CiViTAS
Cleaner and better transport in cities

THE CIVITAS INITIATIVE
IS CO-FINANCED BY
THE EUROPEAN COMMISSION

MIRACLES

COMPETITIVE AND SUSTAINABLE GROWTH
&
ENERGY, ENVIROMENT AND SUSTAINABLE DEVELOPMENT
PROGRAMMES

MIRACLES Project GRD1 – 2001 – 40047

Rome Winchester Barcelona Cork

MIRACLES
MULTI INITIATIVE
FOR RATIONALISED
ACCESSIBILITY
AND CLEAN LIVEABLE
ENVIRONMENTS

Deliverable D 4.2

REPORT ON EVALUATION RESULTS

Annex 2 – 2nd Implementation Report for Winchester

Version N°4.0
31st March 2006

MIRACLES DELIVERABLE n°4.2

Annex 2 – 2nd Implementation Report for Winchester

Workpackage 4 / Version 4.0 / March 2006

Classification

This report is:

Draft	
Final	X
Internal	
Public	X

Contributors in Winchester:
TRG: Mike McDonald, Graham Wall, Andy Richards, Tim Felstead, Tom Cherrett, Fraser McLeod, Mark Ambler
HCC: Andy Wren, Ken Laughlin

Editors in Winchester:
Mike McDonald (Workpackage leader), Graham Wall, Andy Richards, Tim Felstead

Issue Date

Version N°: 1.1	Date of issue: 30th November 2005
Version N°: 2.1	Date of issue: 22nd December 2005
Version N°: 3.1	Date of issue: 23rd February 2006
Version N°: 3.2	Date of issue: 21st March 2006
Version N°: 4.0	Date of issue: 31st March 2006

MIRACLES Project Office
ATAC – U.O. Sviluppo attività internazionali – Rome
Tel: +39 06 46959621
Fax: +39 06 046959252
e-mail: atacineurope@atac.roma.it
Web: www.miraclesproject.org

TABLE OF CONTENTS

1. INTRODUCTION 1
2. MEASURE 5.1 2
3. MEASURE 6.2 14
4. MEASURE 7 33
5. MEASURE 8.2 56
6. MEASURE 9.2 72
7. MEASURE 10 90
8. MEASURE 11.1 105
9. MEASURE 11.2 118
10. MEASURE 12.1 126
11. MEASURE 12.2 144
12. MEASURE 12.3 151
13. CITY-LEVEL RESULTS - ECONOMY 164
14. CITY-LEVEL RESULTS - ENERGY 168
15. CITY-LEVEL RESULTS - ENVIRONMENT 174
16. CITY-LEVEL RESULTS - SOCIETY 179
17. CITY-LEVEL RESULTS - TRANSPORT 187

1. Introduction

This document is Annex 2 to D4.2 and also forms the MIRACLES deliverable "2nd Implementation Report for Winchester". The Annex is a compilation of the detailed Measure-Level templates (MLTs) and City-Level templates produced for Winchester as part of the evaluation process within MIRACLES. See the main body of the D4.2 deliverable for a summary and interpretation of the template results within this annex.

For the Winchester site, there were 11 individual Measures in all, each reported within a separate MLT. Within this document, each chapter corresponds to a MLT. In addition, the final chapter details the city-level results, which have been sub-divided into five key areas: economy, energy, environment, society and transport.

2. Measure 5.1

MEASURE-LEVEL RESULTS	
Measure title: Set up of city centre clean zone	**Project: MIRACLES**
Measure number: 5.1	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

The objectives for this measure were to:

- Reduce the impact of traffic on the environment; and
- Reduce the number of poorly maintained vehicles in the study area.

M2: Measure description:

Using a portable Remote Sensing Device (RSD), CO, HC and NO_x emissions from vehicles entering the city on main arterial routes were measured. The RSD measures emissions without the need to stop the passing vehicles. The results were used to determine if an individual vehicle was deemed a 'high polluting vehicle'. Based on the database of measurements and results from a stated preference questionnaire, four hypothetical strategies on the use of the emissions measurements were assessed. These strategies ranged from the use of roadside Variable Message Sign (VMS) to report immediate emissions results to providing vehicles identified as 'high polluters' with discounted emissions measurements.

The Implementation – how was the measure implemented?

M3: Innovative aspects:

Studies from the USA and some EU countries have shown that approximately 10% of vehicles contribute about half of transport related emissions in urban areas. Using the same type of equipment used to derive this statistic, this measure developed a database of emissions measurements from road-side remote sensing measurements. The database was then used to identify 'high polluting' vehicles. The capability to make individual emissions results publicly available to inform drivers via roadside VMS and web based lists was developed, although not implemented within the timescale available for this evaluation. Such systems allow drivers to check their emissions all year round rather than once annually through the UK road worthiness vehicle test commonly known at the MOT.

M4: Situation before CIVITAS:

The Winchester Movement and Access Plan (WMAP) received a national award for developing Clear Zone initiatives. The work was largely funded through the National Government bidding process and through investment of the Local Authority revenue and, as such, had total political backing. Work to date has included considerable reductions of road space in two major city centre streets with expanded walking and cycling facilities and controlled parking zones – the emissions measurement work is new.

Under UK law all cars over three years old must undergo an MOT each year and have the associated certificate before it can be driven on public roads. Within this test procedure selected exhaust gases from the vehicle's engine are measured and compared to appropriate standards. Many components of these emissions tests are in compliance with EU law and are therefore implemented within other EU countries. Beside these annual emissions tests that form part of the MOT the Vehicle and Operator Services Agency (VOSA) undertake a relatively small number of roadside tests throughout the UK following the same emissions testing procedure as the MOT. Failing these emissions tests often indicates that the vehicle is in need of repair. Apart from the annual MOT, random VOSA checks, or similar checks undertaken as part of regular vehicle servicing owners have no other way of knowing if their engine and other emissions related systems are operating correctly.

MEASURE-LEVEL RESULTS

Measure title: Set up of city centre clean zone	Project: MIRACLES
Measure number: 5.1	City: Winchester

M5: Design of the measure:

The use of Remote Sensing devices at the roadside to measure passing vehicle emissions has been used in the USA and to a much lesser extent Europe over the last 15 years. The resultant emissions databases have been used for research purposes and very rarely to provide feedback to drivers. An extensive literature review was undertaken on potential RSD systems for use with the project. All except one system were built in the USA. The REVEAL system was developed within the EC REVEAL project by a consortium of European partners with the lead commercial partner (Golden River Traffic Ltd) being in the UK. Early discussions with the suppliers and site visits indicated that the REVEAL unit would be able to fulfil all the requirements of the intended MIRACLES measure. The advantage of a UK supplier and technical support was deemed preferential over the US systems and the price was comparable with US systems. The UK supplier also confirmed they could deliver additional capabilities relating to VMS interfaces and an integrated Automatic Number plate Recognition System (ANPR). A separate speed and acceleration measurement system had also been developed by TRG with the aim to integrate these measurements with the corresponding vehicle measurement. The REVEAL RSD unit consists of two units facing each other either side of the carriageway. Figure 1 shows the main RSD unit and the retroflector unit. Only the main RSD unit requires power and connection to a computer workstation.

Figure 1: REVEAL RSD unit with i) main RSD unit *(left)* and ii) retroflector unit *(right)*

Based on best practise from the US, five potential sites in Winchester were identified where the highest number of meaningful emissions measurements could be gathered. The nature of these sites meant that emphasis was placed on inbound commuter vehicle emissions although many returning resident vehicles were also measured. A map showing the location of these sites is given in Figure 2.

The arterial roads used so far are:

- St Cross Road (B3335)
- Badger Farm Road (A3040)
- Andover Road (B3420)

MEASURE-LEVEL RESULTS	
Measure title: Set up of city centre clean zone	**Project: MIRACLES**
Measure number: 5.1	**City: Winchester**

Two other locations have been identified but not used at this stage:

- Bar End Road (B3404)
- Easton Lane

Figure 2: Map of Winchester showing locations of RSD measurement sites.

MEASURE-LEVEL RESULTS	
Measure title: Set up of city centre clean zone	**Project: MIRACLES**
Measure number: 5.1	**City: Winchester**

Specific (i.e. in order of 1m) location of the RSD equipment was planned although considerable Health and Safety restrictions on the siting of the equipment near live carriageways prevented this. This was in part due to inflexibility in the separation of the two RSD cabinets on either side of the carriageway (i.e. was required to be between 6m and 7m). Figure 3 shows the scale of traffic management required on the approach to the RSD measurement position.

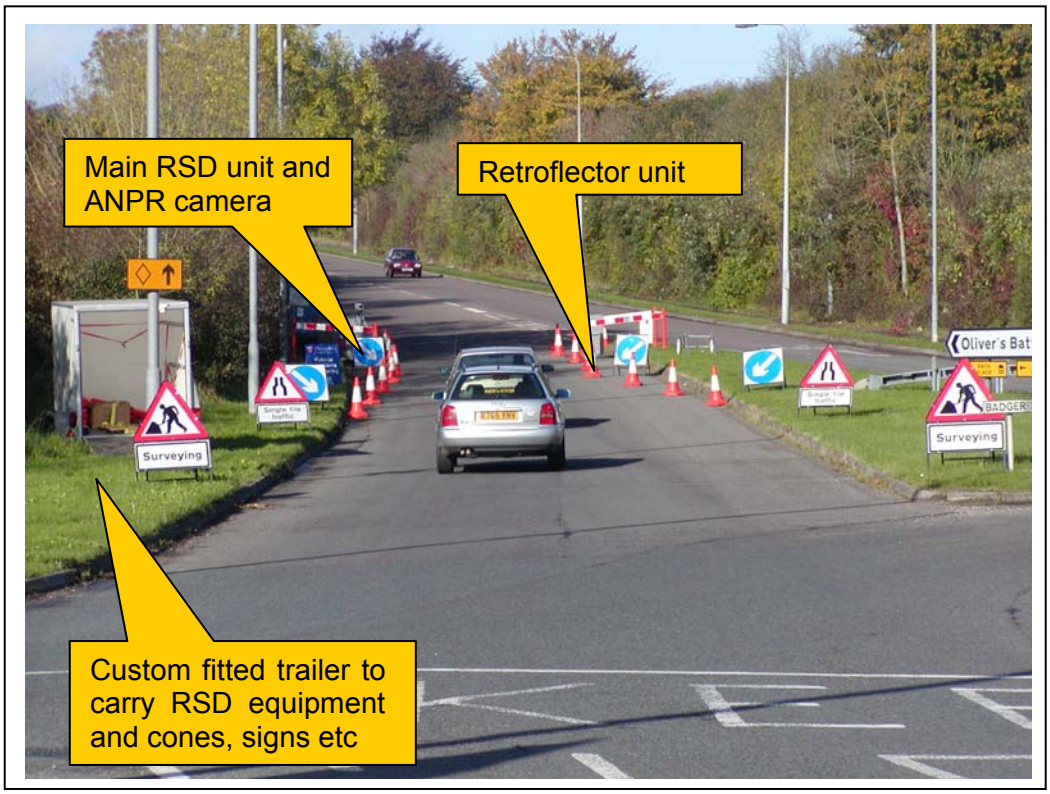


Figure 3: Typical site set up for RSD unit.

The initial emphasis of this measure was to target vehicles producing high levels of CO and HC pollutants. During the first two years of the MIRACLES project air quality measurement and modelling highlighted NO_x and PM_{10} as the problematic pollutants for Winchester City Centre. Based on this information an Air Quality Management Area (AQMA) covering these pollutants was declared. Ambient NO_x air concentration is the dominant cause for UK local authorities declaring AQMAs.

Statutory declaration of an AQMA for the centre of the city provides Winchester City Council (WCC) with both the responsibilities and the powers to detect and act to mitigate levels of pollution that exceed acceptable thresholds within this zone. WCC are required to develop an Air Quality Action Plan (AQAP) detailing how the expected exceedance is to be mitigated. The AQAP will incorporate all of the measures being developed within the MIRACLES project, and will become the mechanism by which the measures will be sustained after the end of the project.

Literature reviews suggested that tackling high polluting vehicles for CO and HC is not a successful strategy for reducing NO_x and PM_{10} ambient air concentration since, in general, the responsible vehicles for the former pollutants do not coincide with the responsible vehicles for the latter. A greater emphasis was placed on identification of vehicles with high NO_x emissions (PM_{10} emissions are not measured by the RSD units procured for this measure).

Following late delivery of the RSD equipment (six months) and a further nine months of problems

MEASURE-LEVEL RESULTS	
Measure title: Set up of city centre clean zone	**Project: MIRACLES**
Measure number: 5.1	**City: Winchester**

relating to the accuracy of the resultant emissions measurements from the unit, the RSD unit required physical modification to make it suitable for regular outdoor use (further two months). It was found the RSD unit performed poorly during inclement weather (rain and cold in particular). It was originally intended to undergo intensive campaigns during the summer months but the delays described above prevented this. The unit collected 19 days worth of data over a four month period (July –Oct 05) resulting in a total of approximately 35,000 vehicle measurements.

Analysis of the database highlighted further improvements in the set up of the RSD system (contrary to the supplied instructions), which required investigation. The sensitivity of the equipment to low exhaust concentrations of the pollutants of interest was not as high as expected resulting in many vehicles having no valid emissions readings due to measurement error at low pollutant concentrations. The RSD unit could identify 'high-emitting vehicles' but an understanding of how these vehicles compared to the other vehicles in the Winchester vehicle fleet was impossible because of the equipment sensitivity issue. Data presented below shows how many vehicles were above a range of thresholds which identify gross polluting vehicles. These thresholds are based on tailpipe emission limits from both the US and UK in-service emissions testing regime.

In addition, it was hoped that access to the UK Driver and Vehicle Licensing Agency (DVLA) database could be arranged. This would allow a better understanding of any relationships between RSD emissions measurements with the fleet being observed such as vehicle make, model, age, engine technology and emissions. However, the cost of purchasing this data for the whole fleet was prohibitive for the expected sample size required, although recent changes to the DVLA website allow limited vehicle information to be checked.

Due to these delays, a practical application of the intended methods of feedback to drivers was not undertaken. A questionnaire was handed out to 2000 Winchester car users to provide some quantification on the likely take up of a number of methods of feedback and uses of individual vehicle emissions measurements. The questionnaire asked respondents what vehicle maintenance they would undertake as a result of various feedback mechanisms based on the emissions measurements.

The hypothetical feedback mechanisms tested in the questionnaire were:

a) **A VMS at the roadside** – the sign is intended to activate every time a valid emissions measurement is collected. This requires the measurements to pass a number of software filters before being banded as good, fair or poor. The RSD also integrates ANPR to gather the measured vehicle registration plate and displays it with the measurement. A change over time from GOOD to POOR would indicate that the vehicle has an emissions related fault which needs addressing with the incentive to the driver of preventing the need for expensive repairs in the future and fuel savings of up to 10%. A further use of the RSD to 'clean screen' vehicles with the incentive of forgoing the need for the emissions test element of the annual MOT (as is used in the USA) was also explored.

b) **A public, web-based database** – in this scenario the public could check all emissions measurements gathered using the RSD by typing in their registration number. In the same manner as a), a change in the reading for the worse would indicate their vehicle had a fault.

c) **High polluting vehicles being eligible for subsidised inspection and maintenance** – vehicle owners would have the opportunity, if their vehicle was identified as POOR, to apply for a free emissions check and report on any required maintenance. In addition, interest in subsequent subsidised maintenance was also examined.

d) **VMS redirecting POOR vehicles to the Park and Ride site** – the compliance with a VMS sign suggesting that vehicles measured as POOR use Park and Ride instead of driving into the city centre.

Very little was done in terms of publicity for this measure due to uncertainties of when full scale implementation would occur.

MEASURE-LEVEL RESULTS

Measure title: Set up of city centre clean zone	**Project: MIRACLES**
Measure number: 5.1	**City: Winchester**

M6: Actual implementation:

Stage 1: Identification and procurement of RSD system and associated ancillary devices (January 2004)

Stage 2: Site selection (April 2004)

Stage 3: Traffic management design for selected sites (April 2004)

Stage 4: Initial testing of RSD and physical modifications (September 2004 – June 2005)

Stage 5: Data collection from three sites (August 2005 – November 2005)

Stage 6: Analysis of results (January 2006)

Stage 7: Set up optimisation of RSD based on results from analysis (January 2006 – February 2006)

Stage 8: Public questionnaire on potential uses of RSD measurements to encourage voluntary vehicle maintenance (March 2006)

M7: Deviations from the plan:

i). NO_x identified as the key pollutant. This is currently unregulated in annual emissions checks of cars over three years old, yet is the pollutant responsible for nearly all local authorities failing to meet air quality standards. Since the unit could also measure CO and HC emissions, it was still used to identify high polluters of these pollutant species. These pollutants are only valid for petrol vehicles since, under the current testing regime, diesel vehicles are not tested for CO or HC emissions, only opacity of the exhaust plume.

ii). Precise, optimal location of the RSD unit at the generally selected sites was not always possible as the need to carry out the works in compliance of UK Roadworks laws meant the scope for moving a site up or down the road even by 10m - 20m was limited.

iii). The timings of measure implementation were continually revised due to a) problems relating to delayed delivery of the equipment from the supplier (six months late) and b) problems obtaining accurate results during first nine months of trialling.

iv) A final stage of implementation planned to use the RSD unit as a filter to select vehicles which would then be tested under an adapted version of the MOT test emissions check. RSD's have previously been used in this way in Europe (including the UK) to good effect. The percentage of vehicles which failed the MOT style test was higher for a sample filtered using the RSD when compared against a random sample of vehicles. Failures of the roadside MOT emissions check could then be subject to a monetary fine. However, this final stage of enforcement was not pursued.

v) Indicators based on decile pollutant concentration values and actual RSD measurements to detect reductions in high-polluting vehicles were removed. This is in part due to lack of instrument sensitivity to accurately report low decile values and the lack of on-road implementation of the various feedback strategies now assessed through the WP5 questionnaire.

The following indicators were not used:

W5.1/Econ4a	Subsidy provided for vehicle maintenance
W5.1/Econ5a	Dissemination costs
W5.1/Econ6a	Revenue generated by fines
W5.1/Env1a	Decile value for CO
W5.1/Env1b	Decile value for HC

MEASURE-LEVEL RESULTS

Measure title: Set up of city centre clean zone	**Project: MIRACLES**
Measure number: 5.1	**City: Winchester**

W5.1/Env1c	Decile value for NOx
W5.1Econ3a	Maintenance costs
W5.1/Econ4a	Subsidy provided for vehicle maintenance
W5.1/Econ5a	Dissemination costs
W5.1/Econ6a	Revenue generated by fines
W5.1/Env2a	MOT emissions test – change in CO
W5.1Env2b	MOT emissions test – change in HC
W5.1/Soc2a	Awareness rating

The Evaluation – how was it done and what are the results?

M8: Method of measurement (indicator type; data sources; frequency collection; format of data):

The data came from four sources:

- **Hampshire County Council cost statements** – these outlined the hours worked on MIRACLES split by work package and staff grade along with any equipment / consumables bought. The figures come from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4. This provided the cost of implementation; monitored purchase, implementation and dissemination costs; recorded until the end of the project.
- **Awareness/acceptance questionnaires (see Measure 10) –** these surveys measured public acceptance and awareness of the measure.
- **WP5 questionnaire** – this survey examined public reaction to a number of voluntary maintenance strategies based on the RSD measurements. This is scheduled to take place in March 2006 with results available after the end of the project.
- **RSD emissions monitoring unit –** this provided the number of gross polluting vehicles of CO, HC and NO_x emissions.

M9: Achievement of quantifiable targets:

N/a

M10: Achievement of evaluation-related milestones:

Evaluation of this measure has been adapted and delayed as a result of the delays etc described in section M7. A thorough evaluation is still ongoing.

M11: Report on the measure results:

Economy

Hampshire County Council cost data

The data from Hampshire County Council came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3 (with the addition of an estimate for Year 4). Staff hours for Work package 5.1 was a total of 2025 hours at a cost of £51,300. TRG also had responsibilities for implementation on this work package (about 600 hours at a cost of about £12,000) (W5.1/Econ2a). In addition, HCC spent about £110,000 on the monitoring equipment with accessories and consumables (see Table 1).

Table 1: Equipment/consumables bought on Work package 5.1 during Years 1, 2 and 3 of the project

Equipment/consumables bought	Cost/value (£)
RSD equipment and ancillaries - Golden River Traffic Ltd	99,600
Traffic management signs, contes, barriers etc. - Parker Merchanting	700
VMS modification - Varitext Limited	6,830
RSD external adjustments - Foxcraft Engineering	1,500
Daily transport hire costs (approx)	26
Daily transport fuel costs (approx)	4
Daily fuel cost for generator (approx)	7

Based on the above costs an approximate cost per measurement can be calculated. Including only, an

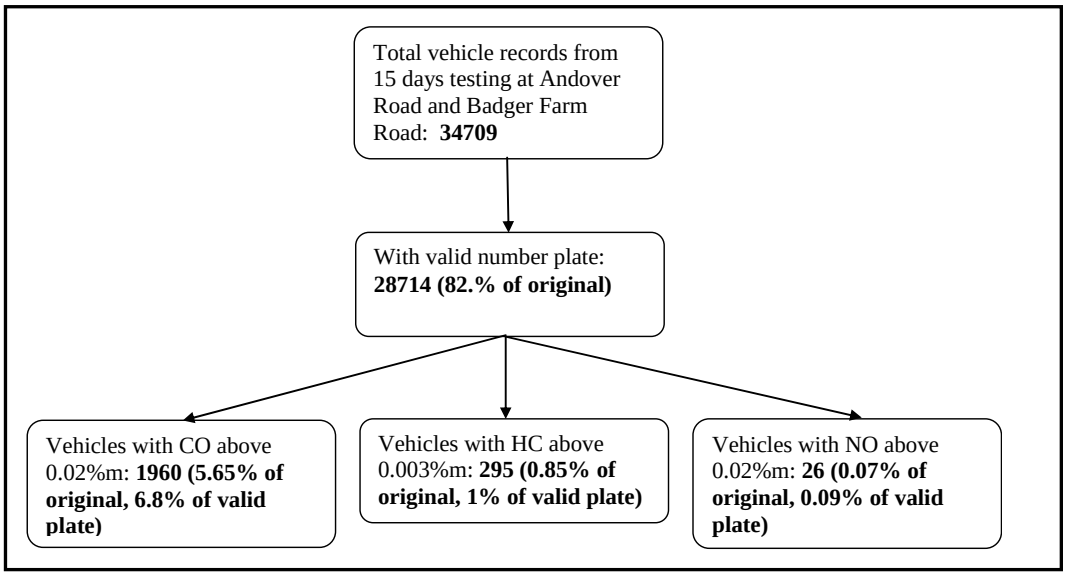
average cost of approximately £0.21 per measurement is achieved. When fixed costs are included, for the ~ 28000 valid measurements taken the cost is £3.75 per measurement though obviously the more measurements taken with the unit, the weight of the fixed costs decreases. This is also considerably less than the estimated £10 per emissions test under the UK MOT regime.

Environment

RSD emissions monitoring unit

During the measurement campaign between August 2005 and November 2005, 34709 RSD measurements were acquired. Measurements with no associated number plate were excluded from the database – this reduced the number measurements to 28714. As described in section M5, the sensitivity limits of the RSD instrument required a certain pollutant concentration to be obtained for it to be considered a valid reading. As a result, RSD measurements below these limits were excluded from the database. Figure 4 shows the losses for each measured pollutant as a consequence of these exclusions. It can be seen that removing measurements below these sensitivity limits drastically reduces the number of valid readings. Following the analysis of results, a number of ways in which to improve the number of valid readings has been suggested; most are beyond the scope of MIRACLES but some physical set-up changes are being investigated.

Figure 4: Losses due to use of valid readings (i.e. measurements with valid reg. number) and measurements above sensitivity limit for CO, HC or NO_x.



Regardless of the threshold used for each pollutant, the actual numbers of vehicles that exceed them are very low as a percentage of all valid measurements.

Based on valid readings (i.e. number plate matched and above relevant sensitivity limit) the number of suspected failures based on a range of 'cut points' is presented in Table 2. Two methods of stating the cut-points are presented. The first is by average percentage concentration of the pollutant gas in the vehicles exhaust plume (either % or ppm) as would be measured using a normal tailpipe probe; the second uses the ratio of 'pollutant to CO_2' in the plume as measured by the RSD unit. The proportion of high-polluting vehicles in the Winchester dataset is very small for all three pollutants. However, this does not mean their impact in terms of total contribution to fleet emissions is small. It is impossible to relate

the impact of the high-polluters to the fleet emissions as a whole without a larger proportion of low-polluting vehicles included. Increasing plume capture may increase the proportion of low-emitting vehicles able to be included in the final analysis of this measure in March 2006.

Table 2: Numbers and percentage of vehicles which exceed a range of polluter thresholds for CO, HC and NOx. Taken from a sample of valid 28714 measurements and the relevant number of measurement above the sensitivity limit for CO, HC and NO_x.

	Pollutant and threshold							
	CO			**HC**			**NO**	
	Gross Polluter	**Super Polluter**	**MOT 1992**	**Gross Polluter**	**Super Polluter**	**MOT 1992**	**Gross Polluter**	**Super Polluter**
Threshold (% of exhaust)	5% or 50000ppm	2.8	3.5	0.15% or 1500ppm	0.15%	0.12%	1%	0.6%
Pollutant/CO2 threshold	0.55	0.2	0.33	0.011	0.011	0.00857	0.071	0.043
# of vehicles	**29**	**309**	**113**	**107**	**107**	**132**	**2**	**7**
% of valid and (*above sensitivity limit*)	**0.1** (*1.5*)	**1.1** (*15.8*)	**0.4** (*5.8*)	**0.4** *(36.3)*	**0.4** *(36.3)*	**0.5** *(44.7)*	**0.006** *(7.7)*	**0.02** *(26.9)*

Society

The Winchester Transport questionnaire (Jan/Feb 2005) posed some initial questions on the usefulness of the feedback stages - these will be examined in more detail in the WP5 questionnaire which will be disseminated in March 2006.

The questions and results from the transport questionnaire are presented in Figures 5 & 6. The questions began by introducing the concept of the AQMA and the use of emissions monitoring. The statement was:

> *'Winchester City Council has recently declared the city centre as an Air Quality Management Area. As part of a range of activities to reduce air pollution in Winchester, the emissions of vehicles travelling within Winchester will be monitored so that the owners can be advised and assisted if their vehicles emissions are higher than they should be. Owners of persistently gross polluting vehicles could ultimately be fined.'*

Respondents were then asked a series of questions relating to the statement and the concept of emissions monitoring.

MEASURE-LEVEL RESULTS

Measure title: Set up of city centre clean zone	Project: MIRACLES
Measure number: 5.1	City: Winchester

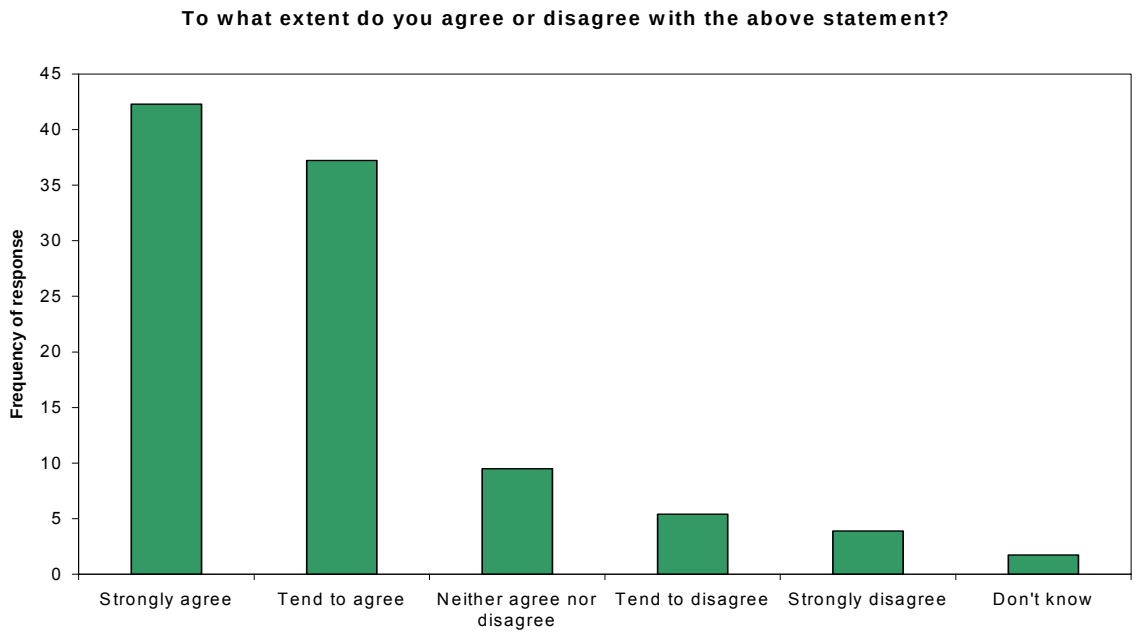


Figure 5: Response on agreement or disagreement with the above statement

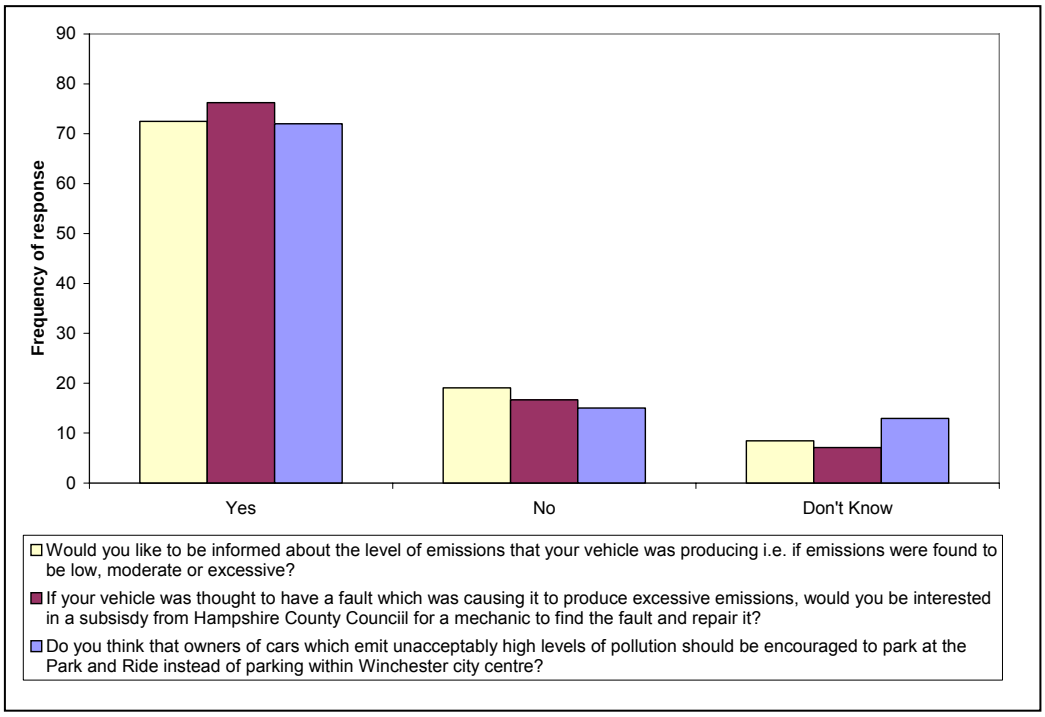


Figure 6: Responses to a series of questions relating to use of RSD emissions measurements and driver feedback strategies

MEASURE-LEVEL RESULTS

Measure title: Set up of city centre clean zone	Project: MIRACLES
Measure number: 5.1	City: Winchester

The responses were very much in favour of information and feedback on vehicle emissions, and would suggest strong public support for the strategies explored in this work package. A more through questionnaire which describes in detail what vehicle owners would have to do or expect with each type of feedback strategy will be carried out in March 2006 with results available after the end of the project.

A summary of the measure indicators (as defined in the Local Annex of D4.1) is shown in Table 3.

Table 3: Summary of measure indicators for W5.1

Indicator no. (Meteor no.)	Indicator name	Baseline (2005)	MIRACLES 2006
W5.1/Econ1a	Purchase/loan & installation cost	£100,000	N/a
W5.1/Econ2a	Power costs	£7 per day	£7 per day
W5.1/Econ2b	Labour costs	N/a	See HCC cost data
W5.1/Env1d	Numbers of gross polluting vehicles	< 1%	Unknown
W5.1/Soc1a	Acceptance rating	80%	Unknown
W5.1/Soc3a	Operator confidence in technical parameters	N/a	See M14

The measure will continue beyond the lifetime of the MIRACLES project.

Up-scaling

This measure can not be up-scaled until a full assessment of the RSD equipment has been carried out on the three arterial routes.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

The AQMA was a main driver for this measure with the aim of reducing the emissions of city centre traffic (in particular the gross polluting vehicles). Public and local government acknowledgement of an emissions problem is desirable to support the identification of high-polluting vehicles.

The units of measurement from the RSD unit and the statutory MOT are different (e.g. ratio of CO/CO2 rather than ppm). In addition, the current MOT test emissions checks (as mandated by the EC) do not cover the full range of pollutants measured by the RSD especially those considered a problem in Winchester City Centre (i.e. NO_x and PM_{10}). This measure will investigate these issues further; this may result in recommendations for changes to the current MOT regime.

Initial software and hardware problems with the RSD unit results resulted in lengthy delays before meaningful use on road could be undertaken. These delays were exacerbated by a contractual dispute between the RSD unit supplier and its developers. Following these delays, a lack of sensitivity of the RSD unit (possibly due to flawed set up instructions) meant a full range of emissions measurements for each pollutant could not be gathered. Following discussions with the RSD unit developers, improvements to the sensitivity of the equipment could be gained through some relatively basic software and hardware changes. Alternatively other, more proven RSD systems can be procured from a number of US firms. The delays experienced during this demonstration can be attributed to using newly developed equipment, rather than deficiencies in the principle of RSD to identify high polluting vehicles.

Direct access to the contact details of vehicle owners (i.e. in the UK the DVLA database) would enable

MEASURE-LEVEL RESULTS

Measure title: Set up of city centre clean zone	Project: MIRACLES
Measure number: 5.1	City: Winchester

improved targeting and maintenance of the relatively small proportion of high polluting vehicles. If this were possible the cost effectiveness of this type of measure would be greatly improved.

Sharing the cost of the RSD unit with other neighbouring authorities or hiring the RSD equipment may be a more cost effective option in identifying the scale of the high polluting vehicles in the local vehicle fleet before committing to a full purchase for more intensive use of the measurements.

M13: Interrelationships with other measures

This measure is supported by the awareness raising Measure 10 as well as Measure 6.2. Environmentally linked parking charges.

M14: Lessons learned

1. NO_x and PM_{10} are key pollutants causing declarations of AQMA's in the UK, this is likely to be the case elsewhere in Europe. Any measure of this type should use an RSD unit capable of accurately detecting these pollutants (such systems are available on the USA market). The unit used in this trial gave only an indication of NO_x/CO_2 (due to lack of sensitivity of the equipment to this pollutant) and there was no facility to measure particulates (although reference is made in the REVEAL reports to the use of the RSD 'reference' channel as a proxy for opacity).
2. Links to vehicle records held by regional or national agencies (e.g. in the UK this would be the DVLA) would allow enrichment of the captured RSD records with fuel type, age, emissions standard etc.) and enable a more targeted approach to contacting the owners of the identified high polluting vehicles.
3. A rigorously proven RSD unit should be used for such trials. In hindsight, the extra cost of purchasing equipment from the USA would have enabled the measure to be implemented on schedule with a high degree of confidence in the results (based on extensive trials and real life applications in the US). It is possible to identify those vehicles which are 'high-emitting vehicles' using the REVEAL RSD instrument, but more accurate instruments could also be used to determine the contribution of high-polluting vehicles to the overall fleet emissions.
4. At this stage, initial questionnaire results and anecdotal evidence from a number of members of the public indicates that regular feedback to vehicle owners on their emissions would be welcome. It is not known what subsequent actions would be undertaken to repair a faulty vehicle, although further results will be available in March 2006.

Contact Point

💻.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

3. Measure 6.2

MEASURE-LEVEL RESULTS	
Measure title: Adoption of flexible parking policies and environmentally linked parking charges	**Project: MIRACLES**
Measure number: 6.2	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

The objectives were to promote:

- energy efficiency of the vehicle fleet parking in Winchester city centre by implementing a variable tariff at several car parks;
- an optimal pricing policy to internalise external costs.

M2: Measure description:

A variable tariff was implemented at several 'Pay and Display' long stay car parks in Winchester city centre and offered a discount of 75% or 50% on the usual cost of a season permit for those vehicles in the road tax bands with the lowest CO_2 emissions. In addition, owners of electric vehicles or hybrid (i.e. petrol/electric or diesel/electric) vehicles were offered free season permits.

It was originally intended to also implement the parking discount scheme at several 'Pay on Foot' car parks by using ANPR technology to recognise vehicles entering the car park and assigning the appropriate tariff to the dispensed ticket, but technical problems prevented this.

The measure also implemented a parking policy which limits any new Winchester parking provision to the Park and Ride (P&R) car parks. Parking charges discouraged long stay parking (particularly all day) in the city centre and encouraged the use of the (P&R) car parks.

The Implementation – how was the measure implemented?

M3: Innovative aspects:

This system of varying parking pricing according to the environmental performance of a vehicle was the first known example of such a system in the UK.

M4: Situation before CIVITAS:

There are about 3,300 car parking spaces in Winchester city centre, all of which were 'Pay and Display' before MIRACLES i.e. they were operated using pay-on-entry parking machines where the driver had to estimate the parking duration and pay for this time in advance. During MIRACLES, Winchester City Council (WCC) converted the ticketing systems at several major car parks (Chesil multi-storey, Tower Street multi-storey, The Brooks, and Middle Brook Street) to the more flexible 'Pay on Foot' system i.e drivers pay for the car parking ticket when they return to their vehicles, meaning that their parking time is calculated more accurately.

Two P&R sites serving Winchester have been in existence since 1994. During the MIRACLES life-cycle, the parking capacity at one of them (St Catherine's) was extended by 420 spaces, although not specifically as part of the project.

M5: Design of the measure:

A Parking Review was established by WCC as an informal group, open to the public, to discuss parking policies including charges, the MIRACLES measures, and their intended impact through the Air Quality Action Plan (AQAP) to deter all day parking in the city centre and encourage use of the P&R car parks.

Four multi storey car parks in Winchester city centre were converted to a 'Pay on Foot' payment system, which enabled the public to more accurately pay for the parking time used. This had the added benefit of cutting costs by removing the need for parking wardens, the main reason why these car parks were not included in the discount scheme. A variable tariff was implemented at several 'Pay

and Display' car parks in Winchester city centre which included St. Peters, Gladstone Street, Chesil Street (surface), Durngate, Coach Park, Worthy Lane and Cattle Market (see Figure 1). In total, about 1,020 spaces were potentially eligible for the variable tariff.

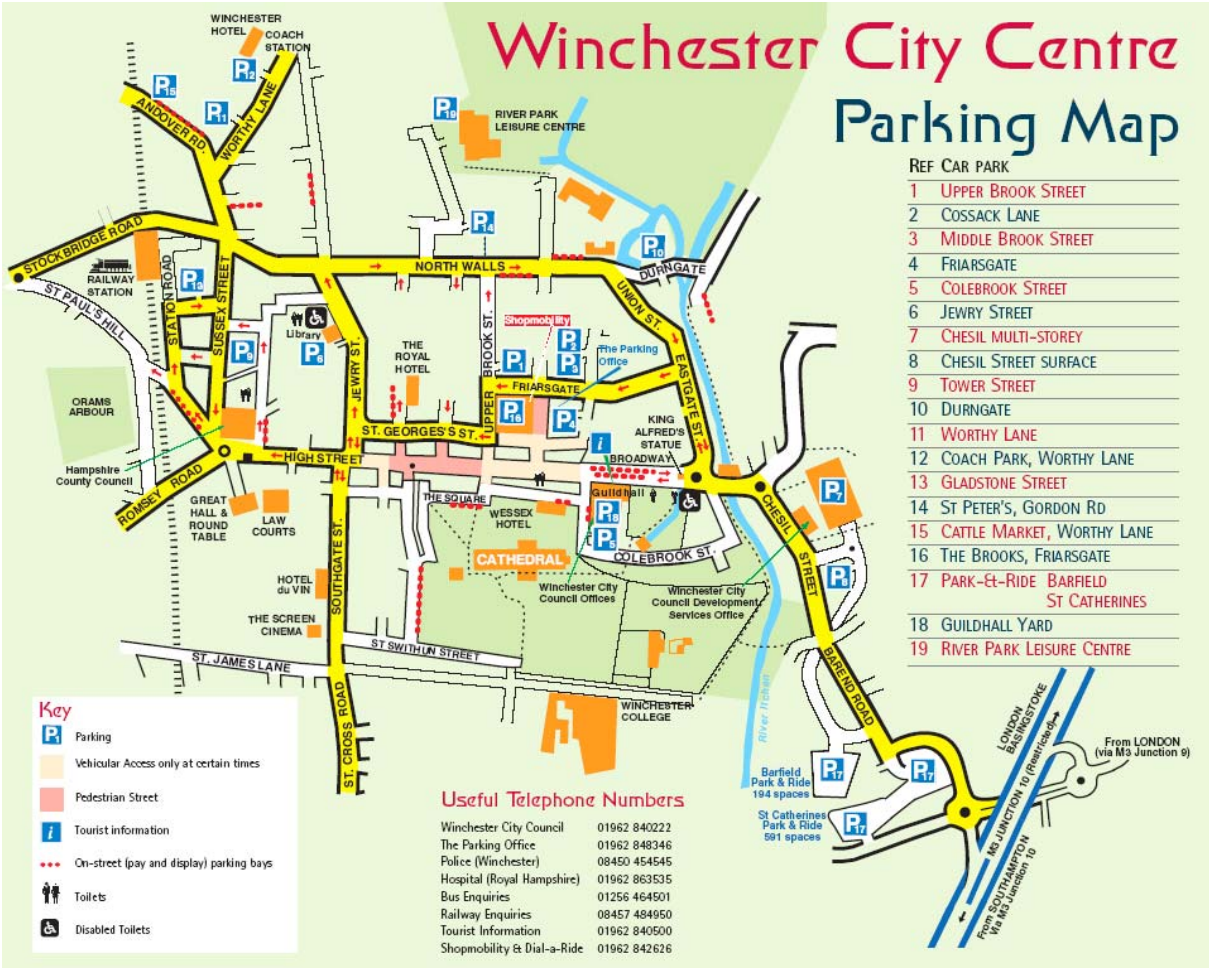


Figure 1: Map of car parks in Winchester city centre

A charging scheme for the cost of parking in Winchester was developed according to the engine technology and CO_2 emissions of the vehicle being parked. This was applied to season permit holders in 'Pay and Display' car parks only and the offer was implemented within a rolling programme based on permit renewal dates. The tariff was based on current UK tax bands, which are based on a vehicle's CO_2 emissions per kilometre. The measure offered a discount of 75% or 50% on the usual cost of a season permit for those vehicles belonging respectively to the A or B road tax bands. These are the tax bands for vehicles with the lowest CO_2 emissions (<120 kg CO_2/km). In addition, owners of electric or hybrid vehicles were offered free season permits. The discounts were only offered to season permit holders and applicants were required to submit vehicle registration documents to the local parking office to prove that their vehicle was eligible.

It is important to note that the price for vehicles not eligible for the discount was not raised as a penalty; although a charging policy was adopted to deter all day parking. However, the proportion of vehicles within Winchester qualifying for a discount was estimated at less than 1% (based on a survey

of vehicles parked in Winchester car parks), as shown in Table 1.

Table 1: Estimated make-up of vehicles using Winchester car parks

Tax Band (post 2001)	CO_2 (g/km)	Approx.% of Winchester fleet	Proposed discount %
A (not hybrid /electric*)	Up to 100	<1	75
B	101 to 120		50
C	121-150	10	0
D	151-165	6	0
E	166-185	6	0
F	Over 185	8	0
Pre-2001	Not classified	70	0

* Battery electric & hybrid petrol/electric vehicles are eligible for free parking. A list of vehicles qualifying for the battery/hybrid vehicle discount is reviewed periodically.

This initiative was accompanied by a public awareness campaign to promote the scheme and the merits of energy efficient travel. A database of registered discount users was established as part of the scheme implementation. To supplement this strategy, people renewing parking season permits were offered a two-week free trial of the Park & Ride service.

M6: Actual implementation:

Implementation occurred in the following stages:

Stage 1: Implementation of new parking charges (June 2002 and April 2005);
Stage 2: Conversion of 4 car parks from 'Pay and Display' to 'Pay on Foot' (January – March 2003);
Stage 3: Survey of public opinion regarding various tariffs (August 2003);
Stage 4: Trial of new 'environmental' season ticket tariff (May 2004 – end of project);
Stage 5: Free 2-week trial of Park & Ride site (May 2004 – September 2005).

M7: Deviations from the plan:

It had been intended to implement the discounted parking scheme at the 'Pay on Foot' type car parks by using ANPR technology to recognise vehicles entering the car park and assigning the appropriate tariff to the dispensed ticket and check that the correct vehicle was being driven with the associated card. (The ANPR system was originally designed as part of Measure 11.2). However, operational problems with the introduction of the 'Pay on Foot' system meant that WCC were reluctant to add the ANPR function to the system until the basic system operated satisfactorily. This did not occur within the lifetime of MIRACLES and so the discounted parking scheme was not implemented at any 'Pay on Foot' car parks. (Season tickets are not issued at 'Pay on Foot' car parks in Winchester).

