cyclists in the PTE areas are replaced by trips by cycle. Potential trips per year saved were converted into km replaced assuming that 40% of the trips replaced were <2km (assume 1.5km trip distance) and 60% were 2-5km (assume 3.5km trip distance), and presented in Table 3-33.

Decongestion and carbon emissions savings were valued as previously described and presented in Table 3-31 and Table 3-32.

Table 3-21 Estimated annual car km to work replaced by cycle trips

	Estimated annual km abstracted from the road network		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	523,634	1,428,092	916,580
Metro	1,033,780	2,819,400	2,163,992
GMPTE	1,211,174	3,303,201	2,496,368
Centro	1,253,173	3,417,746	1,964,524
Merseytravel	539,176	1,470,481	816,561
Nexus	522,739	1,425,652	797,371

Table 3-22 Estimated annual decongestion value (current prices) of car km to work replaced by cycle trips

	Estimated annual value of decongestion benefits in PTE areas (£)		
PTE area	Lower estimate	Upper estimate	Nearest neighbour estimate
SYPTE	£148,188	£404,150	£259,392
Metro	£292,560	£797,890	£612,410
GMPTE	£342,762	£934,806	£706,472
Centro	£354,648	£967,222	£555,960
Merseytravel	£152,587	£416,146	£231,087
Nexus	£147,935	£403,460	£225,656

Table 3-23 Estimated annual carbon emissions savings (current prices) of car km to work replaced by cycle trips

	Estimated value of carbon emissions savings (£)		
PTE area	**Lower estimate**	**Upper estimate**	**Nearest neighbour estimate**
SYPTE	£5,634	£15,365	£9,861
Metro	£11,122	£30,333	£23,282
GMPTE	£13,031	£35,538	£26,858
Centro	£13,483	£36,771	£21,136
Merseytravel	£5,801	£15,821	£ 8,785
Nexus	£5,624	£15,338	£ 8,579

3.4.6 Summary

Premise	Delivery of interventions improving cycle routes, improved workplace cycling facilities and financial incentives to cycle to work can increase levels of cycling to work
Sources	Forecasts from an academic study[39] predicting changes in mode share for the commute to work for journeys of 7.5 miles or less following the provision of various levels and types of intervention
Supported assumptions	Changes in mode share result when cycling facilities are improved or travel by cycle is rewarded financially
Unsupported assumptions	Similar levels of increase in the mode share of cycling result following the delivery at a PTE scale of the same types of interventions as investigated in the academic study used as evidence
Parameters	Existing cycle trips to work are estimated from census travel to work data for the relevant area Trips in scope for transfer to cycle are those of 7.5 miles or less A fraction of currently not cycling to work begin to do so following delivery of different levels of interventions
Costs	£150,000 per mile of traffic free cycling route £200 per indoor cycle parking space
Output values	Over 37,000 additional commuters cycling to work following high level improvements to route infrastructure, increasing cycle mode share to on average 3.4% with decongestion benefits of

	up to £2.5 million and carbon emission savings of up to £96,000 Over 15,000 additional commuters cycling to work following improvements to workplace cycling facilities, increasing cycle mode share to on average 2.7% with decongestion benefits of up to £1 million and carbon emission savings of up to £39,000 Up to 259,000 additional commuters cycling to work following financial incentives to cycle to work, increasing cycle mode share to on average 10.7% with decongestion benefits of up to £17.5 million and carbon emission savings of up to £665,000
Value for money	Based on calculations including high level assumptions, an estimated BCR of 6:1 for cycle parking facilities, 5:1 for cycle route improvements and 1:1 for financial incentives to cycle to work.
Strength of evidence	●●○○○

3.5 Discussion

The scenarios presented in this section of the report reflect the extent of impact that can be achieved in terms of increasing levels of cycling, and realising the associated benefits. In particular, it highlights the impacts that a targeted programme of delivery can achieve, relative to the more generic town-wide scenario.

The very wide variation in the outcomes from railway station oriented interventions within each PTE area reflect the density of distribution of stations, as well as the established travel patterns for the area. However, they also show that in most cases, there is the scope to make a notable impact through simple measures to improve parking facilities and to enhance access.

Estimated benefits for cycle trips to school are fairly substantial, even without the inclusion of some potentially notable benefits - specifically, the health benefits for children travelling to school by cycle cannot currently be robustly estimated. However, we have been unable in the time available to work up detailed estimates of the value for money of this type of measure in PTE areas.

Targeting commuter journeys is also shown to be effective in PTE settings, particularly through the delivery of improved cycling facilities at work places and improvements to cycle routes. Although the travel to work scenarios are treated as distinct entities, we can speculate that a combined programme that encompasses infrastructure, at-destination facilities and incentives may more than match the sum of the parts.