A supplement to the discounted parking scheme was that a free two-week trial of the Park & Ride service was offered to all people renewing season permits of Winchester city centre car parks.

Six of the indicators originally defined for this Measure within D4.1 were not collected either because of a lack of data or because they were redundant due to a re-design of the Measure. These indicators are listed below:

- W6.2/Econ2a – Power costs
- W6.2/Econ3a – Maintenance costs
- W6.2/Eng1a – Fuel efficiency;

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	**Project: MIRACLES**
Measure number: 6.2	**City: Winchester**

- W6.2/Env1a – Age of vehicle;
- W6.2/Env1b – Engine technology;
- W6.2/Soc3a – Stated preference on where to park.

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

Data came from a variety of sources:

Hampshire County Council (HCC) cost statements – these outlined the hours worked on MIRACLES split by work package and staff grade along with any equipment/consumables bought. The figures come from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.

Acceptance/awareness questionnaire surveys - A questionnaire was sent to all season permit holders to gain an understanding of car park user awareness of the scheme and any influence it may have had on people's decisions to purchase a low CO_2-emitting vehicle. In addition, the questionnaire surveys undertaken to measure the public acceptance and awareness of the MIRACLES project within Winchester also contained questions relevant to the parking discount scheme. Details of the surveys relevant to this Measure are shown in Table 2.

Number plate capture survey - This is described in City level Tran3b – Travel speeds in the peak periods on key arterial routes. The number plates captured during sampling were matched with known vehicle details held by the DVLA to develop the CO_2 emissions profile of the Winchester car fleet. Sample sizes were 3102 and 1582 for 2004 and 2005 respectively.

Table 2: Details of the relevant acceptance/awareness questionnaire surveys

	Name of survey	Date of survey	Sample size	Purpose
1	Season permit holder survey	2004/05	165	Assessment of parking discount scheme
2	Winchester Transport	January/February 2005	914	Acceptance of specific measures within MIRACLES
3	MIRACLES Awareness	January/February 2005	850	Awareness of specific measures within MIRACLES

M9: Achievement of quantifiable targets:

N/a

M10: Achievement of evaluation-related milestones:

All the evaluation related milestones (as in the Local Annex of D4.1) have been achieved. As described in M7, implementation of the scheme did not occur at the 'Pay on Foot' car parks, and so season permit holders were the only respondents directly targeted within the evaluation.

M11: Report on the measure results:

Economy

HCC cost data

The data from HCC came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3. The staff hours for Work package 6.2 for Years 1 – 3 was a total of 1804 hours at a cost of £46,690 (***W6.2/Econ2b***). In addition, there were costs attributable to this Measure of about £30k for purchasing ANPR equipment (CRS Ltd) since the car parks were a destination for the new ANPR system (see W11.2). There were also costs of £3,480 associated with power supplies relating to the ANPR equipment (SEC Ltd), £1,000 for signs and sign erection, £2,800 for parking tickets (Bemrose Booth Ltd) and about £2,500/year to WCC for funding half of the free season tickets given to the

hybrid/electric vehicle drivers (WCC) (***W6.2/Econ1a***). It should be noted that the conversion of the car parks was funded outside the MIRACLES project.

Energy

There were 379 vehicles issued with a season permit at car parks within the scheme in May 2005. Of these, 17 (4.4%) were eligible for a discount in May 2005. The scheme has only been operating since 2004, but a time series analysis (per quarter year) found that the number of new registrations has increased slowly over the lifetime of MIRACLES to a total of 29 by October 2005; five vehicles registered in Q3 2004, five in Q4 2004, two in Q1 2005, six in Q2 2005, nine in Q3 2005 and two during October 2005. The 29 qualifying vehicles consisted of 16 hybrid electric vehicles (13 Toyota Prius and 3 Honda Civic/Insight) and 13 low emission 'B' category vehicles (2 Audi A2, 4 Peugeot 206/307, 3 Citroen C3 Desire, 2 Renault DC, 1 Vauxhall Astra and 1 Smart City). In October 2005, there were only 359 vehicles with a season permit.

Although the sample size is very small, there is an indication that hybrid vehicles are proving to be the more popular choice of the low CO_2 emitting vehicles. This is despite there being only two (of approximately forty) models that would qualify for some form of discount. It remains to be seen whether this is due to the greater discount offered to these vehicles. CO_2 results are examined in the following section and can be treated as a proxy for energy use.

Table 3: Numbers of low CO_2 vehicles registering for discounted season permits

Date	No. of permit holders in eligible Car Parks	No. of vehicles qualifying for discounts (# and **(%)**)			
		Hybrid/Electric	A (non hybrid)	B (non hybrid)	Total
May 2005	379	12 (3.1)	0 (0.0)	5 (1.3)	17 (4.4)
October 2005	359	16 (4.5)	0 (0.0)	13 (3.6)	29 (8.2)

N.B. By December 2005, the number of qualifying vehicles had reached 35 (21 hybrid/electric and 14 B category)

Emissions

Figure 2 shows the proportions of vehicles by CO_2 tax category in the observed fleet entering Winchester for 2004 and 2005 together with the weighted fleet assumed to represent the October 2005 WP6 parking fleet. Error bars on the figure represent the confidence intervals (the range in which the true answer for the Winchester vehicle fleet lies given the percentage observed in the Winchester samples) at a 95% confidence level. The proportion of vehicles which qualify for the WP6 parking discounts (Bands A & B) has shown a year on year increase. The level of difference between Winchester 2004 and Winchester 2005 indicate that the difference is statistically significant (i.e. estimated confidence intervals do not overlap). Part of this change can be attributed to background improvements to vehicle fuel efficiency (directly proportional to CO_2 production). However, the much larger proportion of vehicles qualifying for discounts amongst the weighted WP6 car park fleet shows that, for these car parks at least, the scheme is having an influence on the parking fleet above any background changes – this increase may also be responsible for some of the change between the 2004 and 2005 fleet.

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	Project: MIRACLES
Measure number: 6.2	City: Winchester

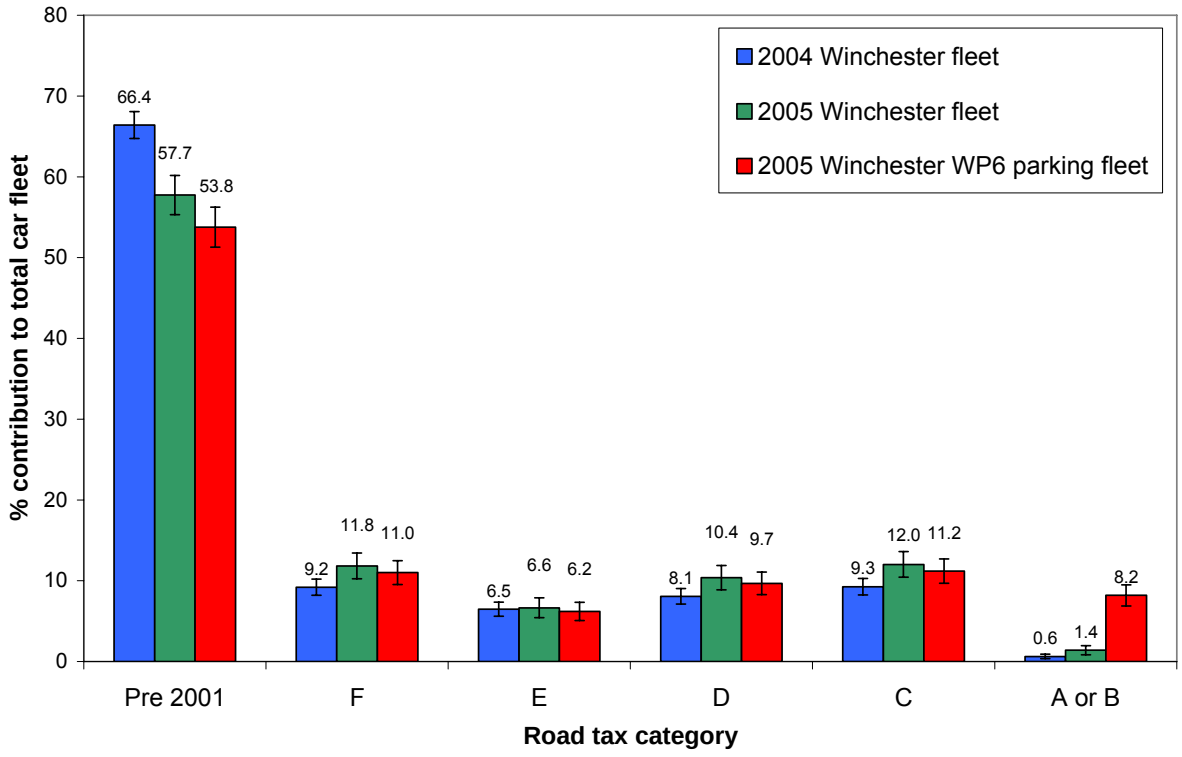


Figure 2: Comparison of proportions of cars, broken down by road tax band, for 2004 and 2005 general *Winchester* car fleet and MIRACLES WP6 parking fleet (as of Oct 2005) (only includes cars registered after March 31st 2001).

To understand the background changes occurring in the UK car fleet, national level data can be examined. Figure 3 shows how the proportion of vehicles in the national fleet, by CO_2 tax band, has changed from 2002 to 2004. Unfortunately data for 2005 will only be released in mid-2006. Within the national fleet, it is clear that a there is an increasing proportion of Bands A & B cars being registered relative to other tax bands. This supports the trend shown in the Winchester fleet. It would also seem that for 2004, when accounting for the possible range in which the true value for the whole car fleet lies, the proportion of Bands A & B can be considered comparable between the National and Winchester fleets. Further confidence in the method used to derive the Winchester car fleet can be gained by comparing 2004 national and Winchester figures (see Figure 4).

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	Project: MIRACLES
Measure number: 6.2	City: Winchester

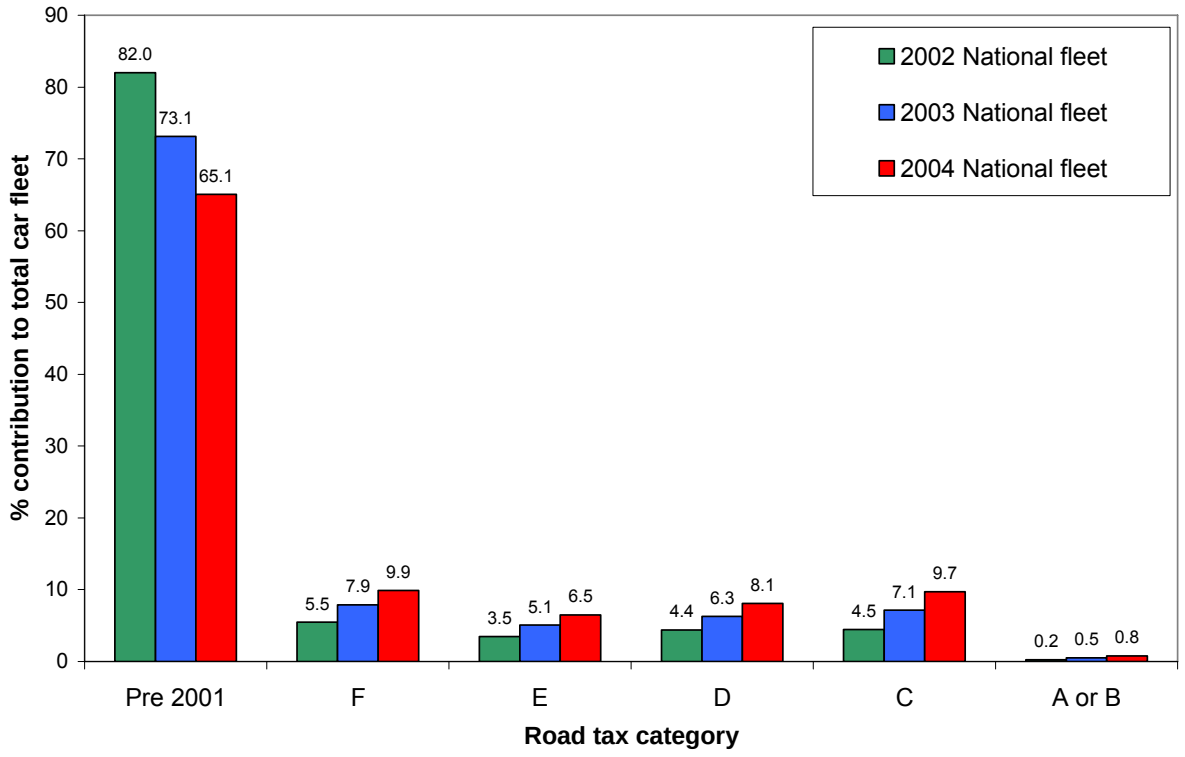


Figure 3: Comparison of proportions of cars, broken down by road tax band, for 2002-2004 national car fleet (Source: DfT, 2005)

The use of observed car fleet data for this evaluation is further supported by the close nature of the observed Winchester fleets of 2004 and 2005 and the estimated car park fleet in 2003 given in Table 1. The uncertainty in the 2003 survey is potentially relatively large, as assumptions were made based on vehicle models rather than definitive information from the DVLA as used for the 2004 and 2005 datasets. Again, a background turnover of the car fleet can be seen with a decreasing proportion of vehicles being first registered before March 31st 2001 as time progresses.

Using the short-term trend from the three years of national data available, the percentage share of Band A and B cars has been increasing by 0.3% each year. If this trend continues, the 2005 share of Band A and B vehicles in the 2005 national fleet would be 1.1%. This national figure is lower than that observed in the general Winchester fleet for 2005 although falls within the range in which the true value for the Winchester fleet could lie (see Figure 4). It is possible that, year on year, the proportion of Band A and B cars in the Winchester has grown quicker than the national trend. The 2005 national figures will make this clearer.

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	Project: MIRACLES
Measure number: 6.2	City: Winchester

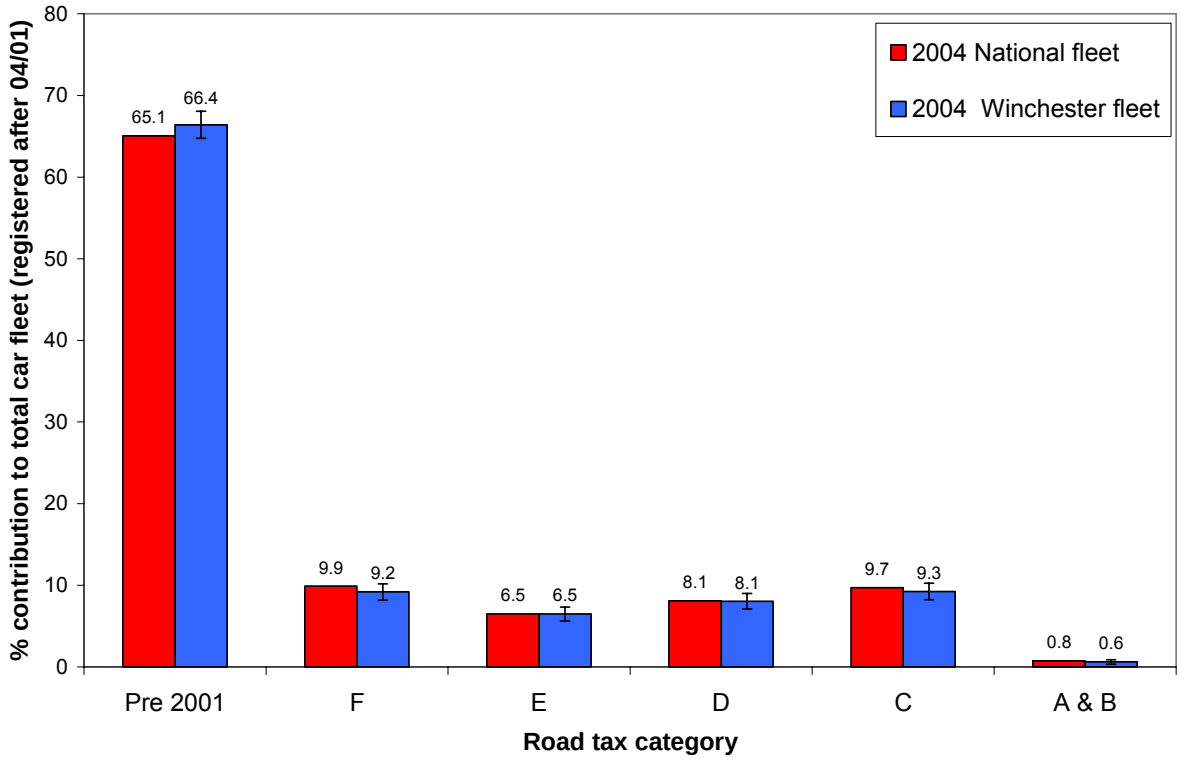


Figure 4: Comparison of proportions of cars, broken down by road tax band, for 2004 national car fleet and 2004 Winchester fleet

The reduction in CO_2 emissions as a result of this measure can be estimated by comparing the observed Winchester fleet of vehicles (which includes some low CO_2 vehicles) to that of an assumed car park fleet which has had the proportion of low CO_2 vehicles increased to match the known proportion using the eligible car parks. This is undertaken by adding 'dummy vehicles' to the overall fleet so that 4.4% of vehicles in this overall fleet are low CO_2 vehicles (i.e. produce 120g/km CO_2 or less) – each dummy vehicle is given the average CO_2/km for those vehicles which have discounted parking (109.5 g/km). By isolating those vehicles of an age that, if they had low enough emissions, could qualify for the discount from both the observed fleet entering Winchester and the new dummy fleet, the average CO_2 per km can be obtained together with the relative contribution to total CO_2 emissions/km for the various road tax bands. These results are presented in Figure 5 (***W6.2/Env2a***). It should be noted that these data sets are based on snapshots of vehicle fleet.

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	Project: MIRACLES
Measure number: 6.2	City: Winchester

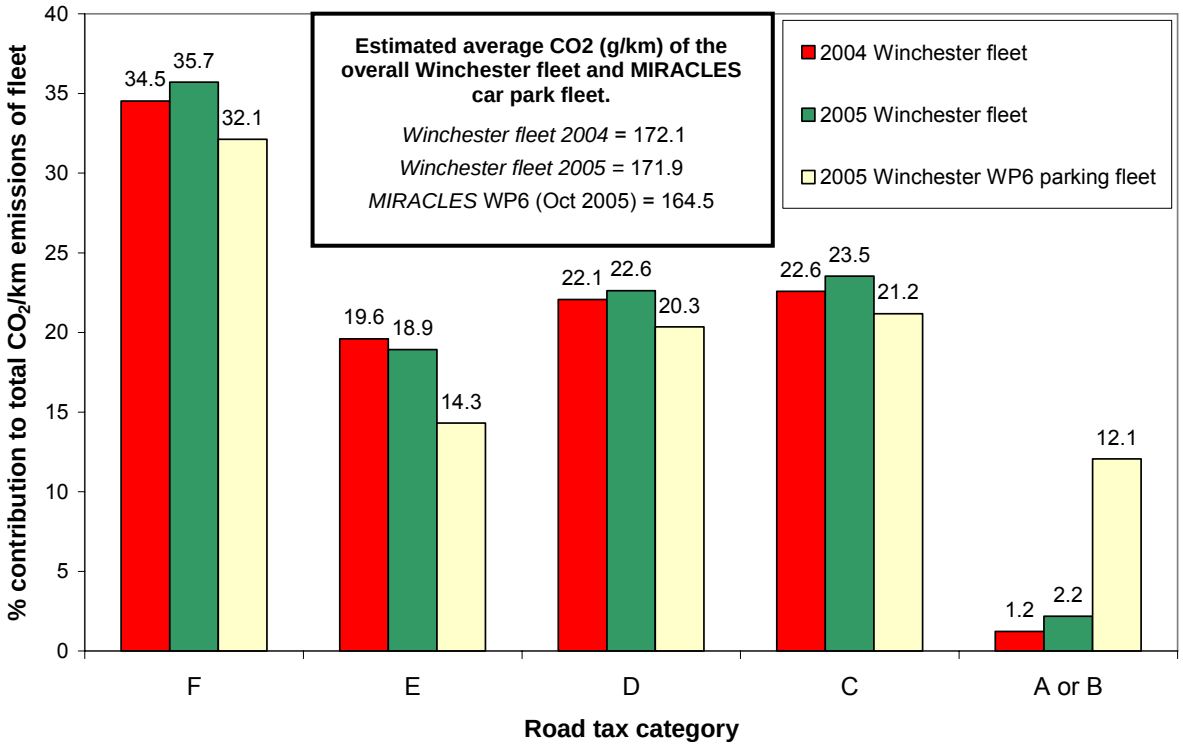


Figure 5: Estimated percentage contribution to fleet CO_2 (g/km) of different road tax bands in the pre-WP6 and Year 1 WP6 season permit car park fleet, and (inset) average CO_2 emissions rate (g/km) of general Winchester fleet for 2004 & 2005, and the WP6 car park fleet.

Using data relating to the known fleet entering Winchester in 2004 and 2005 and assuming this population of vehicles matches the population applying for season permits, only about 1.4% would qualify for a low CO_2 vehicle parking discount. This can be compared to the 8.2% of vehicles that have qualified for discounts within the eligible car parks by October 2005. However, since this scheme does not cover all Winchester car parks, it is possible that people are simply moving their season permit from a car park not included in the scheme. A check on the possibility of users relocating their vehicles is to see how many low CO_2 cars there should in the whole season permit holder fleet (i.e. not just cars included in the WP6 scheme). This can be based on the total number of season ticket holders for all Winchester car parks.

The total number of season permit holders in Winchester car parks is 763 (359 eligible and 404 ineligible). Assuming that 2% (upper value of confidence interval – see Figure 2) of vehicles in this parking fleet are in the A or B bands, then approximately 15 CO_2 band A or B season ticket holders would be expected to be parking in Winchester car parks. This is half of the number observed in October 2005 in the included car parks making simple relocation amongst season ticket holders seem unlikely. However, some of the drivers with vehicles included in the scheme may not park every day but sufficiently often so it is still cheaper to buy the permit. No data is available at present to confirm whether this is happening.

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	**Project: MIRACLES**
Measure number: 6.2	**City: Winchester**

Society

165 season ticket holders completed and returned the questionnaire. 37% of the respondents were male and 63% female. Not surprisingly, in view of the audience targeted by the questionnaire, the majority of the respondents were mainly commuters and therefore middle-aged (see Table 4).

Table 4: Age range frequency distribution of respondents

Age Range	17-19	20-24	25-34	35-44	45-54	55-64	65+
No. of respondents (%)	0.0	4.9	16.6	22.1	35.6	18.4	2.5

The questionnaire then stated: "*The cost of road tax for a car first registered after 1st March 2001 is based on the average amount of Carbon Dioxide (CO_2) the vehicle produces per kilometre. To make the system simpler, the CO_2 emissions are grouped into six bands – A, B, C, D, E & F – with A being the least polluting*". The respondents were asked if their car was first registered with the DVLA after 1st March 2001. Of those people who knew the answer, 51.6% answered yes. These people were then asked which CO_2 road tax band their car belonged to (Table 5).

Table 5: Road tax band of car (if registered after 1st March 2001)

Road tax band	A	B	C	D	E	F	Don't know
No. of respondents (%)	0.0	3.9	15.6	22.1	5.2	14.3	39.0

Nobody owned a car in the non-hybrid A tax band and only 3.9% (i.e. three people in the whole sample) owned a car (or knew that they owned one) in the B category. None of the three B band cars was an electric or hybrid vehicle. One of the vehicles had been owned since before 1st May 2004 and the other two since after 1st May 2004 (the date when this Measure commenced). The two drivers who had purchased a B band car since 1st May 2004 stated that the discounted parking scheme had not influenced at all their decision to purchase a low CO_2 emitting vehicle.

The respondents were asked if they were aware that vehicles in the A or B road tax bands were eligible for a 75% or 50% discount on the cost of a standard car park season ticket. 74.8% of the season ticket holders were aware of this and 72.7% were aware that electric or hybrid vehicles were eligible for a free parking ticket (***W6.2/Soc2a***). This high awareness level was to be expected since all permit holders were sent information on the scheme with their permit renewal notice, although some of the respondents did not receive the information as their employer paid for their parking space. The awareness amongst the general public (from the MIRACLES Awareness questionnaire survey) was much lower than permit holders (10.0% for A or B vehicles and 11.6% for electric/hybrid vehicles); again this result would be expected given the relative exposure to the methods of dissemination for this measure. Figure 6 presents the awareness of the scheme for the permit holders and the general public.

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	Project: MIRACLES
Measure number: 6.2	City: Winchester

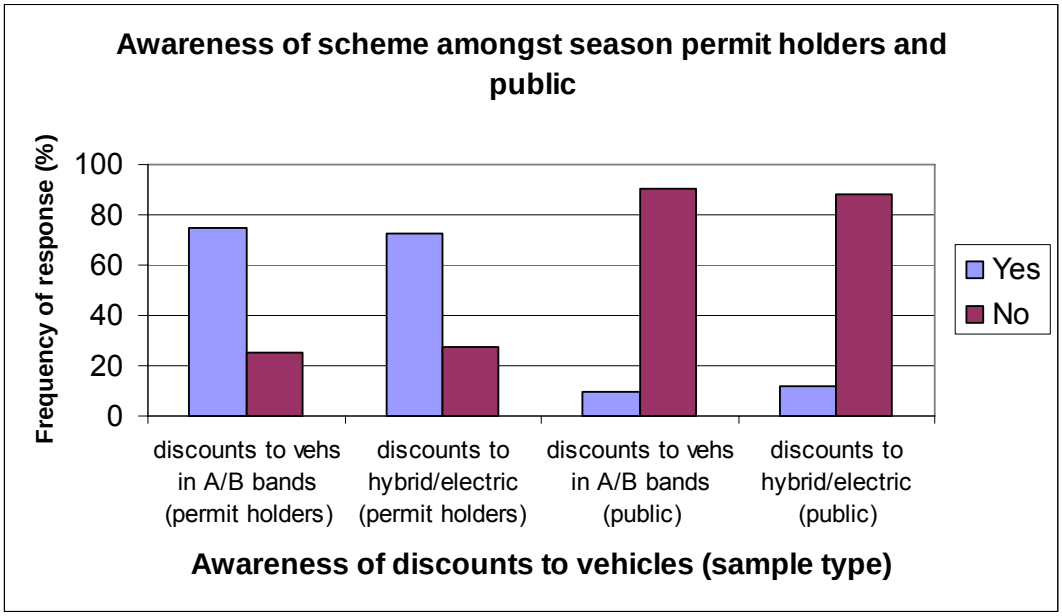


Figure 6: Awareness of scheme amongst car park permit holders and the general public

Those season permit holders who were aware of the scheme were asked from what source they had obtained the information (but only 53 respondents answered this question). The most cited source was "*information sent by Winchester Parking Office*" (69.8%), followed by "*work in local authority*" (20.8%), the "*cutting the cost of parking leaflet*" (18.9%) and "*advert on back of parking tickets*" (7.5%).

Respondents were asked if the parking ticket discounts would encourage them to purchase a more environmentally friendly car in the future. 31.4% stated that yes, they would consider purchasing a vehicle in the A or B road tax band, but 50.9% would not consider such a vehicle. (The remainder did not know). Regarding consideration of future purchase of an electric or hybrid car, 10.2% stated yes, they would consider such a purchase, but 70.8% said no.

Therefore, this measure has some potential for a greater shift in future years as permit holders account for the potential money saved on parking in their vehicle purchasing decisions, although it is acknowledged that this 'stated preference' result should be treated with caution. It is interesting that the purchase of a conventional vehicle in the A or B band (i.e. petrol or diesel engine) would be more popular than that of a hybrid/electric vehicle, and this is in contrast to the trend of higher registration of hybrids in the discount permit scheme.

Respondents were asked if they agreed with WCC's policy of offering discounted parking to more environmentally friendly vehicles. 58.0% of the sample of season permit holders either strongly agreed or tended to agree with the scheme (***W6.2/Soc1a***), while only 19.7% either strongly disagreed or tended to disagree. A comparison of these results with those obtained from the general citywide public questionnaire surveys (Winchester Transport questionnaire survey) is illustrated in Figure 7. Although the results from the two surveys are generally consistent, there was slightly more support from the general public. (69.7% of the public generally agreed with the scheme and 12.9% generally disagreed).

MEASURE-LEVEL RESULTS	
Measure title: Adoption of flexible parking policies and environmentally linked parking charges	**Project: MIRACLES**
Measure number: 6.2	**City: Winchester**

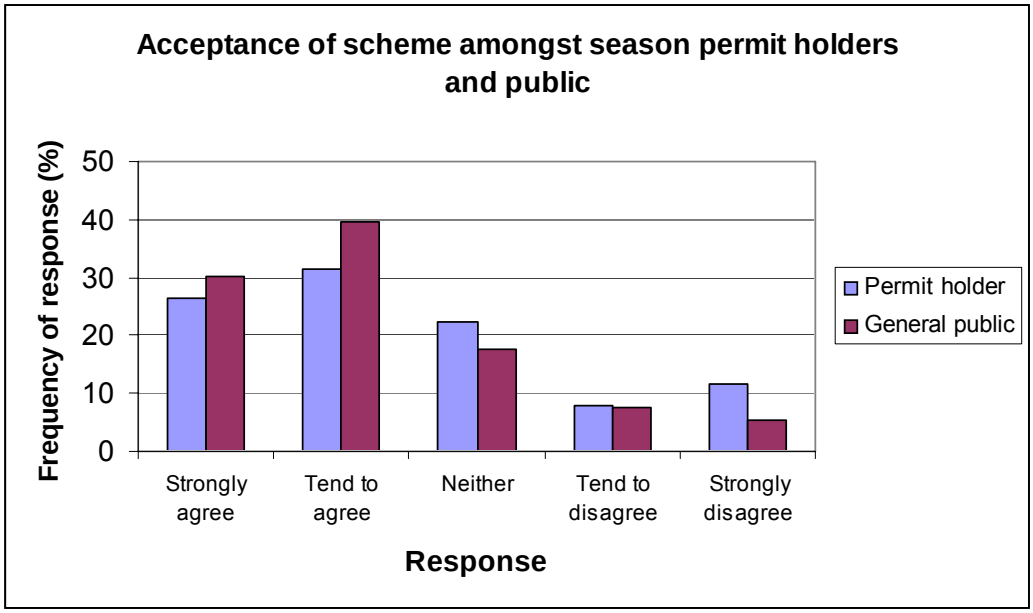


Figure 7: Acceptance of measure amongst season permit holders and the general public.

An additional aspect of the trial was to offer people renewing their season permits the option of trialling the P&R service for free for two weeks. (However, this scheme finished at the end of September 2005 because the P&R car parks were very close to capacity). The questionnaire asked if the respondent had used the Park and Ride service during this trial period. Just 7.4% answered yes. The main reasons cited for not using (or continuing to use) the Park and Ride service were "*journey into work would take longer*" (53.5%), "*P&R is in wrong location when considering my route to work*" (48%), "*service does not run when I need it*" (17.6%), "*place of work is too far away from P&R bus stop*" (12.6%), "*need quick access to car*" (11.3%), "*did not know about P&R trial*" (8.2%) and "*service too infrequent*" (8.2%).

WCC recorded that of the 379 season permit holders, 51 took up the free P&R trial. Of these, 47 did not renew their season ticket implying that they continued to use the P&R site (although some may have moved from the area or no longer required a season ticket for other reasons). This is reflected in the fall in season tickets from 379 in May 2005 to 359 in October 2005.

The survey asked the question: "*Excluding the parking ticket discounts, what else would help persuade you to, in future, purchase a car which qualified for the A or B road tax bands or was an electric/hybrid car?*" The most frequently cited response related to affordability / financial concerns e.g. "*reduction in the price of purchase cost of hybrid car*" and "*I always buy second-hand so would need plenty to choose from on second-hand market*". Some respondents were concerned about reliability issues e.g. "*Electric/hybrid cars need to be tested longer to confirm reliability and re-sale value*" while others thought they lacked performance e.g. "*When they give same performance acceleration speed as petrol driven cars*" and "*When I find a car of this genre which is big enough for my needs and appeals aesthetically*".

The respondents were also asked: "*Explain why you think WCC is encouraging people to drive cars with relatively low CO_2 emissions?*" Not surprisingly, the majority of responses related to reduction of environmental pollution / emissions" e.g. "*To reduce CO_2 emissions within Winchester*" and "*Reduce pollution in the city generally but combat/reduce greenhouse gases going into the atmosphere which*

MEASURE-LEVEL RESULTS	
Measure title: Adoption of flexible parking policies and environmentally linked parking charges	**Project: MIRACLES**
Measure number: 6.2	**City: Winchester**

are causing global warming". However, several responses were more sceptical e.g. "*Probably because you have been given a government target to reach*" and "*Because there is a mistaken belief that there is an air quality problem in Winchester and this will improve it, but I car-share and get nothing yet arguably save double the pollution*".

Transport

The seven most popular city centre parks in terms of ticket sales are The Brooks, Middle Brook Street, Tower Street, Friarsgate, Jewry Street, St Peters and Chesil Multi-storey. Ticket sales generated at these seven car parks, as well as the two P&R car parks, are shown in Table 6. It can be seen that all the city centre car parks showed a decrease in ticket sales over the lifetime of MIRACLES (an average of about 16%). Between 2001/2 and 2004/5, there was an overall decrease in the numbers parking in the city centre in the seven most popular car parks (about 235,000) (***W6.2/Tran1a***). In contrast, there was an increase of about 36,000 people parking at the P&R car parks. This was attributable to the St Catherine's P&R site extension in February 2004, which increased its capacity by 420 spaces (see Measure 7).

Table 6: Ticket sales for Winchester city centre and P&R car parks

	2001/2	2002/3	2003/4	2004/5	Percentage change
The Brooks	363,605	341,906	335,696	331,574	-9%
Middle Brook St	315,849	287,086	236,733	236,128	-25%
Tower Street	237,929	232,322	198,418	196,598	-17%
Friarsgate	214,614	192,929	193,407	183,417	-15%
Jewry Street	138,524	140,327	143,633	121,114	-13%
St Peter's	119,515	113,787	115,510	94,064	-21%
Chesil MSCP	91,693	99,321	96,644	83,353	-9%
Barfields P&R	54,471	55,065	57,425	53,859	-1%
St Catherine's P&R	53,593	47,525	53,795	91,141	70%
Total - City centre car parks	1,481,729	1,407,678	1,320,041	1,246,248	-16%
Total – P&R car parks	108,064	102,590	111,220	145,000	34%

An alternative method of presenting the results is illustrated in Figure 8, which presents the total annual percentage changes in ticket sales.

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges
Measure number: 6.2

Project: MIRACLES
City: Winchester

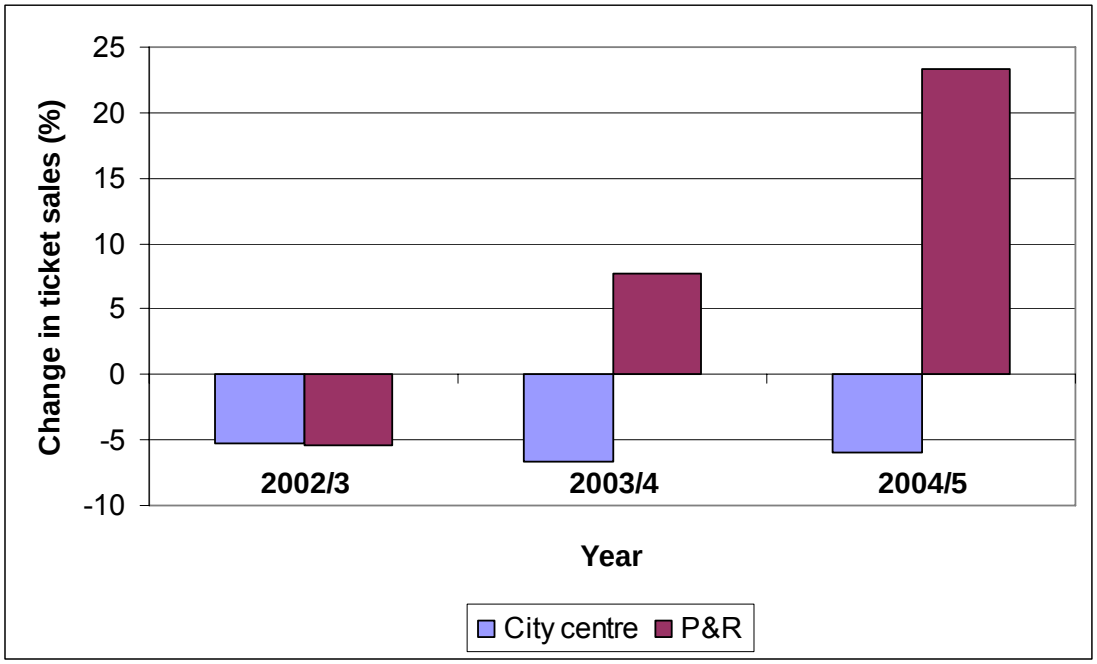


Figure 8: Percentage changes in ticket sales for the city centre car parks and the P&R car parks

Table 7: Changes in ticket sales/policy for all city centre car parks

Car Park	% change	Actual change	All day charge 06/2002	All day charge 2005	Min stay 2002	Min stay/charge 2005
Middle Brook St	-25	-79,721	£10	£15	1/2hr	1/2hr (70p)
Tower Street	-17	-41,331	£4.80	£6	2 hr	1 hr (70p)
The Brooks	-9	-32,031	£10	£15	1 hr	1 hr (70p)
Friarsgate	-15	-31,197	£10	N/A	1 hr	1 hr (70p)
St Peter's	-21	-25,451	£4.80	N/A	1hr	1/2hr (30p)
Jewry Street	-17	-17,410	N/A		1/2hr	1/2hr (30p)
Chesil Surface	-18	-10,007	£2.80	£3.50	1hr	1 hr (50p)
Chesil MSCP	-9	-8,340	£2.80	£3.50	2 hr	1 hr (50p)
Upper Brook St	-3	-2,138	N/A		1 hr	1 hr (70p)
Guildhall Yard	-28	-2,002	N/A		1 hr	1 hr (70p)
Barfield P & R	-1	-612	All day £1.50			
Durngate	+5	+1,150	£2.80	£3.50	2hr	2hr (£1)
Coach Park	+11	+1,715	£2.80	£3.50	2hr	2hr (£1)
Cattle Market	+9	+2,352	£2.80	£3.50	2hr	2hr (£1)
Worthy Lane	+14	+3,641	£2.80	£3.50	2hr	2hr (£1)
Gladstone St	+95	+21,073	£4.80	£6.00	2hr	1hr (70p)
St Cath's P&R	+70	+37,548	All day £1.50			
Total (non P&R)	-13%	-219,697				
Total (P&R)	+34%	+36,936				

N.B. Data was not available for Cossack lane (2003), Colebrook Street (2004) and River Park Leisure centre (2002-2003).

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	Project: MIRACLES
Measure number: 6.2	City: Winchester

Charges at the city centre car parks were increased on 1st June 2002 by about 20% and on 4th April 2005 by about a further 25%. The ticket sales/policy for all city centre car parks (as shown in Figure 1) is detailed in Table 7.

For all city centre car parks (excluding P&R), there was a smaller decrease in ticket sales of 13% (220,000). Tables 6 and 7 show how the parking charging/policy has had some effect in reducing all day parking in the city centre by the following methods:

1. Significant price differential between the P&R and city centre car parks - The P&R daily charge was maintained at £1.50 throughout MIRACLES, which was significantly lower than anywhere else in the city. The new extension at St Catherine's P&R car park has seen a 70% increase in ticket sales at this car park (see Measure 7 for more details).

2. Significant increase in all day parking charge at selected car parks - Middle Brook Street and The Brooks car parks had a very large combined decrease in ticket sales (112,000), mainly due to the increase of all day parking from £10 in 2002 to £15 in 2005.

3. Significant price difference in parking charges for car parks on the outskirts of the city – Worthy Lane, Cattle Market, Coach Park and Durngate also saw ticket sales increases of 5% to 14%. Parking charges were significantly cheaper than other city centre car parks (£1 for 2 hours and £3.50/day in 2005).

3. Converting selected long stay car parks to short stay - Friarsgate and St Peter's car parks no longer permit all day parking but only short stay up to a maximum of 4 hours. These two car parks had a large combined decrease in ticket sales of about 56,000.

4. Reducing the minimum stay period at selected car parks - Gladstone Street car park saw a 95% increase in ticket sales from 2001/2 to 2004/5 probably due to a change in parking charging in 2002/3 where the minimum stay was reduced from 2 hours to 1 hour (and where all day parking was only £6).

5. Removing free car parks from the city centre area - the River Park car park near the leisure centre used to be a free car park prior to November 2003 (so no data prior to this date is available) when WCC converted it to Pay and Display to prioritise it for leisure centre users and prevent commuters there parking free all day. It provided the cheapest short stay parking in the city (20p/hour in 2005) with about 180,000 ticket sales in 2004/5

Table 8: Revenue generated (£'s) from Winchester city centre and P&R car parks

	2001/2	2002/3	2003/4	2004/5	Percentage change
The Brooks	346,032.70	381,833.70	427,686.45	439,551.95	27.0
Middle Brook St	266,490.50	280,301.35	253,789.05	255,835.70	-4.0
Tower Street	504,983.05	557,018.55	561,824.35	549,239.15	8.8
Friarsgate	244,654.65	248,079.20	256,403.25	247,577.05	1.2
Jewry Street	120,071.55	137,492.65	143,928.85	126,275.15	5.2
St Peter's	187,254.45	196,555.30	203,690.30	182,294.35	-2.6
Chesil MSCP	154,342.30	185,221.85	218,289.80	215,795.00	39.8
Barfields P&R	57,736.10	55,768.95	46,707.20	36,413.40	-36.9
St Catherine's P&R	58,506.75	57,350.75	54,449.45	86,341.50	47.6
Total - City centre	1,823,829.20	1,986,502.60	2,065,612.05	2,016,568.35	10.6
Total – P&R	116,242.85	113,119.70	101,156.65	122,754.90	5.6

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	Project: MIRACLES
Measure number: 6.2	City: Winchester

Table 8 shows the equivalent results for the seven city centre car parks and two P&R sites in terms of revenue generated (***W6.2/Econ4a***). There was an average revenue rise across the seven most popular city centre car parks of about 11%, which can be explained by the increase in car park charges during the project duration. The St Catherine's P&R site saw a 48% increase in revenue, largely due to the increase in parking capacity. The Barfields P&R car park remained unchanged in the number of spaces it offered and saw a reduction in revenue of 37%. This was due to the daily charge of £1.50 per vehicle remaining unaltered during the lifetime of MIRACLES as well as the introduction of cheaper smart cards (£1.20) in January 2003. In April 2003, 40% of P&R users bought their ticket via the smart card; this rose to about 60% by March 2005.

An alternative method of presenting the results is illustrated in Figure 9, which illustrates the total annual percentage changes in ticket revenue.

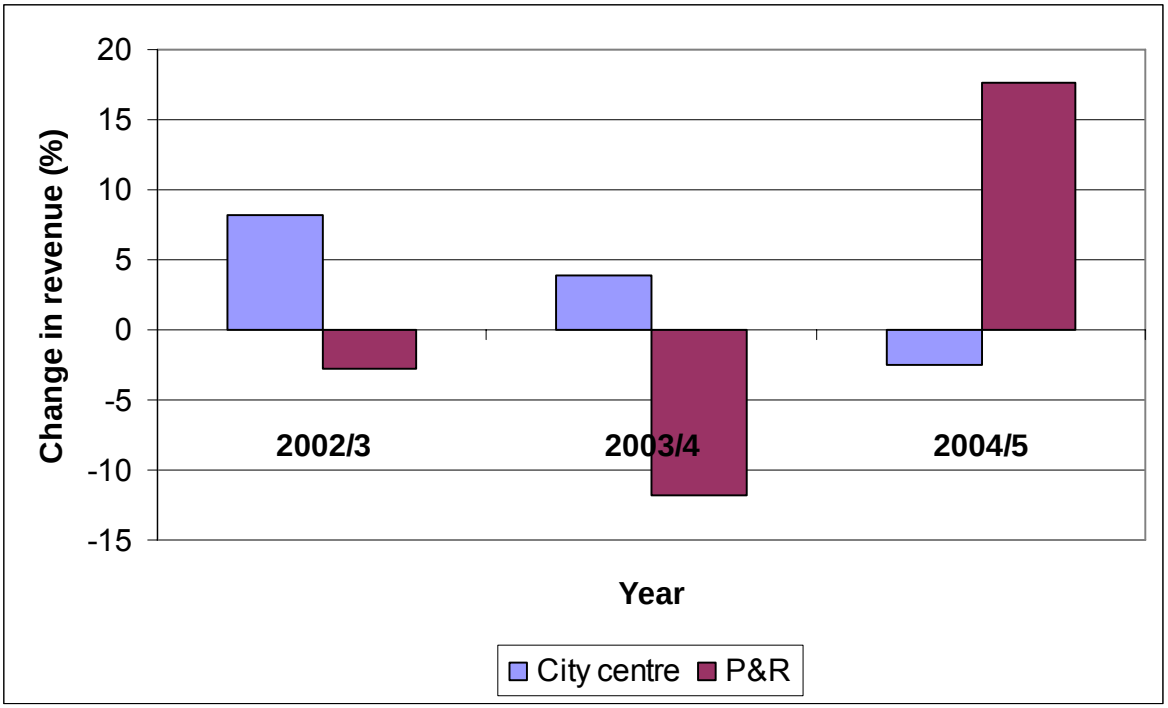


Figure 9: Percentage changes in revenue for the city centre car parks and the P&R car parks

The results show that there has been some success in deterring drivers from parking in the city centre (the number of tickets sold reduced by 16%) and instead switching to use either one of the P&R car parks (the number of tickets sold increased by 34%) or a car park on the outskirts of the city. Parking charges/policy can be an effective tool in encouraging/deterring parking behaviour although political agreement is necessary. While a reasonably large price differential between the P&R and the city centre car parks remains, more drivers would be expected to switch to using the P&R. However, unless more capacity can be given to the P&R car parks (which are expected to be at capacity by the end of 2005), the parking charging policy will not have the desired effect.