4 Discussion

4.1 The findings, their implications and their application

4.1.1 Overview of key findings

The exercises set out with in this report were designed to estimate the potential impact and value for money from a step change in the delivery of interventions in support of cycling, both large scale investment in packages of measures, and investment targeted at addressing perceived barriers to cycling for journey of specific purpose. A non-systematic review of the evidence revealed a narrow range of studies suitable for use in support of this study. Evidence for the impacts of town wide interventions was taken from the Cycling Demonstration Towns and Sustainable Travel Town programmes, whilst evidence related to the potential for raising cycling mode share for specific journeys, namely to school, workplaces and railway stations, was obtained from a small number of studies reporting on perceived barriers to cycling as a mode choice (in the case of journeys to school and to railway stations) and the impact of specific levels of interventions raising the proportion of trips made by cycle (workplaces).

We acknowledge the technical limitations in attempting to transfer the available evidence base to the PTE areas. High level assumptions have necessarily been made in the calculation, tempered where appropriate by conservative assumptions in terms of the level of change in cycling levels resulting from interventions in the various scenarios explored. As a result, we anticipate the findings of the modelling reported herein to be conservative.

Focusing initially on the impact of town wide packages of measures, Cycling Demonstration Towns-type interventions could result in up to 307,000 new cyclists across the PTE areas, making 96 million trips per year and lifting cycling mode share to around 2.4%. Benefits accrued to these new cyclists alone could total in the region of £716 million over a ten year period. Benefit to cost ratios could be up to 3.2:1. Programmes with a broader sustainable travel are also found to have a substantial impact on travel patterns in the PTE areas. Delivery of Sustainable Travel Towns-type interventions could generate 16 million additional cycle trips per year across the six PTE areas, lifting cycling mode share to 1.9%. Replacement of up to 71.6 million car trips per year could be achieved, with an associated decongestion and carbon savings value of up to £181.4 million

In relation to journeys for specific purposes, the provision of secure parking at stations could lead to an additional 1,600 cycle trips to stations per day across the six PTE areas, with 2.9% of all trips to suburban and inner city stations being made by cycle. Changes of this magnitude could yield annual benefits in terms of decongestion and carbon emissions savings of up to £528,900. Delivery of interventions to encourage those who currently drive to the station but would like to cycle to do so could result in nearly 3,000 additional cycle trips to stations across the six PTE areas each day, with potential benefits of up to £959,000. Levels of cycling to stations in Holland are some 20 times those seen in the UK – if interventions were delivered to encourage uplift of cycle trips to stations to the same order of magnitude as seen in Holland, cycle trips to access suburban and inner city stations would total 99,000 each day, representing an upper bound of what could potentially be achieved across the PTE areas.

Interventions to overcome perceived barriers to cycling to school could result in some additional 2.5 million trips to school by cycle each year, representing 1.6% of trips to school with an associated benefit of up to £1.4 million.

Research has shown that improvements to cycle routes, provision of cycling facilities in workplaces and financial incentives to cycle to work can all increase cycling mode share for journeys to work. Applying the conclusions of this research across the six PTE areas, route improvements could increase cycling to work to up to around 3.4% (from an average base of 2.2%), with annual decongestion benefits valued at up to £2.6 million. The provision of indoor parking and showers alone could increase the percentage cycling to work to 2.7%, and a £1 per day incentive to cycle to work could result in 2.9% cycling mode share, with annual decongestion benefits valued at around £1 million and £1.6 million, respectively.

4.1.2 What this work tells us

This series of exercises clearly shows the potential for impact of major investment in cycling in PTE areas. The impacts of investment comparable to that delivered in the CDTs and STTs are shown to be very considerable, in terms of volumes of cycling activity, economic impact and value for money. The same is true for the modelling of specific journeys, where relatively modest changes have rather strong impacts. Data from Holland serves to emphasise just how modest these assumptions are, where a simple replication of the levels of activity seen in trips to the station show clearly massively inflated relative benefits.

The scenarios presented suggest a range of delivery packages, but this is not an exhaustive list of the possibilities available to PTE authorities. The examples that we have chosen represent strong investment in cycling (among other modes, in some instances), but are primarily those circumstances where the best evidence is available for conducting such exercises. Location specific investment packages will obviously need to be drawn up to suit local circumstances, and involving the relevant local stakeholders.

What is less readily demonstrable through this exercise is the nature and extent of impact on public transport providers. Evidence suggests that a major shift towards cycling has benefits to public transport providers through increased patronage (attributable to more multi-modal staged trips involving cycling and public transport), reduced congestion, reduced need for parking space at interchanges, expanded catchment areas, and improved transport network resilience. Some of the possible negatives are perceived rather than evidenced. However, in both cases the evidence does not allow for ready quantification and impact modelling in most instances.