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges
Measure number: 6.2

Project: MIRACLES
City: Winchester

A summary of the measure indicators (as defined in the Local Annex of D4.1) is shown in Table 9.

Table 9: Summary of measure indicators for WP6.2

Indicator no. (Meteor no.)	Indicator name	Baseline 2002	Business as Usual 2005	MIRACLES 2005
W6.2/Econ1a	Purchase/loan and installation costs	N/a	N/a	£2,600 / year
W6.2/Econ2b	Labour costs	N/a	N/a	£46,690
W6.2/Econ4a	Revenue generated from parking	City centre: £1,824k P&R: £113k	N/a	City centre: £2,017k P&R: £123k
W6.2/Env2a (8-11)	Emissions (CO_2)	172.1 g/km	171.9 g/km	164.5 g/km
W6.2/Soc1a (14)	Acceptance rating	N/a	N/a	Season ticket holders: 58.0%; Public: 69.7%
W6.2/Soc2a (13)	Correct awareness	N/a	N/a	Season ticket holders: 73.8%; Public: 10.8%
W6.2/Soc4a & 5a	Operator confidence in technical parameters /Acceptance of measure	N/a	N/a	See M14
W6.2/Tran1a	Yearly parking flow	City centre: 1,482k P&R: 108k	N/a	City centre: 1,246k P&R: 145k
W6.2/Tran2a	Patronage on P&R	N/a	N/a	See Measure 7
W6.2/Tran2b	Stated reason for new patronage	N/a	N/a	See Measure 7

The measure will continue beyond the lifetime of the MIRACLES project.

Up-scaling

As stated in Table 3, there were 359 season ticket holders for car parks eligible for the variable tariff. Including the season card holders parking at the two “pay on foot” car parks of Tower Street and Chesil Street multi storey, there are approximately 770 season permit holders in total (October 2005). A desktop study has been carried out to investigate the potential additional emission reductions of up-scaling the measure so that all of the season permit holders in Winchester would be eligible for the scheme.

A number of assumptions were made in this up-scaling. These were:

- The effect of the measure on encouraging regular season ticket holders to preferentially purchase low CO_2 vehicles on scale described above is real and not simply occasional car park users applying for the discounted season tickets.
- The up-scaled measure is adopted by the larger season ticket fleet considered.
- Drivers with qualifying vehicles using the ‘pay on foot’ car parks have not already changed their preferred car park because of the scheme.
- There are sufficient numbers of qualifying vehicles left in the Winchester area for the scheme to expand.

MEASURE-LEVEL RESULTS

Measure title: Adoption of flexible parking policies and environmentally linked parking charges	Project: MIRACLES
Measure number: 6.2	City: Winchester

- The up-scaled measure was implemented during the same period as the observed measure.

The results of the up-scaling on an overall amount of CO_2 emissions saved per kilometre is presented in Table 10.

Table 10: Up-scaled results

Fleet	Average CO_2/km (g)	Approx. No of season tickets	Total CO_2/km (g)	Difference (g and **(%)**)
Winchester overall 2004	172.1	360	61956	-
Winchester overall 2005	171.9	360	61884	72 **(-0.1)**
Winchester WP6 fleet (Oct 2005)	164.5	360	59220	2736 **(-4.4)**
Up-scaled overall 2004	172.1	770	1325517	-
Up-scaled overall 2004	171.9	770	132363	154 **(-0.1)**
Up-scaled WP6 fleet	164.5	770	126665	5698 **(-4.4)**

The results show that with only natural changes to the vehicle fleet 154gCO_2/km would be saved in the up-scaled measure; this is equivalent to one small/medium-sized car being removed from the road. In the WP6 fleet, this saving is 5698 gCO_2/km; equivalent to 37 vehicles being removed from the road.

In practice, the extension of the discount scheme to short-stay car parks is currently being considered, although there are no plans to encompass all the city centre car parks. A balance will need to be struck between targeting more drivers and maintaining a cost-neutral overall parking charge

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

The Air Quality Action Plan for Winchester drove this measure. A barrier was that the scheme only applied to the 379 season permit holders using the relevant car parks in Winchester. Of these, only 35 (in December 2005) vehicles were eligible for a discount. Therefore, the number of drivers directly affected by this Measure was very limited, and no quantifiable impacts could be directly measured. The number of car parks at which the scheme was implemented was also hampered by getting the relevant contractors to co-operate and work together to overcome technical issues in the installation of the ANPR equipment.

M13: Interrelationships with other measures

The ANPR element of this measure is linked with Measure 11.2
The use of P&R facilities is linked to Measure 7
The aim of a cleaner fleet entering Winchester is related to Measure 5.1

M14: Lessons learned

1. The scheme has been associated with a small but statistically significant rise in the proportion of vehicles in Bands A or B in the Winchester fleet from 2004 to 2005 (0.6% to 1.4%). Part of this change is probably due to improvements in vehicle fuel efficiency. However, the much larger proportion of vehicles qualifying for discounts amongst the WP6 car park fleet (8.2%) shows that the scheme may be having a positive influence on the wider fleet.
2. The scheme could have been demonstrated at a wider level, by targeting more vehicles e.g. all season permit holders, those vehicles with tax bands just below the A and B levels, or LPG vehicle owners. The up-scaling results showed how an expanded scheme could help to reduce CO_2 emissions further in the city centre area. Most people were aware of the scheme, but few vehicles were eligible. In some respects, the target audience is linked to the wider citywide political and financial decisions that have to be made by the local authorities. For instance, the

MEASURE-LEVEL RESULTS	
Measure title: Adoption of flexible parking policies and environmentally linked parking charges	**Project: MIRACLES**
Measure number: 6.2	**City: Winchester**

P&R site in Winchester is heavily subsidised by the parking revenue generated from the city centre car parks and any significant reduction in this may adversely affect the P&R service. There are plans to extend the scheme to include resident parking permits and pre-paid Park and Ride smart cards.

3. The public generally agreed with the scheme, and there was some indication that it would influence future purchases of low CO_2 emitting vehicles. However, people choose the car they purchase based on numerous factors, and any effects can only be measured in the long-term. Winchester City Council will continue with the discount scheme, and it is recommended that further post-project monitoring is undertaken to assess the longer-term impacts.
4. There has been evidence that maintaining a large price differential between the P&R and city centre car parks has resulted in an increased usage of the P&R and a reduction in long stay city centre parking.
5. There has also been evidence that other parking policy/charging measures such as significant increases in all day parking at selected car parks, significant price differences in parking charges for car parks on the outskirts of the city, converting selected long stay car parks to short stay, reducing the minimum stay period at selected car parks and removing free parks from the city centre area has also had the desired effect of encouraging drivers to park on the outer part of the city centre area.
6. Problems with cross-organisational co-operation can reduce the efficiency of introducing more radical schemes as well as introduce political and institutional barriers to new parking policies/charges. WCC require political approval for any parking charge increases or policy changes.
7. Technical problems with the ANPR equipment meant that the scheme could not be trialled at 'Pay on Foot' car parks. The ANPR system was compatible with the existing equipment, but WCC were reluctant to change to a new untested system in addition to the problem of getting different contractors to co-operate and work together.
8. Hybrid/electric vehicles are still a new concept with the technology often perceived by the public as unproven.

Contact Point

.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

4. Measure 7

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

This measure sought to improve the quality of the bus service in Winchester in terms of waiting facilities, re-branding of buses, discount ticketing schemes, improved routes and greater integration of bus and rail. As improving the bus service quality (Measure 7.1) and bus service information (Measure 7.2) were so closely integrated, for evaluation purposes they were treated as a single measure (i.e. Measure 7).

The specific objectives of the Measures (7.1 and 7.2) implemented in Winchester were to:

- contribute to an 8% increase in bus patronage during the project timescale;
- improve the satisfaction rating of public transport by 8%;
- integrate public transport services.

M2: Measure description:

The aim was to improve three main city centre bus routes in Winchester (X1, X5 and P&R) in terms of quality and passenger information (see M11 for bus route information and map). This was achieved by implementing a package of mini-measures which were the introduction of new cleaner buses to operate on X1 and X5, increased frequency of X5, better information for passengers at bus stops and in timetables, easier integration between rail and bus travel and access to real-time passenger information through kiosks and the internet (see Measure 11.1). In addition, a new cross city route was established linking services from the Park and Ride car parks to the hospital located on the north-east side of the city. The key driver was the setting up of a Bus Quality Partnership (BQP) that brought together the key stakeholders, Stagecoach bus company, Hampshire County Council (HCC) and Winchester City Council (WCC).

The Implementation – how was the measure implemented?

M3: Innovative aspects:

The use of the BQP to deliver change through combined public and private sector finance was unique to the UK.

M4: Situation before CIVITAS:

Bus passengers already had some real-time passenger information via the STOPWATCH displays at 35 bus shelters, covering most of the main X1, X5 and P&R bus stops. Static trip planners (non real-time) had also been available within the city (see Measure 11.1). All the information sources used for multi-modal traveller information were co-ordinated through the Traffic and Travel Information Centre, previously developed through the earlier ROMANSE project. The P&R service had been operating since 1994 and bus routes X1 and X5 were established city centre routes. Hampshire County Council published a new bus timetable each year as well as monitoring the delivered quality of service. Winchester City Council subsidised the Park and Ride service, with the two P&R car parks offering 360 spaces (165 St Catherine's and 195 at Barfields).

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

M5: Design of the measure:

The design stages were:

1. Physical changes to the area outside the railway station to improve integration for passengers between bus and rail.
2. A bus priority scheme near the railway station to reduce bus journey times.
3. A BQP with Winchester's main bus operator Stagecoach. This agreement required Stagecoach to support and implement all related activities in the MIRACLES project.
4. Seventy-six new bus stop flags and poles (with timetable and route information) on X1 and X5. In addition, new bus shelters at selected stops with high passenger demand. Also, new stop specific information (including maps) installed at every P&R bus stop.
5. Increasing the frequency of X5 from every 15 minutes to every 10 minutes in addition to the introduction of simplified discounted flexible ticketing arrangements for passengers making it easier to use different buses (X1 was reduced in frequency from every 12 minutes to every 15 minutes from October 2003).
6. The purchase and re-branding of 13 new Euro III buses with various logos and information to illustrate their new clean nature as well as their route and regularity (see Figure 1).
7. Pocket travel maps and route specific timetables. The maps detail core urban routes and stops for the passenger and have been distributed free of charge from a range of outlets, including the tourist information centre and the bus and railway stations (see Figure 1).
8. A cross-city route linking the P&R passengers with a large number of employers on the northeast of the city (including the hospital) starting as a 7-month trial.

It was initially planned that this measure would encompass the cleaning up of the Winchester bus fleet through re-powering of engines to a higher Euro emissions standard, but this was undertaken as part of Measure 12.1. In addition, the installation of Bus Display Information Systems (BDIS), electronic information kiosks and Information Display units (IDU) to improve multi-modal traffic information were reported within Measure 11.1.

Figure 1: One of the new buses and a PT plus map

MEASURE-LEVEL RESULTS

Measure title: Improving bus service quality and information	Project: MIRACLES
Measure number: 7 (7.1 & 7.2)	City: Winchester

M6: Actual implementation:

The measure was implemented in 8 stages (some of which ran concurrently or overlapped). These stages were:

Stage 1: Physical improvements to the rail/bus interchange (March 2003)
Stage 2: Implementing bus priority measures near to the interchange (March 2003)
Stage 3: Set up a Bus Quality Partnership (September 2003)
Stage 4: Install new bus stop information and infrastructure (October 2003)
Stage 5: Increased frequency of X5 and new ticketing structure (October 2003)
Stage 6: Purchase/re-branding of 13 new buses (October 2003)
Stage 7: Introduce pocket travel maps and route specific timetables (November 2003 and updated in September 2004)
Stage 8: Set up a cross-city bus route (March 2005)

M7: Deviations from the plan:

None

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

The data came from three sources:

- **HCC cost statements** – these outline the hours worked on MIRACLES split by work package along with any equipment/consumables bought. The figures come from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.
- **Stagecoach bus company** – Stagecoach (the main bus operator in Winchester) have supplied data from their own records on costs, revenues, passenger numbers and age of fleet covering the financial years 2002/3, 2003/4 and 2004/5 for MIRACLES route X1 and X5 and non-MIRACLES routes X6 and X7. Due to commercial sensitivities, costs, revenues and passenger numbers have been represented by percentage changes from the previous year.
- **Bus passenger questionnaire surveys** – three bus passenger questionnaire surveys were carried out. Details of the three surveys are shown below in Table 1.

Table 1: Details of the three bus passenger surveys

	Date of survey	Routes surveyed	Sample size	Purpose
1	9, 10, 12 June 2004	X1, X5, P&R	X1: 426 X5: 490 P&R: 480 Total: 1396	Interim survey of measures implemented so far
2	26, 27 April & 13 May 2005	X1, X5, P&R	X1: 182 X5: 200 P&R:347 Total: 729	Final survey of all measures implemented
3	25 May 2005	P&R extension	P&R ext: 13 Total: 13	Assessment of new route

M9: Achievement of quantifiable targets:

- Patronage increase on the three MIRACLES routes (X1, X5 and P&R) of 5% (from 2001/2 to 2004/5); X5: +19%, X1: -12% and P&R: +34% (car park ticket sales).
- Overall passenger (satisfaction) rating of very good or quite good increased from the interim survey to the final survey by 4% (83% to 87%): X1: +3% (75% to 78%), X5: +6% (81% to 87%) and P&R: 0% (remained at 92%).

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

- Better integration of the public transport services due to physically improving the interchange area outside the railway station with a 97% increase in passengers boarding bus services X1 and X5 from 2002/3 to 2004/5 at this bus stop.

M10: Achievement of evaluation-related milestones:

All the evaluation related milestones (as in the Winchester Annex of D4.1) have been achieved, although some were delayed due to commercial sensitivities of some of the data.

M11: Report on the measure results:

The private bus company Stagecoach operates all the bus services that were assessed. The four routes are described below and shown in Figure 2.

- **Service 1 (X1)**: This commercial service travels from Stanmore (south-west of the city) to Harestock (north-west of the city) via Winchester City Centre.
- **Service 5 (X5)**: This commercial service travels from Winnall (east of the city) to Badger Farm (South of the city) via Winchester City Centre
- **Park and Ride Service (P&R)**: This non-commercial service is subsidised by Winchester City Council. The Park and Ride bus service in Winchester began in 1994 but was subsequently extended with 420 extra spaces being added to St Catherine's car park in February 2004. An extra bus was introduced during the morning and evening peak periods in order to cope with the anticipated extra demand. The service traverses a circular route of the city centre before returning to Barfields and St Catherine's car parks.
- **Park and Ride Extension (P&R ext)** - A fourth bus service, the Park and Ride extension (a non-commercial service subsidised jointly by Winchester City Council and Hampshire County Council) was run as a trial from 7 March 2005 – 30 September 2005. It was to service the various employers on the north-east side of the city, notably the Royal Hampshire County Hospital, Hampshire Constabulary and University College Winchester, which have inadequate parking capacity for their staff on-site. The route is not on Figure 1 but is similar to the P&R except that it takes a more direct route to the city centre before going to the hospital.

In addition, commercial data was provided by Stagecoach from two routes not affected by the MIRACLES project (X6 and X7). This data was compared to the MIRACLES routes X1 and X5 in order to get clearer indications of the effects of the MIRACLES measures and provide a basis for the "Business as Usual" scenario.

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

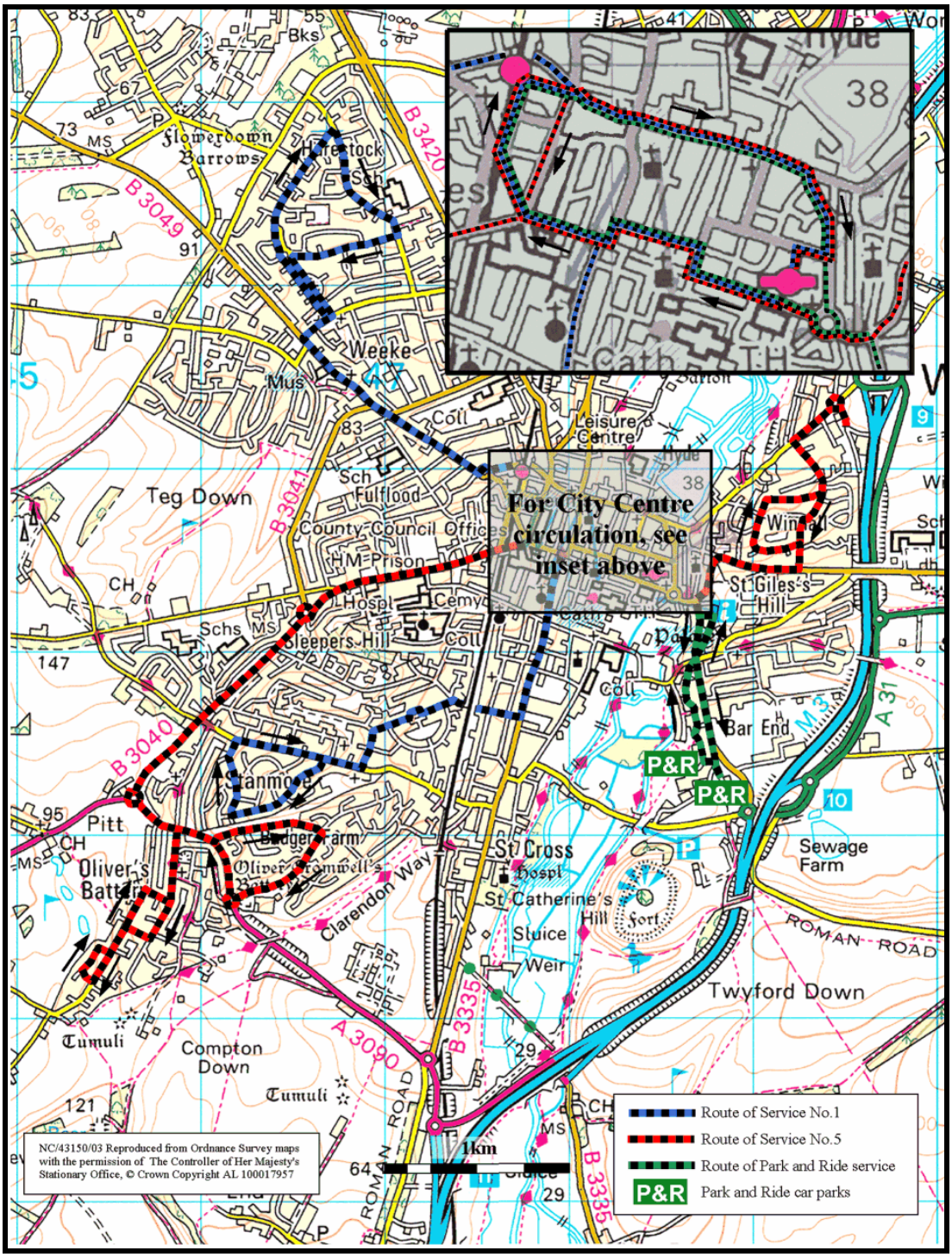


Figure 2: Map showing the X1, X5 and P&R bus routes in Winchester

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

HCC cost data

The data from HCC came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3. Staff hours for Work package 7 for Years 1 – 3 was a total of 1259 hours at a cost of £31,640 with Year 4 estimated at 361 hours at a cost of £13050. In addition, HCC spent about £50,000 on installing the bus stop flags and poles (W7/Econ1a), £20,000 on design and production of timetables/posters at the stops and 20,000 PT+ maps and £100,000 to Stagecoach to subsidise the purchase of new Euro III buses (see Measure 12.1). The company Ad Shell was given free advertising in many of the bus shelters in return for paying for maintenance and power costs (W7/Econ2a and W7.1/Econ3a).

Stagecoach bus company data

Operating revenues and costs

The operating revenues for 4 city centre bus services (X1 and X5 being the MIRACLES routes; X6 and X7 being non-MIRACLES routes) are shown in Figure 3 below. They are expressed as percentage changes (from 2001/2). Fare rises were made in October of each year and were 7%, 3%, 4% and 5% in 2001/2, 2002/3, 2003/4 and 2004/5 respectively.

Figure 3: Annual percentage change in operating revenues

With the exception of X1 and X7 for 2002/3, there were revenue increases for all years and all four routes. Of the two MIRACLES routes (X1 and X5), there were noticeable annual increases in revenues for X5 in 2003/4 and 2004/5 (19.9% and 19.1%, respectively). These years corresponded to the time when the frequency was increased to every 10 minutes and new low-floor, Euro III buses were introduced on the route. Comparing 2001/2 to 2004/5, there was an increase in revenues on all four routes; X1: 11.8%, X5: 46.0%, X6: 19.2% and X7: 8.0% (W7/Econ4a). For the two MIRACLES routes X1 and X5 combined, there was an increase in revenues of 26.6% with the figure for X6 and X7 being 15.8%. This was despite a decrease in patronage (see next section) for X1, X6 and X7, and

MEASURE-LEVEL RESULTS

Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

showed that the fare increases as well as the subsidy from HCC for the new buses (resulting in lower maintenance costs) were responsible for the increases in revenue.

Operating costs for each route were also represented as a percentage change comparing 2004/5 and 2003/4. The values were: X1: +7.2%, X5: +12.4%, X6: +7.8% and X7: +11.5% (W7/Econ5a). Taking into account the changes in patronage (see Figure 3) and route distance (see Table 3), the operating cost per passenger km from 2003/4 to 2004/5 decreased by 1% for X1 and 13% for X5 (W7.2/Econ3a). Labour cost per operating hour increased by 11.5% and 6.8% in 2003/4 and 2004/5 respectively (19.1% from 2002/3 to 2004/5) (W7/Econ2b). Table 3 shows the route mileage for each of the four routes for 2002/3, 2003/4 and 2004/5 and the overall percentage change in labour cost per year. Due to the increased frequency of X5 from every 15 minutes to every 10 minutes, the overall labour costs for X5 saw the largest increase in 2003/4 of 33.4%, associated with a 19.6% rise in route mileage. The decrease in route mileage from 2003/4 to 2004/5 for X1 was due to the reduced frequency of the service from every 12 minutes to every 15 minutes. It is unclear why X7 also had a much higher rise in cost than X1 and X6. The overall changes in labour costs for each route from 2002/3 to 2004/5 were as follows; X1: 0%, X5, 30.5%, X6: -4.9% and X7: -10.0%.

Table 3: Route mileage and overall labour operating costs

				Overall labour cost per year (% change for 2003/4 and 2004/5)	
	2002/3	2003/4	2004/5	2003/4	2004/5
X1	22835	23273	19218	+13.7%	-11.8%
X5	18502	22128	20276	+33.4%	-2.2%
X6	8128	8246	6494	+13.2%	-15.9%
X7	4880	4946	3687	+13.1%	-20.4%

Patronage

Due to the commercial sensitivity of patronage data, passenger numbers were expressed as a percentage change from the previous financial year. Passenger numbers were obtained in 4-weekly intervals from 2001/2 to 2004/5. Figure 3 shows the percentage annual change in passenger numbers for each of the four commercial routes. Ticket sales for the P&R route are given in the next section. The increase of 19.2% for X5 was statistically significant at the 99% confidence level using a paired t-test ($t = 18.49$; $df = 11$). No bar is present in Figure 4 for bus route X6 for 2004/5 as the percentage change in passenger numbers for that year was zero.

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

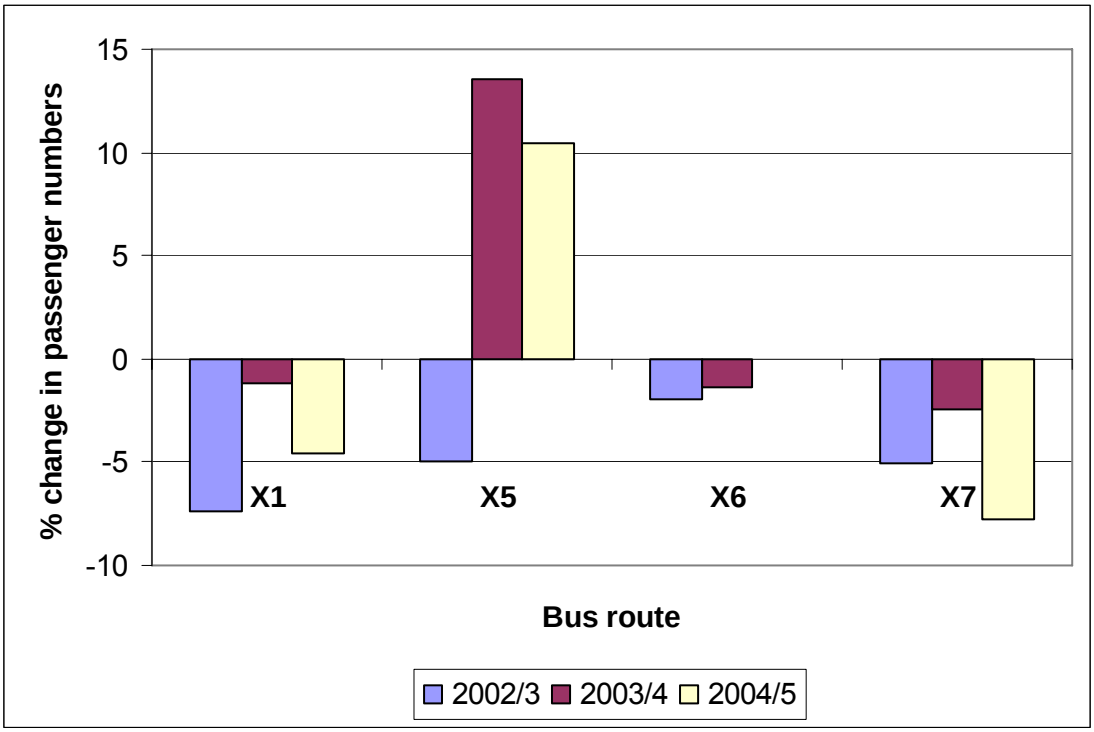


Figure 4: Annual percentage change in passenger numbers

The results for X5 were encouraging, and patronage increased by 13% in 2003/4 and 10% in 2004/5. The two MIRACLES routes X1 and X5 saw a combined increase of 2.0% in patronage over the lifetime of the project. This was due to the fact that the route it served included destinations with high passenger demand such as two major supermarkets, the city centre, the railway station, Winnall Industrial Estate as well as the residential areas of Badger Farm and Oliver's Battery. P&R ticket sales increased by 34% during the lifetime of the project (see Park and Ride service section for more details). Assuming average vehicle occupancy of 1.2 for vehicles in the P&R car parks, there was an overall patronage increase on the three MIRACLES bus routes (X1, X5 and P&R) of about 5% (W7/Tran2a). For the two non-MIRACLES bus routes X6 and X7, the figure was a reduction of 6.4%. There is currently an average 2% decline in bus patronage in Hampshire. However, recent research looking at 11 cities in the UK, which set up a BQP, saw increases in patronage of between 7% and 30% showing that the BQP is important in delivering passenger growth.

A marketing campaign was undertaken to try and attract more passengers by publicising the improvements to the bus services (particularly the introduction of new vehicles through MIRACLES). Altogether, a total of £14,000 was spent on route branding (giving basic route, frequency and fare information on the outside of the vehicle), promotional leaflets, leaflet delivery, free travel on first day of timetable for X5, free travel promotion and discount vouchers contained in the promotional leaflets.

These discounted tickets were popular with passengers as they offered various forms of unlimited travel. They included:

Megarider – 7 days unlimited travel on any Stagecoach bus within Winchester ticket zone
Dayrider - 1 day unlimited travel on any Stagecoach bus within Winchester ticket zone

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

Nightrider - 1 evening unlimited travel on any Stagecoach bus within Winchester ticket zone
Goldrider – 7 days of unlimited travel on any Stagecoach bus in the UK outside London
Day Goldrider - 1 day of unlimited travel on any Stagecoach bus in the UK outside London

Figure 5 shows the number of Megarider, Dayrider, Nightrider, Goldrider and Day Goldrider tickets sold in 2003/4 and 2004/5.

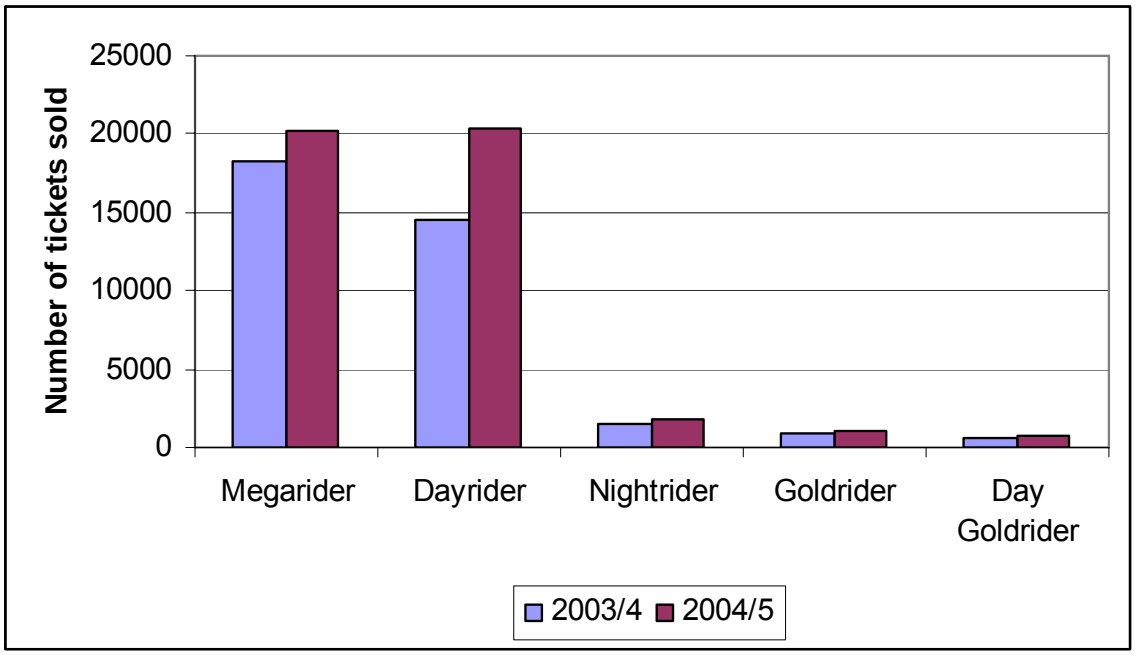


Figure 5: Numbers of discounted tickets sold in 2003/4 and 2004/5

Overall, there was an overall annual increase of 23% in the number of these tickets sold for 2004/5 (W7/Soc1b). This increase is encouraging and shows the increasing popularity of these tickets to the passenger.

The Stagecoach bus company supplied an origin-destination table for bus routes X1 and X5. Stagecoach knew where passengers boarded the bus from on-board ticket sales and estimated where they alighted based on the fare charged. Some inaccuracies may result because some passengers bought discounted flexible tickets and their alighting and subsequent boarding points were unknown. A key contribution to the increase in passenger numbers in X5 was the increase in the number of passengers travelling from the railway station interchange (particularly to the hospital, where the numbers almost trebled) and the hospital (particularly to the railway station interchange which doubled). It was calculated that the railway interchange saw an annual percentage increase in passengers boarding on either X1 or X5 of 66% in 2003/4 and 18% in 2004/5 (with an overall increase of 97% from 2002/3 to 2004/5) (W7/Tran1a). The physical improvements at the railway interchange may have contributed to this increase by providing easier integration between modes and a more attractive infrastructure/area with passenger information available (BDIS) for waiting passengers.

Trips to and from Battery Hill Corner (near Stanmore) also saw noticeable increases. Stanmore is a high-density residential area containing various council estates and tower blocks. Questionnaire results for the Final survey (see bus passenger surveys section) showed that 48% of passengers for

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

X5 had no car (an increase of 10% from the interim survey). Passengers from these estates would have contributed to this increase, as they had no real alternative to the bus.

Predicted emissions

An estimate of the reduction in emissions per passenger was calculated for X1 and X5 'before' and 'after' the new Euro III buses replaced the older Euro I vehicles. Table 4 below shows the emission factors for Euro I and Euro III vehicles (from 2002 version of the Stanger Emission Factor Toolkit).

.

Table 4: Emission factors for Euro 1 and Euro III buses (g/km) in urban areas

	NOx	PM10	CO	HC
Euro I	10.77	0.515	2.73	1.392
Euro III	6.67	0.213	1.57	0.709

Route mileage for X1 decreased by 16% between 2002/3 and 2004/5, whereas for X5 it increased by nearly 10% due to the increased frequency of the service. Passenger numbers had decreased by 12% for X1 and had increased by 19% for X5. As a result, the reductions in NOx, PM10, CO and HC per passenger for X1 was 42%, 61%, 46% and 52% respectively; for X5 it was 43%, 62%, 47% and 53% respectively (W7/Env1a). As there are no emission factors available for Euro II with traps, no 'before' and 'after' comparison of the P&R route could be made. The increase in route mileage for X5 was compensated in the emission calculations by the increase in passenger numbers over the lifetime of MIRACLES.

Park and Ride service

Winchester City Council paid Stagecoach bus company to run the Park and Ride service (see Table 5), one of the bus services covered by the BQP. There was a large increase in the costs in October 1999 when the contract was last re-tendered and new, high quality buses were specified.

Table 5: Amount paid to Stagecoach for running the P&R service during MIRACLES

	Amount	Comments
2002	£211,476	3 buses operating Mon to Fri peaks, 2 buses off peak, 3 buses Saturday
2003	£246,236	3 buses operating Mon to Fri peaks, 2 buses off peak, 3 buses Saturday
2004	£289,000	4 buses operating Mon to Fri peaks, 2 buses Mon to Fri off peak

Winchester City Council also supplied data on the number of Park and Ride car park tickets sold per month since April 1997, and this was split by car park (Barfields and St Catherine's). The daily rate has been £1.50 per vehicle since 1st June 1998. A pre-paid card costs £1.20. Ticket totals up to March 2003 included pre-paid cards whereas from April 2003, the ticket sales were split between cash and card sales.

Figure 6 shows the ticket sales (split by car park) from April 2002 to April 2005. It is worth noting that following the extension to St Catherine's car park in February 2004 from a capacity of 165 to 585 spaces, there was a noticeable percentage annual increase of 70% in ticket sales at this car park (from 53,593 in 2001/2 to 91,141 in 2004/5) compared to a 1% reduction at the Barfields car park. Overall, there was a 34% increase in P&R ticket sales over the lifetime of the project, which was statistically significant at the 99% confidence level using a paired t-test ($t = 10.43$; $df = 11$). It was thought that the success of the scheme was due largely to the extension of St Catherine's car park (not specifically a MIRACLES measure) as well as the low car park ticket charge (£1.50/day) compared to alternative city centre car parks (minimum of £2.80/day from June 2002 and £3.50/day from April 2005).

MEASURE-LEVEL RESULTS

Measure title: Improving bus service quality and information	Project: MIRACLES
Measure number: 7 (7.1 & 7.2)	City: Winchester

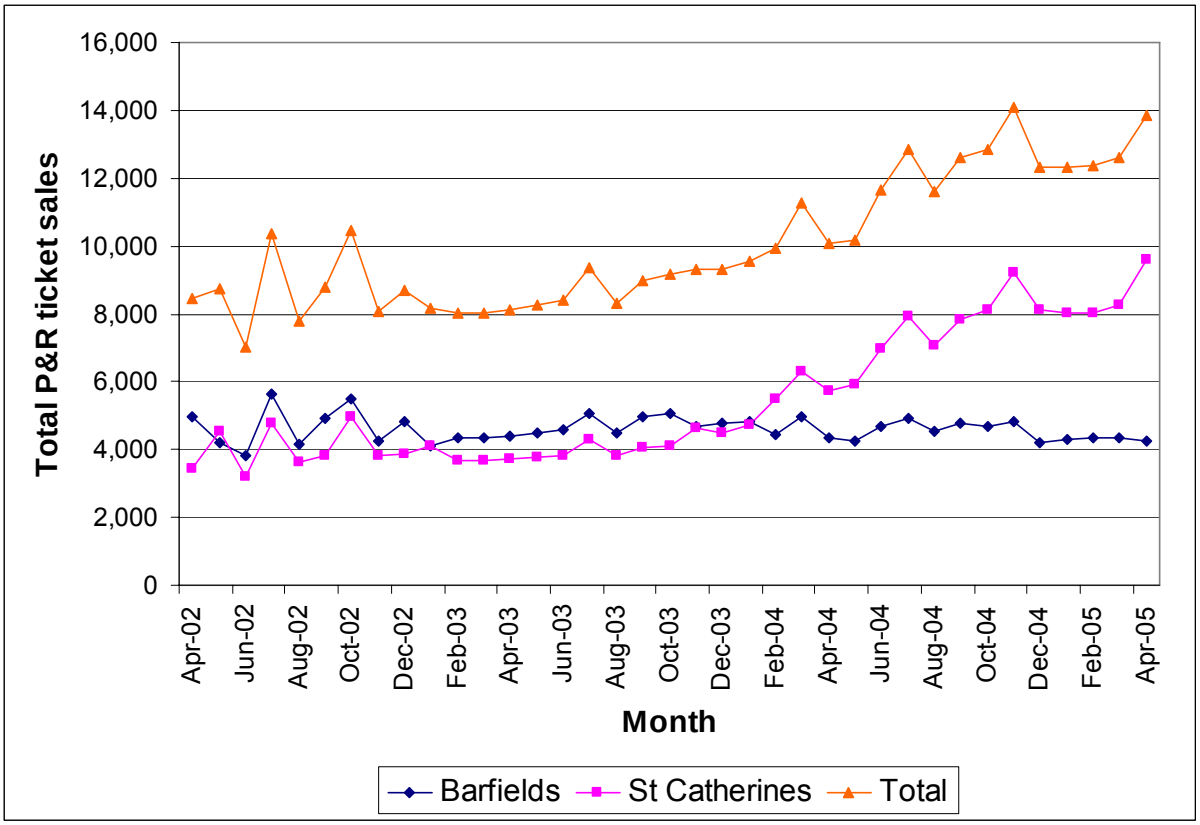


Figure 6: Monthly tickets sales for the Park and Ride car parks in Winchester

Income from ticket sales was calculated for each year since 2002/3 and compared with the amount of money Stagecoach bus company were given by Winchester City Council to subsidise the P&R service (see Tables 4 & 5). For the service to break even in 2004/5, it was estimated that 20,000 tickets a month needed to be sold. However, these figures did not include the capital costs of setting up, running and maintaining the scheme (£938,000 in 1994 to set up the scheme and £3,850,000 to extend it in 2003/4). The shortfall in income is cross-subsidised from city-centre parking charges. Of the 44 towns or cities in the UK that run a P&R scheme, 61% require revenue support from the local authority which shows that cross-subsidy is often necessary for a successful scheme. The cross-subsidy shown in Table 6 was seen as worthwhile as it helped Winchester City Council achieve its aims of reducing the impact of traffic on the environment as well as reducing air pollution and noise in the city centre.

Table 6: Subsidy from Winchester City Council to run the P&R service

	Total ticket sales	Income (card)	Income (cash)	Total income	Subsidy
2002/2003	102,590	27,699.30	123,108.00	150,807.30	60,668.70
2003/2004	110,014	53,187.60	98,536.50	151,724.10	94,511.90
2004/2005	145,484	77,673.60	121,134.00	198,807.60	90,192.40

At the present rate of increase, St Catherine's car park will reach capacity by the end of November 2005. Daily ticket sales at St Catherine's car park reveal that there are daily fluctuations (Monday and

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

Friday having the lowest numbers of tickets sold) resulting in some spare capacity on these days.

Park and Ride extension

Stagecoach bus company was paid £55,000 (£30,000 from Winchester City Council and £25,000 from Hampshire County Council) to run the Park and Ride extension to the northeast area of the city for a 7-month trial period. Its purpose was to provide hospital staff with an alternative mode of travel to work on the one day of the week they were not allowed to park on site. A patronage survey carried out from Monday 18th April to Friday 29th April 2005 showed that average passenger numbers were very low (averaging a total of 16 passengers for the 6 AM services and 19 passengers for the 6 PM services). It was estimated that for the trial (150 operating days), there was a maximum of around 5,250 passengers, which provided an income of £7,875. The service made an estimated loss of £47,125 and was not relaunched after the end of the trial period.

A bus passenger survey was carried out on 25th May 2005 with 13 passengers (11 female, 2 male) completing a questionnaire. All passengers rated the service either very good or quite good with location of the bus stops the most important factor, particularly the stop at the hospital. Of the 13 passengers, 6 worked flexitime and 4 worked shifts. Only 2 of the passengers (15%) had heard of MIRACLES.

The reason for the low passenger numbers may be due to the hospital not properly enforcing their 4-day a week parking policy for staff. Even if it was enforced, there was a large number of staff exemptions in addition to the low daily parking charges (£0.50 for exempt staff and £1.00 for staff not exempt), which were lower than the P&R charge of £1.50 per day. It may be the case that female staff travelling back late at night would prefer to travel home in their own car for reasons of safety and convenience even if the service was still operating at that time.

Bus fleet

During MIRACLES, the Winchester bus fleet changed both in terms of average age and environmental emissions rating. There were 59 buses in operation in Dec 2002 and 2003, and 56 in Dec 2004. The fitting of cleaner engine technology to the majority of the existing Stagecoach's Winchester bus fleet included the introduction of 13 new buses (plus one spare) on X1 and X5 fitted to Euro III emissions standard (Euro standards are discussed in more detail in Measure 12.1).

The age of each bus in the fleet for 2002, 2003 and 2004 is shown in a histogram in Figure 7. Overall, the average age of the bus fleet reduced from 7.27 years in 2002 to 6.71 years in 2004, although it increased to 7.63 years in 2003. In addition, the number of buses less than 2 years old increased from 4 vehicles in 2002 to 13 vehicles in 2004, and those less than 4 years old increased from 11 to 17 vehicles. Normally, Stagecoach would keep double-deckers for 16 years, single-deckers for 12 years and mini-buses for 10 years. The introduction of the newer cleaner buses with low floors (as well as a newer fleet in general) was a positive influence in attracting new passengers to the service from the bus questionnaire survey (see bus passenger questionnaire section) and therefore helped to increase both patronage and the satisfaction rating of the service. As a result of the new buses being introduced, maintenance costs (servicing the vehicle each month) reduced by about 60% (W7.1/Econ3a).

MEASURE-LEVEL RESULTS

Measure title: Improving bus service quality and information	Project: MIRACLES
Measure number: 7 (7.1 & 7.2)	City: Winchester

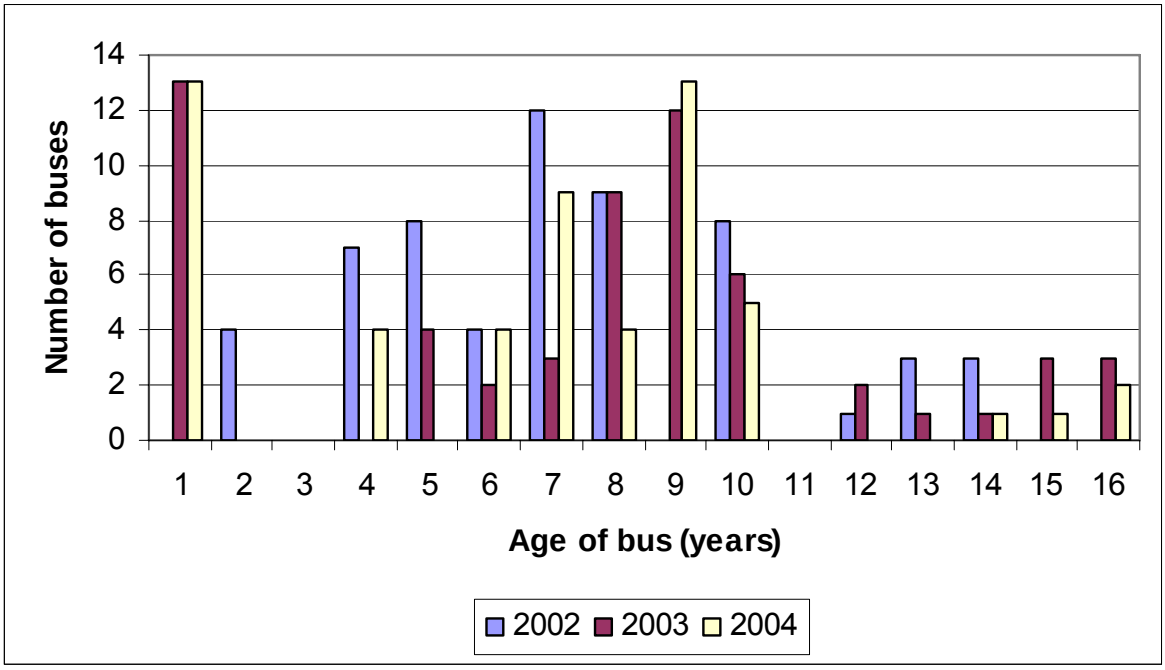


Figure 7: Age of the bus fleet in Winchester

Within the MIRACLES project, 10 buses operating on routes passing through the city centre (e.g. X4 and X6) were re-powered from pre-Euro or Euro I to Euro III standards. The introduction of new buses and cleaner buses had an effect on the emissions ratings of the bus fleet in general, and on X1 and X5 in particular. Before MIRACLES, X1 used Euro II vehicles and X5 used Euro I vehicles. Both services now use new Euro III vehicles. The clean-up program reduced the emissions of 27 buses in the Winchester fleet (see Measure 12.1).

Lost miles

Stagecoach recorded the number of "lost miles", which included external reasons (such as weather, diversion, accident, incident/delay and other) and internal reasons (such as no driver, no vehicle, breakdown, congestion or other). Of all miles lost, almost all were for internal reasons (99.2%, 93.8% and 94.0% for 2002/3, 2003/4 and 2004/5 respectively). This was mainly due to congestion, breakdown or having no driver. The total number of buses in the Winchester fleet that were classified as failures reduced from 2030 in 2002/3 to 705 in 2004/5, as shown in Table 7. The number of buses that ran early (more than 1 minute early) or late (more than 5 minutes late) for the whole of the bus fleet in Winchester during 2002-2005 is also shown.

Table 7: Numbers of buses in the Winchester fleet running early or late

	Scheduled trips	Number of early running	Number of late running	Total number of failures
2002/3	213956	127	1612	2030 (0.95%)
2003/4	221866	103	408	566 (0.26%)
2004/5	204910	36	512	705 (0.34%)

The number of late running buses for each week in 2002/3, 2003/4 and 2004/5 is shown in Figure 8. It shows that in 2002/3 the value was particularly high during weeks 28 and 32 (July/August 2002). This

was due to congested conditions because of extensive road works in the city centre area. If this data was removed, the percentage of failures (buses not running to schedule) was 0.68%, still noticeably higher than the two subsequent years. The data provided covered the whole Winchester bus fleet and it was not possible to distinguish between specific bus routes. However, it highlights the problem of how congestion in the city centre can adversely affect the punctuality and frequency of the bus service, minimising the positive effects of the improvements made.

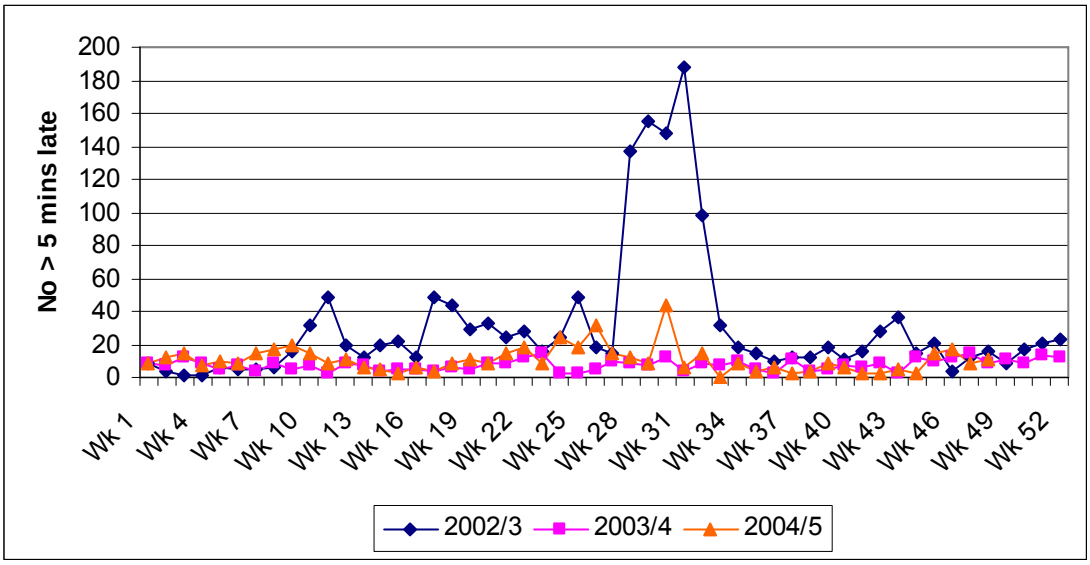


Figure 8: The number of buses in the Winchester fleet running late

Bus stop information from HCC

As part of the BQP, HCC had responsibility for installing bus poles and Stagecoach was responsible for providing most of the timetable casing. The improvements to the bus stop infrastructure were implemented to enhance the user-friendliness of the service. The percentage of bus stops on routes X1, X5 and P&R with poles, shelters, route information and raised kerbs are given in Tables 8 and 9 (W7/Tran3a, 3b & 3c). The results show that there was a general improvement in the bus stop infrastructure with a significant increase in the number of stops for X1 and X5 having poles. The P&R stop infrastructure was already in place before MIRACLES.

Table 8: Bus stop information on X1 and X5 before MIRACLES

	Shelters	Poles	Shelters with poles	Poles only	Route information	Raised kerbs
X1	36/57 (63%)	16/57 (28%)	4/57 (7%)	12/57 (21%)	52/57 (91%)	14/57 (25%)
X5	34/45 (76%)	8/45 (18%)	1/45 (2%)	7/45 (16%)	42/45 (93%)	14/45 (31%)
P&R	15/15 (100%)	15/15 (100%)	15/15 (100%)	15/15 (100%)	15/15 (100%)	15/15 (100%)

MEASURE-LEVEL RESULTS

Measure title: Improving bus service quality and information	Project: MIRACLES
Measure number: 7 (7.1 & 7.2)	City: Winchester

Table 9: Bus stop information on 1 and 5 after MIRACLES

	Shelters	Poles	Shelters and poles	Poles only	Route information	Raised kerbs
X1	41/57 (72%)	57/57 (100%)	27/57 (47%)	16/57 (28%)	57/57 (100%)	14/57 (25%)
X5	34/45 (76%)	41/45 (91%)	22/45 (49%)	10/45 (22%)	42/45 (93%)	14/45 (31%)
P&R	15/15 (100%)	15/15 (100%)	15/15 (100%)	15/15 (100%)	15/15 (100%)	15/15 (100%)

Bus passenger surveys for X1, X5 and P&R

The effectiveness of the various bus measures was evaluated by undertaking two bus passenger questionnaire surveys; an interim and a final survey (no 'before' survey was carried out).

A wide range of questions included age, sex, number of cars owned in their family, trip purpose, awareness of MIRACLES and questions regarding the respondents impressions of various aspects of the bus service such as bus shelters, frequency of service and ticketing arrangements. The questionnaires were handed out to passengers travelling on the bus. The survey focused on the three city centre bus routes (X1, X5 and P&R), where the changes from the MIRACLES project were hoped to have an effect in improving the service. The main results from the surveys were split by bus route in order for a comparison of the different bus services to be made. A positive satisfaction rating was defined to be either a "very good" or "quite good" for the overall rating the passenger gave the service.

The bus passenger surveys (Interim and Final)

The results have been divided into four sections:

- The bus passenger and his/her journey (Table 10)
- The bus passenger's change in bus usage (Table 11)
- Positive influences affecting the change in bus usage (Table 12)
- The bus passenger's rating of the service (Table 13 and Figure 9)

Information about the sample of passengers and the journeys they made is provided in Table 10. The majority of the passengers that participated in the survey were female. The P&R service had more working age people than the other services (χ^2 = 60.1 (Interim) and χ^2 = 68.5 (Final) where $\chi^2_{(0.01)}$ (3 df) = 11.34) as well as more people having at least 2 cars (χ^2 = 338.6 (Interim) and χ^2 = 228.6 (Final) where $\chi^2_{(0.01)}$ (3 df) = 11.34). Most passengers using the P&R service started their journey from home and were travelling to work (χ^2 = 63.5 (Interim) and χ^2 = 120.5 (Final) where $\chi^2_{(0.01)}$ (2 df) =9.21). Trip distances were shorter for P&R journeys given the nature of this circular city centre route.

Awareness of MIRACLES was low for passengers on all three bus services, although it had increased noticeably from the interim survey to the final survey on X1 and P&R. Considering all bus routes, the awareness increased from 10% in the Interim survey to 25% in the Final survey. This was a big increase on a previous MIRACLES travel survey showing an awareness of only 5% in July 2003. The higher figure for the P&R passengers (35%) may be due to a number of factors including the re-branding of the buses and the new shelters with the MIRACLES logo on them. X1 and X5 had a higher proportion of younger and older passengers using the service, particularly for shopping and social/leisure activities (about 40% and 15% respectively). About 40% of respondents on these two services had no car and therefore may well have had no alternative to the bus. This compares with

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

only 4% using the P&R service.

Table 10: The bus passenger and his/her journey (Interim, Final)

	X1	X5	Park & Ride
Sex	Male : 31%, 30% Female: 69%, 70%	Male : 31%, 25% Female: 69%, 75%	Male : 38%, 28% Female: 62%, 72%
Age	15–19: 12%, 8% 20 – 64: 63%, 72% Over 65: 25%, 20%	15 – 19: 11%, 16% 20 – 64: 71%, 64% Over 65: 18%, 20%	15 – 19: 5%, 1% 20 – 64: 85%, 91% Over 65: 10%, 8%
Number of cars	None: 48%, 42% One: 33%, 37% Two: 17%, 18% Over two: 2%, 3%	None: 38%, 48% One: 40%, 35% Two: 19%, 14% Over two: 3%, 3%	None: 4%, 3% One: 30%, 31% Two: 50%, 47% Over two: 16%, 19%
Main trip purposes	To/from work 39%, 32% Shopping: 40%, 41% Social/leisure: 14%, 16%	To/from work 41%, 33% Shopping: 38%, 34% Social/leisure: 15%, 14%	To/from work 59%, 69% Shopping: 21%, 12% Social/leisure: 11%, 10%
Mean trip distance (km)	4.9, 5.2	4.8, 4.7	2.3, 2.5
Awareness of MIRACLES	5%, 20%	9%, 13%	17%, 35%

Table 11 shows how the frequency of passenger bus use changed as a result of the changes made to the services. About a quarter of passengers used the service more since the changes were introduced. The P&R service saw a noticeable increase in the number of new users (19% compared to about 6% for X1 and X5), with the increase for X5 in part due to its increased frequency. It is unclear what proportion of these new passengers recently moved into the area (to live or work), but the increase was still encouraging.

Table 11: Changes in passenger bus use (W7/Eng1a)

	X1	X5	Park & Ride
Bus use same	309 (75%) 128 (70%)	322 (68%), 122 (61%)	302 (69%), 140 (46%)
New passengers	25 (6%), 15 (8%)	32 (7%), 26 (12%)	82 (19%), 123 (41%)
More frequent passengers	49 (12%), 18 (10%)	75 (16%), 36 (19%)	24 (5%), 29 (10%)
Less frequent passengers	30 (7%), 21 (12%)	45 (9%), 17 (8%)	29 (7%), 9 (3%)

The positive influences that contributed in encouraging these new or more frequent passengers are indicated in Table 12 (W7/Tran2b). The three most positive influences were comfort of travel on the bus, frequency of service and bus traveller information. Comfort was the top positive influence for new or more frequent X1 and X5 passengers with frequency of service being top for similar P&R passengers.

The PT+ pocket travel map and the Bus Display Information Signs (BDIS) had a low positive influence on passengers, probably due to the fact that they were much less noticeable and had little impact on their journey. The physical changes at the railway interchange had a low positive influence on the P&R (9%) and X1 (20%) but a much higher influence for X5 (35%). An increase in trips to and from the railway interchange contributed noticeably to the rise in patronage this service. The overall rating and awareness of MIRACLES for new or more frequent passengers were generally higher than the overall

average for all passengers. In addition, more frequent passengers tended to be much more aware of the potential positive influences such as the newer cleaner buses than the new passengers. More frequent users of the P&R service were much more aware of MIRACLES than any other group of passengers (46%), showing that the re-branding of the buses along with the new shelters had some impact in raising the profile of MIRACLES.

Table 12: Positive influences (%) for new and more frequent passengers (Final survey)

	X1		X5		Park & Ride	
	New users	More frequent users	New users	More frequent users	New users	More frequent users
Appearance of bus shelters	29%	44%	35%	44%	26%	35%
Bus traveller information at bus stops	21%	68%	38%	68%	34%	44%
Overall bus traveller information across Winchester	36%	48%	23%	48%	28%	20%
Rail Station Interchange (including change in routes)	7%	36%	15%	36%	4%	4%
Frequency of bus service	36%	79%	46%	79%	49%	46%
BDIS	21%	38%	26%	38%	19%	29%
Environmentally cleaner buses	29%	58%	27%	58%	39%	42%
Comfort of travel on (new) buses	43%	82%	39%	82%	47%	58%
PT+ pocket travel map	21%	18%	9%	18%	5%	4%
Overall rating of very good or quite good	80%	91%	92%	91%	94%	89%
Awareness of MIRACLES	29%	14%	13%	14%	39%	46%

Bus passenger ratings of the three different bus services, including results from the “any other comments” question are shown in Table 13. (About 40% of passengers had a relevant positive comment, negative comment and/or suggestion to make in both surveys). The negative comments may be applicable to Stagecoach (e.g. punctuality/frequency of services, drivers and fare structure), HCC (e.g. location and condition of bus shelters/poles) or WCC (e.g. location and condition of P&R shelters and operating condition of ticket machines).

Of the relevant ‘other comments’, for the X5 service only, bus passengers noticed improvements to the service (W7/Soc2a). This may be due to the fact that this service had the most noticeable change, with its frequency being increased from every 15 minutes to every 10 minutes. Changes to the X1 and P&R services may have been less noticeable in comparison. The P&R service received the highest percentage of positive comments (36% overall) mainly in respect to its punctuality, frequency and cost. It also had the best rating overall, particularly in relation to the appearance and passenger information provided at the new bus shelters as well as the comfort and frequency of the service.

Overall, the most common positive comments were made about the driver (30%) who was often described as being friendly and helpful particularly on the P&R service. This was followed by

comments about the cost/ticketing and route/frequency (both 21%), facilities/information (17%), punctuality/cancellation (9%) and cleanness of bus (2%). The main negative comment was the lack of punctuality or cancellation of services (38%) followed by rude or fast bus drivers (24%), poor facilities/information (17%), poor bus route/frequency (12%), expensive fares/poor ticketing arrangements (8%) and cleanness of bus (1%). Over half of the suggestions involved recommending new/modified bus routes and their frequency (52%). This was followed by improvements to facilities/information and fares/ticketing arrangements (both 14%).

Table 13: Bus passenger's rating of the service

	X1	X5	Park & Ride
Noticed improvements	32%, 25%	56%, 46%	36%, 33%
Positive comments	14%, 13%	24%, 23%	43%, 28%
Negative comments	67%, 70%	59%, 39%	39%, 42%
Mean overall rating* (standard deviation)	2.17 (0.79) 2.18 (0.80)	2.03 (0.76) 1.96 (0.65)	1.70 (0.65) 1.71 (0.66)
Overall rating of very good or quite good	75%, 78%	81%, 87%	92%, 92%

* 1- Very good, 2 – quite good, 3 – Neither good nor poor, 4 – Quite poor, 5 – Very poor

The most highly rated service was the P&R with a score of about 1.70, with the appearance of bus shelters, convenience, cost and frequency being most important. X5 has the second best rating (of about 2.00) with location of bus stop, frequency and bus journey times being the most important aspects. X1 had the lowest rating, but still with a reasonable score of about 2.17. Location of bus stop, comfort and convenience were rated the most important aspects for this service. It is of interest that cost of bus fares was only rated in the top most important aspects of the P&R service. Bus fares are important but not necessarily rated as the most important aspect by passengers. However, the use of a flat fee car park charge for all occupants of a vehicle at the P&R car parks (presently a very low £1.50) is an attractive option to existing and potential P&R users, as well as encouraging higher occupancies in the vehicles parked. The overall rating of very good or quite good for all routes increased from 83% to 87% (up 4%) (W7/Soc1a).

A plot of the 99% confidence interval for the mean of the overall rating of each of the three bus services for the interim and final surveys is shown in Figure 9. There was no significant difference between the means for each route between the two surveys. However, there was a significant difference (at the 99% level) in the mean for each of the three routes when compared with each other for each survey. The P&R had the best rating with a confidence interval which was non-overlapping the other two routes (1 is the best score and represents "very good"; 2 and 3 represent "quite good" and "neither good nor poor" respectively). The confidence intervals for the Final survey are larger than for the Interim survey for each route mainly due to the smaller sample size.

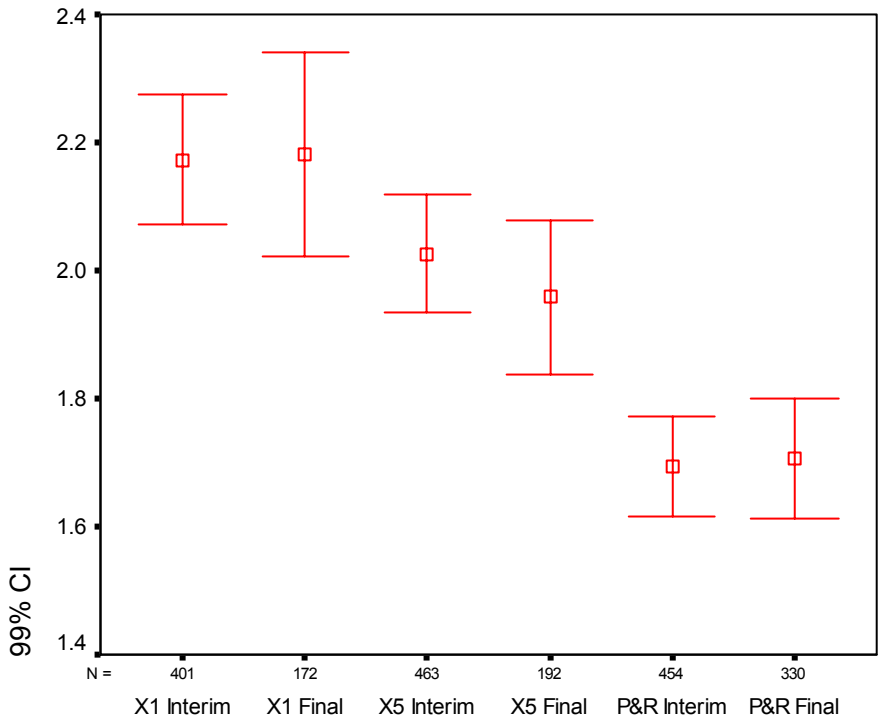


Figure 9: 99% Confidence interval of the mean overall rating for each bus route

MEASURE-LEVEL RESULTS

Measure title: Improving bus service quality and information	Project: MIRACLES
Measure number: 7 (7.1 & 7.2)	City: Winchester

A summary of the relevant indicators is shown in Table 13.

Table 13: Summary of measure indicators for W7

Indicator no. (Meteor no.)	Indicator name	Baseline 2002	Business as Usual 2005	MIRACLES 2005
W7/Econ1a.	Cost of bus poles/flags etc	N/a	N/a	£50,000
W7/Econ2a	Power costs	None	None	None
W7/Econ2b	Labour costs for bus driver	Base (2002/3)	+19.1%	+19.1%
W7.1/Econ3a*	Maintenance costs	Base (2002/3)	No data available	-60%
W7.2/Econ3a*	Operating cost per passenger	Base (2003/4)	No data available	-13% to -1%
W7/Econ4a (1)	Operating revenues	Base (2001/2)	8% – 19%	12% - 46%
W7/Econ5a (2)	Operating costs	Base (2003/4)	8% – 12%	7% - 12%
W7/Engy1a (3)	Passenger modal switch	Interim: 6% – 19%	No data available	Final: 6% - 41%
W7/Env1a (8-11)	Emissions (NOx, PM10, CO)	Base (2002/3)	No data available	X1: -42%, - 61%, -46%, -52% X5: -43%, - 62%, -47%, -53%
W7/Soc1a (14)	Rating of service (good/very good)	No data available	No data available	Interim: 83% Final: 87%
W7/Soc1b	Number of discounted tickets	Base (2003/4)	No data available	+23%
W7/Soc2a (13)	Correct awareness of improvements (X1, X5, P&R)	Interim: 32%, 56%, 36%:	N/a	Final: 25%, 46%, 33%
W7/Soc3a	Operator confidence in technical parameters	N/a	N/a	See M14
W7/Tran1a	Patronage alighting or boarding at interchange	Base (2002/3)	N/a	+97%
W7/Tran2a	Patronage of new improved routes	Base (2001/2)	-6% to -2%	+6%
W7/Tran2b	Reason for new patronage	See text before Table 11	See text before Table 11	See Table 11
W7/Tran3a	% bus stops with shelters & poles	See Table 8	No data available	See Table 9
W7/Tran3b	% bus stops with route information	See Table 8	No data available	See Table 9
W7/Tran3c	% bus stops with accessible kerbs	See Table 8	No data available	See Table 9

* With the exception of these two indicators, all other indicators for W7.1 and W7.2 were the same and have therefore been combined into one indicator.

MEASURE-LEVEL RESULTS

Measure title: Improving bus service quality and information	Project: MIRACLES
Measure number: 7 (7.1 & 7.2)	City: Winchester

The measure will continue beyond the lifetime of the MIRACLES project.

Up-scaling

No up-scaling of these results was carried out because X5 was considered to be the only city centre route in Winchester that would see passenger growth if improvements were made.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

The Bus Quality Partnership was a major driver in improving the MIRACLES bus services in Winchester. Hampshire County Council invested resources in improving the infrastructure at bus stops; Stagecoach introduced new buses, a marketing campaign and new discounted tickets; Winchester City Council sought to improve the P&R service by extending St Catherine's Car Park and seeking to introduce cleaner buses to the route by allowing bidders to submit bids for hybrid/electric vehicles. The capacity of the P&R car parks is a barrier to enable more people to use the service. Following the significant increases in ticket sales at St Catherine's car park in 2004/5, it was expected that it would be at capacity again by the end of 2005. WCC have plans to build two new P&R car parks which will increase capacity. The location of both existing P&R car parks to the south of the city was a barrier to car drivers coming from Newbury, Andover and Stockbridge (located to the north of the city). WCC plan to build one of the new P&R car parks on the north side of the city (Andover Road) which would attract more of these drivers. The parking policy/charges at the hospital were a barrier to the success of the P&R extension service. Congestion in the city centre was a barrier to delivering a more frequent X5 bus service.

M13: Interrelationships with other measures

This measure had close links with Measures 12.1: Cleaner vehicle buses and 11.1: Improved multi-modal traveller information as described above.

M14: Lessons learned

1. Of the four commercial bus routes (X1, X5, X6 and X7), only X5 saw an increase in passenger numbers. The unique factor for this was thought to be that it was a route with potential for passenger growth since it serves destinations with high passenger demand such as two major supermarkets, the city centre, the railway station, Winnall Industrial Estate as well as the residential areas (some high density council estates) of Badger Farm, Oliver's Battery and Stanmore.

2. An important improvement used on X5 to capitalise on this potential was to increase the frequency of the service to every 10 minutes. This increased frequency was unique to X5. In contrast, the reduction in frequency of X1 from every 12 minutes to every 15 minutes may have contributed to the decrease in passenger numbers for this service.

3. Previous research has shown that passenger growth is linked to the extent of the BQP (LEK/ Commission for Integrated Transport 2002). The expected rises in passenger numbers are on average 5% (-25% - 10%) for minimal infrastructure improvements, 15% (5% - 50%) for a comprehensive route upgrade and 30% (20% - 45%) for high quality schemes (e.g. including guided bus ways). The bus routes in Winchester could be classified as follows: X1 a minimal improvement (-12%), X5 a comprehensive upgrade (+19%) and the P&R with the extension to the car park was a high quality scheme (+34%).

4. Similar research (LEK/ Commission for Integrated Transport 2002) shows that passenger numbers take up to 2 years to peak after implementation of improvements, giving time for passengers to change their existing travel behaviour. After the two years, patronage can either level off or decline if further improvements are not made. It is important that Stagecoach bus company (along with their partners in the Winchester BQP) 'refresh the quality bus product' in order to meet rising passenger expectations and subsequent rises in passenger numbers.

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

5. Congestion in the city centre meant that the improvement to X5 in terms of increased frequency would not necessarily be matched by improved punctuality, particularly in peak periods (mentioned by several passengers in the bus questionnaires). The bus priority measures near the station may have been helpful but more extensive measures may be necessary (such as bus lanes) for the improvements to be fully effective.

6. Passengers stated that comfort (along with frequency) was one of the most important positive influences in using the service (either for the first time or more frequently in the future). Therefore the introduction of cleaner, newer and more comfortable buses contributed to the success of X5. Without the subsidy from HCC, it is doubtful whether Stagecoach would have purchased new buses.

7. An effective marketing campaign was helpful in promoting and raising awareness of the new service.

8. Although cost of fares is not the most important factor to passengers, the introduction of a range of flexible, discounted tickets was seen to be very popular with passengers

9. Without the potential for passenger growth (as seen to be the case on X1), improvements made to a particular bus route will at best only have a marginal effect on passenger numbers. With an average national decline of 2% per year in patronage in the UK, improvements to a route may still result in a fall in passenger numbers.

10. Improvements that are made need to have a positive impact on the passenger's journey. The introduction of a new map and physical changes to the interchange can be seen by passengers to be more cosmetic, and therefore not so cost effective.

11. The extension to the St Catherine's P&R car park, which increased its capacity, made a noticeable contribution to the increase in patronage on the P&R service.

12. The success of the P&R service has been due to the significant price difference in the cost of using the service compared to the comparable cost of parking at a city centre car park (£1.50/day compared to a minimum of £2.80 from June 2002 and £3.50/day from April 2005). The failure of the new cross-city P&R service to the hospital was due largely to the significant price difference in the cost of service compared to the comparable cost of parking at the hospital.

13. A successful P&R scheme will often require a subsidy. The level of that subsidy could however be reduced by raising the current low P&R charge whilst keeping the city centre parking significantly higher which may have political implications.

14. A detailed survey of passenger demand and relevant parking policies is necessary to see whether a new service (such as the cross city P&R) has a viable passenger base, before a financial commitment is made.

15. Clarity with regards to the parking policy (charging structure and enforcement) at the hospital and other employers in the area was another critical factor in deciding whether the cross-city P&R scheme was viable and would be a success. Enforcement and financial incentives for staff that use the service were necessary for the route to be successful.

16. From an evaluation point of view, the implementation of a large number of mini-measures simultaneously meant that it was difficult to determine which of the measures had the most significant effect. Implementing the measures individually with a time gap in between may have helped to clarify which mini-measures had a significant effect on passenger numbers.

17. As a result of the improvements, Winchester now has a newer, more environmentally friendly, comfortable fleet of buses with a high passenger rating. In particular, it now has a very frequent service running to and from the major origin-destinations around the city as well as a very successful P&R scheme that is reaching capacity. As mentioned in point 4, these improvements must be built

MEASURE-LEVEL RESULTS	
Measure title: Improving bus service quality and information	**Project: MIRACLES**
Measure number: 7 (7.1 & 7.2)	**City: Winchester**

upon in order for passenger numbers to continue to rise.

Contact Point

💻.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

5. Measure 8.2

MEASURE-LEVEL RESULTS	
Measure title: New cycling opportunities	**Project: MIRACLES**
Measure number: 8.2	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

This measure aimed to increase the level of cycling in Winchester in terms of modal spit and number of journeys being made. It was hoped that there would be an increase in both the levels of awareness and acceptance of cycling as a sustainable transport mode.

The specific objectives were to:

- Contribute to the national goal of quadrupling cycling by 2012 (compared to 1996 base)
- Stimulate the use of sustainable transport for tourists and residents;

M2: Measure description:

Three improvements were made to the existing cycling facilities. These were:

- **Bikeabout**: The major initiative within measure 8.2 was the introduction of the MIRACLES Bikeabout scheme, specifically developed for the Winchester environment and provided members of the public with easy access to bicycles.
- **Installation of new cycle parking**: 75 additional cycle stands were made available for installation by Winchester City Council upon request.
- **A revised Pocket Cycle Map:** This map was re-designed to provide cyclists with an up-to-date map of Winchester's safe and suggested cycle routes, useful contact information, the location of Bikeabout and citywide cycle parking. 9,000 maps were printed and distributed to various Information centres, outlets, meetings and seminars as well as Bike Week and the Alternative Transport Day (see Measure 10).

The Implementation – how was the measure implemented?

M3: Innovative aspects:

Bikeabout was the first scheme of its type to be implemented in Winchester. Previously a Hampshire County Council Bikeabout scheme was operated at Portsmouth University as part of the ENTRANCE project (1995-97). The Portsmouth scheme was operated for the University Staff and Students and although it was free, bicycles could only be borrowed for a duration of three hours, after which a fine was imposed. MIRACLES Bikeabout was available to all members of the public and loan periods were flexible ranging from one day to one month depending on the member's requirements.

M4: Situation before CIVITAS:

The Winchester Cycle Network was being developed prior to the start of the project in conjunction with the Winchester Cycle Forum (a body representing cyclists within the city). A number of cycle routes were being expanded and delivered through wider measures to hand over road space to cyclists and pedestrians. These improvements were funded through the Local Transport Plan process. Electronic cycle counters were available to record cycle movements and a cycle map was being prepared. No Bikeabout scheme existed before MIRACLES. A previous edition of the pocket cycle map was available to cyclists within Winchester but this was updated with Bikeabout information and MIRACLES branding. There were 234 cycle stands located in the city centre area before MIRACLES.

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

M5: Design of the measure:

The measure was designed in the following stages:

1. A preliminary feasibility report was undertaken by Atkins on Bikeabout in June 2003. A further detailed literature review was undertaken of national and international cycle loan and hire schemes similar to the proposed Bikeabout scheme (September 2003). The review proposed a best practice for implementing Bikeabout specifically into the Winchester Environment. The bottom-up approach was designed to allow for flexibility in the adoption of Bikeabout by demonstrating a human operated scheme that would have the opportunity for expansion and further innovation where suitable. Key aspects of Bikeabout were to provide;
   - Free Bikeabout membership (one off administration fee of £15 per person or £25 for joint membership)
   - a free cycle helmet
   - high visibility jacket
   - pocket cycle map
   - free access to borrow a Bikeabout bicycle for between one day and one month.

2. Procurement of 50 Bikeabout bicycles suitable for public use. The Pashley Pronto was chosen since Royal Mail had rigorously tested its design to withstand intense use. 10 bicycles were purchased in February 2004 for the pilot scheme and an additional 40 were purchased in April 2004 for the public scheme.
3. Procurement in March 2004 of safety equipment i.e. two hundred bicycle helmets and high visibility jackets that were given free to Bikeabout members.
4. Piloting of the Bikeabout scheme at University College Winchester (UCW) in March-April 2004, to establish strategic methods of operation. The pilot was undertaken to identify if the proposed method of processing memberships, loans, monitoring of the bicycles and bicycle maintenance was sufficient when operating the public scheme. Ten bicycles were procured at this stage and six were available for use at any one time during the pilot scheme. The remaining four were retained for use as spare bicycles during the pilot phase. A limited number of staff and students were invited to pilot Bikeabout so that a close control could be kept of the progress of the scheme.
5. The three stages of registering and using Bikeabout were;
   a. Applicants completed a membership form and provided a form of identification for verification to the Bikeabout operator. (UCW students and staff were required to provide their student or staff ID cards). For the public scheme, applicants were required to provide a proof of address such as a driving licence or utility bill/bank statement. A fee was payable at the time of application. The application was also subject to the applicant's agreement of the Bikeabout Terms and Conditions. The key conditions were that Bikeabout bicycles were borrowed and ridden at the members own risk and they were liable for any losses and damage occurring as a result of their negligence during the loan period.
   b. Once registered, members could request the loan of a bicycle from the operator. This was logged manually and the member would be told when the bicycle was due back, typically within 24 hours. If this time limit was exceeded, then a fine of up to £10 per day could be issued.
   c. To return a bicycle, the member simply returned the bicycle to the operator and the bicycle was logged back in.

   This method of operating Bikeabout was successful and as a result the methodology was carried forward and used in the operation of the full Bikeabout scheme.

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

6. Implementation of a Bikeabout Node in Gladstone Street car park, opposite Winchester Railway Station in June 2004. A secure Rovacabin was used, hired from SGB. A secure lockable Hamble compound was installed in September 2004 for use of bicycles by members of the public. This consisted of a secure depot compound and lockable compound for ten Bikeabout bicycles. Forty Bikeabout bicycles were available for public use. The terms of the trial was as described for the pilot trial. The Bikeabout operator in the secure depot undertook maintenance of the bicycles.
7. Implementation of a Bikeabout secure lockable compound at Winchester Park & Ride St Catherine's car park for use by members of the public parking in the P&R in Spring 2005. This provided a service for people parking in the St Catherine's P&R car park and wishing to cycle to Winchester. This was installed to be operated as an unmanned facility where the borrowing of bicycles was by prior arrangement.
8. Distribution of a revised cycle map in Winchester, detailing cycle routes, parking, locations, Bikeabout and contact general information. These were also provided to each Bikeabout member at the time of first registration.
9. Installation of up to seventy-five new cycle stands throughout Winchester between 2003 and 2005 by Winchester City Council.

M6: Actual implementation:

The measure was implemented in 8 stages (some of these stages ran concurrently or overlapped). These were:

Stage 1: An initial survey and review was undertaken by Atkins (June 2003) to investigate suitable locations for secure cycle parking (the nodes), assess the potential market including, ways to encourage take up and provide essential features in the design for such a scheme.
Stage 2: Procurement of 50 Pashley Pronto Bikeabout bicycles: 10 in February 2004 and 40 in April 2004 (see Figure 1).
Stage 3: Seventy-five new secure cycle stands were made available for installation throughout the city centre (ongoing throughout MIRACLES).
Stage 4: A pilot of the Bikeabout scheme was operated at UCW (formerly King Alfred's College) in April/May 2004.
Stage 5: Installation of a Bikeabout node and lockable compound for all students and staff to use at UCW (see Figure 1).
Stage 6: A Bikeabout node was implemented opposite Winchester Railway Station in Gladstone Street car park see Figure 1 (June 2004). A map of the Bikeabout locations is shown in Figure 2.
Stage 7: Bikeabout leaflets and new cycle maps were distributed via the Bikeabout Operators, commuter forum, business forum, Bikeabout, University College and various community forums (from June 2004).
Stage 8: Installation of a Bikeabout lockable compound for ten bicycles was constructed at Winchester St Catherine's Park and Ride (May 2005). In addition, the scheme was operated from the Tourist Information centre from October 2005.

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

Figure 1: Photos of the Bikeabout Node, at Gladstone Street Car Park

M7: Deviations from the plan:

A new cycle lane (0.75 km) parallel to the rail line was not installed because it was too expensive to undertake a feasibility study and acquire land from South West Trains. Only 11 of the 75 available cycle stands were sited during MIRACLES because there was sufficient capacity of cycle parking in the existing network. The remaining stands will be installed when and where required. The installation of the secure cycle compound at the St Catherine's Park and Ride site was delayed until a suitable location became available.

New government targets no longer focus on quadrupling cycling by 2012 from the 1996 base figures (one of the objectives of this measure) since this was considered to be unachievable at a national level. The new targets simply aimed to increase walking and cycling over the next 20-30 years and make it a more convenient, attractive and realistic choice for many short journeys at the local level. Reallocation of road space was also identified by the government as a key initiative to increase cycling.

Four of the indicators originally defined for this Measure within the Evaluation Plan were not collected either because of a lack of data or because they were redundant due to a re-design of the Measure. These indicators are listed below:

- W8.2/Econ5a – Cost per passenger km;
- W8.2/Engy1a – Passenger fuel efficiency;
- W8.2/Env1a – Emissions;
- W8.2/Tran2a – Length of cycle network.

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

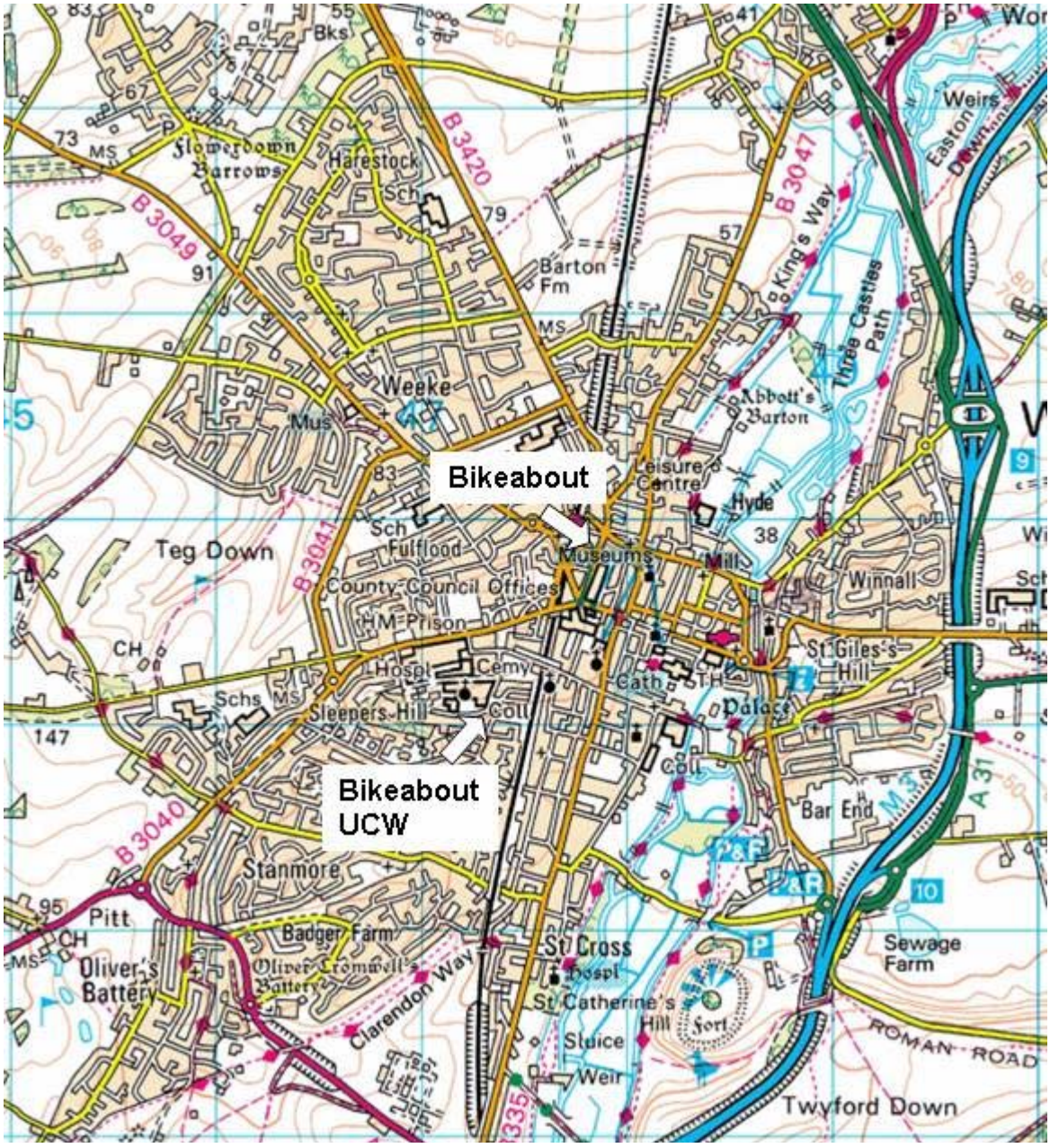
The data came from the following sources

- **HCC cost statements** – these outlined the man-hours worked on MIRACLES split by work package and staff grade along with any equipment/consumables bought. The figures came from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.
- **HCC Traffic Count data** – measured the cycle flow on the arterial routes within the Winchester network. These data showed the number of cyclists on the following roads for years 1997-2003. Some data was available for 2004-2005. Flow was measured on eight arterial roads (results shown in Figure 5) over a 24-hr 5-day mean period during the month of July.
- **Hampshire County Council Cycle Parking Surveys** – measured the use of cycle parking facilities throughout Winchester. This survey was undertaken manually and provided a count at the sites for 2002-2005.
- **Bikeabout User Questionnaires** – provided an assessment of the Bikeabout scheme by its users. A pilot survey was undertaken in July and August 2004. There were two user surveys: the first was undertaken as a postal survey in November 2004, and the second was distributed by hand and post during the summer of 2005.
- **Bikeabout Travel Diaries** – were undertaken to provide measurement of the energy and emission savings from Bikeabout and were distributed with the 2005 user questionnaires.
- **The Winchester Transport Questionnaire** and **MIRACLES Awareness Questionnaire –** these are detailed in measure 10.

Table 1: Details of Bikeabout User Surveys and Travel Diaries:

	Type of Survey	Date of Survey	Sample size	Purpose
1	Pilot Questionnaire	July-August 2004	5 completed	Pilot of Bikeabout User opinion survey
2	User Questionnaire 1	November 2004	60 (23 returned)	Initial Bikeabout User opinion survey
3	User Questionnaire 2	Summer 2005	160 (30 returned)	Second Bikeabout User opinion survey
4	Travel Diary	Summer 2005	160 (12 returned)	Bikeabout Users Travel Diaries measuring trip type, distance and modal choice

MEASURE-LEVEL RESULTS	
Measure title: New cycling opportunities	**Project: MIRACLES**
Measure number: 8.2	**City: Winchester**



NC/43150/03 Reproduced from Ordnance Survey maps with the permission of The Controller of Her Majesty's Stationary

Figure 2: Map of Winchester Showing Bikeabout Locations.

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

M9: Achievement of quantifiable targets:

N/a

M10: Achievement of evaluation-related milestones:

All the evaluation related milestones (as outlined in the Annex of D4.2) have been achieved.

M11: Report on the measure results:

Economy-

HCC cost data

The data from HCC came from their annual cost statements for the MIRACLES project. The staff hours for WP 8.2 totalled about 2160 hours at a cost of £53,000. Staff costs for temporary operators provided by Manpower UK Ltd varied between £150 and £350 per week at a rate of £10.40 per hour, varied by demand and opening times of Bikeabout (W8.2/Econ2b). Hire costs for the secure Rova Cabin were £22.90 per week. The cost for the preliminary feasibility report by Atkins was £10,000. The total spend on equipment and consumables for years 1-4 was approximately £49,000. The significant costs were £19,000 for 50 bicycles and £2,500 for spares (Pashley Holdings LTD), £3,700 for procurement and installation of a secure cycle compound (Lock-It-Safe LTD) in year 3 and £9000 in year 4, £4,000 for Bikeabout leaflets and pocket cycle maps (Hampshire Printing Services), £3,500.00 for logo plates (Foxcraft Engineering), £1,300 for 200 cycle helmets (Hi Gear LTD) and £900 for 200 hi-visibility jackets (Parker Merchanting) (W8.2/Econ1a). The approximate cost of maintaining each bicycle including spares is approximately £50 per year according to the manufacturer (W8.2/Econ3a). With around 160 members, the revenue generated from the scheme was about £2,000 (W8.2/Econ4a).

Society

The Winchester Transport Questionnaire was undertaken to ascertain the public's level of acceptance of MIRACLES. The questionnaire was designed so that for certain questions, a statement was provided about the aims of an initiative. The participants were asked to read the following statement and state their level of agreement.

Relating to the Bikeabout initiative, the following statement was written in the questionnaire: "*HCC and WCC are trying to encourage people to travel by bicycle more often instead of by car, by providing free loans of Council owned Bikeabout bicycles to members of the public, increasing the availability of cycle parking and improving Winchester cycle routes*". Out of a total of 914 questionnaires, 883 people answered the question. 65.6% of respondents generally agreed with the objectives, 18% neither agreed nor disagreed and 12% generally disagreed (W8.2/Soc1a and Soc1b). The results suggest that there is a high level of agreement with the objectives of Bikeabout with the majority of respondents showing a positive attitude towards the scheme. An example of public support was that since Bikeabout's launch in 2004, of ten bicycles that had been reported as missing, nine were recovered because members of the public reported bicycles that appeared to have been abandoned.

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

Public Acceptance of Bikeabout

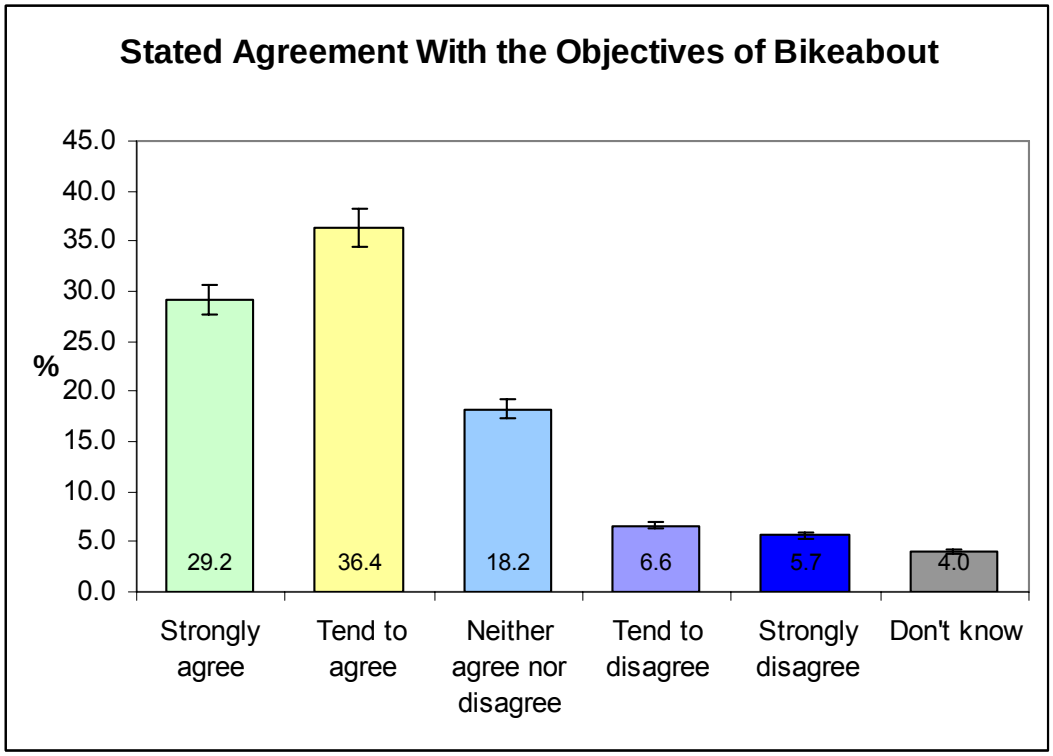


Figure 3: Public acceptance with the objectives of Bikeabout

For the respondents who indicated that their main method of travel within Winchester was by car or by motorbike, 61% of the valid responses agreed with the statement, 20% neither agreed nor disagreed and 14% disagreed. For those people who indicated that their main method of travel involved bus or train, a total of 77% valid responses agreed with the statement, 14% neither agreed nor disagreed and only 9% disagreed. This result was similar to those respondents who indicated that their main method of travel was by walking or bicycle, where 75% of the valid responses agreed, 13 % neither agreed nor disagreed and 10% disagreed.