4.1.3 What should the response be?

The most immediate and current impetus for this work (at the time of publication) is to inform and support bids to the Local Sustainable Transport Fund and to assist in the development of proposals within the context of Local Transport Plans. There is a clear stipulation for the inclusion of a strong evidence base in LSTF bids, and this work can constitute a part of that evidence base.

More widely, and less time-critically, we imagine that there is scope for the PTEs to give encouragement to local authorities in their areas to adopt cycling as a mainstream part of their wider packages of delivery. The general principle of there being enormous potential for uplift in levels of cycling activity, and the extensive benefits associated with such activity, is a point worth bearing in mind in relation to all delivery activities within PTE areas. More detailed reviews of the local circumstances that dictate what interventions may be appropriate in PTE areas can be undertaken, or existing reviews can be revisited in the light of this report. Activity need not necessarily be solely cycling focussed – cycling can and should be built-in to wider transport delivery programmes, and again the information presented in this report can be used to support that integration. Further development of expertise and capacity in delivery of cycling-related schemes within PTEs and PTE area local authorities may also be appropriate where circumstances permit.

4.1.4 How should the findings of the report be used?

We have tried to select a broad enough palette of examples that PTE authorities can draw on one or more of the presented scenarios to use as a proxy for the cycling schemes that are under active consideration in their respective areas. We appreciate that most schemes will not be exclusively cycling focussed, but expect that wider packages can be assessed for impact and value for money using the examples presented in this report in combination with other data relating to the impact and value for money of other modes affected by any given package. This integrated modelling will present a more complete picture of the overall impact of diverse packages.

This sort of approach should be readily applicable in the context of the generation of evidence to underpin LSTF bids, and to construct a case for LTP3 investment. We have aimed to optimise the transferability of the data, analysis and results used in the report, and we hope that judicious selection of the most relevant scenarios presented within the report should allow scheme promoters to adapt or develop relevant sections.

Finally, we anticipate that further development and refinement of the body of work presented in the report may be attempted in due course. Some suggestions for further work are made in the following section.

4.2 Possibilities for the further development of this work programme

4.2.1 Conducting the same exercises in a specific setting

A more detailed look at the same sets of interventions in a more specific geographical setting would offer the advantages of providing a more finely tuned estimate of impacts. Specifically there might be a perceived need at some stage for an equivalent exercise for a PTE area or for an individual local authority.

4.2.2 Conducting different exercises on a similar theme

There is no doubt that a range of alternative scenarios could be generated on a similar theme. The content of this work was primarily determined by the availability of data and by the need to use a fairly generic group of settings. Focus on different types of trips and destinations within the same context could be very valuable, depending on the need of any particular activity.

Two key examples are the possibility of including walking in the overall assessment, and of building in evidence from different sets of interventions. On the former, although the needs of cyclists and pedestrians are very different, there is also an element of commonality of infrastructure and information need that makes ‘co-delivery’ efficient, effective and desirable. Modelling them side-by-side could therefore be a useful approach. On the latter, there may well be different datasets that are available now, or that become available at some future time, that could be applied in this context. Data availability is further considered below.

4.2.3 Evidence gaps and future data requirements, and new research

Our search for available datasets was not exhaustive, and it may well be that there are other datasets that could be used in the context that we have used material in this report. More data on workplaces, railway stations, schools, corridors and town-wide or PTE-wide interventions may well be available. As suggested above, more location specific data will always be valuable when used in this context.

Appropriate evaluation of interventions seeking to impact on sustainable and active modes will be essential. The evidence base is still modest, and any further additions would be most welcome.

Closely linked to the above point, it may be that the PTEs wish to review their wider monitoring programmes in the context of the evidence of the potentials for cycling. If a step-change in investment in cycling is envisaged, it makes sense to be able to demonstrate the impact, and therefore a strong programme of data collection that encompasses cycle use should be implemented.

In terms of new research, there are a number of issues that we feel are particularly pertinent in the context of this study. In particular we would like to highlight the limitations of the current appraisal mechanisms, and the treatment of some benefits associated with sustainable and active modes (relative to motor-vehicle and public transport benefits). Also, the paucity of demand response elasticities in relation to cycling, and the limited knowledge of the principle determinants of what are the most important factors in people making a decision to engage in cycling in large urban settings are also issues that would benefit from further study.