This suggested that the people already travelling by sustainable methods of travel such as bus, foot, bicycle and train for the main part of their journey were more inclined to agree with the idea of Bikeabout.

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	**Project: MIRACLES**
Measure number: 8.2	**City: Winchester**

Energy/Environment

The frequency that the Bikeabout members travelled by bicycle, car and foot within Winchester is shown in Figure 4. 54.5% travelled by foot most days, 47.5% travelled by bicycle most days and only 9.3% travelled by car most days. The frequency of people who only travelled by foot and bicycle 2-3 times per week decreased to 34.1% and 22.5% respectively, whilst the number of journeys made by car increased to 18.6%. The majority of Bikeabout members (63%) only used their car once per week or less to travel within Winchester. It was considered that Bikeabout therefore replaced some of the journeys made by car or by foot.

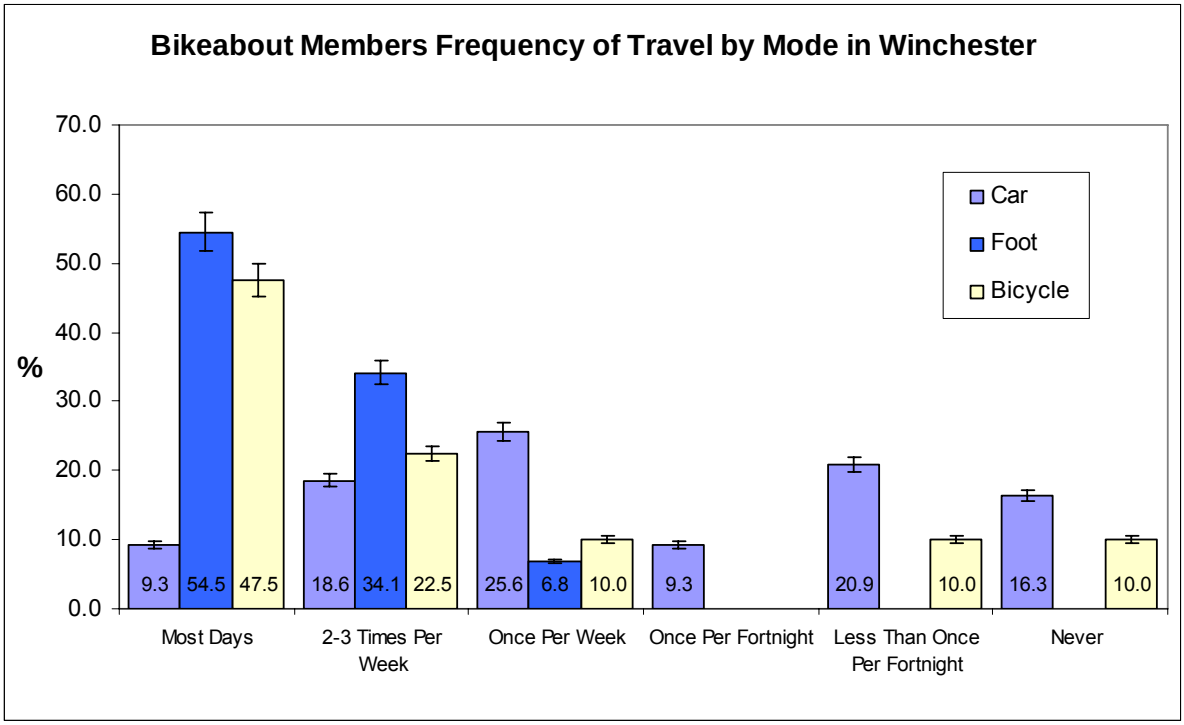


Figure 4: Bikeabout member's frequency of travel by mode in Winchester.

The results from the travel diaries are summarised in Table 2. (A total of 12 travel diaries were returned by members). Three members of Bikeabout had switched from Car to Bikeabout for their journeys within Winchester. The average distance cycled was 2.7 miles per trip and 57% of journeys were round trips. The majority of trips (38%) were for social/leisure/recreation, 26% of trips were for shopping, 21% of trips were travelling to work and 15% of trips were returning home. If Bikeabout had not been available, 32% of trips would have been made by walking, 21% of members would not have made the journey, 15% would have travelled by bus, 15% would have travelled by car, 10% by their own bicycle and 7% would have been dropped off by a colleague. Due to the low sample size, no cost per passenger km, Emissions savings or fuel efficiency could be calculated (W8.2/Econ5a; W8.2/Engy1a; W8.2/Env1a).

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities | **Project: MIRACLES**

Measure number: 8.2 | **City: Winchester**

Table 2: Results summary from the Bikeabout Travel Diary

Serial No	Date	Start Location	End Location	Start Time	End Time	Distance (miles)	Purpose	Means of travel if not Bikeabout
1	16-Aug	Home	Home	10:15	11:30	2	Shopping	Walk
1	17-Aug	Home	Home	14:00	16:30	2	Social	Car
2	03-Aug	Home	Work	07:45	08:15	3	Travel to Work	Car
3	07-Aug	Home	Home	10:00	14:30	4.5	Social	Bus
4	07-Aug	Home	Home	10:00	14:30	4.5	Social	Bus
4	14-Aug	Railway Station	Home	09:50	10:30	2.5	Returning Home	Bus
5	11-Aug	Home	Railway Station	07:00	07:09	0.75	Travel to Work	Own Bike
5	11-Aug	Railway Station	Home	18:00	18:05	0.75	Returning Home	Own Bike
6		Railway Station	Railway Station			2	Social	Would not have gone
7	26-Jul	Bikeabout Depot	Bikeabout Depot			5 Day cycle tour	Social	Rented another bike (if possible) or would not have come to Winchester
8	31-Jul	Home	Home	10:50	12:55	3	Shopping	Car
8	02-Aug	Home	Home	10:49	11:00	1.5	Travel to Work	Walk
9	22-Aug	Home	Shops	10:15	12:00	1	Shopping	Walk
10	30-Jul	Home	Home	11:00	13:00	3	Social	Would not have gone as came specifically to ride
10	31-Jul	Home	Home	15:00	18:00	6.5	Social	Would not have gone as came specifically to ride
11	15-Aug	Home	Work	08:30	08:40	1.5	Travel to Work	Walk
11	15-Aug	Work	Home	17:10	17:25	1.5	Returning Home	Dropped off by colleague
12	29-Jun	Home	Home	10:30	11:30	4	Shopping	Walk
12	30-Jun	Home	Home	15:00	16:30	4	Shopping	Walk

Cycle flows on the Winchester Network

Cycle count data measuring the cycle flows on Winchester's network is displayed in Figure 5 (cyclists in Winchester by year 2002 - 2004). The surveys were undertaken in July for each year and over a 24-hour 5-day mean period and were an aggregation of inbound and outbound traffic.

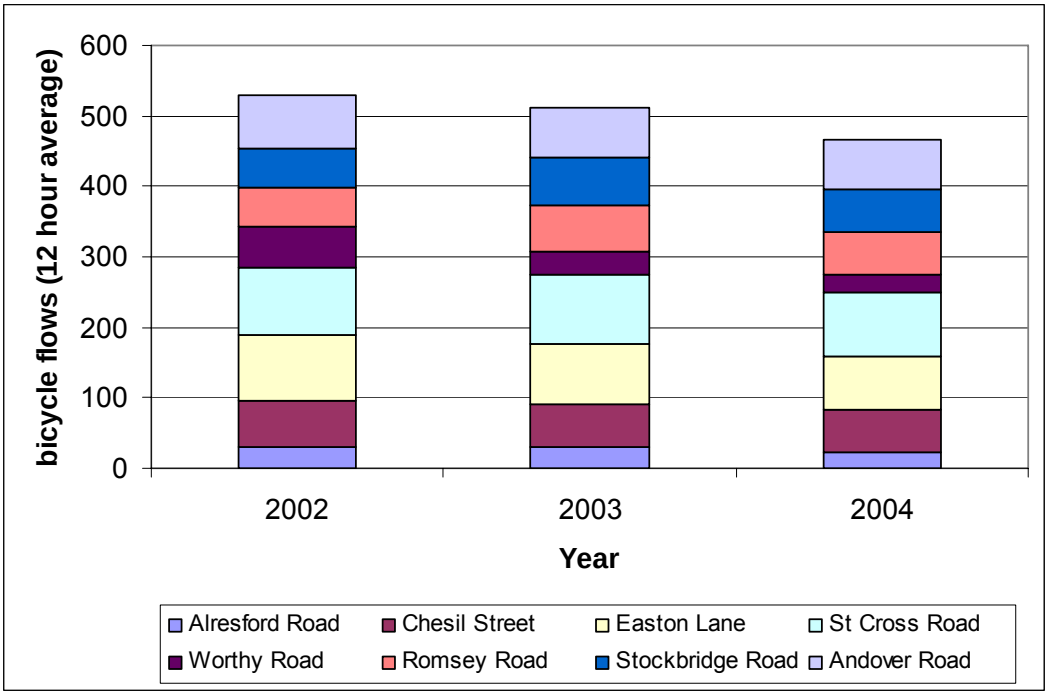


Figure 5: Total bicycle flows on eight strategic arterial roads

Overall, there was a 12% decrease in the 12-hour average cycling flows on the arterial routes from 2002 to 2004 (down from 529 to 467). The reduction was greatest for inbound flows (-16%) compared to outbound flows (-9%). The largest significant reduction was on Worthy Road which saw cycling flows decrease by 58%. This may be a result of the corresponding increase in traffic flows on this route of 6%. As the maximum number of bicycles parked in the city centre increased from 2002 to 2005, it is thought that Bikeabout may have helped to increase cycle flows within the city centre area. Some of the reduction may also be due to errors in the automatic counting of cycling by detectors.

Use of Storage Facilities

The cycle parking surveys undertaken during 2002-2005 were carried out at locations throughout Winchester. In 2002 there were a total of 234 cycle stands in the District of Winchester. Eleven cycle stands were installed in city centre locations during the lifetime of the project. The main types of cycle parking found within Winchester are Sheffield stands, CycleVice and Stands. The survey also accounts for the use of some non-official cycle parking facilities such as fences at various sites.

The survey provided a useful estimate of the number of bicycles in Winchester as flow data on the network does not account for a single cyclist crossing several count sites during the day. There was an increase in the number of bicycles parked in Winchester over the past four years, where peak numbers recorded are shown in Figure 6. These results showed a 46% growth from 2002 to 2005 (W8.2/Tran1c). This could be partly due to the presence of 50 extra Bikeabout bicycles in the city centre area.

MEASURE-LEVEL RESULTS	
Measure title: New cycling opportunities	**Project: MIRACLES**
Measure number: 8.2	**City: Winchester**

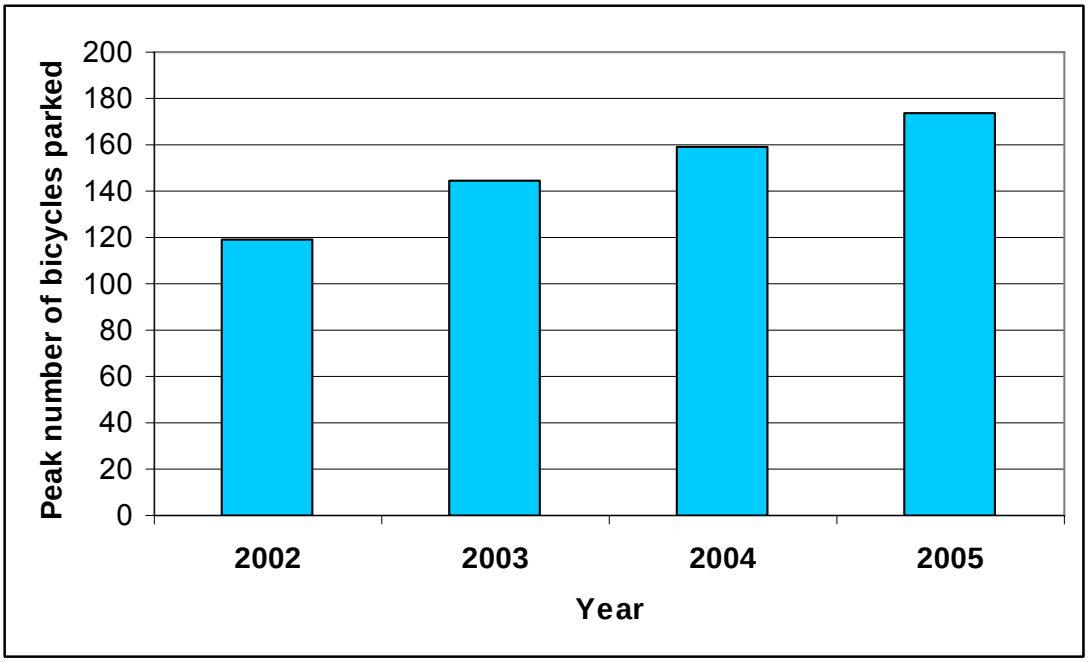


Figure 6: Peak Number of Bicycles Parked in Winchester (2002-2005)

Results from the Winchester Transport Questionnaire showed that 45.9% of people said that they would travel by bicycle more if there were improved access throughout Winchester through safe cycle routes. The Atkins scoping report (2003), identified issues picked up in comments from the transport questionnaires and this included the recognition of the limited space available for developing dedicated cycling facilities within the City. Interviewees felt the flow of traffic and the narrow streets of Winchester were not ideal for cycling. In addition to this, parts of Winchester city centre are pedestrian only zones, limiting bicycle access. 36.5% of people said that they would travel by bicycle more if there was the provision of secure cycle parking and 37.3% said that they would cycle more if there was the provision of additional general cycle parking. Although Winchester had an ample capacity of cycle parking with a free capacity of approximately 35% in 2005, specific secure compounds and cycle lockers would offer cyclists a more attractive option when parking their bicycle, reducing the chance of their bicycle being stolen of damaged. Additional regular cycle stands may also be effective if they were installed at requested locations such as places of work, retail and recreation, particularly if none were already available. 15.3% said that the provision of changing facilities for cyclists would make them cycle more. 23% stated that they would travel by bicycle more if they could borrow a bicycle for free. The results indicate that by implementing a combination of pro-cycling measures, Winchester could see an additional and potentially sustainable increase in the number of cyclists on the network.

Stated reason for the use of cycling

The results from the Bikeabout User Questionnaire showed that 26.9% of users were 18-24, 17.3% were 25-34, 21.2% were 35-44, 19.2% were 45-54 and 15.4% were above 55 years old. 32% of males said that they were likely or very likely to use the scheme compared to 27% of females. 61.5% of the respondents were male.

For full-time employees, 29% were likely/very likely to use the scheme. The corresponding result for part-time employees was 38%. 34% of students were likely/very likely to use the scheme and 67% of unemployed people felt they were likely/very likely to use the scheme. 81% of retired people were unlikely/very unlikely to use the scheme and 100% of homemakers were unlikely/very unlikely to use the scheme. The results from the Bikeabout User Survey showed that 71.9% of members were in employment, 25% were students, the majority of which were linked to the UCW scheme and 9.4% were retired.

Data from the Bikeabout User Questionnaire, shown in Figure 7, identified that of a total of 47 valid responses, 12.8% used Bikeabout to return home, 19.1% used Bikeabout to travel to work and 6.4% during work, 12.8% for shopping, 19.1% for education and 29.8% used it as a means of social, leisure and recreation. This showed that a higher proportion of members used Bikeabout to travel to work and a lower proportion used it for recreation (W8.2/Tran1c & Tran1d).

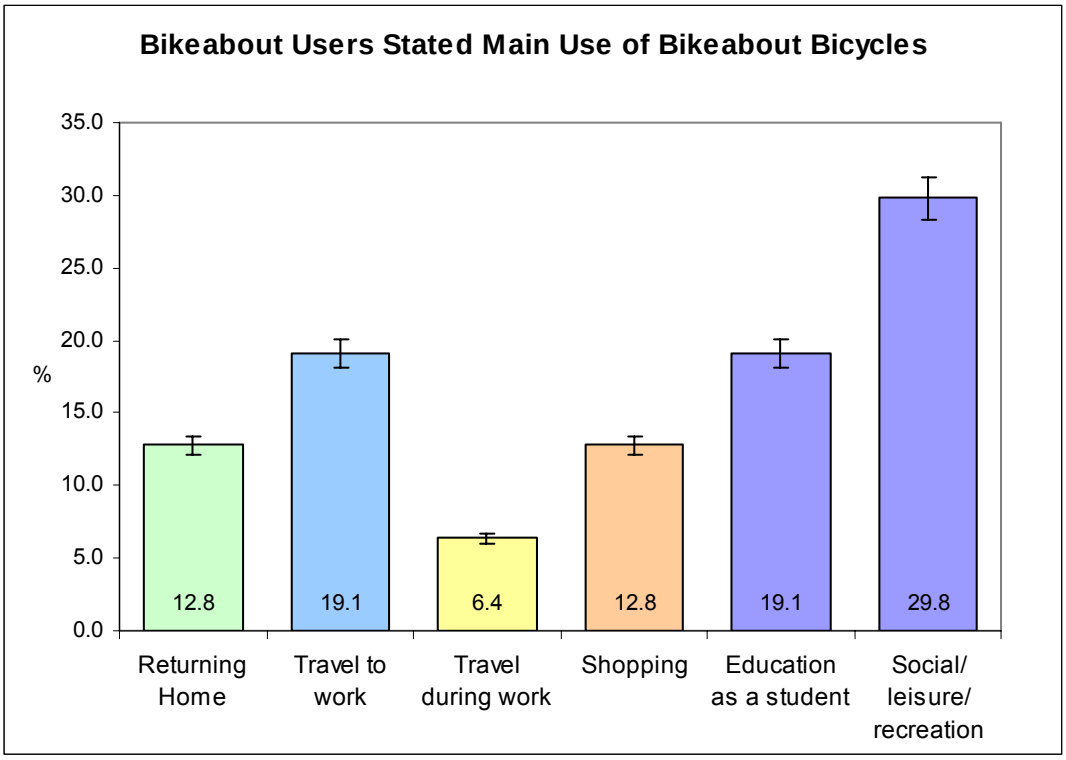


Figure 7: The percentage of Bikeabout users who stated their main use of Bikeabout

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

Conclusions

- The level of agreement and effectively acceptance of Bikeabout was 65.6% showing good public support for the scheme.
- Awareness of the scheme was 37.5%.
- The scheme had over 170 members in December 2005.
- 72% of the members stated that they did have access to another bicycle.
- Cycle flows recorded between 2002 and 2004 showed a 12% decline.
- The cycle parking survey measured an increase in bicycles parked in Winchester between 2002 and 2005 of 46%.
- Overall, 83% of Bikeabout members thought it was good or very good.
- The travel diaries showed that people might be willing to switch mode from car to bicycle.

Bikeabout has continued to grow in membership since its introduction. The scheme was positively received by the public and achieved a good level of awareness (37.5%) compared to other initiatives (see WP10). The cycle map had a much lower awareness of 5.9%. Peak usage resulted in almost all the bicycles being used at one time and if the membership continued to grow additional bicycles would be required. The potential benefits of the Bikeabout scheme in Winchester are being realised, with some members switching from travelling by car to Bikeabout bicycle. It is expected that doubling the number of bicycles would help to increase membership and as a result increase the levels of cycling in the City. The more Bikeabout bicycles in the city, the greater the visual impact will be. There is the potential to increase the number of new cyclists by expanding Bikeabout through multiple nodes and businesses. An example of this is already being undertaken with the Tourist Information Centre (TIC).

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

A summary of the relevant indicators is shown in Table 3.

Table 3: Summary of measure indicators for W8.2

Indicator no. (Meteor no.)	Indicator name	Baseline 2002	Business as Usual 2005	MIRACLES 2005
W8.2/Econ1a	Purchase/loan & installation cost	N/a	N/a	See HCC cost data
W8.2/Econ2a	Power & communication costs	None	N/a	None
W8.2/Econ2b	Labour costs	N/a	N/a	See HCC cost data
W8.2/Econ3a	Maintenance costs	N/a	N/a	See HCC cost data
W8.2/Econ4a	Revenue generated from Bikeabout – hypothetical	N/a	N/a	About £2,000
W8.2/Soc1a/1b (14)	Acceptance rating – locals	N/a	N/a	65.6% generally agreed
W8.2/Soc2a/2b (13)	Awareness rating – locals	N/a	N/a	Bikeabout: 37.5%; Cycle map: 5.9%
W8.2/Soc3a	Operator confidence in technical parameters	N/a	N/a	See M14
W8.2/Soc4a	Numbers receiving discounted loans for purchase of electric bike	N/a	N/a	2 people at HCC
W8.2/Tran1a	Cycle flows on network	Base	N/a	-12% (2004)
W8.2/Tran1b	Number of new cyclists	N/a	N/a	Up to 115
W8.2/Tran1c	Stated reason for use of cycling	N/a	N/a	See Figure 7
W8.2/Tran1d	Use of Bikeabout bicycles	N/a	N/a	See Figure 7
W8.2/Tran1c	Use of storage facilities	See Figure 6	N/a	See Figure 6

This measure will be continued after the MIRACLES project.

Up-scaling
No up-scaling of this measure was carried out as the scheme already covered the whole city centre area.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

The Winchester Air Quality Action Plan was a major driver for recognising the need to increase the number of cyclists within Winchester. There were three main barriers within the implementation of Bikeabout. Firstly, the scheme could not be sited at the Railway station as originally planned, potentially reducing the convenience for commuters, although it was sited within close proximity. Secondly, the topography and road layout of Winchester was a major barrier to increasing cycling as there was limited space to install specific cycle lanes, which may have encouraged cycling. Thirdly, the cost of land acquisition to install a new cycle lane near the railway was too high.

MEASURE-LEVEL RESULTS

Measure title: New cycling opportunities	Project: MIRACLES
Measure number: 8.2	City: Winchester

M13: Interrelationships with other measures

This measure is linked to the raising awareness Measure 10 and the development of environmental access control in Measure 5.1.

M14: Lessons learned

1. There was limited existing cycle specific infrastructure within Winchester and limited scope to develop and install new cycle lanes due to the lack of road space and the high cost of such schemes. Although the Pocket Cycle map identified and suggested and safe routes, better integration and installation of new routes would have been of ongoing benefit to cycling in the City.
2. Winchester is a relatively small city with a population of just over 100,000. Most facilities are within walking distance within the City Centre thus reducing the attractiveness of travelling by bicycle when it is convenient to walk or travel by the existing bus services.
3. Only eleven cycle stands were installed in city centre locations during the project. There was potential for installing some of them at company locations but this was deemed to be not a good use of taxpayer's money. Seeking a financial contribution from these companies for their installation could have made better use of the 75 cycle stands that were available.
4. The Bikeabout operators played a key part in promoting the scheme through leaflet distribution and by providing face to face and telephone contact to members of the public and Bikeabout members. They were able to deal with issues as they arose and undertake maintenance on the bicycles.
5. It was possible to operate reduced opening times from November 2004 to April 2005 as demand for Bikeabout reduced substantially, where only regular members required bicycles. A single operator was available Friday and Saturday to process loans and returns and memberships although HCC staff were on hand throughout the rest of the week during normal office hours. During the summer months Bikeabout was open from 7am-7pm Monday to Saturday and membership grew by 5-10 members per week during this period of 2005.
6. The ideal Bikeabout system offering the most flexible access for trips would have been a multimodal automated system, which would allow key nodes to be installed throughout Winchester and its residential areas. Access to the bicycles registered through smart cards would allow them 24 hour access and the ability to make point to point journeys without the need to hire or return the bicycles to a single location. However the cost of such a scheme would be approximately £250,000 for three sites and 75 bicycles. Each additional node would cost between £15,000 and £50,000.
7. One of the key benefits to members was that after the initial £15 administration, a bicycle was free to borrow. Although the Atkins report suggested people would be willing to pay a charge of up to £1.50 per hour and £5-10 per day, the benefit of renting a bicycle on a regular basis would be limited and it may be more cost effective for a member to purchase their own. However hire schemes for tourists can charge up to £30 per day for bicycle hire so there is the potential to focus on this aspect when the scheme is expanded to the TIC venue.
8. After MIRACLES has ended, there is the potential to transfer bicycles from the public scheme in Winchester to businesses as pool bicycles, where they become responsible for loaning and maintaining them to staff in a similar manner to UCW.

Contact Point

.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

6. Measure 9.2

MEASURE-LEVEL RESULTS	
Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

This measure consisted of three mini-measures:

1. the Collectpoint scheme;
2. production and distribution of a freight map; and
3. a waste-recycling scheme.

Their respective objectives were to:

- reduce the number of missed home deliveries;
- increase the efficiency and use of urban freight delivery; and
- initiate an urban waste-recycling service using environmentally friendly vehicles.

M2: Measure description:

The Collectpoint scheme

The Collectpoint company were previously involved in Business to Business (B to B) delivery, but were interested in initiating a Business to Consumer (B to C) service. An opportunity arose within MIRACLES for such a trial to take place, and this measure sought to reduce the numbers of private vehicle trips associated with missed home deliveries. A chain of local convenience stores was used as a delivery point.

Freight map

A freight map of Winchester was developed and published and given out to organisations or companies receiving deliveries to improve the efficiency of urban freight delivery.

Waste-recycling scheme

An electric vehicle was used within a waste cardboard and paper recycling service for Winchester city centre businesses. A local company, Dove Recycling, ran this scheme.

The Implementation – how was the measure implemented?

M3: Innovative aspects:

The main innovative aspects were

- the use of local convenience stores to act as delivery points for carriers, re-directing missed deliveries to householders; and
- promotion of a business cardboard and paper recycling scheme using electric vehicles.

M4: Situation before CIVITAS:

A local freight forum involving businesses in the Winchester area had previously been established to investigate ways of improving the business operations and reducing the environmental impact of transport movements. Regarding this, a freight map had been produced, which required some updating and circulating to a wider audience. There was no previous use of the Collectpoint system amongst businesses or householders nor was there any use of environmentally friendly vehicles for waste collection purposes in Winchester.

MEASURE-LEVEL RESULTS	
Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

M5: Design of the measure:

The Collectpoint scheme

The idea behind the concept was to set up a series of Collectpoints operating from local convenience stores, which would receive customer deliveries during their hours of operation (typically 07:00 – 23:00). Householders in the Winchester trial area would be able to purchase goods on-line and have them delivered to a Collectpoint of their choice (although only a handful of retailers offered Collectpoint specifically as an alternative delivery location on their web-sites). This would save any inconvenience in terms of the householder having to reschedule missed deliveries or collect the parcel from the carrier depot.

A Collectpoint initial trial was undertaken for 10 weeks between July and September 2004. Promotional flyers were distributed to 20,000 households. There was also local radio advertising, bus adverts, and various articles and adverts in the local newspapers. However, the response rate overall was disappointing, partly due to on-line problems with the Collectpoint website and voucher scheme.

In parallel, a questionnaire was sent out in September 2004 to 1600 households in Winchester, asking about home shopping activity, experiences of missed deliveries and attitudes to the Collectpoint scheme. A high response rate of 49% (790 households) was obtained, mainly because the householders had previously agreed to participate as panel members. Respondents were asked if they were willing to participant in a more detailed Collectpoint trial and 312 people expressed an interest. These questionnaire results are reported in Section M11. In addition, a routing software package was used to estimate potential quantifiable benefits associated with Collectpoint relating to reduced redelivery mileage etc. It is acknowledged that these findings are not ex-post results, relating more to a justification for the scheme in the first place.

After the technical problems with the scheme had been rectified, it was planned to conduct a second demonstration of Collectpoint during the summer of 2005 by offering a free trial of the Collectpoint service to Winchester residents. Invitations to take part in this trial were to be sent to the 312 questionnaire respondents who had expressed an interest. The trial was also to be publicised more widely within the Winchester area to gain as many triallists as possible. Triallists were to be able to use the service for free as many times as they wanted, provided they completed an on-line questionnaire devised to gain feedback about their experience of using Collectpoint and to provide information about their travel habits. However, the B to C part of the Collectpoint company was disbanded before the trial could begin and so any further trials within MIRACLES had to be abandoned. Therefore, the only ex-post results available for this sub-measure related to the initial Collectpoint trial.

MEASURE-LEVEL RESULTS

Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

Freight map

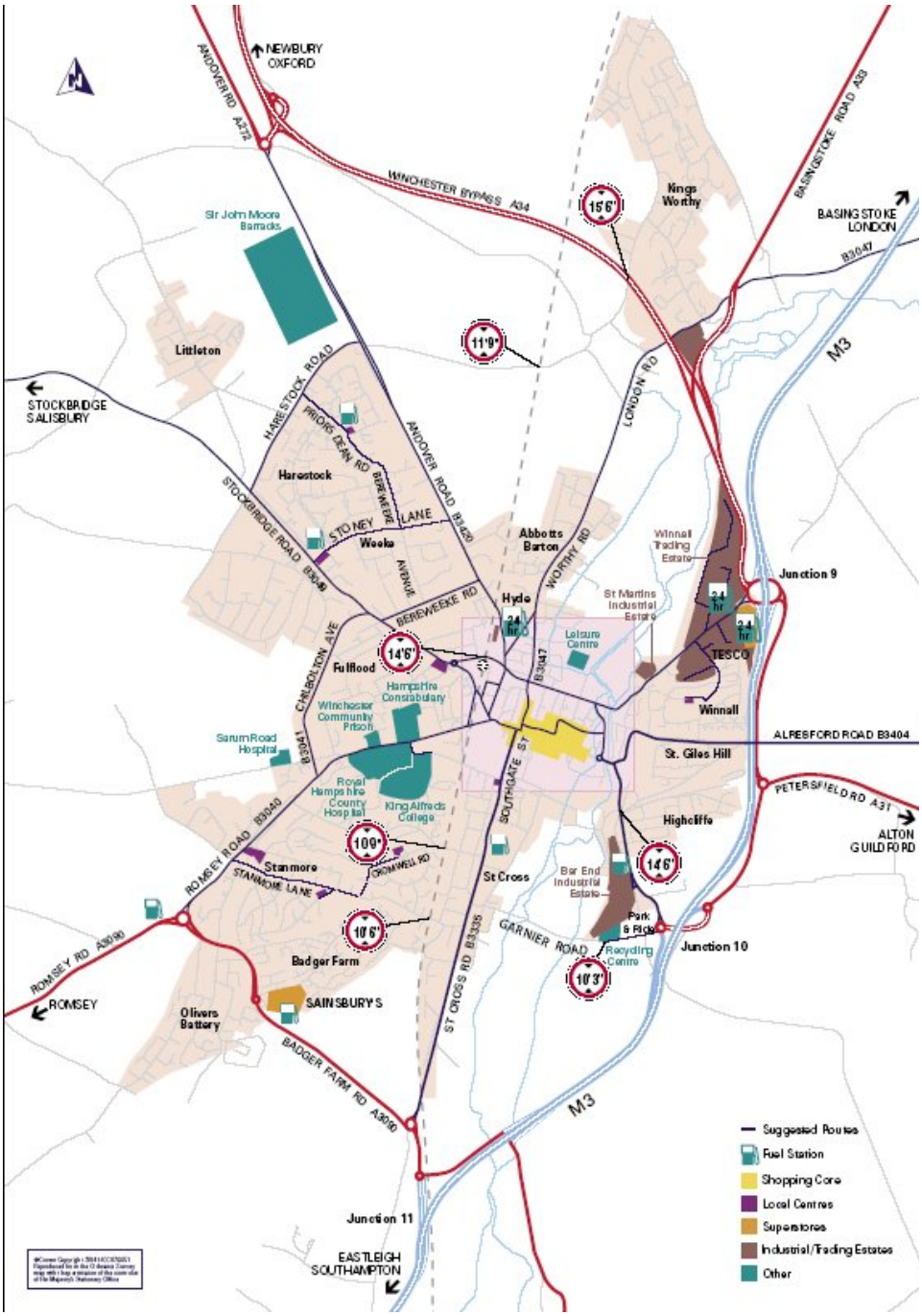


Figure 1: The Winchester Freight Map (part of)

MEASURE-LEVEL RESULTS

Measure title: Sustainable Urban Distribution	Project: MIRACLES
Measure number: 9.2	City: Winchester

A freight guidance map entitled "Freight Routes and Restrictions in Winchester" was designed and distributed (5,000 in total) to many outlets in and around Winchester, including local businesses, garages and motorway service areas.

The freight map was double-sided: one side illustrated the strategic advisory routes for freight vehicles to use approaching Winchester (as shown in Figure 1), while the reverse map (not shown in this template) provided more detailed information regarding Winchester City Centre specifically.

Waste-recycling scheme

The waste-recycling collection service run by Dove Recycling was trialled and operated using an electric vehicle (see Measure 12.3). A questionnaire survey of 100 businesses on Winchester High Street was undertaken by Dove to assess the demand for such a service and gather information about the waste types currently being produced and recycled. As a result, several businesses expressed an interest in the Dove Recycling waste collection service. By the end of October 2005, Dove was collecting waste from 35 businesses in Winchester (see Figure 2).

Figure 2: Dove Recycling using the Citroen Berlingo electric van

M6: Actual implementation:

The Collectpoint scheme

- Initial Collectpoint trial and publicity (July – September 2004);
- Questionnaire survey asking about attitudes to Collectpoint scheme and recruiting participants in a follow-up trial (September 2004);
- B to C part of the Collectpoint Company disbanded (June 2005).

MEASURE-LEVEL RESULTS	
Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

Freight map

- Development and production of updated freight map for Winchester (August 2004);
- Distribution of map to outlets and freight companies in and around Winchester (from October 2004).

Waste-recycling scheme

- Questionnaire survey undertaken of 100 businesses in Winchester to assess demand for a waste-recycling scheme (April 2005);
- Trial of the waste-recycling scheme (from April 2005);
- Data collected regarding volume of waste collected by Dove.

M7: Deviations from the plan:

At the beginning of the project, it had been expected this Measure would have designed a co-ordinated urban delivery service to try and reduce the trend of increasing vehicle miles by small delivery vehicles. The delivery service would have replaced predominantly diesel van deliveries with electric van deliveries, delivering 100% reductions in tailpipe emissions. Prior to MIRACLES, HCC had commissioned TRG to conduct a questionnaire survey of over 450 shops and businesses in Winchester to examine freight patterns to develop the understanding of the problems faced. In addition, as part of the MIRACLES project, the depot managers of the six local courier companies in Winchester were interviewed. The conclusion of these surveys was that Winchester was too small a city for a freight urban distribution centre to be effective and efficient, and therefore it was not feasible to run such a scheme.

It was intended to carry out a locker-box trial (secure storage box for unattended delivery solution to businesses). Research was carried out to investigate this option with a questionnaire interview survey to businesses in the city centre. Only 7 out of 41 of the businesses interviewed were willing to use a public locker-box with issues such as location, distances between premises and the locker-box, out-of-hours service, space and cost being important issues in their decision. Discussions with Royal Mail and Bybox (a commercial locker-box company) then took place to consider developing a trial for freight companies to deliver packages to a locker-box. However, neither company were interested in such a trial during the timescale of the MIRACLES project (although Royal Mail did show renewed interest towards the end of the project).

The Collectpoint trial was to be another example of an alternative home delivery service. However, a comprehensive trial of the Collectpoint scheme was not undertaken, primarily due to the disbanding of the Business to Consumer arm of the company during June 2005. The earlier trial had been delayed due to technical difficulties with the Collectpoint website and voucher registration system and it had been anticipated that the second trial would have built upon these lessons learned.

Discussions with a retail chain (Marks and Spencer) were held with a view to trialling a home delivery service using one of the electric vehicles. However, despite initial optimism, this trial never materialised due to the changes to local management personnel at Marks and Spencer. This trial was superseded by the Dove waste-recycling scheme.

Twelve of the indicators originally defined for this Measure within D4.1 were not collected either because of a lack of data or because they were redundant due to a re-design of the Measure. These indicators are listed below:

- W9.2/Econ1a - Purchase/loan and installation costs
- W9.2/Econ2a - Power costs
- W9.2/Econ3a - Maintenance costs

MEASURE-LEVEL RESULTS

Measure title: Sustainable Urban Distribution	Project: MIRACLES
Measure number: 9.2	City: Winchester

- W9.2/Econ4a - Cost per person km
- W9.2/Econ5a - Cost per tonne delivered
- W9.2/Engy1a – Energy consumption
- W9.2/Env1a – Emissions
- W9.2/Soc1c – Increase in home shopping transactions
- W9.2/Soc3a – Reduced number of failed home deliveries
- W9.2/Soc3b – Increase in purchases from local stores
- W9.2/Soc4a – Operator confidence in technical parameters
- W9.2/Tran1a – Reduction in freight vehicle mileage

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

The data came from several sources:

Hampshire County Council cost statements – these outlined the hours worked on MIRACLES split by work package and staff grade along with any equipment/consumables bought. The figures come from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.

The Collectpoint scheme

- A questionnaire was sent out in September 2004 to 1600 households in Winchester, asking about home shopping activity, experiences of missed deliveries and attitudes to the Collectpoint scheme. 790 responses were obtained.
- A trial was undertaken during July to September 2004.

Freight map

- Telephone calls were made to those Hampshire businesses sent a freight map to assess the perceived usefulness of the map.

Waste-recycling scheme

- Dove Recycling undertook interviews with 100 businesses on Winchester High Street to assess the opportunities for establishing a recyclable waste collection service.
- A waste-recycling service was then trialled by Dove Recycling using a Berlingo electric van.

M9: Achievement of quantifiable targets:

Of the original objectives, the only one that was fully met related to the waste-recycling scheme: i.e. Dove Recycling used an electric vehicle to trial a waste-recycling service for local businesses. In addition, the target number of freight maps were designed and distributed, and the Collectpoint scheme was trialled.

M10: Achievement of evaluation-related milestones:

See M7.

M11: Report on the measure results:

Hampshire County Council cost data

The data from HCC came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3 (an estimate for Year 4 will be made when figures are available). Staff hours for Work package 9.2 for Years 1 – 3 was a total of 1397 hours at a cost of £35,192. In addition, HCC spent about £8,500 in sub-contracting Atkins (consultants in the design of the freight map), £950 on the freight map design and distribution, £960 on the Collectpoint service, and £600 on the Collectpoint leaflet (*W9.2/Econ6a*).

MEASURE-LEVEL RESULTS	
Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

The Collectpoint scheme

Initial Collectpoint trial

Within the initial 10-week Collectpoint trial in 2004, 75 people registered on the Collectpoint website and were entitled to a free voucher (***W9.2/Soc1b***). However only 8 people used their voucher (***W9.2/Soc2a***). All voucher users were male, with 50% of them returning to raise a second voucher. The trial overall was disappointing, partly attributable to on-line problems with the voucher scheme.

The MIRACLES Awareness questionnaire survey (see Measure 10) found that 10% of the general public were aware of the Collectpoint scheme (***W9.2/Soc1a***). Results from the Business questionnaire found that 3% of businesses were aware (***W9.2/Soc1a***).

Home shopping questionnaire survey

Although the initial Collectpoint trial provided a lack of ex-post results, the questionnaire distributed in parallel to 1600 Winchester households garnered some useful data regarding home shopping activity, experiences of missed deliveries and attitudes to the Collectpoint scheme. The response rate was 49% (790 households). The key results from the questionnaire survey are now summarised:

1. Delivery failure rate

The respondents were asked to estimate their rate of first-time failure of a typical home delivery (i.e. the proportion of occasions when the parcel had to be returned to the depot because nobody was at home when the carrier attempted to deliver). The responses are summarised in Figure 3. The average first time failure rate was estimated to be 20% from these responses.

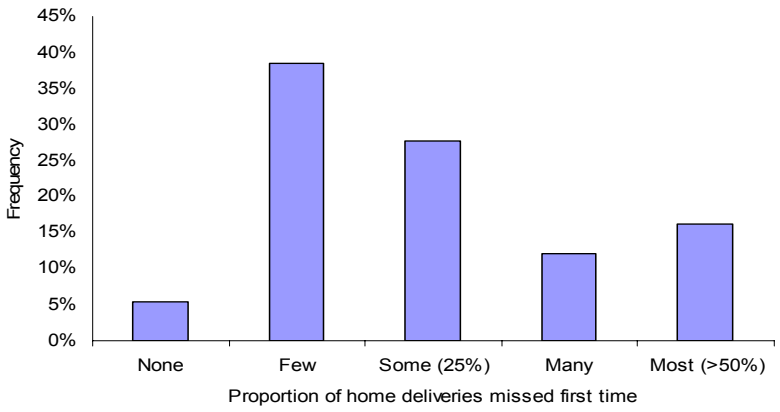


Figure 3: Respondents' estimates of the proportion of home deliveries missed first time

MEASURE-LEVEL RESULTS	
Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

2. Travelling to a local Collectpoint

The average distance from the Winchester residents' homes to their nearest Collectpoint (i.e. a participating local convenience store) was calculated to be 1.8km by road, based on there being five Collectpoint locations in Winchester. The preferred modes of travel to the Collectpoint are shown in Figure 4.

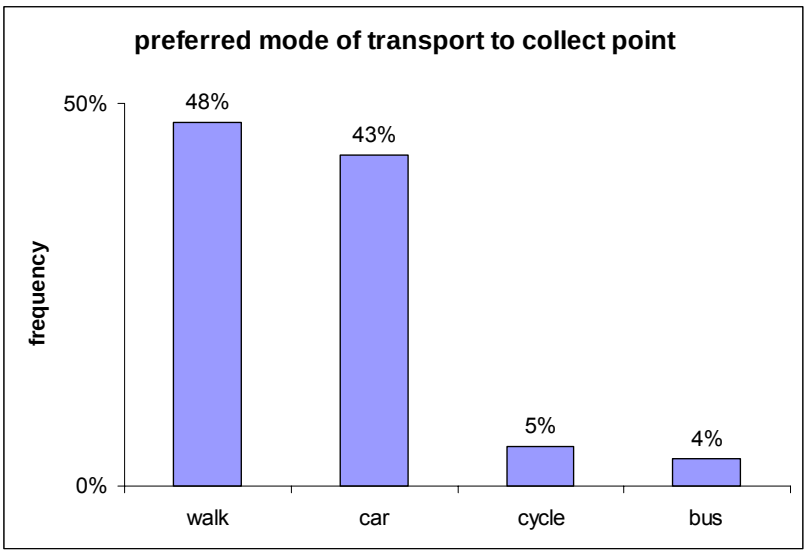


Figure 4: Stated preference of travel mode to visit Collectpoint

3. Public attitude to the Collectpoint scheme

The respondent was asked if they would consider using the Collectpoint scheme provided there was a relevant store near their home or work. The response was generally positive, with only 11% of respondents saying they would not consider using the scheme. The most frequently mentioned reasons why not were security of the package, personal security, unsuitability of a local shop to act like a post office, difficulty in collecting large or heavy items and fraud.

Analysis to assess potential benefits of Collectpoint delivery method

A desktop study was undertaken to estimate the potential travel mileage and time savings to carriers and to the general public associated with the carrier taking failed deliveries to a "collect point". The main transport costs compared in the study were time and distance incurred by the carrier and by customers in delivering or collecting the goods. Two alternative delivery methods were compared:

1. *'Existing' delivery method,* (based on a typical methodology used by some carriers e.g. TNT) and characterised by:
   - Up to two attempts were made to deliver a package to the person's home on successive days.
   - Those packages that were not delivered on either attempt were returned to the carrier's depot.
   - Individuals then collected missed deliveries from the carrier's depot.
2. *'Collectpoint' delivery method*, characterised by:
   - Only one attempt was made to deliver a package to the person's home.
   - Packages that were not delivered to the person's home were taken to the individual's nearest Collectpoint on the same day.
   - Individuals then collected missed deliveries from their local Collectpoint.