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6 Appendix 1

6.1 Transferring evidence to the PTE areas – scope and limitations

In the first instance, local authorities within PTE areas are compared to CDTs and STTs on a limited number of variables anticipated to influence the ways in which people travel in these areas. The factors compared were:

- Population density[40]
- Population age distribution[41]
- Employment status[42]
- Percentage population describing themselves as being in good health[43]
- Trip length distribution (data on distance travelled to work was used for the purpose of this comparison)[44]
- Car ownership[45]
- Levels of public transport use[44]
- Existing levels of cycling each area[46]

6.1.1 Demographic variables

Population estimates for each local authority were obtained for 2009[41]. The spatial population density is calculated. The proportion of the population aged under 16, 16 to 64 (men)/59 (women) and 65 and over (men)/60 and over (women) are shown, as is the average employment rate for 16-64 year olds[42].

Table 6-1 Population, population density, age distribution and average employment rate

PTE area	Total population (mid 2009 estimate)	Population density (people per km^2)	%Under 16 years	%16 to 64 (men)/59 (women)	%65 and over (men)/60 and over (women)	Average employment rate (%, 16-64)
SYPTE	1,317,300	892	18.6%	61.8%	19.6%	66.7%
Metro	2,226,800	1,063	19.7%	62.5%	17.8%	69.0%
GMPTE	2,601,000	2,107	19.7%	62.2%	18.1%	67.6%
Centro	2,638,700	2,940	20.1%	60.7%	19.2%	63.5%
Merseytravel	1,350,600	2,148	18.4%	61.2%	20.3%	65.4%
Nexus	1,106,400	1,792	17.3%	62.9%	19.8%	66.1%
Aylesbury	173,500	192	20.5%	61.6%	17.9%	77.5%
Brighton and Hove	256,300	3,088	16.1%	67.5%	16.4%	70.0%
Darlington	100,400	510	19.2%	60.2%	20.7%	68.7%
Derby	244,100	3,129	19.2%	62.6%	18.2%	71.2%
Exeter	118,800	2,528	15.2%	66.8%	18.1%	77.8%
Lancaster	139,800	243	16.9%	62.1%	21.0%	72.3%
Peterborough	171,200	499	20.9%	62.6%	16.5%	69.9%
Worcester	94,700	2,870	18.7%	63.5%	17.8%	75.5%

Despite the variability in the population figures and density, the age distribution of the population and the employment rates are not at wild variance with one another. There is no obvious pattern of difference between the PTE areas and the listed non-PTE areas.

6.1.2 Transport characteristics

DVLA data on car registrations in 2009[45] were used with Office of National Statistics population data to estimate car ownership per head of population in the CDT, STT and PTE areas, presented in Table 6-2. In the case of Aylesbury, Exeter and Worcester, the use of 2001 Census data was necessary to distinguish car ownership in the relevant local authorities from Unitary Authority level data (Buckinghamshire, Devon and Worcestershire Unitary Authorities, respectively). Census data on mode of travel to work[44] was used as a proxy of general levels of public transport use. Average percentage trips to work made by rail (train and light rail/underground) and bus are presented in Table 6-2. Sport England's Active People Survey (APS) data was used to derive the proportion of the population in each area reporting that they did 'some' cycling[46].

Table 6-2 Approximate car ownership, trips by train and bus, and rates of participation in cycling

PTE area	Licensed cars (DVLA, 2009)	Approximate cars per head of population	% travelling to work by train	% travelling to work by bus	% APS (2006) respondents doing 'any' cycling
SYPTE	543,450	0.41	2.0%	12.8%	7.6%
Metro	926,490	0.42	2.4%	13.0%	7.7%
GMPTE	1,105,564	0.43	3.1%	11.2%	7.9%
Centro	1,254,636	0.48	2.5%	13.8%	8.1%
Merseytravel	527,824	0.39	4.7%	12.5%	8.3%
Nexus	396,548	0.36	6.8%	16.0%	8.6%
Aylesbury Vale*	93,947	0.57	4.4%	2.6%	11.5%
Brighton and Hove	91,000	0.36	9.4%	13.7%	13.7%
Darlington	45,000	0.45	1.3%	11.1%	8.6%
Derby	114,000	0.47	0.9%	10.0%	11.0%
Exeter *	46,778	0.42	1.1%	10.5%	11.8%
Lancaster	57,525	0.43	1.5%	6.2%	13.7%
Peterborough	79,000	0.46	2.4%	7.1%	17.2%
Worcester*	45,026	0.48	1.5%	4.9%	12.2%

Levels of car ownership may reasonably be expected to impact the potential success of a programme focused on increasing levels cycling. There is some degree of variation, with car ownership lower in some of the PTE areas than is the case for many of the other listed areas, although there is no consistent pattern which makes the two types of areas distinct in terms of car ownership. Bus and train use for travel to work are generally higher in PTE areas than is the case for the other listed areas, although there are examples among this latter group where particularly high levels of public transport commuting are observed.

Sport England's Active People Survey (APS) data [46] are used to generate data on levels of cycling participation. The average percentage of APS respondents doing 'any' cycling across each of the areas in question is presented. For the purposes of this comparison 2006 APS data were used in order to give a pre-intervention comparison between CDTs and other areas. On the basis of this comparison, PTE areas consistently have a lower base level of cycling compared to the CDT areas.

6.1.3 Trip length distribution and self-reported levels of good health

Trip length distribution was examined using census trip to work data as a proxy for journeys in general. The average percentage trips to work <2km, 2-5km and 5-10km across local authorities in PTE areas were calculated. Data on the proportion of the population in each local authority describing themselves as being in 'good health' was obtained from Census data[43].

Table 6-3 Proportions of trips in length categories and population 'good health' levels

PTE area	Average % trips to work <2km	Average % trips to work 2-5km	Average % trips to work 5-10km	Average population describing themselves as being in 'good health'
SYPTE	19.6%	24.4%	23.8%	63.4%
Metro	21.7%	26.0%	22.3%	66.4%
GMPTE	21.3%	26.3%	24.0%	65.4%
Centro	20.7%	29.7%	24.4%	65.0%
Merseytravel	19.9%	24.5%	25.2%	64.8%
Nexus	19.9%	28.1%	26.4%	62.9%
Aylesbury	20.5%	12.2%	10.8%	73.1%
Brighton and Hove	25.3%	24.3%	9.9%	65.6%
Darlington	27.5%	26.1%	8.7%	65.7%
Derby	21.2%	34.5%	15.1%	63.0%
Exeter	33.3%	33.6%	8.2%	66.7%
Lancaster	27.4%	22.7%	15.8%	64.0%
Peterborough	22.0%	30.9%	18.7%	67.6%
Worcester	29.5%	28.2%	6.4%	69.2%

Although typically more of the trips in the CDT areas and the STT towns are less than 5km in length, even in the PTE areas consistently around 50% of trips are of less than 5km. There are no particular differences between the proportions of population reporting themselves to be in good health.

6.1.4 Identification of 'most similar' areas from which to draw evidence for local authorities within PTE areas

Each of the indicators listed above are plotted for each local authority and each CDT and STT. The most similar area to each PTE local authority for each indicator is identified from these graphs. The CDT and STT most frequently identified as being similar to the local authority in question are the ones used in following calculations of the potential benefits in the PTE areas following the delivery of cycling-oriented interventions. A second comparison was made using Corresponding Local Authorities classifications issued by the Office for National Statistics[8]. Where a local authority was identified as having a CDT or STT areas within the top five most comparable areas, then this area was used in calculations.

A full table and graphs of comparisons are included in the appendix to this report. The individual CDTs and STTs used in calculations for each individual local authority area are presented in Table 6-4.

Table 6-4 Cycling Demonstration Towns identified as similar to local authorities in PTE areas and used in subsequent calculations

PTE area	Local Authority	Comparable STT area	Comparable CDT area
SYPTE	Barnsley	Darlington	Darlington
	Doncaster	Darlington	Darlington
	Rotherham	Darlington	Darlington
	Sheffield	Darlington	Derby
Metro	Bradford	Darlington	Darlington
	Calderdale	Darlington	Darlington
	Kirklees	Darlington	Derby
	Leeds	Darlington	Exeter
	Wakefield	Darlington	Derby
GMPTE	Bolton	Worcester	Derby
	Bury	Worcester	Derby
	Manchester	Worcester	Derby
	Oldham	Darlington	Darlington
	Rochdale	Darlington	Darlington
	Salford	Darlington	Darlington
	Stockport	Worcester	Exeter
	Tameside	Darlington	Darlington
	Trafford	Worcester	Derby

PTE area	Local Authority	Comparable STT area	Comparable CDT area
	Wigan	Peterborough	Derby
Centro	Birmingham	Darlington	Darlington
	Coventry	Darlington	Derby
	Dudley	Darlington	Darlington
	Sandwell	Peterborough	Derby
	Solihull	Darlington	Darlington
	Walsall	Darlington	Darlington
	Wolverhampton	Darlington	Derby
Merseytravel	Knowsley	Darlington	Darlington
	Liverpool	Darlington	Derby
	Sefton	Darlington	Darlington
	St Helens	Darlington	Darlington
	Wirral	Darlington	Darlington
Nexus	Gateshead	Darlington	Darlington
	Newcastle upon Tyne	Darlington	Darlington
	North Tyneside	Darlington	Darlington
	South Tyneside	Darlington	Derby
	Sunderland	Darlington	Derby