MEASURE-LEVEL RESULTS

Measure title: Sustainable Urban Distribution	Project: MIRACLES
Measure number: 9.2	City: Winchester

The key parameters affecting carrier and customer travel are now discussed:

a) Proportion of missed first time deliveries and redeliveries

First time delivery failure rates of 10%, 30% and 50% were considered, to test the sensitivity of the results and because estimates for this parameter varied widely between different data sources. It was assumed that half of all redeliveries would fail. This figure was based on estimates provided by a small number of carriers who were contacted as part of a telephone survey. The impact of high levels of delivery failure rate on vehicle capacity was not considered in this analysis.

b) Number of Collectpoint locations

The number of Collectpoint locations in an area affects both the carrier's and customer's travel. A greater number of locations will benefit the customer, as their average travel distance is reduced. The carrier will have more Collectpoints to visit, however, so there is a likely to be a negative effect for the carrier. The effects of having one, three, five or seven Collectpoints in Winchester were investigated. In each case it was assumed that the carrier would have to visit all of the Collectpoints. In practice, some Collectpoints would not be visited on some days, depending on the locations of failed deliveries.

c) Distance of carrier's depot from delivery area

This distance affects the transport costs of the carrier but it also has a crucial effect on the costs to those customers who would have to travel to the carrier's depot in the existing delivery method scenario. The further the depot is from the delivery area, the more costly it is to collect and, consequently, there is more potential benefit for the Collectpoint delivery method. The location of the carrier's depot clearly depends on the carrier in question. As an example, the nearest Parcelforce depot for the Winchester area is located in Southampton, a distance of 23.4 km away.

d) Carrier's driving distance on delivery round

The carrier's driving distance was estimated with the aid of routing software (DPS Route LogiX), which aimed to produce the quickest routes. Fifty delivery addresses were randomly sampled from the Winchester residents in the survey. For the existing delivery method the carrier had to visit additional addresses, representing the failed deliveries from the previous day. The number of redeliveries varied according to the proportion of failed deliveries being modelled. These redeliveries were also randomly sampled. For the Collectpoint delivery method, each Collectpoint was visited immediately after all of the addresses in the Collectpoint catchment area had been visited.

e) Customer's road travel distances

For the Collectpoint delivery method, the total customer driving distance was calculated as *number of failed first time deliveries* x *average distance by road from homes to and from nearest Collectpoint* x *proportion of people travelling by road.*

For the existing delivery method the total customer driving distance was calculated as *number of failed redeliveries* x *distance by road from depot to central delivery area* x 2 x *proportion of people travelling by road.*

f) Customer time

Customers' travel time by road was calculated as *distance/speed*, where an average speed of 30kph (=19mph) was assumed for travel in Winchester. The average speed to the depot in Southampton was calculated to be 79kph (=49mph), as a substantial part of this journey is on the M3 motorway. In addition to travelling time, the customer was assumed to spend an average of five minutes at the Collectpoint. This time would involve possible queuing in the shop, verifying their identity, waiting for their package to be found, handed over and any necessary paperwork to be completed. No data was available for this value, so an approximate estimate was made.

MEASURE-LEVEL RESULTS

Measure title: Sustainable Urban Distribution	Project: MIRACLES
Measure number: 9.2	City: Winchester

Case study example results

The transport costs for the existing and Collectpoint delivery methods were estimated for a Winchester case study using the methodology described above to investigate the effects of varying two key parameters: the proportion of failed deliveries and the number of Collectpoints. The results are presented as the percentage savings acquired by the Collectpoint method. (A negative values means that the Collectpoint method increased the amount of time required or distance travelled).

Effect of proportion of failed deliveries

First time delivery failure rates of 10%, 30% and 50% were considered and the results are shown in Figure 5.

It can be seen that the Collectpoint delivery method substantially reduces the travel distance and time incurred by customers. The percentage savings equate to total savings of around 100km and one hour of customer distance and time associated with each delivery round. The carrier's delivery round was up to 22km longer for the Collectpoint delivery method due to the following factors:

1. Each Collectpoint had to be visited **after** all of the delivery attempts had been made in its catchment area. This meant the carrier having to "double back" on itself to visit the Collectpoints, considerably lengthening the route. There may be some scope here for investigating optimal carrier routing strategies to try to reduce this trip distance.
2. It was assumed that the carrier would have to visit all the Collectpoints. In practice this might not be required for every Collectpoint if there is no package to take there.

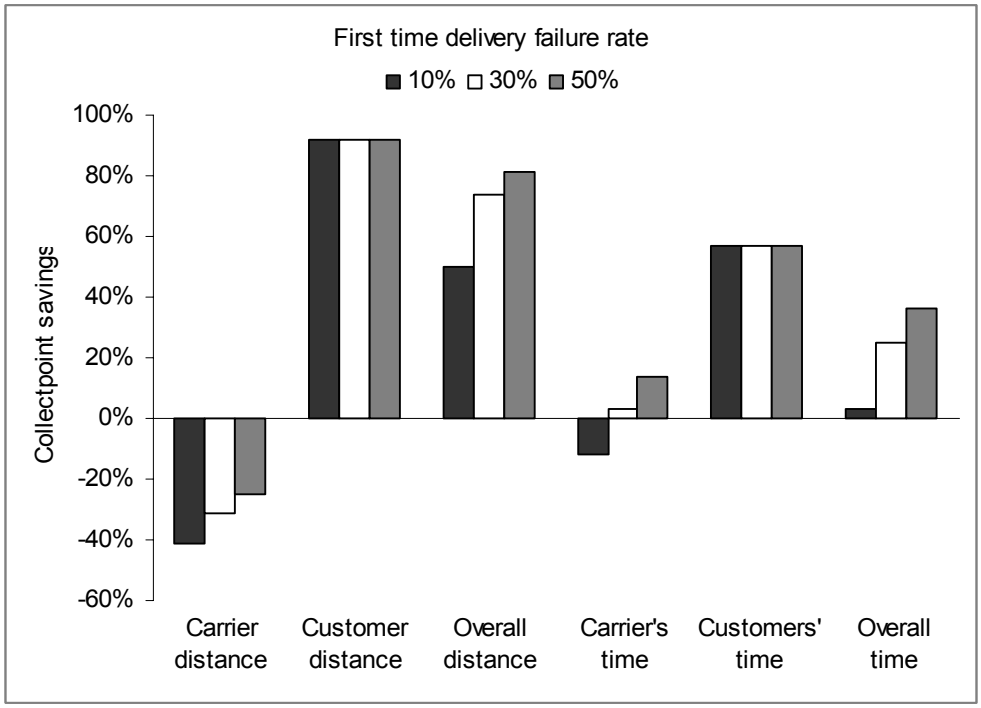


Figure 5: Impact of delivery failure rate on Collectpoint benefits

MEASURE-LEVEL RESULTS	
Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

3. For the existing delivery method, an optimal route, including all the redeliveries, was used, which was not much longer than the equivalent route excluding the redeliveries. This was due to the fact that all the delivery addresses considered were within a relatively compact area. If the households were spread over a wider area then the existing delivery method would tend to become more inefficient in terms of the length of the carrier's delivery round.

Although the Collectpoint method was worse for the carrier in terms of distance travelled, the carrier gained time savings by having fewer deliveries to make. These effects tended to balance each other so that the overall impact on the carrier's time was small.

Effect of Collectpoint availability

The number of Collectpoints available in the delivery area was varied: one, three, five or seven Collectpoints were considered. The locations used were the five convenience stores that participated in the initial Collectpoint survey, plus two locations chosen to fill gaps in the coverage. The average customer distance to their nearest Collectpoint varied from 1.4km (assuming seven Collectpoint locations), to 2.7km with only one Collectpoint location. The impacts on Collectpoint savings are shown in Figure 6. This shows the level of benefit to customers but added mileage for carriers as a result of increasing the number of available Collectpoints.

Effect of depot distance

In the case study example, the depot was over 23km from the delivery area, which led to considerable customer savings for the Collectpoint delivery method. The effect of reducing the depot distance was considered. It was found that the Collectpoint delivery method resulted in customer distance savings as long as the depot was about twice as far away as the average distance to a Collectpoint. This was based on an assumption that the number of redeliveries resulting in a trip to the carrier would be equal to half of the number of failed first time deliveries requiring a trip to the Collectpoint. Customer time savings accrued for the Collectpoint delivery method whenever the depot distance was more than 2.5 times the average Collectpoint distance. No impact of depot distance was modelled for the carrier as it was assumed that the number of trips between the depot and the delivery area would be the same for each delivery method.

Summary

Despite the lack of ex-post results, analysis of a hypothetical scenario provided an indication of the potential levels of transport benefits that may have been accrued from using the Collectpoint delivery method. The main transport benefits are gained by customers, as packages are collected from a local point rather than from a remote depot. Customer mileage savings of over 80% were found in the case study example where the carrier's depot was 23.4km away from the centre of Winchester. Carrier mileage was found to increase as a result of having to visit the Collectpoints after visiting the delivery addresses. The impact on the carrier's time was small however, as extra time in driving was offset by reduced time due to fewer attempted deliveries. Overall time and distance savings were positive for all of the scenarios considered, indicating that the Collectpoint delivery method could produce overall environmental benefits.

MEASURE-LEVEL RESULTS	
Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

Freight Map

A telephone survey of businesses in Winchester, Southampton and Portsmouth was undertaken to assess the usefulness of the freight map. (The map had been distributed to the businesses two months earlier). Of the 61 companies, 44 were contacted by phone (the remaining 17 companies could not be contacted as there was no reply or inaccurate contact details). Of the 44 companies contacted, only two thought they remembered receiving the map (the rest either did not remember or had thrown it away). Comments included “why did you send us the map as we do not deliver into Winchester” and “our drivers have been driving for over 30 years so why do they need a map”. A secondary aim of distributing the maps to local businesses was to raise awareness of their existence and to enable them to be referenced during future trips.

The map was also distributed to a number of motorway service stations and petrol stations where it was available to the general public free of charge. The manager of one service station stated that the maps had been popular with the public and requested that HCC sent additional copies. He added that he is asked directions to various places within Winchester up to 10 times a day and therefore uses the map to explain the directions to the public. Some lorry drivers, taxi drivers and van drivers also used the map but it was mainly used and taken by the general public to find a particular location in Winchester i.e. the map ended up serving a different purpose that that for which it was originally designed.

The Winchester Business Questionnaire (see Measure 10) was sent out to 550 businesses in Winchester and asked their awareness of the freight map. Of the 100 responses, three were aware of the map, and two requested a copy. However, it is anticipated that awareness of the map could increase in the future since it can be downloaded from the Winchester MIRACLES website, the URL of which was included in the Business Questionnaire.

The maps generally were not sent to a particular person (e.g. the freight manager of the company) and so may not have reached the people that might have benefited. It was difficult to target the right person due to high staff turnover and lack of access to an up-to-date database. Even if the freight manager had received the map, it is the drivers who may benefit most (some of whom do not work for that company but are sub-contracted) and there was no evidence that the map actually reached the drivers. In addition, many lorries are now fitted with GPS navigational tracking devices, which could make a map redundant.

Waste-recycling scheme

A preliminary questionnaire survey was undertaken by Dove Recycling on behalf of HCC to investigate opportunities for using electric vehicles for collecting dry recyclable materials from businesses in Winchester. Following the survey, a waste-recycling collection scheme was trialled by Dove among interested Winchester businesses.

Waste-recycling questionnaire survey

100 businesses on Winchester High Street were interviewed, covering a variety of retailers (clothing, food, books, toys, jewellery, mobile phones, shoes and stationery) as well as organisations such as estate agents, opticians and restaurants. Considering all 100 responses, 32% of the businesses stated that they did recycle waste, while 68% did not.

Each business was asked how many external bins they had. The results are shown in Figure 7. Less than 30% of businesses did not use bins due to space issues and used sacks instead.

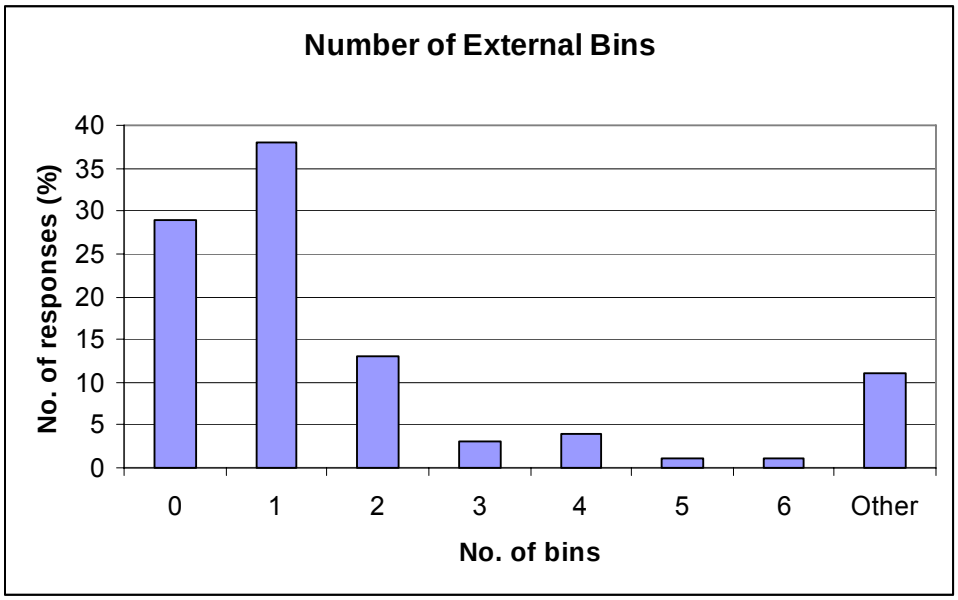


Figure 7: Number of external bins (all businesses)

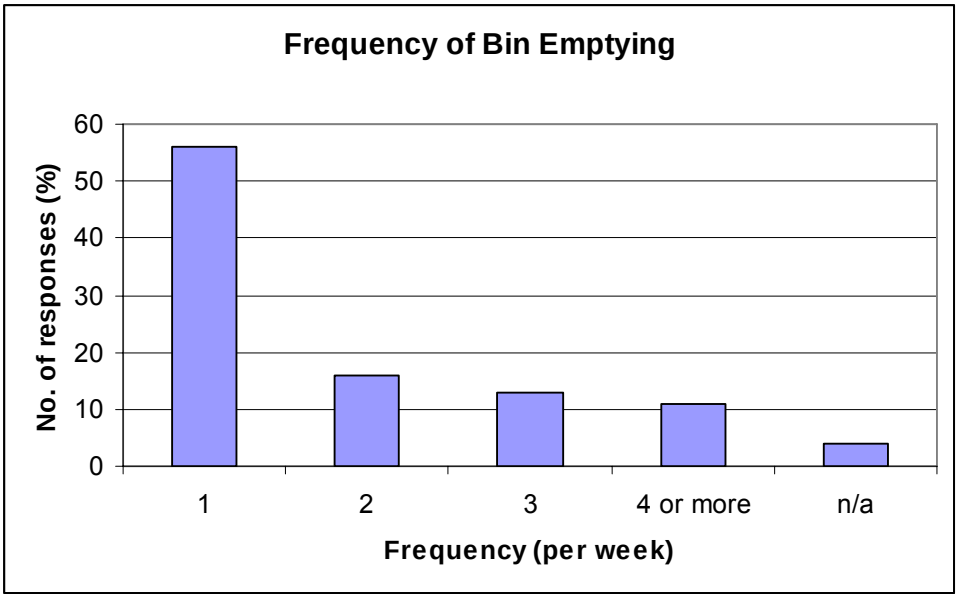


Figure 8: Frequency of emptying external bins (all businesses)

The businesses were asked how frequently (per week) their external bins were emptied, and 55% stated that they had a weekly collection (Figure 8). They were also asked to name the '*contractor*' for this task. 66% replied *SERCO*, 14% *Biffa*, 3% *SITA*, 2% *Cleanaway* and 1% *ONYX*. In addition, 6% cited a member of staff and 8% did not know (or did not answer the question).

A follow-up interview with SERCO found that the High Street was served by one dedicated 26 tonne refuse collection vehicle, working Monday to Friday, with a driver and two loaders. All waste collected is taken to Otterbourne transfer station (11.3 km from Winchester) where it is then moved to Fairoak landfill site by Hampshire Waste Services. No separation or recycling of the waste by the High Street businesses currently takes place. All businesses set up a contract with SERCO and are provided with a bin as part of the service agreement. If a bin is not appropriate, sacks are provided. Current charges range from £1.75 per 120 litre bin collection to £7.95 per 1100 litre bin collection.

Each business was shown a list of materials that may have formed part of their waste, and had to estimate the approximate percentage that contributed towards their total waste output. The results were averaged across all businesses to generate an 'average' composition of the total waste, and this is shown in Figure 9. The results suggest that 75% of the contents of the average bin generated by the businesses on Winchester High Street was made up of paper and cardboard and could be directly recycled. SERCO stated that setting up specific recycling collections for small-medium size enterprises would not be cost effective. However, a smaller operator (e.g. Dove Recycling) could make significant in-roads to improving recycling levels within a city centre, which would be aided by the use of an environmentally friendly vehicle.

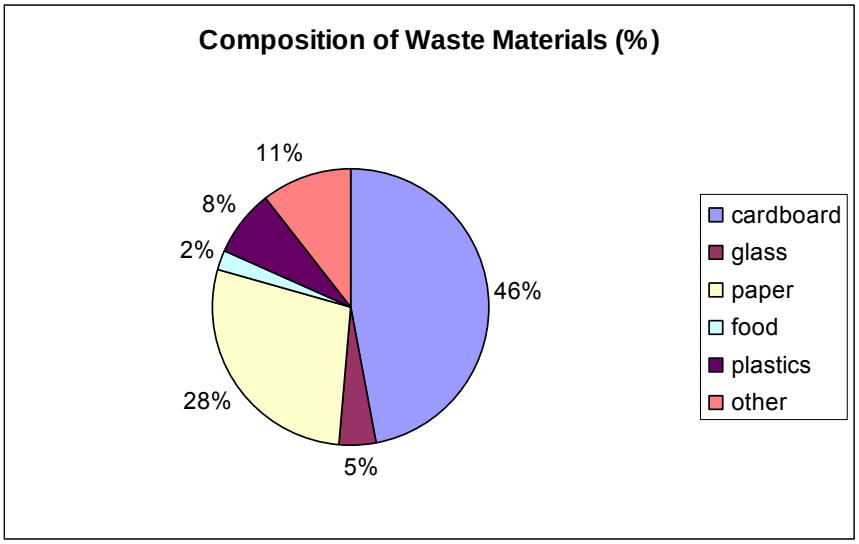


Figure 9: Average composition of the total waste (all businesses)

MEASURE-LEVEL RESULTS

Measure title: Sustainable Urban Distribution	Project: MIRACLES
Measure number: 9.2	City: Winchester

Each business was asked if there were any problems that arose with their refuse collection. The responses were assigned into generic categories, and are shown in Table 1.

Table 1: Existing problems with refuse collection (all businesses)

Problems	No. of responses (%)
No recycling done	35
No external space for wheelie bin	16
Waste does not fit into bin	10
Too expensive to recycle	3
Waste left lying around	3
Problems with recycling specific waste types	4
More frequent collections needed	4
Running out of storage space	5
Other	4
No problems	16

Each respondent was asked to suggest possible solutions to their problems. 51% stated that a local business that collects recyclable waste would be beneficial. 55% of the respondents stated that they would be interested in taking part in a collection trial of their recyclable waste using electric vehicles.

Waste collection records

As of October 2005, Dove Recycling collected waste from some 35 businesses in Winchester. Each participating business was charged a collection fee of £6.50 per week, and they received one or two collections per week, depending on their needs. Each collection consisted of a maximum of 3 bags of about 50-litre capacity. The waste was taken away by Dove to their premises where it was bulked into containers and then disposed of at the appropriate local waste-recycling site.

The waste records for the period April-June 2005 supplied by Dove are shown in Table 2. (All values are in kg and a 'dash' indicates that the company had not yet signed up to the scheme). Although the scheme was still in its infancy, it is encouraging that the number of local businesses participating in the scheme increased from 4 in April 2005 to 15 in June to 35 in October 2005. Consequently the total quantity of recyclable waste collected each month has increased; for example, from 276kg in April to 1004kg in June 2005. Dove plan to expand the scheme city-wide throughout Winchester, and now also offer collection services in Southampton, Bishops Waltham, Andover and Petersfield.

There was evidence from Dove's contacts with the businesses that many of the local businesses signed up to the scheme primarily because Dove was using an electric van to collect the waste. The businesses believed that their involvement with such a scheme created a good impression with the public and was therefore a useful Public Relations exercise in addition to the environmental benefits of having their waste recycled. Indeed, Dove is planning to buy a larger electric van when they manage to sign up 60 businesses in Winchester.

Another consequence of using an electric vehicle is that is has relatively low running costs. For instance, a diesel van is used for the Petersfield collections and businesses there are charged more than the Winchester businesses as a result of the higher running costs associated with the van.

MEASURE-LEVEL RESULTS

Measure title: Sustainable Urban Distribution | **Project: MIRACLES**

Measure number: 9.2 | **City: Winchester**

Table 2: Waste records from Winchester businesses served by Dove Recycling

	Weight (kg) of waste collected in April 2005				Weight (kg) of waste collected in May 2005				Weight (kg) of waste collected in June 2005			
	Paper	Cardboard	Glass	Cans	Paper	Cardboard	Glass	Cans	Paper	Cardboard	Glass	Cans
Age Concern	112	5	0	0	119	8	0	0	115	11	0	0
Savells	57	26	0	0	64	15	0	0	65	13	0	0
Smiths Gore	45	0	0	0	37	49	0	0	53	0	0	0
WT Partners	31	0	0	0	29	0	0	0	36	0	0	0
Atkins	-	-	-	-	26	0	0	0	77	5	0	0
WAG Gift shop	-	-	-	-	-	-	-	-	9	0	0	0
Winchester university	-	-	-	-	-	-	-	-	234	0	0	0
Zoo Jewellers	-	-	-	-	-	-	-	-	11	0	0	0
Waterstones	-	-	-	-	-	-	-	-	0	45	0	0
Winchester Diocese	-	-	-	-	-	-	-	-	87	0	0	0
Snooker club	-	-	-	-	-	-	-	-	0	14	49	13
Club Francais	-	-	-	-	-	-	-	-	0	17	0	0
Complete	-	-	-	-	-	-	-	-	7	0	0	0
CGA Frazer	-	-	-	-	-	-	-	-	6	0	0	0
RWT	-	-	-	-	-	-	-	-	137	0	0	0
Total	**245**	**31**	**0**	**0**	**275**	**72**	**0**	**0**	**837**	**105**	**49**	**13**

Additional waste records supplied by Dove show that 965kg of recyclable waste was collected during October 2005. Although their client base consists of 35 Winchester businesses, collections were made from only 15 of them during October, implying that not all businesses required a regular collection service and that the total amount of waste collected is still around one tonne per month.

MEASURE-LEVEL RESULTS

Measure title: Sustainable Urban Distribution	Project: MIRACLES
Measure number: 9.2	City: Winchester

A summary of the measure indicators (as defined in the Local Annex of D4.1) is shown in Table 3.

Table 3: Summary of measure indicators for WP9.2

Indicator no. (Meteor no.)	Indicator name	Baseline 2003	Business as Usual 2005	MIRACLES 2005
W9.2/Econ6a	Design and production cost of freight map	N/a	N/a	£8500 + £950
W9.2/Soc1a (13-14)	Acceptance / awareness rating (Collectpoint)	N/a	N/a	10% of general public, and 3% of businesses
W9.2/Soc1b	Number of households using Collectpoint	N/a	N/a	75 people registered, 8 used voucher.
W9.2/Soc2a (13)	Increase in no. of purchases made by Collectpoint customers	N/a	N/a	8 people used voucher
W9.2/Soc2b (13-14)	Awareness and usefulness of freight map	N/a	N/a	3% of businesses

With the exception of the Collectpoint mini-measure, the measure will continue beyond the lifetime of MIRACLES.

Up-scaling

This measure was not up-scaled since the urban goods delivery service (the Collectpoint scheme) was not trialled in sufficient detail The waste-recycling collection scheme only started in April 2005 and the lack of data meant that an understanding of the potential effects of extending the scheme city-wide was lacking.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

The Air Quality Action Plan (AQAP) was a main driver for this measure with potential emissions savings made from collecting recyclable waste with an electric van and reducing the number of failed home deliveries with Collectpoint. Many businesses used the waste recycling service in order to demonstrate their 'green' image with their customers. The disbanding of the B to C arm of Collectpoint in addition to technical problems with its website resulted in a fully operational trial not being implemented. Resistance to change from the internet retailers and customers until the scheme has shown to be successful was a barrier to its implementation.

M13: Interrelationships with other measures

This measure is linked with WP12.3: Clean fuel support vehicles and WP10: Innovative soft measures.

M14: Lessons learned

The Collectpoint scheme

1. The initial Collectpoint trial was not a great success, partly marred by technical difficulties with the Collectpoint website and voucher system. Only a few people used the service. It was also thought that the unfamiliarity of the staff with the system at the local convenience stores affected public perception and ease of use of the system.

MEASURE-LEVEL RESULTS	
Measure title: Sustainable Urban Distribution	**Project: MIRACLES**
Measure number: 9.2	**City: Winchester**

2. Preliminary analysis using routing software showed that if a fully-working Collectpoint scheme had been implemented, there were potential benefits to be gained in terms of reduced time and distance travelled.
3. There was a lack of data to assess whether the Collectpoint scheme would have been commercially viable although this trial may suggest it is not.
4. For the Collectpoint scheme to be successful, Internet retailers (such as Amazon) need to incorporate it into their system as an alternative delivery option. However, before a company such as Amazon agreed to this, they would first need to see the scheme being demonstrated successfully.
5. Customers may feel they are taking a risk by changing their home delivery option, particularly if it is still in the trial stage. Even with a successfully demonstrated scheme, customers will take time to change to a new home delivery method.

Freight map

6. There was no evidence that the freight map was used by freight companies, although this could be partly attributable to the monitoring / evaluation process since there was no easy way for genuine users to provide feedback. Some subjective comments suggested that the map was being used as a basis for providing directions to the public or as a simplified parking map. The freight map may have been a useful tool for freight drivers, but the map could have been distributed to this audience more effectively. However, within the life-cycle of the MIRACLES project, the use of satellite navigation systems has increased considerably, resulting in a lower need and reduced effectiveness of a freight map, although it is unlikely that navigation systems have waiting restrictions (for example) included.

Waste-recycling scheme

7. A relatively small amount of recyclable waste was collected, typically about one tonne per month. Nevertheless, this appears to be an economically viable venture for Dove since they now operate the waste-recycling service on a full-time basis (they were formerly a cleaning company for businesses). They now have a client base of 35 Winchester businesses and have expanded the scheme to other towns in Hampshire.
8. Encouragingly, Dove Recycling reported that the participating Winchester businesses saw the use of an electric van to remove their waste as a worthwhile public relations exercise and it enforced the impression that they are a ‘green’ company.

Contact Point

💻.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

7. Measure 10

MEASURE-LEVEL RESULTS	
Measure title: Innovative soft measures	**Project: MIRACLES**
Measure number: 10	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

The objectives of this measure were as follows:

- Raise public awareness of the developments and achievements of the MIRACLES initiatives to 5% by promoting the benefits to both residents and visitors.
- Encourage the development of work place travel plans with an increase of at least 2,000 employees covered by such a plan in the Winchester area by the end of MIRACLES.
- Encourage a change in modal choice for business related travel and working practice in order to minimise the impact of business travel. This included increasing public support of the aims of MIRACLES including sustainable transport by 25%.

The Awareness (W10.1) and Mobility Management (W10.2) measures originally defined were closely integrated, and so were treated as a single measure (i.e. Measure 10).

M2: Measure description:

This Measure was to raise awareness and acceptance of the other measures being implemented in MIRACLES. Much of the dissemination was closely associated with each individual measure and was accounted for within those measure specific evaluations. A variety of dissemination methods were used to raise the awareness and acceptance of both MIRACLES and CIVITAS with both the visitors and residents of Winchester and businesses in the city centre. These awareness methods included leaflets, radio advertisements, a Winchester MIRACLES website, demonstration days and a school art competition. In addition, businesses, organisations and schools in the Winchester area were encouraged and helped to develop a green travel plan to increase sustainable transport and reduce reliance on the private car.

The Implementation – how was the measure implemented?

M3: Innovative aspects:

None. (Note that it was a supporting measure raising awareness).

M4: Situation before CIVITAS:

This work package built on Hampshire County Council's (HCC) HEADSTART campaign which was set up to increase public awareness and participation in a staged approach to:

- raise awareness of transport problems
- increase acceptance that individuals can personally contribute to solving the problem
- change attitudes towards car use
- encourage individuals to take action to change their travel behaviour

HCC had also been involved in a series of initiatives including a pilot project into personalised journey planning at four major employers in Winchester. Prior to MIRACLES, HCC appointed a Work Place Travel Plan Co-ordinator to provide advice and support for businesses and schools wishing to develop a green travel plan. As a result, about 4,000 employees were covered by a green travel plan. The HCC website also contained information regarding green travel plans as well as other public transport information.

MEASURE-LEVEL RESULTS	
Measure title: Innovative soft measures	**Project: MIRACLES**
Measure number: 10	**City: Winchester**

M5: Design of the measure:

This work package was designed around the following series of mini-measures:

- Use of variety of publicity material such as leaflets, brochures, radio and newspaper advertisements and logos to promote and raise awareness of the project.
- Improve air quality awareness by applying a pollution-forecasting model to Winchester, developed by the National Meteorological Centre.
- Develop software to support the financial case for a switch to clean engine technology.
- Support a variety of publicity events such as National Bike Week, Alternative Transport Day and a school art competition (see Figure 1).
- Encourage businesses, organisations and schools in Winchester to develop a green travel plan.
- Develop and maintain a MIRACLES website for Winchester.
- Run a series of Workshops/focus groups to raise awareness and receive feedback on each MIRACLES measure.
- Develop awareness of the air quality plan.

Figure 1: The MIRACLES stand at the Winchester Bike week

MEASURE-LEVEL RESULTS

Measure title: Innovative soft measures	Project: MIRACLES
Measure number: 10	City: Winchester

M6: Actual implementation:

This measure was implemented in the following stages (some ran concurrently or overlapped):

Stage 1: A series of innovative soft measures to raise awareness of MIRACLES (on-going)
Stage 2: Provide a link from website to pollution-forecasting model (April – July 2004)
Stage 3: Provide a link to clean engine technology software (April - July 2004)
Stage 4: Support the demonstration days/weeks and other publicity events (one day in June and September of each year of MIRACLES)
Stage 5: Encourage the development of green travel plans (ongoing)
Stage 6: Develop the MIRACLES website for Winchester (April 2004 – end of project)
Stage 7 Of the series of workshops originally planned, only one Motorvate seminar took place (see M7 and Measure 12.2)
Stage 8: Develop and implement an air quality plan for Winchester (May 2004 – July 2005)

M7: Deviations from the plan:

There was originally a plan to develop software to support the financial case for a switch to clean engine technology; this already existed and so a web-link from the Winchester MIRACLES website was created so visitors could access it. Workshops, with the exception of the Motorvate seminar (see Measure 12.2) were replaced with a road-show where exhibition boards were taken to various venues such as the Sustainable Business Awards at the Guildhall in November 2005. This raised the awareness of MIRACLES in schools and community groups (W10/Econ5a, Soc1c & 1d).

Five of the indicators originally defined for this Measure within D4.1 were not collected either because of a lack of data or because they were redundant due to a re-design of the Measure. These indicators were:

- W10/Econ5a – Cost of Workshops;
- W10/Soc1d – Usefulness of Workshop
- W10/Soc4a – Number of website visitors;
- W10/Soc4b – Number of website visitors linking to air quality website;
- W10/Soc4c - Number of website visitors linking to cleaner engine website.

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

Data came from a variety of sources:

HCC cost statements – these outlined the hours worked on MIRACLES split by work package and staff grade along with any equipment/consumables bought. The figures came from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.

Acceptance/awareness questionnaire surveys – Five sets of questionnaire surveys were undertaken to measure the public acceptance and awareness of the MIRACLES project within Winchester (see Table 1).

MEASURE-LEVEL RESULTS

Measure title: Innovative soft measures | **Project: MIRACLES**

Measure number: 10 | **City: Winchester**

Table 1: Details of the five acceptance/awareness questionnaires

	Name of survey	Date of survey	Sample size	Purpose
1	Winchester Travel Baseline	July/August 2003	4495	Establish a baseline of data before implementation of measures
2	Winchester Transport	January/February 2005	914	Acceptance of specific measures within MIRACLES
3	MIRACLES awareness	January/February 2005	850	Awareness of specific measures within MIRACLES
4	Business	May 2005	96	Awareness/acceptance of MIRACLES measures
5	Winchester Travel Final	July/August 2005	1771	Assess how the MIRACLES measures have altered the baseline of data

Green travel plan survey – A green workplace travel plan is a package of measures with the objective of widening travel choices by all modes of transport and reducing unnecessary car use. Travel plans are focused particularly on employees but also take into account customers, visitors, business travel, fleet management and deliveries. A questionnaire survey was undertaken of businesses, organisations or schools in the Winchester area that were known by HCC to either already have a green travel plan or were interested in developing one. Each organisation was initially telephoned to ensure that the contact details were correct as well as asking whether they would be willing to complete a short questionnaire. The questionnaire was 1 side of A4 and was estimated to take only a couple of minutes to fill in. In total, 16 questionnaires were returned.

School travel plan list – A list of schools in the Winchester District who had a travel plan (or were thinking about it) was compiled by the Winchester Highway and Transport Advisory Panel in November 2004. A School Travel Plan is a school initiative gaining support from children, staff, parents, governors and the wider community, to develop a document that identifies current issues and problems on the school journey. It also sets out aims, objectives and targets for the school, with respect to school travel and includes an action plan of measures to help achieve these and a strategy for monitoring and reviewing the progress made. To help determine levels of current School Travel Plan (STP) activity in Hampshire and to assist in the determination of planning applications (where a STP is required), Hampshire County Council devised assessment criteria for schools developing and implementing STPs. They were:

- Level zero – showed an interest in developing a STP
- Level one – working towards a STP
- Level two – draft STP
- Level three – active STP

Schools who reach Level three with their School Travel Plan are eligible to bid for funding from the County-wide Safer Routes to Schools Programme. The Programme provides funding for measures identified within plans that will make it safer and more desirable to walk, cycle and use passenger transport on the journey to, and from, school. These measures could include footways, cycleways, improved crossings and traffic calming.

M9: Achievement of quantifiable targets:

- Awareness of MIRACLES at 20% (32.6% for businesses)
- 11,835 employees now covered by a workplace travel plan (an additional 7,722 since

MEASURE-LEVEL RESULTS

Measure title: Innovative soft measures	Project: MIRACLES
Measure number: 10	City: Winchester

MIRACLES began.

- Agreement of the general public with the objectives of MIRACLES was 70.9% who either strongly agreed or tended to agree (59.4% for businesses).

M10: Achievement of evaluation-related milestones:

All the evaluation related milestones (as in the Winchester Annex of D4.1) were achieved.

M11: Report on the measure results:

HCC cost data

The data from HCC came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3 and an estimate for Year 4. Staff hours for Work package 7 was a total of 3895 hours at a cost of £97,300. Timesheets of staff at HCC allocated their time to a specific work package but did not give further information regarding time spent on sub-tasks (e.g. designing website, green travel plan assistance or air quality plan promotion) (W10/Econ1a, 2a and 3a). In addition, HCC spent about £28,000 in sub-contracting the Meteorological Office for developing the pollution-forecasting model for Winchester, £11,000 on preparation and broadcasting of three radio advertisements, £3,600 on promotional material including leaflets, newspaper adverts, photography & freebies, £2,300 on promotional boards or panels, £1,320 on website design, £1,000 to support each demonstration day (W10/Econ4a) and £500 on the art competition.

Green travel plan survey

Table 2: Travel plan survey of Winchester

Organisation	When plan implemented	Plan approved by board?	Member of staff responsible for plan	Number of employees covered
BUSINESSES/COLLEGES				
IBM	2003	Yes	Yes (1 day/week)	3,100
Winchester Hospital	2003	Yes	Yes (15 hrs/week)	3,000
Hampshire County Council	2000	Yes	Yes (now 2 PT)	2,700
Inland Revenue	2000	Yes	Yes (1 day/mth)	683
Hampshire Constabulary	2002	Yes	Yes (5 hrs/week)	560
University College Winchester	2004	Yes	Yes (1 day/week)	550
Peter Symonds College	2001	Yes	Yes (5 hrs/week)	510
Winchester City Council	2003	Yes	10 hrs/week	500
Sparsholt College	2001	Yes	Yes	220
Olivers Battery Dental Surgery	2004	Yes	15 minutes/week	12
SCHOOLS				
Kings Secondary School	2002	Yes	Yes	1720 (120 staff. 1600 pupils)
Henry Beaufort School	2001	Yes	Yes	1090 (90 staff; 1000 students)
St Bede CE Primary School	2004	Yes	Yes	324 (15 staff, 309 pupils)
Perins School	2002	Yes	Yes (1 week/year)	100
BUSINESSES DEVELOPING A PLAN				
Upton McGougan PLC	Developing a plan	-	-	100
Environmental Agency	Developing a plan	-	-	150

MEASURE-LEVEL RESULTS

Measure title: Innovative soft measures	Project: MIRACLES
Measure number: 10	City: Winchester

A list of the companies/organisations/schools who responded to the questionnaire survey is shown in Table 2. Of the 16 organisations that responded, 14 had a travel plan.

In addition to Upton McGougan PLC and the Environmental Agency, three other organisations were known to either have a plan or expressed an interest in developing one. Overall, 11,835 employees were covered by a travel plan in the Winchester area (excluding staff at schools), which was an increase of 7,772 during the MIRACLES project. This meant that about 35% of the total workforce in Winchester was covered by a travel plan.

The survey also asked about:

Parking controls: Only the Hospital and University College required staff to buy permits to park on site. Staff at the Inland Revenue and St Bede Primary School had only limited parking available for some staff. All the other organisations had plenty of free parking and found resistance from staff for any proposed changes to this arrangement. The Hospital subsequently introduced a system where staff could use their car park four days a week but have to use alternative transport on the fifth day. In March 2005, there were 175 members of staff with the restricted permits which are reviewed annually. Staff living within 1 mile from the hospital are ineligible for a permit; there are plans to extend this restriction zone to the city boundary.

Financial loans: With the exception of the four schools, interest free loans were available to staff from all the organisations listed for buying season tickets, bicycles or home computer/laptops.

Encouraging cycling: All of the organisations had cycle lockers/stands with 8 of the listed organisations also having showers/changing facilities.

Encouraging car sharing: All the organisations apart from the Dental Surgery (with only 12 employees) encouraged car sharing to some degree. The schools communicated its desirability to staff but had no formal scheme. Five of the organisations (Environmental agency, Hampshire Constabulary, University College Winchester, Winchester City Council and Winchester Hospital) were part of internet based Hantscarshare.com scheme with Peter Symonds about to join. Staff were also encouraged to use Liftshare.org in four of the organisations including Winchester City Council and the Hospital, but little interest was reported and it had even been poorly received.

Support and partnerships: all the organisations asked Hampshire County Council for advice about how to set up a travel plan. The schools have Level 3 plans which means they have been officially approved by the County Council. Most of the other partnerships mentioned were informal with other Local Authorities or Winchester Commuter Forum. Two organisations felt that they received little or no support for the development and implementation of their plan from HCC.

Follow-up surveys: All the organisations (apart from the Dental Surgery) carried out a regular follow-up survey of how staff travelled to work either every year or every two years. IBM found a slight increase in car sharing, home working and use of public transport. Peter Symonds College and Perins School found no real change except for a small increase in the number of cyclists. The Inland Revenue found a 6% decrease in single car occupancy commuting. A survey at HCC in 2002 found an increase in single occupancy car travel (+7%) and a reduction in car sharing (-9%) compared to 1999.

In summary, green travel plans were still a relatively new concept for most of the organisations listed. Only a small proportion of businesses in Winchester had a travel plan, although this number should increase in the future since planning permission for renting new office/commercial floorspace now requires the prospective tenants to submit a travel plan. Organisations with large numbers of staff had a greater responsibility and resources to develop and implement a plan. One of the biggest barriers

was staff resistance to any form of parking restrictions at work or car sharing. Companies such as the Inland Revenue, who had limited parking for only 23% of their staff, potentially have the greatest opportunity to reduce single occupancy commuting by car.

School travel plan list - Over 100 schools in Hampshire completed a School Travel Plan and there are currently more than 100 schools working with the team to develop a plan. A list of schools in the Winchester area from the Winchester Highway and Transport Advisory Panel in November 2004 revealed that there were currently 22 schools at various stages of having or implementing a STP (3 L0, 10 L1, 1 L2 and 8 L3). It is expected that more schools in Hampshire (including Winchester) will develop a travel plan, particularly as there is potentially financial benefits from the Safer Routes to Schools programme.

Results of acceptance/awareness questionnaire surveys

Awareness of MIRACLES. The Winchester Travel Questionnaire asked people if they were aware of the Winchester Movement and Access Plan (WMAP), CIVITAS and MIRACLES logos (see Figure 2). Table 3 shows the results from four questionnaire surveys.

Figure 2: Logos shown in the Winchester Transport Questionnaire.

Table 3: Awareness of WMAP, MIRACLES and CIVITAS

Name of survey	WMAP	MIRACLES	CIVITAS
Winchester Travel - Baseline	20.0%	3.2%	3.0%
MIRACLES awareness	19.4%	9.9%	12.8%
Winchester Travel - Final	24.9%	20.0%	14.2%
Business	41.0%	24.1%	32.6%

A minority of people were aware of the respective logos although the results showed that awareness of MIRACLES increased from 3.2% in July/August 2003 to 24.1% in July/August 2005 (W10/Soc1a). There were significant differences between these two results (heterogeneity χ^2 = 17.72 and $\chi^2_{(0.01)}$ (1df) = 6.63). Awareness of businesses was much higher for all three logos showing that initiatives such as the clean vehicle trials (where many businesses had already been contacted) had raised awareness of the project (W10/Soc2b). Awareness of MIRACLES of bus passengers also increased during the project (from 10% in the Interim survey to 25% in the Final bus passenger survey – see Measure 7). Before MIRACLES, WMAP was the major program in Winchester to make people aware of sustainable transport issues and had been on-going for about 10 years. This may explain why WMAP's awareness among Winchester residents was much higher than that of MIRACLES.

How made aware of MIRACLES: Those people that were aware of the MIRACLES project were asked in the Awareness questionnaire how they were informed. 13% stated that they were informed through the local newspaper, 13% through a leaflet or poster, 11% through the Bikeabout bicycles and 10% from another source (which included being contacted by HCC or made aware through their job).

MEASURE-LEVEL RESULTS

Measure title: Innovative soft measures	Project: MIRACLES
Measure number: 10	City: Winchester

Only 7% of respondents were aware of MIRACLES through Bike Week even though awareness of this event was very high (over 50% - see Table 4). This was also true for the Sustainable Transport Day. From the business questionnaire, businesses that were aware of MIRACLES had been informed through local newspaper (46%), leaflet/poster (36%), information displays at bus stops (25%) and 29% other (which included through HCC or WCC). Figure 3 illustrates the success of the various methods used to inform the general public about MIRACLES.

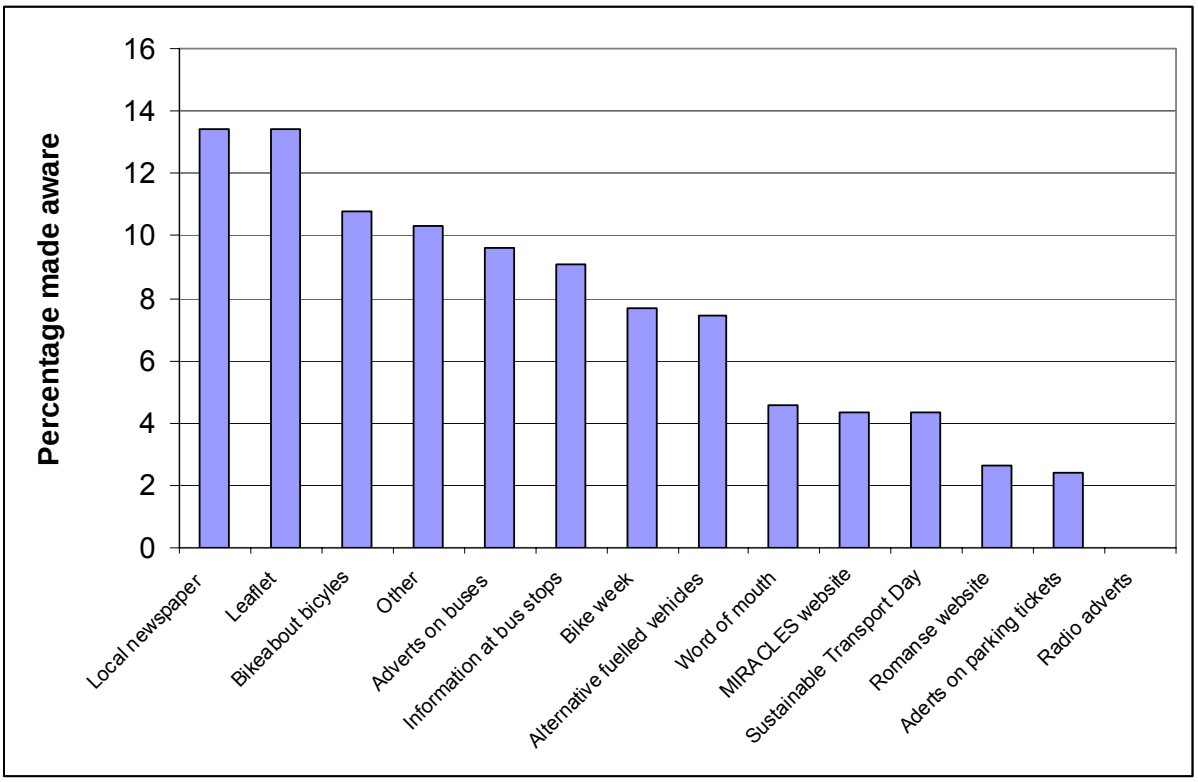


Figure 3: Main method used to inform respondents of MIRACLES

Agreement with objectives of MIRACLES: The Winchester Travel Questionnaire asked people about their level of agreement with the objectives of the MIRACLES project. Although there may be a subtle difference between the level of agreement and overall acceptance, it is assumed that by showing their agreement with the statement of objectives respondents are providing a conservative estimate of their level of acceptance.