7 Appendix 2

7.1 Detailed results of workplace travel scenarios

7.1.1 Impact of cycle route improvements on levels of cycling to work

Table 7-1 Forecast percentage cycling to work following infrastructure improvements

	% cycling to work following infrastructure improvements					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Base (2001 Census data)	2.0%	1.5%	2.6%	2.4%	2.7%	2.1%
Half existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	2.2%	1.7%	3.0%	2.7%	3.1%	2.4%
Half existing major and minor roads with no cycling facilities change to segregated on road cycle lane	2.3%	1.8%	3.1%	2.9%	3.2%	2.5%
Half existing major and minor roads with no cycling facilities change to segregated off road cycle lane	2.4%	1.8%	3.2%	2.9%	3.2%	2.5%
All existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	2.6%	2.0%	3.5%	3.2%	3.6%	2.8%
All existing major and minor roads with no cycling facilities change to segregated on road cycle lane	2.9%	2.2%	3.9%	3.5%	3.9%	3.1%
All existing major and minor roads with no cycling facilities change to segregated off road cycle lane	2.9%	2.3%	3.9%	3.6%	4.0%	3.1%
All existing major and minor roads with no cycling facilities and non-segregated on road cycle lane change to segregated on road cycle lane	3.0%	2.3%	4.0%	3.6%	4.1%	3.2%
All existing major and minor roads with no cycling facilities, non-segregated on road cycle lane and segregated on road cycle lane change to segregated off road cycle lane	3.0%	2.4%	4.1%	3.7%	4.2%	3.2%

Table 7-2 Estimated additional commuters cycling to work following infrastructure improvements

Scenario	Additional commuters cycling to work following infrastructure improvements					
	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Half existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	929	1,254	2,581	2,401	1,288	875
Half existing major and minor roads with no cycling facilities change to segregated on road cycle lane	1277	1,724	3,548	3,302	1,771	1,204
Half existing major and minor roads with no cycling facilities change to segregated off road cycle lane	1,393	1,880	3,871	3,602	1,932	1,313
All existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	2,206	2,977	6,129	5,703	3,060	2,079
All existing major and minor roads with no cycling facilities change to segregated on road cycle lane	3,134	4,231	8,710	8,104	4,348	2,955
All existing major and minor roads with no cycling facilities change to segregated off road cycle lane	3,367	4,544	9,355	8,705	4,670	3,174
All existing major and minor roads with no cycling facilities and non-segregated on road cycle lane change to segregated on road cycle lane	3,483	4,701	9,678	9,005	4,831	3,283
All existing major and minor roads with no cycling facilities, non-segregated on road cycle lane and segregated on road cycle lane change to segregated off road cycle lane	3,715	5,014	10,322	9,605	5,153	3,502

Table 7-3 Estimated annual car km replaced by cycling following infrastructure improvements

Scenario	Estimated annual car km replaced following infrastructure improvements					
	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Half existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	221,816	299,400	616,393	573,532	307,702	299,400
Half existing major and minor roads with no cycling facilities change to segregated on road cycle lane	304,977	411,675	847,542	788,606	423,090	287,511
Half existing major and minor roads with no cycling facilities change to segregated off road cycle lane	332,724	449,100	924,589	860,298	461,553	313,649
All existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	526,812	711,075	1,463,932	1,362,138	730,793	496,610
All existing major and minor roads with no cycling facilities change to segregated on road cycle lane	748,628	1,010,475	2,080,325	1,935,669	1,038,495	705,709
All existing major and minor roads with no cycling facilities change to segregated off road cycle lane	804,082	1,085,325	2,234,423	2,079,052	1,115,420	757,984
All existing major and minor roads with no cycling facilities and non-segregated on road cycle lane change to segregated on road cycle lane	831,809	1,122,750	2,311,472	2,150,472	1,153,883	784,122
All existing major and minor roads with no cycling facilities, non-segregated on road cycle lane and segregated on road cycle lane change to segregated off road cycle lane	887,263	1,197,600	2,465,570	2,294,127	1,230,808	836,396

Table 7-4 Estimated annual decongestion value (current prices) of car km replaced by cycling following infrastructure improvements