The questionnaire asked people to give their level of agreement to the following statement: "*Hampshire County Council and Winchester City Council are trying to encourage people to reduce the number of journeys they make by car and instead, travel by more environmentally friendly and sustainable methods, such as walking, cycling and public transport*". The percentage of respondents who either strongly agreed or tended to agree was 70.9%, which was a slight increase compared to the value in the Baseline survey of 68.9% (W10/Soc1a). There were significant differences between the two sets of data (heterogeneity χ^2 = 13.38 and $\chi^2_{(0.05)}$ (5df) = 11.07). Respondents in the Final survey were less likely to generally disagree with the objectives.

The result from the business questionnaire was much lower at 59.4% (W10/Soc2a) reflecting the view that they may be affected negatively by the implementation of certain environmental policies. Figure 4 shows the results from the Travel Questionnaire Final survey.

MEASURE-LEVEL RESULTS	
Measure title: Innovative soft measures	**Project: MIRACLES**
Measure number: 10	**City: Winchester**

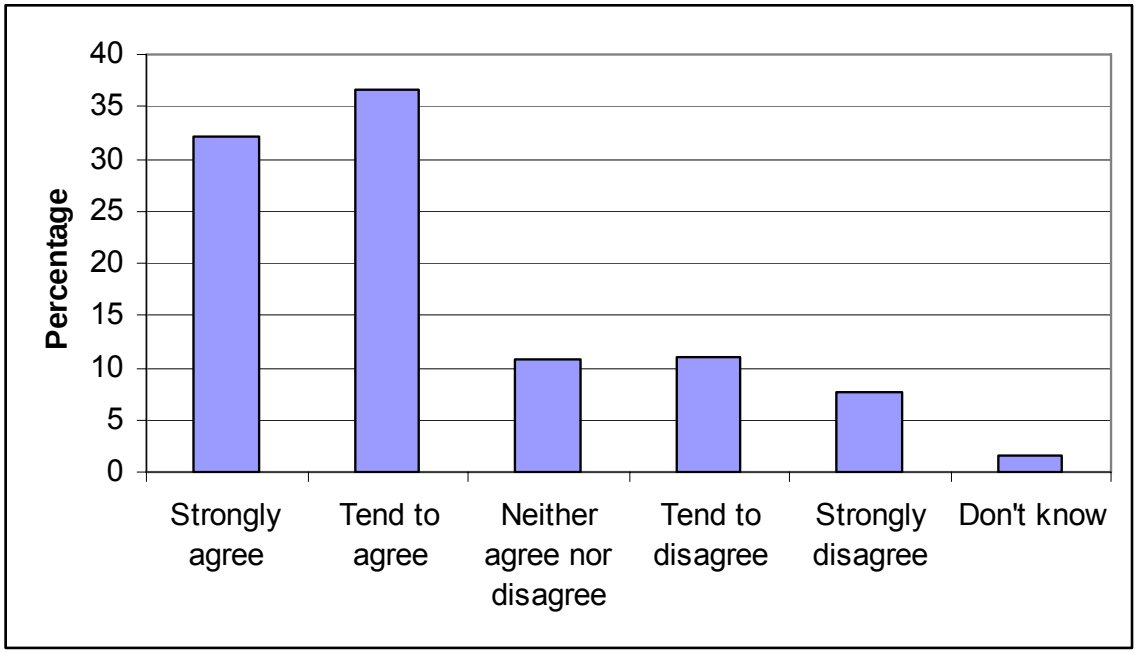


Figure 4: Percentage of respondents stating their level of agreement with the objectives of the MIRACLES project

Importance of reducing car use: The questionnaire asked people to give their level of agreement to the following statement: "*How important do you believe it is for Hampshire County Council and Winchester City Council to reduce car use in Winchester and increase the number of journeys made by more sustainable methods, such as walking, cycling and public transport?*"

80.9% of the general public either strongly agreed or tended to agree, which was a noticeable increase compared to the baseline survey value of 68.9% (see Figure 5). The responses to the last two questions showed a high level of acceptance of the aims of MIRACLES and in reducing car use. However, in practice (as shown by the travel plan survey), people were generally resistant to the idea of restricting free parking at the workplace or of car sharing. This highlights that some people may agree to car reduction in theory but only when it does not affect their own car use.

MEASURE-LEVEL RESULTS	
Measure title: Innovative soft measures	**Project: MIRACLES**
Measure number: 10	**City: Winchester**

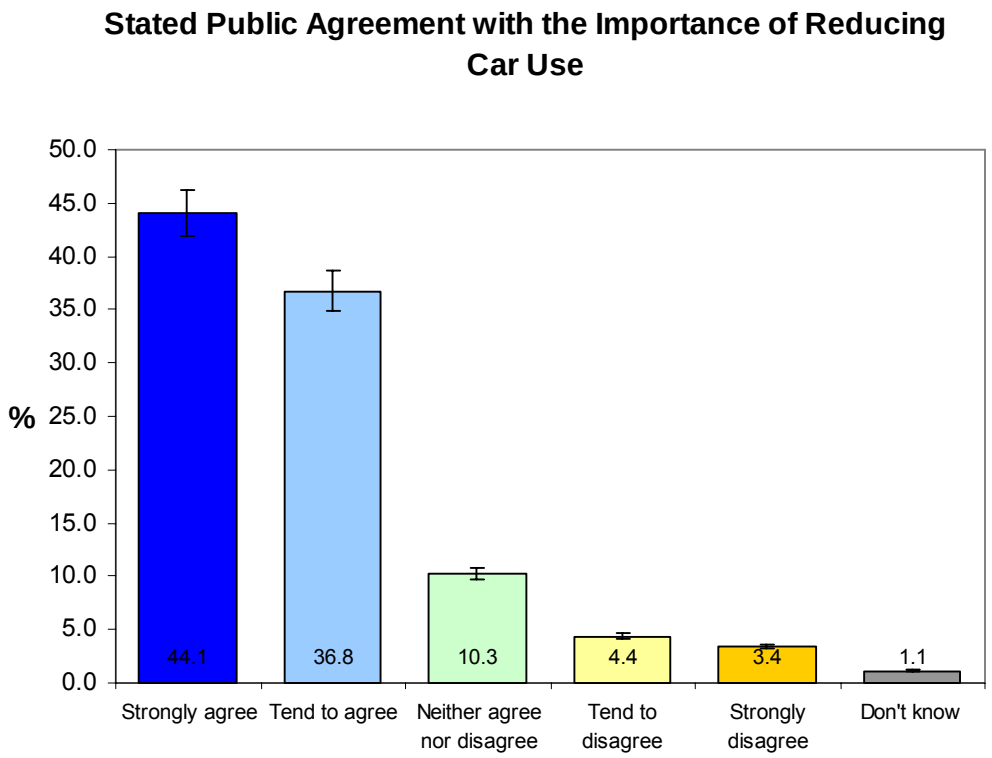


Figure 5: Percentage of valid responses stating their level of agreement with the objectives of reducing car use in Winchester

Awareness of various initiatives: The MIRACLES Awareness/Transport questionnaires asked the general public if they were previously aware of the MIRACLES initiatives prior to receiving the questionnaire. Table 4 shows the results.

MEASURE-LEVEL RESULTS

Measure title: Innovative soft measures	Project: MIRACLES
Measure number: 10	City: Winchester

Table 4: Percentage of the general public aware of the project initiatives

MIRACLES initiative	% public aware
W10 Bike week (W10/Soc3b)	57%
W10 Alternative Transport Day	51%
W11.1 BDIS	49%
W11.1 VMS with traveller information	42%
W8.2 Bikeabout	38%
W7 Improvements to appearance of bus stops	38%
W12.1 Less polluting buses	33%
W11.1 Improved traveller information	32%
W10 AQMA	25%
W11.1 Kiosks	23%
W11.1 ROMANSE website	19%
W12.3 Volvo petrol/LPG	19%
W12.3 European Car Free Day	18%
W7 Bus Quality Partnership	16%
W12.3 Citroen Berlingo electric van	14%
W10 School art competition	12%
W6.2 Free season tickets	12%
W6.2 Passenger transport map (PT+)	12%
W9.1 Collectpoint	10%
W6.2 Discounted season ticket discounts	10%
W10 MIRACLES website (W10/Soc3a)	6%
W8.2 Cycle map	6%

Those initiatives that had a high visual presence also had a high awareness rating, as shown by the results for the demonstration days (Bike Week and Alternative Transport Day), BDIS (bus display in a strategic location outside the railway station or at the bus station), VMS (even though not all were installed), Bikeabout, improved bus stops and the new cleaner buses (see Table 4). The demonstration days were particularly successful at raising awareness as they were strategically located in the precinct area of the city and were highly visual with Bikeabout bicycles and electric vans on show, and stalls providing other information to the public. Staff from HCC were available at the MIRACLES stand to answer people's questions and provide a more personal aspect to the publicity. MIRACLES contributed £1,000 to Winchester City Council for organising each demonstration day (as well as displaying the new bikeabout bikes and electric vehicles). It seemed to provide better value for money than the radio advertisements which cost £11,000. However, only about 12% of people aware of MIRACLES had been informed through these demonstration days (see Figure 3). This shows that although awareness of these events was relatively high (over 50%), people did not necessarily connect or associate them with MIRACLES. To some degree they were separate from MIRACLES as they had been held for many years prior to the start of MIRACLES. (For example, in Winchester, the "Bike Fair and Cavalcade" had been running since 1995 and the national Bike Week since 1923).

Initiatives such as websites, maps, competitions, discounted parking, Collectpoint were not as visible, and were generally targeted at specific groups of people. As a result, they had a lower awareness rating. With the launch of the Personal Digital Assistant (PDA) version of the ROMANSE website on 14th February 2005 and its subsequent publicity, it is hoped that its awareness will rise (see Measure 11.1). The Collectpoint trial had a low awareness probably due to the technical difficulties experienced in the first trial and the fact that the second trial had yet to start. The children's art competition was focused purely on school children with 100 entries from 8 different schools (W10/Soc1b) and so a rating of 12% seemed to be relatively successful. Given the low cost in organising the competition, it

seemed to represent good value for money while at the same time providing a form of creative publicity that got people involved in a pro-active way. The parking discounts were targeted at the small number of season ticket holders that had a clean or electric vehicle. The MIRACLES website had little promotional material advertising its presence in addition to technical difficulties requiring it to be significantly upgraded several months after its launch.

Table 5 shows the awareness of these MIRACLES initiatives from the businesses in Winchester.

Table 5: Percentage of businesses aware of the project initiatives

MIRACLES initiative	% business aware
W8.2 Bikeabout	34%
W7 Improved bus information at bus stops	28%
W12.3 MIRACLES clean fleet trials	28%
W6.2 Season ticket discounts	20%
W10 MIRACLES website	10%
W9.2 Freight map	3%
W9.2 Collectpoint	3%
W7 Passenger Transport map (PT+)	2%

For those initiatives such as the clean fleet trials and season tickets targeted at businesses, awareness of businesses was generally higher than the general public. However, this was based on a much smaller sample size. The more visual initiatives such as Bikeabout, the bus stops and the clean fleet trials again had the highest awareness rating.

MIRACLES website questionnaire

Due to technical difficulties, no data was available. A website questionnaire sought to evaluate the success of the website in disseminating information about MIRACLES. Similarly, no data was available about the number of visitors to the site (W10/Soc4a, 4b & 4c).

Air quality plan

An Air Quality Management Area was developed in September 2003. A 32-point action plan to improve air quality across the centre of Winchester, developing over 2003 and 2004 was published in January 2005 and contained 32 suggested actions to improve air quality over the next few years. Residents were asked to comment on its content.

The questionnaire asked people to give their level of agreement to the following statement "*Winchester City Council has recently declared the city centre as an Air Quality Management Area (AQMA). As part of a range of activities to reduce air pollution in Winchester, the emissions of vehicles travelling within Winchester will be monitored from the roadside as the vehicle drives past. The owners can then be advised and assisted if their vehicle's emissions are higher than they should be. Owners of persistently gross polluting vehicles could potentially be fined.*"

About 80% strongly agreed or tended to agree (see Figure 6) with these aims of the AQMA. This corresponded to a reasonably high awareness of the AQMA of 25% (see Table 4). This shows that residents of Winchester feel very strongly about the issue of air quality and want to see action to reduce the pollution. There may however be reluctance from some of the respondents to change their personal mode of travel from car to public transport, cycling or walking.

MEASURE-LEVEL RESULTS	
Measure title: Innovative soft measures	**Project: MIRACLES**
Measure number: 10	**City: Winchester**

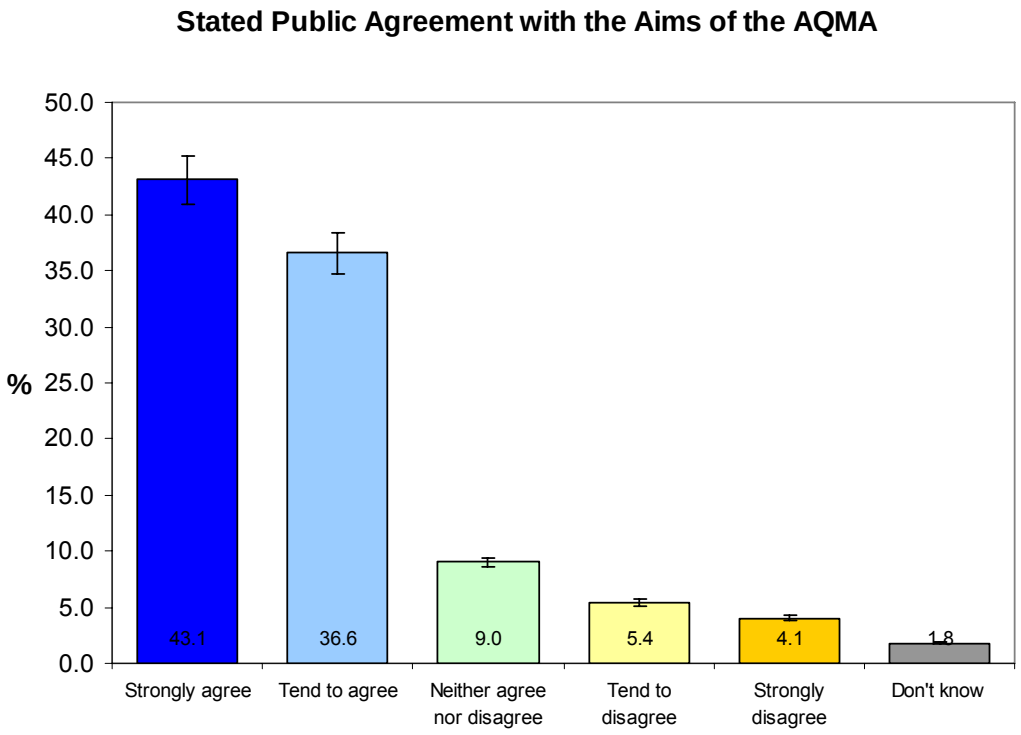


Figure 6: Percentage of valid responses stating their level of agreement with the objectives of AQMA.

MEASURE-LEVEL RESULTS

Measure title: Innovative soft measures	Project: MIRACLES
Measure number: 10	City: Winchester

A summary of the relevant indicators is shown in Table 6.

Table 6: Summary of measure indicators for W10

Indicator no. (Meteor no.)	Indicator name	Baseline 2003	Business as Usual 2005	MIRACLES 2005
W10/Econ1a	Cost of design website	N/a	N/a	See HCC costs
W10/Econ2a	Cost of assisting businesses to develop green travel plan	N/a	N/a	See HCC costs
W10/Econ3a	Promoting air quality plan	N/a	N/a	See HCC costs
W10/Econ4a	Cost of demonstration days/art competition /advertising etc	N/a	N/a	£1000/day
W10/Econ5a	Cost of Workshops	N/a	N/a	See deviations from plan
W10/Soc1a (13-14)	Acceptance/awareness rating	Awa: 3.2% Acc: 68.9%	N/a	Awa: 20.0% Acc: 70.9%
W10/Soc1b	Numbers entering art competition	N/a	N/a	100
W10/Soc2a	Business acceptance rating	No data available	N/a	59.4%
W10/Soc2b	Business awareness rating	No data available	N/a	32.6%
W10/Soc2c	Number of employees covered by travel plans	4,113	No data available	11,835
W10/Soc3a	Awareness of website	N/a	N/a	6%
W10/Soc3b	Awareness of demonstration days	No data available	N/a	Up to 57%
W10/Soc5a	Operator confidence in technical parameters	N/a	N/a	See M14

This measure will be continued after the end of the MIRACLES project.

Up-scaling

As this was an awareness raising measure, no up-scaling was undertaken.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

This measure supported the other work packages with publicity and a variety of awareness raising methods. The Air Quality Action Plan drove the green travel plans for Winchester. Technical difficulties prevented the Winchester MIRACLES website from being fully effective and prevented the website questionnaire being used as an evaluation tool to gather information regarding effectiveness of the website in disseminating information about the project. Staff resistance to car sharing, restricted workplace parking or using public transport where possible was a barrier to the effectiveness of green workplace travel plans. Creative, visual and personal publicity methods were the most effective ways in raising awareness of MIRACLES.

MEASURE-LEVEL RESULTS

Measure title: Innovative soft measures	Project: MIRACLES
Measure number: 10	City: Winchester

M13: Interrelationships with other measures

This measure had a close link with all of the other measures as it supporting measure for the whole project.

M14: Lessons learned

1. Awareness raising events with a combination of a visual aspect as well as a personal contact had the most effect in raising awareness as well as being the most cost-effective. The demonstration days (Bike Week and the Alternative Transport Day) were effective in raising their own awareness but not necessarily that of MIRACLES specifically. A demonstration day specifically for MIRACLES may have changed this situation (such as the road-show).
2. Awareness of MIRACLES grew slowly during the project timescale, and many of the publicity methods had only limited success in raising awareness. This was particularly true of impersonal methods of promotion such as radio advertisements. Creative ways of publicity such as the art competition were cost effective even if targeted at specific groups of people.
3. Awareness of an initiative does not necessarily influence travel behaviour. Many people were aware of an initiative without it affecting them personally.
4. There is a difference between accepting the objectives of an initiative in a theoretical way and being prepared to change travel behaviour as a result. For example, the majority of the public were in favour of reduced car use but it is doubtful that they would support radical measures to implement it, particularly if it restricted the usage of their own car.
5. People who disagreed with MIRACLES generally or some of the initiatives specifically may have done so thinking that it was a waste of taxpayer's money. Great effort therefore needs to be made to better inform people of the benefits of each initiative
6. There was a much greater awareness of WMAP, a sustainable transport initiative that has been on-going for the last 10 years. Awareness of more recent projects such as MIRACLES will therefore struggle to get a high rating in comparison, but if continued, can expect to raise the awareness of sustainable transport in the longer term.
7. Staff resistance to car sharing or restricted workplace parking can resist the effectiveness of green workplace travel plans. Financial incentives for staff or parking restrictions may need to be in place for the plan to succeed.
8. HCC could develop their supportive role of companies to become more pro-active in order to see more travel plans being developed. As with schools, companies could be also given more financial incentives if they have their plan approved by HCC.

Contact Point

💻.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

8. Measure 11.1

MEASURE-LEVEL RESULTS	
Measure title: Improved multi-modal traveller information	**Project: MIRACLES**
Measure number: 11.1	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

The objectives of this measure were to

- Use ITS to provide better information for travellers
- Provide public transport users with real-time travel information

M2: Measure description:

This Measure involved the installation of a variety of displays located at strategic locations to provide public transport information to passengers and thereby improve multi-modal traveller information. The systems included Bus Departure Information System Displays (BDIS), four electronic information kiosks, four Variable Message Signs (VMS), three real-time Information Display Units (IDU) and traffic and traveller information from the ROMANSE website to be accessed by mobile devices.

The Implementation – how was the measure implemented?

M3: Innovative aspects:

Winchester now has a Traffic and Travel Centre which acts as a hub for a series of incoming data sources and presents information on all modes in a strategic manner, seeking to optimise use of the network and support sustainable mode use. New data collection and distribution methods now available through the project help to improve this service and ensure wider coverage and delivery.

M4: Situation before CIVITAS:

A real time bus information system (STOPWATCH) had been installed at 35 bus shelters in Winchester prior to MIRACLES. These signs provide passengers with real time travel information concerning predicted waiting times for the next five buses. The signs also give information concerning route numbers and the expected arrival times and have a facility to display scheduled information when the AVL (Automatic Vehicle Location) system is not working. They can also display other messages regarding cancelled or modified services.

Trip planners were available at various locations around the city before MIRACLES began. These were terminals providing users with information regarding potential public transport and private transport trips that they might wish to make. They did not, however, provide real-time information.

There were four existing VMS signs (including two car park VMS) in Winchester to provide traveller information and car park availability for the Park and Ride and city centre parking (see Figure 2).

No IDUs existed in Winchester before MIRACLES.

The ROMANSE website had been running for several years providing the public with traffic and traveller information. However, the website could not be accessed by mobile devices.

MEASURE-LEVEL RESULTS

Measure title: Improved multi-modal traveller information	Project: MIRACLES
Measure number: 11.1	City: Winchester

M5: Design of the measure:

This measure involved improved information dissemination to travellers, allowing them to make more informed decisions. It linked with Measure 7: Improving bus service quality and information and was designed within the following stages:

1 Three BDIS installed at the railway and bus stations. These provide passengers with a list of the arriving buses (see Figure 1 and 3).
2 Four electronic kiosks installed at strategic locations (Tourist Information Centre, Royal Hampshire County Hospital, Precinct (Middle Brook Street) and outside the railway station). The kiosks deliver information regarding public transport (services, routes, timetables etc), accommodation and tourist/visitor attractions (see Figures 1 and 3).
3 Four VMS installed at strategic points entering the city centre (see Figure 2) displaying general traffic information and estimated journey times to the city centre (see Measure 11.2).
4 Three real–time IDUs installed at Hampshire County Council (HCC), Winchester City Council (WCC) and the Royal Hampshire County Hospital, provide employees with real-time traveller information (see Figure 1). The displays give details of the real-time information that is available on the ROMANSE website. The displays allow employees to view journey time information on strategic routes out of the city. In addition, air quality, bus and train departure information is also displayed allowing employees the opportunity to consider all modal options when planning a journey home.
5 Information available on the ROMANSE website to be accessed via mobile devices to provide on-line traffic and traveller information (http://www.romanse.org.uk). The ROMANSE on-line website has been updated as more information sources became available during the lifetime of the project (i.e. air quality model, scheduled bus departure, travel time on strategic routes into Winchester etc).

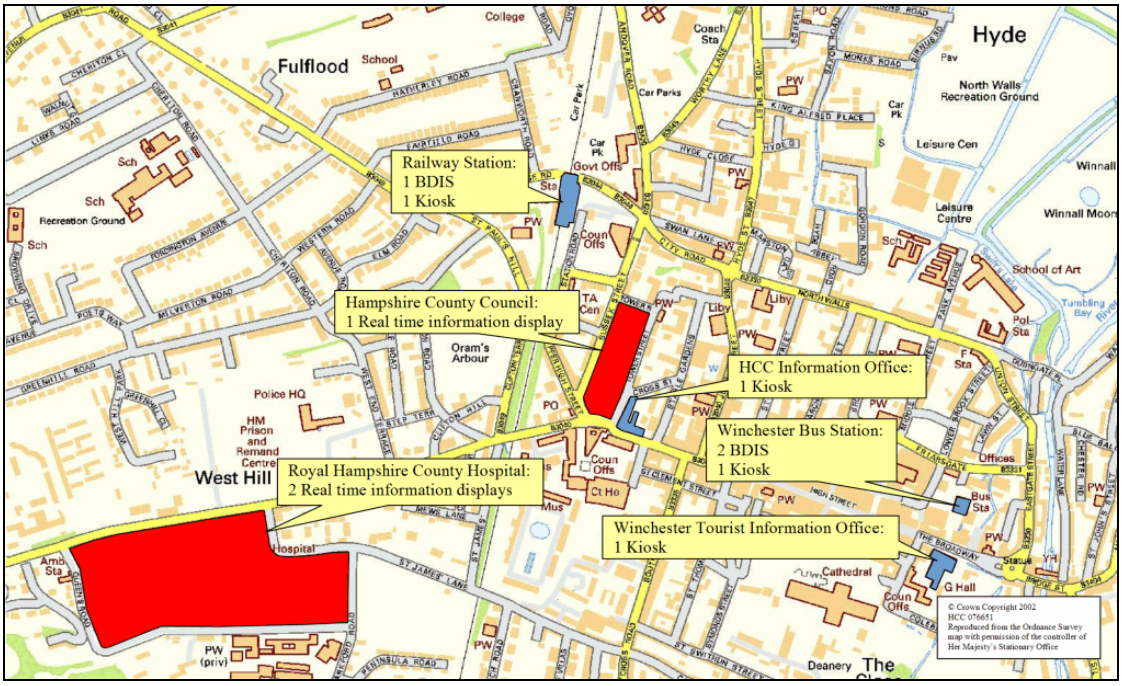


Figure 1: Locations of the BDIS, kiosks and IDU in Winchester city centre

MEASURE-LEVEL RESULTS	
Measure title: Improved multi-modal traveller information	**Project: MIRACLES**
Measure number: 11.1	**City: Winchester**

Figure 1 shows the original locations for the BDIS, kiosks and the IDUs. The two real-time information displays at the hospital includes a kiosk and an IDU. The only change was the relocation of one of the kiosks from the HCC information office to the precinct of the city centre (Middle Brook Street).

Figure 2 shows the location of the existing and new VMS. In addition, a fourth VMS on the north–east of the city was installed in late 2005 on Andover Road (north-east of the city, not shown in Figure 2).

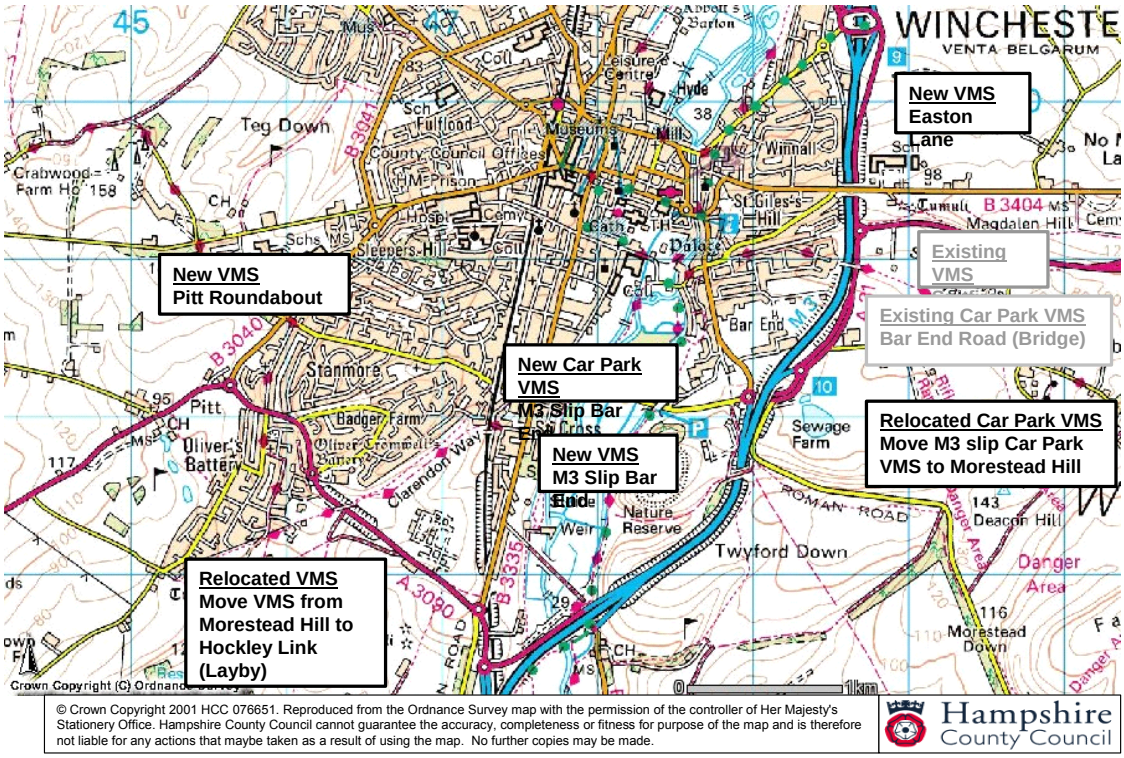


Figure 2: Locations of the existing and new VMS signs

MEASURE-LEVEL RESULTS

Measure title: Improved multi-modal traveller information	Project: MIRACLES
Measure number: 11.1	City: Winchester

Figure 3: BDIS outside the railway station and the kiosk on Middle Brook Street

M6: Actual implementation:

The measure was implemented in five stages (some ran concurrently or overlapped):

Stage 1: BDIS installed (October 2004)
Stage 2: Kiosks installed (October 2004 and December 2004; Railway station kiosk: October 2005)
Stage 3: VMS installed (October 2004; Andover Road in October 2005; fully operational to display journey time information November 2005 - March 2006)
Stage 4: IDUs installed (January 2006)
Stage 5: ROMANSE online website for pda's launched (February 2005)

M7: Deviations from the plan:

The fourth Kiosk at the Railway Station was not installed until October 2005 due to various refurbishment works. Only two IDUs were installed in January 2006 (WCC and the hospital). Delay was caused by various refurbishment works taking place at HCC, WCC and the Hospital in addition to other technical difficulties regarding power supply and communication connections. This resulted in no evaluation being possible. The VMS were not fully operational with the ability to display journey time information from the ANPR system (see Measure 11.2). One of the VMS was delayed because its originally intended location had to be changed (as permission was not granted from the Highway Agency to locate a sign near the exit slip road of the M3) and subsequently soil surveys and foundation design had to be undertaken. This again resulted in a more limited evaluation. In addition, technical problems with the HCC server resulted in no website statistics being available for the ROMANSE website until after the project.

Six of the indicators originally defined for this Measure within D4.1 were not collected either because of a lack of data or because they were redundant due to a re-design of the Measure. These indicators are listed below:

- W11.1/Econ2a – Power and communication costs;
- W11.1/Soc1a – Acceptance rating;
- W11.1/Soc2a – Acceptance rating;
- W11.1/Soc4c – Number of visitors to ROMANSE pda site;
- W11.1/Tran1a – Modal change for users of all information sources;
- W11.1/Tran1b – Reason for modal change.

MEASURE-LEVEL RESULTS

Measure title: Improved multi-modal traveller information	Project: MIRACLES
Measure number: 11.1	City: Winchester

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

The data came from the following sources:

- **HCC cost statements** – these detailed the hours worked on MIRACLES split by work package and staff grade along with any equipment/consumables bought. The figures came from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.

- **Awareness questionnaire survey -** This questionnaire survey was undertaken to measure the public awareness of specific measures in the MIRACLES project within Winchester. It took place in February/March 2005 with a sample size of 850.

- **Kiosk usage monthly reports –** these came from the company Cityspace who supplied the interactive touch screen terminals. These monthly reports (covering October 2004 – November 2005) outlined a number of statistics such as the number of the users and the average time spent per user.

- **Kiosk user and non-user on-street survey** - A questionnaire survey was carried out on 13th May and 10th June 2005 to assess people's views of the kiosks. A separate questionnaire form was used for users and non-users of the kiosk. The survey was carried out as a face-to-face interview. Over 60% of the interviews took place outside the kiosk in the city centre precinct (Middle Brook Street). The rest took place by the kiosk in the Tourist Information Centre. The total sample size was 91 users and 158 non-users.

- **Kiosk on-screen questionnaire survey** – A questionnaire survey was available for kiosk users to fill in at the information terminal in assess their views of them. If the user left their name and address, they would be entered into a free prize draw. A total of 91 responses were received between 23rd July and 27th October 2005.

- **Two BDIS surveys**
  - A Hampshire questionnaire survey was carried out on selected days in May 2005 at seven towns in the county, including Winchester, where BDIS had recently been installed. Fifteen people were interviewed at each site in view of one of the BDIS screens to assess their opinion of it.
  - A Winchester questionnaire survey was carried out in July 2005 to increase the sample size of Winchester respondents. Fifty people were interviewed as they were waiting for a bus near the new BDIS at the railway station.

The questionnaire surveys/interviews carried out are summarised in Table 1.

Table 1: Questionnaire surveys/interviews carried out in Measure 11.1

	Survey title	Sample size	Date	Questionnaire/interview
1	Awareness	850	February/March 2005	Questionnaire
2	Kiosk on-street user	91	May/June 2005	Interview
3	Kiosk on-street non-user	158	May/June 2005	Interview
4	Kiosk on-screen user	60	July – September 2005	Questionnaire
5	BDIS Hampshire	15 per town	May 2005	Interview
6	BDIS Winchester	50	July 2005	Interview

MEASURE-LEVEL RESULTS

Measure title: Improved multi-modal traveller information	Project: MIRACLES
Measure number: 11.1	City: Winchester

M9: Achievement of quantifiable targets:

N/a

M10: Achievement of evaluation-related milestones:

See M7.

M11: Report on the measure results:

HCC cost data

The data from HCC came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3, and an estimate for Year 4. Staff hours (including labour & maintenance of equipment) for Work package 11.1 for Years 1 – 3 was a total of 1682 hours at a cost of £41,817 (W11.1/Econ2b & 3a). In addition, HCC spent about £155.000 on the VMS, £109,000 on the BDIS, £44,000 on the kiosks and £22,000 on the IDUs.

Awareness questionnaire

Results from the awareness questionnaire (see Measure 10) showed that 49% were aware of the BDIS, 42% of the VMS, 23% of the kiosks and 19% of the ROMANSE website (W11.1/Soc2a). Results for the VMS and ROMANSE website were relatively high due to their existence before MIRACLES. The result for the BDIS was relatively high as they were highly visual and located in prominent strategic locations. The awareness of the kiosks was much lower but this could be due to the fact that they had only just been installed. Given the location of one of the kiosks in the precinct area of the city centre (Middle Brook Street), it is hoped that their awareness will increase beyond the life of the project.

Kiosk usage reports

Two kiosks (Tourist Information Centre and the Hospital) were installed in September 2004 with results available from October 2004. The third kiosk (Middle Brook Street on the precinct) was installed in December 2004 with results available from January 2005. A fourth kiosk was installed outside the railway station in October 2005. A user in the reports is defined as a period of continuous usage of more than 60 seconds without a break. Figure 4 shows the numbers using the kiosks from October 2004 to November 2005. The average number of users per month from October 2004 to November 2005 was 1955 but from January 2005 to August 2005 (when the third kiosk was installed), it had risen to 2074 users per month, and had increased to an average of 3358 for October and November 2005 (W11.1/Soc3a).

MEASURE-LEVEL RESULTS

Measure title: Improved multi-modal traveller information	Project: MIRACLES
Measure number: 11.1	City: Winchester

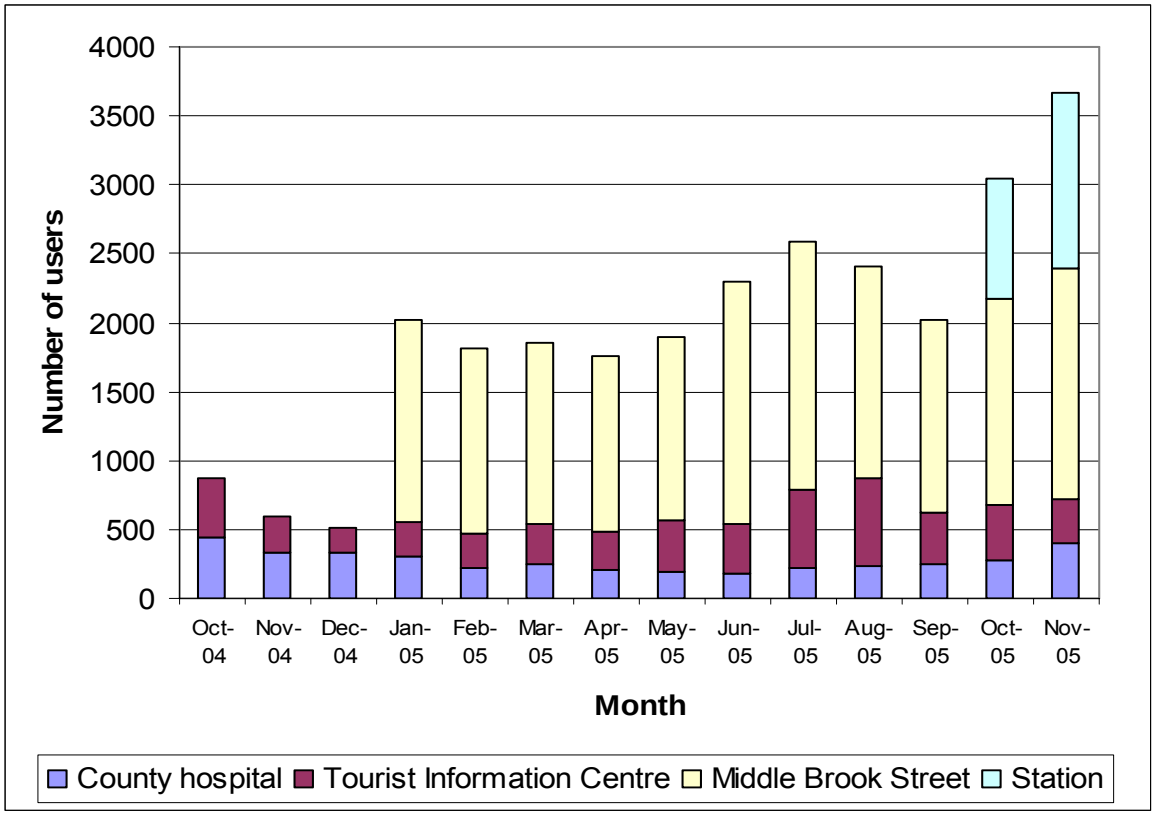


Figure 4: The numbers using the kiosks in Winchester

Figure 4 shows that the installation of the third kiosk at the precinct (Middle Brook Street) led to an approximate quadrupling of the total number of users from January 2005. In addition, the installation of the fourth kiosk led to a 40% increase in the number of kiosk users. This was probably due to the fact that the third and fourth kiosks are located in outdoor areas with high numbers of pedestrian traffic, and therefore a greater number of potential users. They are also both located next to a bus stop, thereby targeting bus passengers with time to spare (as well as rail passengers in the case of the fourth kiosk). Another possible factor was that their outdoor locations meant that people may have felt less inhibited in using them than, for example, in the Tourist Information Centre.

Figure 5 shows the total usage time of the four kiosks from October 2004 to November 2005, and again illustrates the substantial increase in use since January 2005 after installation of the third kiosk.

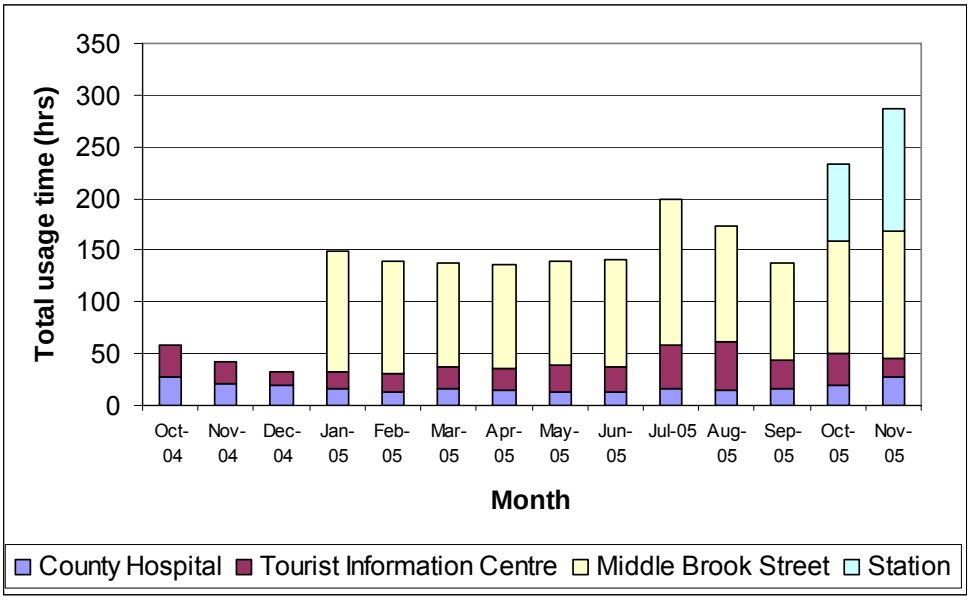


Figure 5: Total usage time at the four kiosks

Figure 6 shows the average usage time per user. For each kiosk, average usage time remained constant at about 3 – 5 minutes, although values were slightly higher at the more recent kiosks.

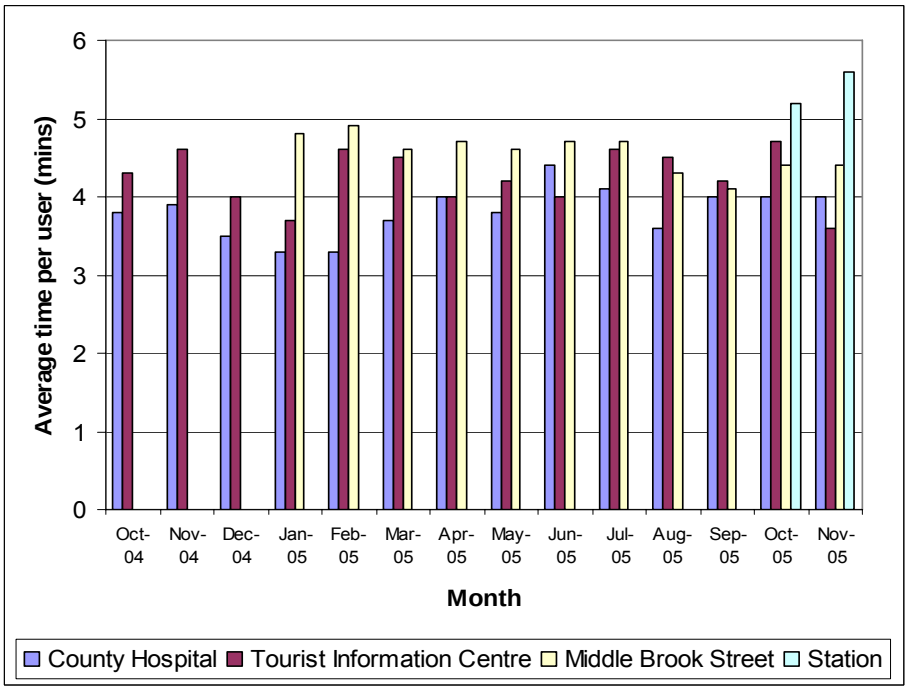


Figure 6: Average time per user at the four kiosks

Figure 7 show the channels (i.e. a collection of pages which together provide a service within the kiosk interface) that were used. E-Government refers to pages on HCC website; freemail refers to e-mail; iPlus Interactive covers weather 'about iPlus', feedback and games; Local Information refers to the tourist 'Visit' pages for Winchester which includes traveller information; news links to the BBC news website. A session is defined to be the use of a single channel by a user. The BBC news website was the default page which appeared at the start of each session.

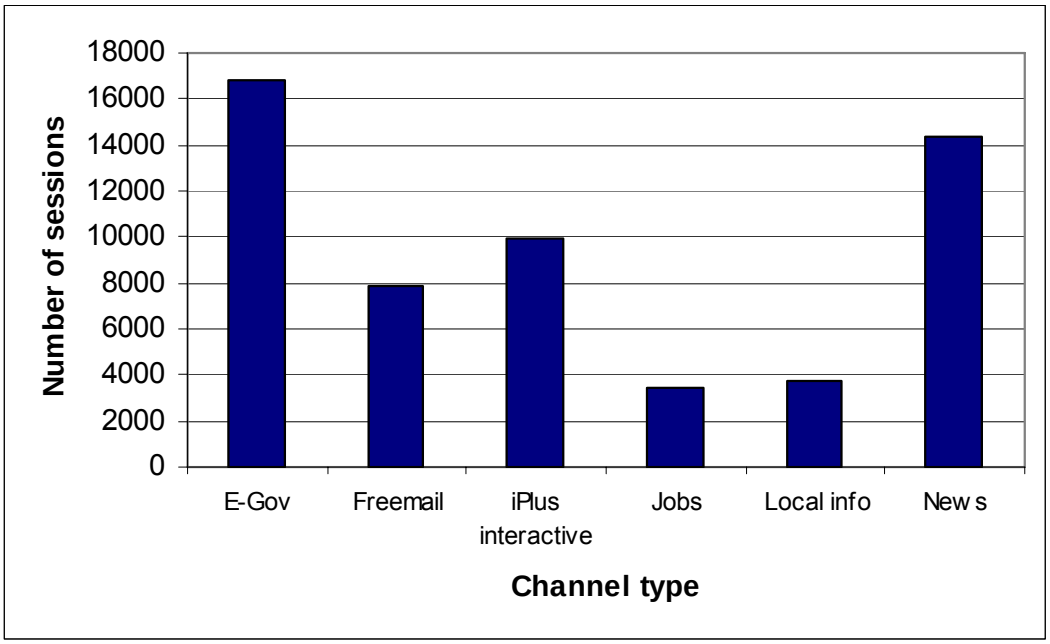


Figure 7: Channel types used on the kiosks (October 2004 – July 2005)

Kiosk surveys

Tables 2 and 3 show the results of the on-street user and non-user interviews and the on-screen questionnaire survey. As mentioned in Table 1, the sample sizes for the on-screen user, on-street user and on-street non-user surveys were 91, 158 and 91 respectively.