Scenario	Estimated annual decongestion value following infrastructure improvements					
	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Half existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	£62,774	£84,730	£174,439	£162,309	£87,080	£59,175
Half existing major and minor roads with no cycling facilities change to segregated on road cycle lane	£86,314	£116,504	£239,854	£223,176	£119,735	£81,366
Half existing major and minor roads with no cycling facilities change to segregated off road cycle lane	£94,161	£127,095	£261,659	£243,464	£130,620	£88,763
All existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	£149,088	£201,234	£414,293	£385,485	£206,814	£140,541
All existing major and minor roads with no cycling facilities change to segregated on road cycle lane	£211,862	£285,965	£588,732	£547,794	£293,894	£199,716
All existing major and minor roads with no cycling facilities change to segregated off road cycle lane	£227,555	£307,147	£632,342	£588,372	£315,664	£214,510
All existing major and minor roads with no cycling facilities and non-segregated on road cycle lane change to segregated on road cycle lane	£235,402	£317,738	£654,147	£608,661	£326,549	£221,906
All existing major and minor roads with no cycling facilities, non-segregated on road cycle lane and segregated on road cycle lane change to segregated off road cycle lane	£251,095	£338,921	£697,756	£649,238	£348,319	£238,700

Table 7-5 Estimated annual carbon emission saving (current prices) of car km replaced by cycling following infrastructure improvements

Scenario	Estimated annual carbon emission saving following infrastructure improvements					
	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Half existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	£2,386	£3,221	£6,632	£6,171	£3,311	£2,250
Half existing major and minor roads with no cycling facilities change to segregated on road cycle lane	£3,281	£4,429	£9,119	£8,484	£4,552	£3,093
Half existing major and minor roads with no cycling facilities change to segregated off road cycle lane	£3,580	£4,832	£9,947	£9,256	£4,966	£3,374
All existing major and minor roads with no cycling facilities change to non-segregated on road cycle lane	£5,668	£7,650	£15,750	£14,655	£7,862	£5,343
All existing major and minor roads with no cycling facilities change to segregated on road cycle lane	£8,054	£10,872	£22,382	£20,825	£11,173	£7,593
All existing major and minor roads with no cycling facilities change to segregated off road cycle lane	£8,651	£11,677	£24,040	£22,368	£12,001	£8,155
All existing major and minor roads with no cycling facilities and non-segregated on road cycle lane change to segregated on road cycle lane	£8,949	£12,079	£24,869	£23,139	£12,414	£8,436
All existing major and minor roads with no cycling facilities, non-segregated on road cycle lane and segregated on road cycle lane change to segregated off road cycle lane	£9,546	£12,885	£26,527	£24,682	£13,242	£8,999

7.1.2 Impact of improvements to work place cycling facilities

Table 7-6 Forecast percentage cycling to work following improvements to work place cycling facilities

	% cycling to work following improvements to workplace cycle facilities					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Base	2.0%	1.5%	2.6%	2.4%	2.7%	2.1%
Outdoor parking provided	2.1%	1.7%	2.9%	2.6%	2.9%	2.3%
Indoor parking provided	2.2%	1.7%	3.0%	2.7%	3.1%	2.4%
Showers and indoor parking provided	2.4%	1.9%	3.2%	2.9%	3.3%	2.6%

Table 7-7 Estimated additional commuters cycling to work following improvements to work place cycling facilities

	Additional commuters cycling to work following improvements to workplace cycle facilities					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Outdoor parking provided	580	783	1,613	1,501	805	547
Indoor parking provided	929	1,254	2,581	2,401	1,288	875
Showers and indoor parking provided	1,509	2,037	4,194	3,902	2,093	1,423

Table 7-8 Estimated annual car km replaced by cycling following improvements to work place cycling facilities

Scenario	Estimated car km replaced following improvements to workplace cycle facilities					
	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Outdoor parking provided	138,635	187,125	385,245	358,457	192,314	130,687
Indoor parking provided	221,816	299,400	616,393	573,532	307,702	209,099
Showers and indoor parking provided	360,450	486,525	1,001,638	931,989	500,016	339,786

Table 7-9 Estimated annual decongestion value (current prices) of car km replaced by cycling following improvements to work place cycling facilities

Scenario	Estimated decongestion value following improvements to workplace cycle facilities					
	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Outdoor parking provided	£39,234	£52,956	£109,024	£101,443	£54,425	£36,984
Indoor parking provided	£62,774	£84,760	£174,439	£162,309	£87,080	£59,175
Showers and indoor parking provided	£102,007	£137,687	£283,464	£263,753	£141,505	£96,159

Table 7-10 Estimated annual carbon emissions saving (current prices) of car km replaced by cycling following improvements to workplace cycling facilities

	Estimated carbon emission savings following improvements to workplace cycle facilities					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Outdoor parking provided	£1,492	£2,013	£4,145	£3,857	£2,069	£1,406
Indoor parking provided	£2,386	£3,221	£6,632	£6,171	£3,311	£2,250
Showers and indoor parking provided	£3,878	£5,234	£10,776	£10,027	£5,380	£3,656

7.1.3 Impact of financial incentives to cycle to work

Table 7-11 Forecast percentage cycling to work following financial incentives to cycle to work

	% cycling to work following improvements to workplace cycle facilities					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
Base	2.0%	1.5%	2.6%	2.4%	2.7%	2.1%
£0.50 per day payment	2.2%	1.7%	3.0%	2.7%	3.1%	2.4%
£1.00 per day payment	2.6%	2.0%	3.5%	3.2%	3.6%	2.8%
£1.50 per day payment	3.1%	2.4%	4.1%	3.8%	4.2%	3.3%
£2.00 per day payment	3.7%	2.9%	4.9%	4.5%	5.1%	3.9%
£3.00 per day payment	5.2%	4.1%	7.0%	6.4%	7.1%	5.6%
£4.00 per day payment	7.3%	5.7%	9.9%	9.0%	10.1%	7.8%
£5.00 per day payment	9.4%	7.3%	12.7%	11.6%	13.0%	10.1%

Table 7-12 Estimated additional commuters cycling to work following financial incentives to cycle to work

	Additional commuters cycling to work following financial incentives to cycle to work					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
£0.50 per day payment	928	1,254	2,581	2,401	1,288	875
£1.00 per day payment	2,206	2,977	6,129	5,703	3,060	2,079
£1.50 per day payment	3,831	11,240	10,645	5,314	3,611	5,171
£2.00 per day payment	5,920	7,991	16,452	15,308	8,213	5,581
£3.00 per day payment	11,260	15,199	31,291	29,115	15,620	10,615
£4.00 per day payment	18,574	25,070	51,614	48,025	25,766	17,509
£5.00 per day payment	25,771	34,785	71,614	66,634	35,750	24,294

Table 7-13 Estimated annual car km replaced by cycling following financial incentives to cycle to work

	Estimated car km replaced following financial incentives to cycle to work					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
£0.50 per day payment	221,816	299,400	616,393	573,532	307,702	209,099
£1.00 per day payment	526,812	711,075	1,463,932	1,362,138	730,793	496,610
£1.50 per day payment	914,990	1,235,025	2,542,619	2,365,818	1,269,271	862,534
£2.00 per day payment	1,414,075	1,908,676	3,929,503	3,656,265	1,961,601	1,333,007
£3.00 per day payment	2,689,515	3,630,226	7,473,760	6,954,072	3,730,888	2,535,326
£4.00 per day payment	4,436,313	5,988,002	12,327,851	11,470,634	6,154,042	4,171,981
£5.00 per day payment	6,155,385	8,308,352	17,104,894	15,915,505	8,538,734	5,802,499

Table 7-14 Estimated annual decongestion value (current prices) of car km replaced by cycling following financial incentives to cycle to work

	Estimated decongestion value following financial incentives to cycle to work					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
£0.50 per day payment	£62,774	£84,730	£174,439	£162,309	£87,080	£59,175
£1.00 per day payment.	£149,088	£201,234	£414,293	£385,485	£206,814	£140,541
£1.50 per day payment	£258,942	£349,512	£719,561	£669,527	£359,204	£244,097
£2.00 per day payment	£400,183	£540,155	£1,112,049	£1,034,723	£555,133	£377,241
£3.00 per day payment	£761,133	£1,027,354	£2,115,074	£1,968,002	£1,055,841	£717,497
£4.00 per day payment	£1,255,477	£1,694,604	£3,488,782	£3,246,189	£1,741,594	£1,183,501
£5.00 per day payment	£1,741,974	£2,351,264	£4,840,685	£4,504,088	£2,416,462	£1,642,107

Table 7-15 Estimated annual carbon emissions savings (current prices) of car km replaced by cycling following financial incentives to cycle to work

	Estimated carbon emissions savings following financial incentives to cycle to work					
Scenario	SYPTE	Metro	GMPTE	Centro	Merseytravel	Nexus
£0.50 per day payment	£2,386	£3,221	£6,632	£6,171	£3,311	£3,221
£1.00 per day payment.	£5,667	£7,650	£15,750	£14,655	£7,862	£5,343
£1.50 per day payment	£9,844	£13,287	£27,356	£25,453	£13,656	£9,280
£2.00 per day payment	£15,214	£20,535	£42,277	£39,337	£21,104	£14,342
£3.00 per day payment	£28,936	£39,057	£80,409	£74,817	£40,140	£27,277
£4.00 per day payment	£47,729	£64,424	£132,633	£123,410	£66,210	£44,993
£5.00 per day payment	£66,225	£89,388	£184,028	£171,232	£91,867	£62,428