Table 2: Comparison of the respondents taking part in each of the three kiosks surveys

	Male/Female	% under 24 years	Main journey purposes	Agree with HCC objectives	Awareness of MIRACLES
On-screen user	53% : 47%	65%	Tourist, shopping, work	64%	34%
On-street user	50% : 50%	18%	Shopping, tourist, work	89%	6%
On-street non user	34% : 66%	25%	Shopping, tourist, work	89%	7%

MEASURE-LEVEL RESULTS

Measure title: Improved multi-modal traveller information | **Project: MIRACLES**

Measure number: 11.1 | **City: Winchester**

Table 3: Comparison of the results from the two kiosk user surveys

	Main info looking for on kiosk	% using kiosk at least once a week	% finding the info they were looking for	% finding it easy to use?	% rated kiosk very good or good
On-screen user	Bus times, games. E-mail	47%	73%	80%	77%
On-street user	Bus times, tourist attractions, car park info	30%	97%	94%	98%

Results from the on-street surveys were more favourable with regard to the kiosks than the on-screen survey. Respondents within the on-street survey rated the kiosks more highly (98% compared to 77% of the on-screen respondents), more found the information they were looking for (97% to 73%), more found them easy to use (94% to 80%) and more agreed with the HCC/WCC broad aim of improving sustainable transport (89% to 64%). It may be that some of the differences were due to the different sample sizes but it should also be noted that the on-screen survey provided an opportunity for the respondent to be fully open (or anonymous) about their opinions of the kiosk, in contrast to talking to an interviewer in the on-street survey. In addition, a much larger proportion of the sample for the on-screen survey were under 24 years old. Some on-screen questionnaires that were received were not filled in seriously and these were eliminated from the overall results.

From the on-screen questionnaire responses, about 50% of respondents stated that they had used the kiosk for travel information, including bus/train fares or timetables or other more general traffic and travel information.

Comments made about the kiosks from either the on-street or on-screen surveys included that the machines were often dirty with coffee and food stains, people could 'hog' them playing games (the second most popular use for the on-screen users), it was difficult to read the screen when it was sunny, the response times could be slow, and respondents did not realise how much information was available on them. Many of the non-users had not noticed the presence of the kiosks, and they were re-branded in late 2005 in a bright colour and with the MIRACLES logo. This should enable them to be more obvious, particularly in the precinct area.

BDIS interview surveys

Table 4: Results of the BDIS interview surveys (%)

	First survey	First Survey (other towns in Hampshire)	Second survey
Noticed BDIS	100	97	68
Intended to check screen	66	89	60
Regular bus user	97	56	62
Clear to read	100	66	98
Easy to understand	100	86	98
Information useful	15	64	98
Information accurate	14	44	12
Used printed timetables	80	50	74
Should display cancellations/delays	100	59	20
Encourage more bus use	0	55	34

Table 4 shows the results of the two BDIS interview surveys. The sample sizes as described in Table

1 were 15 and 50 for the first and second surveys, respectively, and an additional 15 respondents for each other Hampshire town in the 'other' first survey.

The results showed that the BDIS screens in Winchester were noticeable and easy to read. In an awareness survey in Measure 10, 49% of the general public were aware of the screens, which was high in relation to many of the other MIRACLES initiatives. Differences between the two Winchester surveys may be due to the small sample size for the first survey. The results also show that about 60% of respondents planned to check the screens, but only a small minority thought the information was always accurate (12% in the first survey and 14% in the second survey). This could be because the information displayed was not real-time and therefore would be inaccurate when there were delays or cancellations. In addition, the screens were initially only updated every 5 minutes, which resulted in many buses being displayed that had already departed. Updating the screens every 1-minute rectified this. The majority of respondents stated that they were regular bus users who would already know the departing time and location of the bus they were waiting for. Of the 7 Hampshire towns surveyed, Winchester was the last to have BDIS screens installed. Therefore, bus passengers in Winchester had less time to become familiar with them and were still mainly reliant on printed timetables as their main source of information. It is expected that over time, the results for Winchester will become similar to the other towns in Hampshire, where nearly 90% of passengers stated that they check BDIS before boarding their bus.

Information Display Units

The IDUs were not evaluated directly in the MIRACLES project (see M7). However, an evaluation took place through on-street surveys at five of seven IDUs located in the centre of Southampton in 1996. As only 1% of all passers-by were counted as users, people were recruited to view the display and then answer questions. About 25% of the respondents were aware of the IDU; 12% looked at the screen and only 4% had actually read the information displayed. 42% thought the IDU was located in a bad position. Respondents suggested that they should be in 'direct line of sight' of the main flow of passengers and should not face into direct sunlight. Other suggestions included using brightly coloured monitors/stands and larger font sizes. Only 4% thought that the information would have an impact on their journey. A third of respondents stated they would change their journey if there were "long delays ahead". Overall, road users were more able to exercise choice than public transport users or pedestrians.

The two IDUs in Winchester were installed in prominent positions at the Hospital and WCC. It is important that they are visible (in direct line of sight) as employees and visitors leave the premises particularly in the peak periods by car. It is expected that it will take employees/visitors a period of time before they become used to checking the screens before they leave the premises and familiar with the information presented.

MEASURE-LEVEL RESULTS

Measure title: Improved multi-modal traveller information	Project: MIRACLES
Measure number: 11.1	City: Winchester

A summary of the relevant indicators is shown in Table 5.

Table 5: Summary of measure indicators for W11.1

Indicator no. (Meteor no.)	Indicator name	Baseline 2002	Business as Usual 2005	MIRACLES 2005
W11.1/Econ1a	Cost of information systems	N/a	N/a	See HCC cost data
W11.1/Econ2b	Labour costs	N/a	N/a	See HCC cost data
W11.1/Econ3a	Maintenance costs	N/a	N/a	See HCC cost data
W11.1/Soc3a	Average use of kiosks	N/a	N/a	3358/month
W11.1/Soc5a	Operator confidence in technical parameters	N/a	N/a	See M14

This measure will continue after the end of the MIRACLES project.

Up-scaling
No up-scaling of this measure was undertaken as the BDIS and Kiosks were already located in strategic citywide locations. In addition, only a limited evaluation was possible for the VMS and IDUs.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

The Air Quality Action Plan (AQAP) and the Bus Quality Partnership (BQP) were the main drivers. They provided better quality real-time public transport information and therefore encouraged people to use public transport more and their cars less, thus reducing emissions in the city centre area. Technical difficulties regarding power supply and communication connections were a barrier to their installation. The installation of information systems on third party land or property can result in delays.

M13: Interrelationships with other measures

This measure is inter-related with Measure 7: Improving bus service quality and information and Measure 11.2: Improved network management as described above.

M14: Lessons learned

1. The location of the BDIS and kiosks is vital to their usage. An outdoor location in a pedestrian area or a waiting area for public transport is ideal to achieve maximum awareness, usage and benefit for the public. An indoor location can put people off from using the kiosk as they feel unhappy being watched (as was mentioned by kiosk users at the Tourist Information Centre).
2. It can take several months for people to become aware of, and then familiar with, new technologies. Bus passengers may need a long transition period to switch from using printed timetables to exclusively using the BDIS.
3. Many people had not noticed the presence of the kiosks. It is hoped that after re-branding them in a bright colour at the end of the project, they would become much more visible with a subsequent increase in public awareness of their presence.
4. A BDIS displaying real-time bus information would be much more effective in informing passengers of any delays or cancellations. The information displayed on the BDIS was only as accurate as the printed timetable and passengers will not refer to it if they believe the information is inaccurate. It is important that the information displayed is refreshed as often as possible, so that information is not displayed for buses that have departed.
5. The kiosks were highly rated by the vast majority of users as they provided a wide range of real-time information (including passenger information) at strategic locations around the city.

MEASURE-LEVEL RESULTS	
Measure title: Improved multi-modal traveller information	**Project: MIRACLES**
Measure number: 11.1	**City: Winchester**

6. Kiosk users did comment that on occasions the terminals were 'hogged' by children playing games or using e-mail. It may be necessary to have a time limit per session in order to make sure that everyone who wants to use it can do so. Providing games and e-mail on the kiosks may attract more users but may result in them not being used so extensively for their primary purpose (i.e. traffic and traveller information). N.B. the games option was removed from the kiosk at the TIC.
7. To enable more people to use the kiosks (particularly older people not familiar with computers), a workshop showing members of the public how to use them and access a variety of information may help raise awareness and encourage more usage.
8. The kiosks can quickly become dirty (e.g. coffee and food stains) making them less attractive to use (mentioned by users in the survey). Regular cleaning may help to increase their usage.
9. The location of information systems on third party land or property can cause significant delays to their installation (e.g. the kiosk at the railway station and the IDUs at HCC, WCC and the Hospital).

Contact Point

💻.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

9. Measure 11.2

MEASURE-LEVEL RESULTS	
Measure title: Improved network management	**Project: MIRACLES**
Measure number: 11.2	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

The objectives of the project were to:

- Collect real-time journey times on the radial routes into Winchester city centre and export this information to the ROMANSE Traffic and Travel Information Centre (TTIC) at Hampshire County Council (HCC) for further dissemination to travellers via the media described (see Measure 11.1). The information was to be used as a network management and planning tool for HCC in monitoring and improving their knowledge of the network.
- Test the feasibility of using the Origin-Destination (OD) information from the system to develop far more sophisticated, time-based models of traffic movements in Winchester to assist with future traffic and transport planning.
- Use the capabilities of the Automatic Number Plate Recognition (ANPR) system in conjunction with the new parking control measures described in Measure 6.2 and with the air quality monitoring activities described in Measure 5.1.

M2: Measure description:

This measure implemented an ANPR system to gather OD information on the main routes into Winchester for cars and buses. The information was also used to determine journey times for cars and buses along strategic routes into the city centre which could then be made available to travellers either via the VMS or the ROMANSE website. Consideration was also given to the system's suitability to provide OD matrix information, with a view to using this information to develop a more accurate model for Winchester. This in turn allowed better examination of possible transport strategies such as reallocation of road space and improved the longer term planning process and information provision. The ANPR system also supported security enhancements in the city centre car parks and provided monitoring of high-polluting vehicles (detection, vehicle identification via ANPR, announcement via VMS or possible enforcement in Measure 5.1).

The Implementation – how was the measure implemented?

M3: Innovative aspects:

The ANPR system is an innovative measure that has many technical aspects to it. The system comprised a number of cameras and associated image processing assemblies sited at strategic locations in the city centre and on the urban arterial road network in Winchester, together with communications facilities that transmit data to an in-station for the computation of near real-time OD matrices and journey times along the radial routes. It is capable of exporting selected subsets of the data to any other future ANPR systems in Winchester, and of maintaining "white lists" (lists of known vehicles) for the identification of particular categories of vehicles. The system included illumination facilities in the camera assemblies to enable the system to be capable of continuous 24 hours per day operation.

M4: Situation before CIVITAS:

No such ANPR system existed in Winchester before the project began. However, an operational traffic and traveller information centre in Winchester had already been established as part of the ROMANSE project. Closed circuit television (CCTV) cameras at strategic locations around the city were already installed and could be viewed via the ROMANSE website, providing users an indication of the traffic conditions in the Winchester area. In addition, in-road detectors linked to the Urban Traffic Control (UTC) system collected traffic flows and occupancies.

MEASURE-LEVEL RESULTS

Measure title: Improved network management	Project: MIRACLES
Measure number: 11.2	City: Winchester

M5: Design of the measure:

This Measure aimed to improve information for both the network managers and travellers. An ANPR system was designed to enable journey time data to be collected in real-time for both public and private transport. The measure was designed in the following stages:

1. The operational specification of the system was developed and details given of its physical and operational requirements including locations for siting the ANPR cameras. Since the purpose of this application was to provide near real-time OD and journey time estimations for general traffic and specifically for buses, there was an outer cordon (on edge of city) and an inner cordon (near or in city centre) of detection sites (cameras) to provide relevant paired "trip ends" for both estimations.
2. This operational specification was sent out to tender.
3. The installation of the system took place over a two-month period.
4. Before the system was to go 'live', a trial period was necessary to allow the operators to determine errors in reported travel times, development of white and black lists to distinguish basic vehicle types and to fine tune the reporting mechanisms including dissemination. These lists allow bus travel times to be measured separately from the general traffic flow.
5. This information was to be disseminated to travellers in two phases. The first phase was to place inbound journey time information on the web via the ROMANSE website (www.romanse.org.uk) (and related dissemination sources).
6. The second phase of dissemination will take place via VMS at the roadside. This will inform drivers of likely journey times and in some cases, for those travelling in from the south of the city, offer a route choice based on travel times on alternative routes. As part of Measure 11.1, four VMS signs were installed near the relevant ANPR site.
7. The OD capabilities of the system will be assessed. It is anticipated that the benefits of the ANPR system will be the use of the data as a source of an OD matrix for Winchester, the providing of journey times for a variety of modes and as a tool for network and congestion/incident management.

Figure 1 shows the inner and outer cordons for the ANPR system in Winchester.

MEASURE-LEVEL RESULTS	
Measure title: Improved network management	**Project: MIRACLES**
Measure number: 11.2	**City: Winchester**

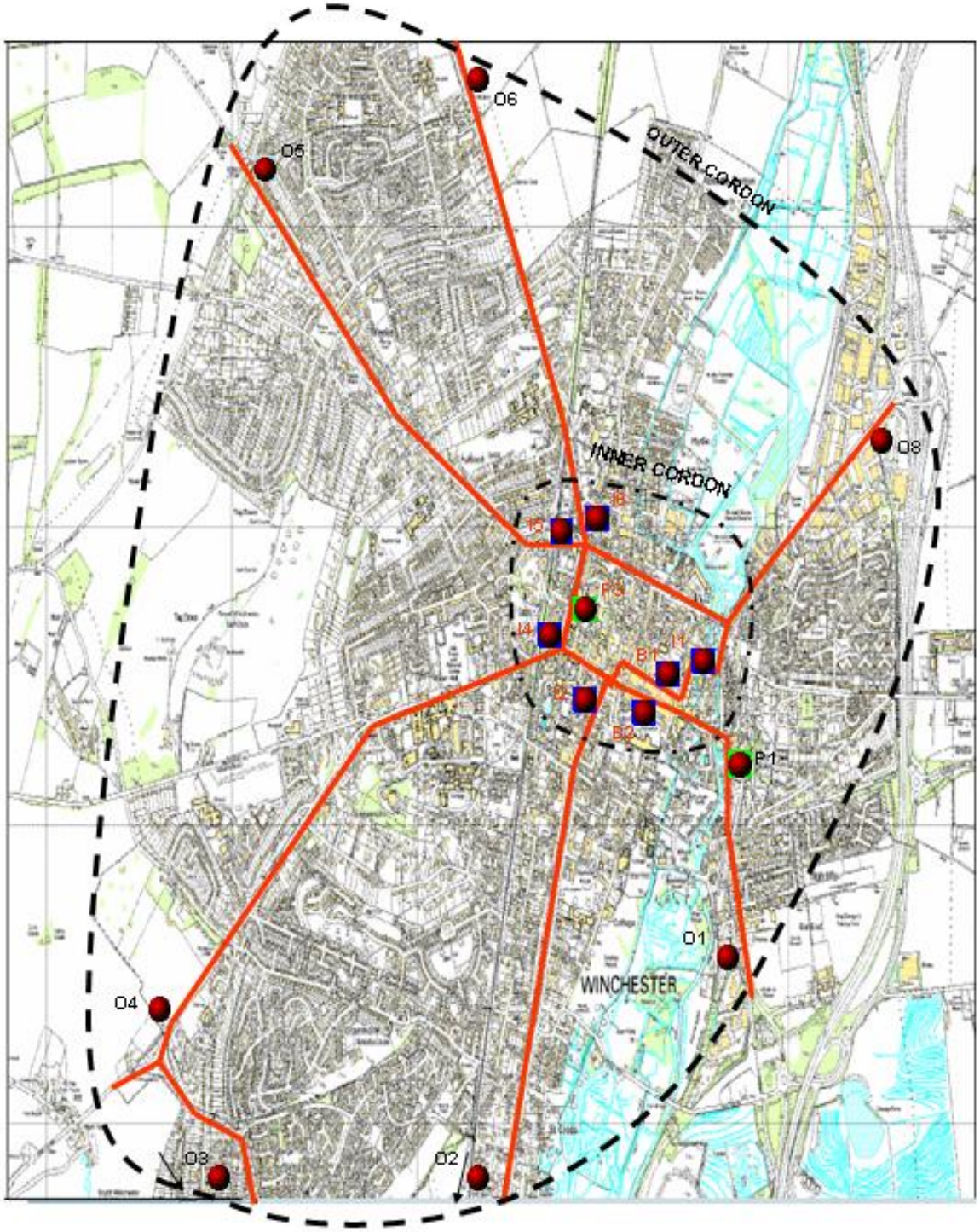


Figure 1: The inner and outer cordons for the ANPR system in Winchester

MEASURE-LEVEL RESULTS

Measure title: Improved network management	Project: MIRACLES
Measure number: 11.2	City: Winchester

M6: Actual implementation:

The measure was implemented in a number of stages (some ran concurrently or overlapped):

Stage 1: Specification of the ANPR system was developed (October 2002).
Stage 2: The specification was sent out to tender (December 2002 – January 2003).
Stage 3: Installation of system over a two month period (March – October 2004)
Stage 4: Trial of system was undertaken (June 2005)
Stage 5: Dissemination phase 1: ROMANSE website (January 2006)
Stage 6: Dissemination phase 2: VMS (November 2005 – March 2006)
Stage 7: The OD capabilities of system assessed (January 2006 – March 2006)

M7: Deviations from the plan:

As mentioned in Measure 11.1, the VMS were not fully operational with the ability to be able to display journey time information from the ANPR system until November 2005. A longer period of validation of the journey times was needed in order to verify their accuracy. There were also communication problems with certain cameras after the system was installed. This resulted in a more limited evaluation taking place. Additional resource and finance would have been required to establish O-D movements from the inner to outer cordons (i.e. along the outbound routes) and thereby generate a full O-D matrix for Winchester. Technical problems meant that the ANPR could not be used in conjunction with the parking control measures (see Measure 6.2) or the air quality monitoring activities (see Measure 5.1).

Six of the indicators originally defined for this Measure within D4.1 were not collected either because of a lack of data or because they were redundant due to a re-design of the Measure. These indicators are listed below:

- W11.2/Econ2a – Power and communication costs;
- W11.2/Econ3a – Maintenance costs;
- W11.2/Soc1a – Acceptance rating;
- W11.2/Soc2a – Awareness rating;
- W11.2/Tran1a – Percentage of travellers changing mode;
- W11.2/Tran2b – Hours in network.

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

The data came from the following sources:

- **HCC cost statements** – these detailed the hours worked on MIRACLES split by work package and staff grade along with any equipment/consumables bought. The figures came from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.
- **Journey time information from ANPR system** – journey time information from each of the outer cordon cameras to each of the inner cordon cameras was available. The results of the ANPR validation exercise carried out in June 2005 were also available.

M9: Achievement of quantifiable targets:

N/a

M10: Achievement of evaluation-related milestones:

See M7.

MEASURE-LEVEL RESULTS

Measure title: Improved network management	Project: MIRACLES
Measure number: 11.2	City: Winchester

M11: Report on the measure results:

HCC Cost data

The data from HCC came from their annual cost statements for the MIRACLES project which included an estimate for Year 4. Staff hours totalled 768 hours at a cost of £20,411 (W11.2/Econ2b). In addition, HCC spent about £154,000 on the ANPR phase one system (including power supply) (W11.2/Econ1a).

The ANPR validation exercise in June 2005 showed that the system was performing well. The weather conditions were clear with intermittent cloud. Although two journeys were missed, the other eight journeys were recorded successfully and were well within the allowed error range of 5 seconds.

Figure 2 shows a graph showing sample journey times from the outer cordon (camera O8) to the inner cordon (camera P1). The system is still being tested and validated before the journey time information can be disseminated via VMS, website or radio.

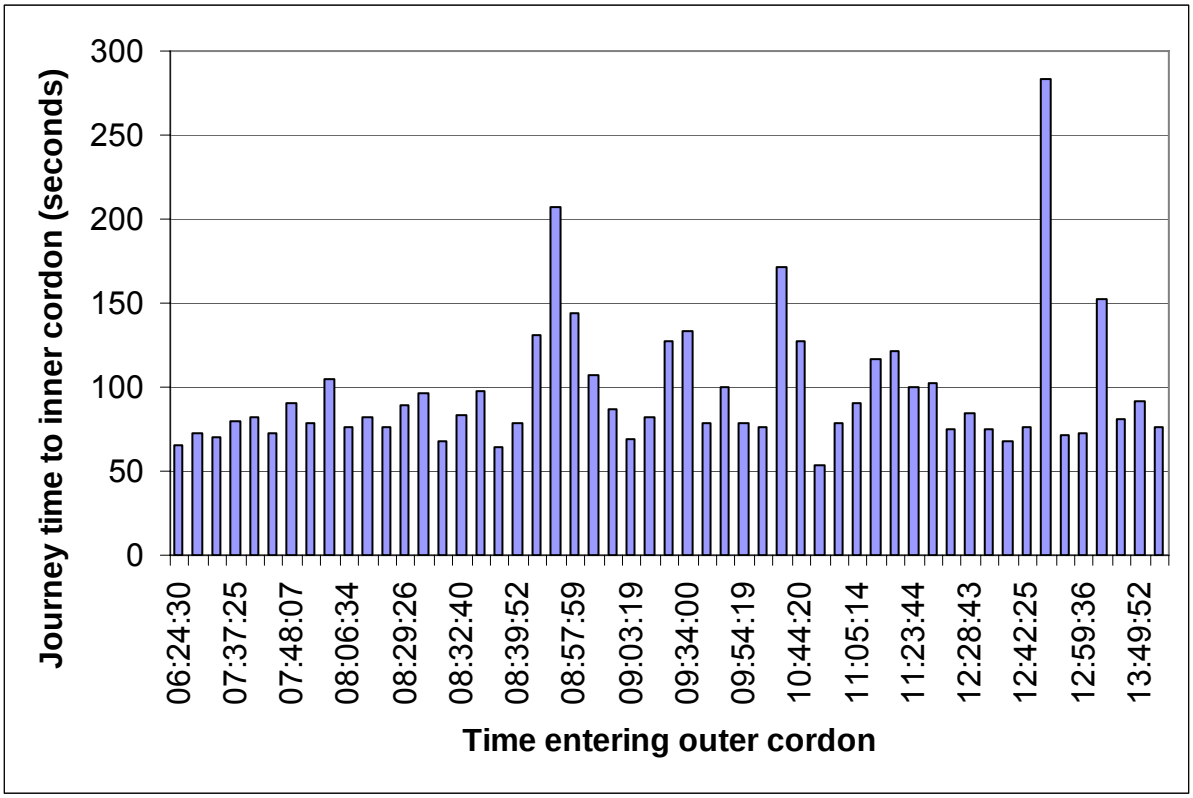


Figure 2: Sample of journey times from the ANPR system

From the Awareness questionnaire (see Measure 10 and 11.1), 42% of respondents stated that they were aware of the VMS displaying traveller information (W11.2/Soc2a).

MEASURE-LEVEL RESULTS

Measure title: Improved network management	Project: MIRACLES
Measure number: 11.2	City: Winchester

VMS displaying journey time information from ANPR

The VMS in Winchester were not evaluated directly within the MIRACLES project. However, there have been numerous evaluations of such systems elsewhere, which indicate the levels of benefits that could be expected in Winchester from a fully operational system. Typically, assessments of VMS have focused on two main categories:

- **user acceptance** – this is primarily aimed at assessing drivers' perception of the signs. Typical performance indicators are attitudinal and focus on awareness of information (e.g. whether drivers are aware of VMS and whether they notice VMS information), ease of use of information, usefulness of information, and self-reported change of behaviour. Questionnaires or interview surveys are often used as the main methods of measurement.
- **impact analysis** - improved network efficiency measures the success of a VMS application and a key performance indicator is the traffic diversion rate, which can often be measured directly using data from on-street monitoring equipment. Other common network-wide indicators include travel time, distance travelled and congestion. These are not usually measured directly on-street, but are estimated using appropriate traffic assignment models. A third common method of impact assessment is through self-reported questionnaires or interview surveys. Such results are more subjective, but they do allow a more in-depth consideration of factors contributing to driver response or compliance.

VMS surveys typically show that they are regarded by the public as being useful. Table 1 summarises 'usefulness' of VMS results from several studies. They are usually perceived as being accurate and reliable (e.g. 82% and 96%, respectively, of drivers surveyed within the FEDICS project to evaluate the Glasgow VMS). There is also evidence that the default VMS message indirectly affects a driver's route choice. For instance, in Southampton, the default message of "NO REPORTED PROBLEMS" served as a route confirmation by reassuring drivers of traffic conditions on their intended route.

Table 1: Summary of Studies Regarding VMS Usefulness

Location	'Usefulness' finding
Southampton	49% of the commuters and 62% of the non-commuters generally rated the VMS as being 'very useful' or 'quite useful'
Glasgow	More than 65% of drivers who had seen the VMS thought they were very or fairly helpful.
London	40% of drivers rated the VMS information as very or quite useful and 40% as only occasionally useful.
Paris	90% of drivers thought the VMS information was a minimum necessity.
Toulouse	77% perceived it as useful.
Amsterdam	89% found the DRIP information generally useful. 52% found it useful for a particular trip.
New York	75% rated the VMS information as moderately useful or better.
Pennsylvania	68% rated VMS information as extremely or very useful and 23% as useful.
Milwaukee, Wisconsin	32% rated the VMS as very useful and 44% as somewhat useful.
Montana	More than 50% found the VMS useful.

In terms of impact analysis, although response rates to VMS are often widely quoted, there is no common consensus regarding the diversion values reported and their effectiveness.

MEASURE-LEVEL RESULTS

Measure title: Improved network management	Project: MIRACLES
Measure number: 11.2	City: Winchester

Table 2 summarises the key results found from several major studies.

Table 2: Summary of Proportions of Drivers Diverting in Response to VMS

Location	Proportion of drivers diverting
Southampton	Loop detector data: diversions of 'relevant' drivers ranged from 2% to 30%. Simulation: if optimal proportions of drivers diverted, then 40% - 60% of the extra journey time caused by the incident could be recovered.
Glasgow	"Road Closed" message: 1 – 9% of all drivers diverted (80 – 100% of 'relevant' drivers). "Queuing on Forth Bridge" message: 13% of all drivers (13% of relevant drivers).
London	"Roadwork Delays" message: 0 - 3% of all drivers.
Midlands	"M6 Congestion: For North Use M42(S), M5" message: 60 – 80% of relevant drivers. "NEC Congestion M42 Junction 6" message: 1 – 3% of all drivers (10 – 25% of relevant drivers). "Accident message" instructing use of a specific route: 27 – 40% of all drivers. "Congestion message" instructing use of a specific route: 5 – 25% of all drivers. "Congestion message" with no instructional advice: 2 – 5% of all drivers.
Paris	"Travel time information": 0 – 4% of all drivers. Alternating "travel time" messages with "queue length" messages: additional drivers (about 2%) diverted when queue lengths were displayed. VMS information reduced traffic on busiest roads by 3 – 6%.
Toulouse	"Sign recommendation to turn right" message: increase in traffic turning right of 56% (compared to left-turn instruction) and 35% (compared to no recommendation).
Amsterdam	"Queue length of 4km on Coentunnel" message: 12% of all drivers.
Aalborg	"Delay information": 10 – 40% of relevant drivers.
New York	"Passive" message: 5 – 10% of all drivers. "Active" message: 10 – 20% of all drivers.
Hanshin, Japan	"Travel time" information relating to three alternative routes: 4% of all drivers diverted from slowest route to one of the two other routes.
Melbourne	"Travel time" message: diversion rate increased by 30%.

A number of difficulties have been cited regarding effective evaluation of VMS. These include:

- field monitoring often fails to determine what proportion of the flow is actually affected by the message and so the baseline is not known;
- different message contents and formats have very different effects;
- the 'base' situation (i.e. the network performance in incident conditions if the VMS had not been implemented) is not known;
- VMS impacts on diversion rates are often modest in reality;
- the impact of additional traffic information (obtained from sources such as radio) cannot be isolated from the VMS impacts.

MEASURE-LEVEL RESULTS

Measure title: Improved network management	Project: MIRACLES
Measure number: 11.2	City: Winchester

A summary of the indicators is shown in Table 3.

Table 3: Summary of measure indicators for W11.2

Indicator no. (Meteor no.)	Indicator name	Baseline 2002	Business as Usual 2005	MIRACLES 2005
W11.2/Econ1a	Purchase/loan & installation cost	N/a	N/a	£154,000
W11.2/Econ2b	Labour costs	N/a	N/a	£20,411
W11.2/Soc3a	Operator confidence in technical parameters	N/a	N/a	See M14
W11.2/Soc4a	Planner confidence in usefulness of system	N/a	N/a	See M14

The measure will continue after the end of the MIRACLES project.

Up-scaling

No up-scaling of this measure was undertaken as the ANPR system already covered the whole of the city centre area.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

The Air Quality Action Plan (AQAP) drove this measure. The barriers included technical software difficulties in disseminating the traffic information from the ANPR system onto the VMS. Technical difficulties regarding power supply, communication connections and requiring permission from third parties were barriers to their installation. Siting such an ANPR system with numerous cameras in a historical city can prove difficult and requires sensitivity.

M13: Interrelationships with other measures

This measure is closely connected to Measure 11.1: Improved multi-modal traveller information with the VMS displaying the estimated journey times into the city centre and the air quality information to motorists. It also interacts strongly with Measure 7: Improving bus service quality and information.

M14: Lessons learned

1. Implementation of the measure did not happen as smoothly as originally planned. This was particularly true where equipment was sited on third party land or property (see Measure 11.1).
2. An ANPR system of this type requires an extensive validation process in order to verify that the information disseminated to the public is accurate. This can subsequently delay the system 'going live'.
3. The siting of cameras in a historical city like Winchester proved difficult and required sensitivity. The sites were discussed in advance with the local planning officer from WCC in order that they didn't cause visual annoyance.
4. More resources and time would have been needed to develop an OD matrix for outbound journeys in addition to the inbound journeys. The experience and knowledge gathered from setting up this ANPR system with inbound sites could be used effectively to develop a full OD matrix including outbound journeys and sites which could be used to develop a computer model.
5. HCC (the network operators) reported that it was a very valuable management and monitoring tool, giving the operator an indication of typical journey times across the network. This can enable congestion or incidents to be detected early.

Contact Point

.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

10. Measure 12.1

MEASURE-LEVEL RESULTS	
Measure title: Cleaner vehicle buses	**Project: MIRACLES**
Measure number: 12.1	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

The objective of this measure was to reduce the environmental impact of the bus fleet owned by Stagecoach (the main bus operator in Winchester). This was undertaken by re-powering (i.e. improving the engine technology) some of the fleet to meet a higher Euro emissions standard as well as replacing some older vehicles with new buses.

A secondary aim was to introduce the public to different vehicle fuel types and demonstrate that the buses could operate with the same drive performance as conventional fuels.

M2: Measure description:

New cleaner engine technology was utilised to improve the emissions of 27 buses operating in Winchester. 13 new Euro III buses were introduced on Services 1 and 5 (X1 and X5), 10 buses were re-powered from Euro I to Euro III standard, and diesel/electric hybrid buses were demonstrated during two week-long trials in 2003 and 2004 along the P&R route. In addition, there was a possibility that four new electric hybrid buses were to be purchased when the Park and Ride (P&R) contract came up for renewal in October 2004 and 2005.

The Implementation – how was the measure implemented?

M3: Innovative aspects:

The use of the Bus Quality Partnership (BQP) to deliver a cleaner fleet through combined public and private sector finance was a relatively new concept to the UK. It included a clean up programme for the Winchester bus fleet. The two hybrid bus trials were the first time this type of bus had been demonstrated in Winchester.

M4: Situation before CIVITAS:

The main public transport operator in the area (Stagecoach) has a fleet of nearly 60 vehicles serving Winchester. Prior to MIRACLES, most of the buses in the fleet were either pre-Euro, Euro I or Euro II emissions standard. There were plans to upgrade these to Euro III standard in a rolling programme, an investment funded entirely through revenue from passengers. There were no hybrid or electric fuel buses in operation. When originally let, the P&R route had a contract that stipulated that vehicles needed to be the cleanest available, then Euro II. This initiative built on the positive relationship between Stagecoach and HCC.

Before MIRACLES, two P&R sites were in operation. They are located between the M3 motorway and Winchester city centre and provide 360 spaces (165 St Catherine's and 195 at Barfields). Funding had been obtained for construction of an extension to the St Catherine's site, offering 428 additional spaces. This funding had been agreed through the National Funding "Local Transport Plan" and a public tender was to be issued by the City Council to seek transport operators to run the bus service.

M5: Design of the measure:

This Measure involved the cleaning up of the Winchester bus fleet with a demonstration of alternative fuel technologies. A number of buses from the Stagecoach fleet were to be subsidised to convert them to Euro III during the project lifetime. The measure was designed in the following stages:

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses	Project: MIRACLES
Measure number: 12.1	City: Winchester

1. Upon agreement of the BQP (see Measure 7), a programme was drafted specifying the technologies required by each bus. This took into consideration factors such as the age of the bus, its current emissions standard, and the cost of retrofitting to attain a Euro III or better standard. After the replacement programme had been drafted, it was used to support a bid for extra funding from national sources. The extra funding for the purchase of cleaner engine technology and alternative fuel buses was sought from the Energy Savings Trust (EST).
2. Thirteen brand new Euro III buses were purchased to run on X1 and X5 city centre BQP routes (see Measure 7). These replaced the previous Euro I buses used before MIRACLES.
3. Cleaner engine technologies were fitted to some of Stagecoach's existing Winchester fleet of around 60 buses. Not all vehicles were retrofitted since it was not cost effective to retrofit some older vehicles.
4. Running the P&R service with hybrid buses would have doubled the cost to Winchester City Council (WCC). Instead, Continuous Regenerative Traps (CRT) were fitted to the existing 4 Euro II buses used on this route.
5. As no hybrid buses were purchased (see point 4), hybrid buses were demonstrated on the P&R route for one week in October 2003 (Electrocity) and one week in December 2004 (Designline) (see Figure 1). In addition, there were plans to trial a Transbus, but this was cancelled when the company went into administration.
6. The 13 new Euro III buses were to be fitted with Selected Catalytic Reduction (SCR).

Figure 1: Electrocity and Designline hybrid electric buses demonstrated on the P&R route

M6: Actual implementation:

This was undertaken in the following stages:

1. Initiation of the BQP (Sept 2003);
2. Purchase of 13 new buses (containing engines compliant with Euro III standard) operating on Services 1 and 5 to replace older vehicles in fleet (Oct 2003);
3. Re-powering of 10 existing Euro I buses to Euro III standard;
4. No new electric hybrid buses were purchased for the P&R route, due to cost and availability issues. Instead, the existing Euro II P&R buses were fitted with CRTs;
5. The hybrid diesel/electric vehicle buses were demonstrated during two one week-long trials along the P&R route (Oct 2003 and Dec 2004);
6. The 13 new Euro III buses are to be fitted with SCR. However, technical problems with the conversion of the first Euro III re-power vehicle resulted in the programme being delayed, although a limited number of Euro III vehicles were successfully fitted with SCR.

M7: Deviations from the plan:

The four new alternative fuel buses for the P&R service were not available for use and are dependent on suppliers, and financial and contractual factors. However, four Euro IV buses will be used from

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses	Project: MIRACLES
Measure number: 12.1	City: Winchester

June 2006. As described in section M6, technical problems meant that only a limited number of Euro III vehicles were successfully fitted with SCR. The indicator W12.1/Soc2a – Correct awareness, originally defined for this Measure within D4.1, was not collected because of a lack of data.

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

The data came from several sources:

HCC cost statements – these detail the hours worked on MIRACLES split by work package and staff grade along with any equipment/consumables bought. The figures came from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.

Stagecoach bus company – Stagecoach (the main bus operator in Winchester) supplied data from their own records regarding parameters such as type of engine fitted to each bus, associated costs and age of fleet.

Smoke test – Stagecoach supplied information regarding smoke test results on their fleet of vehicles. Each bus in the Stagecoach fleet is given this test every month that checks the opacity of the smoke plume coming from the exhaust. Data was collected on Pre-Euro, Euro I, Euro II and Euro III vehicles from March 2003 to May 2005.

EMIT model – this was a vehicle activity model used to estimate emissions for all vehicle types travelling through a key city centre route.

Hybrid Bus Trial – The new electric hybrid buses (Electrocity and Designline) operated through the use of an electric drive train, a turbine and a regenerative braking process. The buses had a range of 150 – 250 miles, offering significant reductions in overall emissions (better than Euro IV standard). A questionnaire survey was carried out to assess the user acceptance and opinions of the two new electric hybrid buses, which were each trialled for a 1-week period on the P&R route. The questionnaires were self-completed by the respondents (and returned at the end of their bus journey to the evaluator). The questionnaires used in the two sets of surveys were generally consistent, although some minor modifications were made to the questionnaire used in the second phase in light of experience gained from responses to the earlier surveys. Details of the questionnaire surveys are shown in Table 1.

Table 1: Details of the two hybrid bus passenger surveys

	Date of survey	Route surveyed	Sample size	Purpose
1	16 & 17 October 2003	P&R	168	To measure user acceptance and opinion of the hybrid bus, and transport and environmental issues within Winchester.
2	22 & 23 December 2004		197	

M9: Achievement of quantifiable targets:

- 27 of the 60 buses in the Winchester Stagecoach fleet were either re-powered with cleaner engines or replaced with newer vehicles, thereby reducing the environmental impact of these buses.
- Smoke tests results showed a significant decrease in the average smoke test results of seven buses that were re-powered from Euro I to Euro III emissions standard.

M10: Achievement of evaluation-related milestones:

All the evaluation related milestones (as in the Winchester Annex of D4.1) were achieved.

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses	Project: MIRACLES
Measure number: 12.1	City: Winchester

M11: Report on the measure results:

HCC and Stagecoach cost data

The data from HCC came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3. Staff hours for Work package 12.1 for Years 1 – 3 (including an estimate for year 4) was a total of 921 hours at a cost of £25,500. In addition, there were costs attributable to this Measure of about £100k for contributing to purchasing 13 new buses (Stagecoach), £250,000 for the bus emissions reduction programme (Stagecoach) and about £5,000 for each hybrid bus trial.

Stagecoach paid approximately £120,000/bus for each of their 13 new Euro III vehicles (W12.1/Econ1a). Re-powering 10 buses to Euro III standard was £15,880/bus (£20,000 for first bus) and adding CRT to 4 P&R Euro II buses was £3,425/bus, of which £2,100/bus was an Energy Savings Trust (EST) grant.

Stagecoach Winchester fleet data

Within MIRACLES, 10 buses operating on routes which pass through the city centre (i.e. X4 and X6) were re-powered from pre-Euro or Euro I to Euro III standards. Before MIRACLES, X1 used Euro 1 or II vehicles and X5 used Euro I vehicles. Both services now use new Euro III vehicles. Table 2 and Figure 2 shows the numbers of buses for each type of emission rating and it can be seen that the clean-up program reduced the emissions of 27 buses in the Winchester fleet.

Table 2: Euro emissions ratings of the Winchester bus fleet

	2002	2005
Pre-Euro	15	7
Euro I	25	8
Euro II	19	17
Euro II + CRT	0	4
Euro III	0	22
Euro III + SCR	0	1
Total	59	59

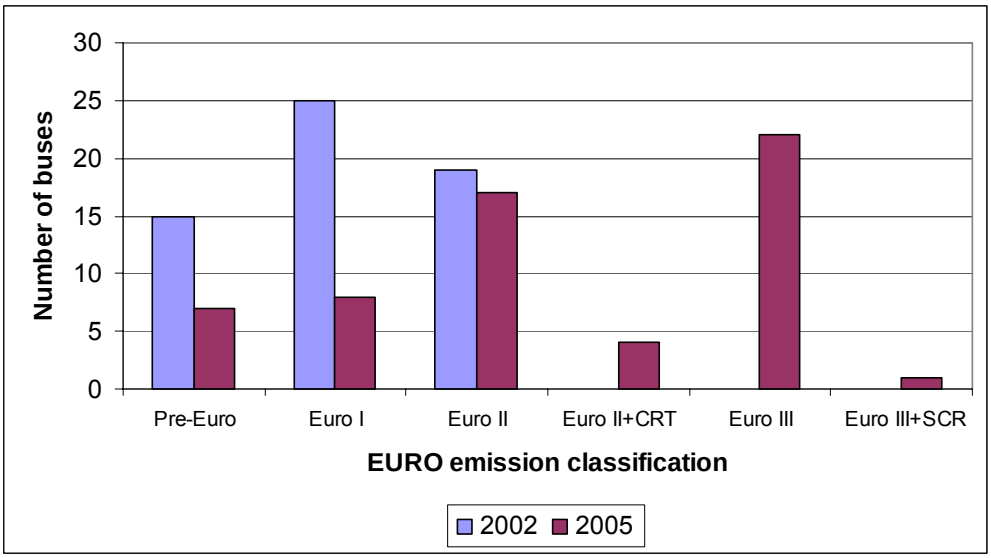


Figure 2: Winchester bus fleet broken down by EURO standard, before and after MIRACLES

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses | **Project: MIRACLES**

Measure number: 12.1 | **City: Winchester**

Maintenance costs (of servicing each vehicle every month) decreased by 60% as a result of the purchase of the new 13 Euro III buses (W12.1/Econ2a). Fuel costs remained similar before and after the 10 buses were re-powered to Euro III standard with consumption between 9 - 11 miles per gallon (mpg). The new buses had a lower figure of about 7.5 mpg (W12.1/Econ 4b, W12.1/Eng1a). This was because they were one tonne heavier and used only in the city centre area with plenty of stops and starts in contrast to the re-powered vehicles which tended to be used for the longer cross city routes.

Lost miles due to breakdowns were compiled for 2002/3, 2003/4 and 2004/5 (see Table 3). They were overall values for the Winchester fleet and so gave no indication of which particular buses were involved. The percentage of lost miles decreased during 2002/3 to 2004/5. This was partly due to the introduction of the 13 new Euro III buses (and the re-powers), which were seen as far more reliable by the operator with less likelihood of overheating (W12.1/Tran1a).

Table 3: Lost miles due to breakdowns for the Winchester fleet

	Lost miles	Total miles	% Lost miles
2002/3	1,792	2,638,931	0.068
2003/4	1,570	2,735,526	0.057
2004/5	1,399	2,399,895	0.058

Smoke test/ emissions data

Smoke test results were compared for the 'before' and 'after' situation for seven buses which were re-powered from Euro I to Euro III standard. These buses ran on a number of different non-MIRACLES BQP cross-city routes. Two non-parametric statistical tests were carried out as the data did not necessarily follow a normal distribution and was a relatively small sample. These tests check for differences in the distribution of two data sets from the same subject (i.e. before and after values for the same bus). The Mann-Whitney test looks for a difference in the 'location' of the distribution of the two data sets being investigated. The two sample K-S test looks for both a difference in location and shape of distribution.

It was expected that the newly re-powered Euro III engine buses would have lower smoke test readings than when fitted with Euro I standard engines. The results of the statistical tests are shown in Table 4 and statistically confirmed this expectation.

Table 4: Statistical test results for the smoke test data for the re-powered vehicles

Test used	Bus No.							
	32310	32312	32324	32314	32323	32325	32326	Total
Mann-Whitney[a]	0.000	0.110	0.000	0.192	0.035	0.000	0.000	0.000
Two sample K-S[b]	0.000	0.215	0.000	0.075	0.034	0.000	0.000	0.000

[a] One tailed significance value given as it is predicted the post 're-engined' vehicles have lower smoke test values than the pre 're-engined' vehicles. [b] A significant difference in smoke test values for both tests is represented by $p < 0.05$

An estimate of the reduction in emissions was calculated for X1 and X5 before and after the new Euro III buses replaced the older Euro I vehicles (it was assumed both services used exclusively Euro I vehicles before MIRACLES). Table 5 below shows the emission factors for Euro I and Euro III vehicles (from 2002 version of the Stanger Emission Factor Toolkit).

Table 5: Emission factors for Euro 1 and Euro III buses (g/km) in urban areas

	NOx	PM10	CO	HC
Euro I	10.77	0.515	2.73	1.392
Euro III	6.67	0.213	1.57	0.709

Route mileage for X1 decreased by 16% between 2002/3 and 2004/5 due to a reduced frequency of

service, whereas for X5 it increased nearly 10% due to an increased frequency of service (see Measure 7 for route mileage figures). As a result, the reductions in NOx, PM10, CO and HC for X1 were 47%, 64%, 50% and 56% respectively; for X5 it was 32%, 55%, 37% and 44% respectively (W12.1/Env1a). As there are no emission factors available for Euro II with CRT or Euro III with SCR, no comparison between Euro II and Euro II + CRT or Euro III and Euro III + SCR could be made.

Questionnaire survey of the hybrid bus trial

The sample size of the first survey conducted in October 2003 was 168; approximately 70% of the respondents were female and 30% were male. The sample size of the second survey in December 2004 was 197; approximately 65% of the respondents were female and 35% were male. A chi-squared test found that there were no significant differences between these two sets of data (heterogeneity χ^2 = 1.03 and $\chi^2_{(0.05)}$ (1df) = 3.84) i.e. the proportions of males / females were consistent.

The age ranges of the respondents were fairly evenly distributed (see Table 6). A chi-squared test revealed that there were significant differences between the two surveys (heterogeneity χ^2 = 15.24 and $\chi^2_{(0.01)}$ (5df) = 15.09). This was predominantly due to a higher proportion of younger people in the first phase of surveys.

Table 6: Age range frequency distribution of respondents

Age Range	17-24	25-34	35-44	45-54	55-64	65+
% of respondents (1st survey)	19.5	25.2	17.6	12.6	13.2	11.9
% of respondents (2nd survey)	14.1	11.5	26.2	15.2	19.4	13.1

Table 7 illustrates the frequency of use of the P&R service. About two-thirds of the respondents in the first survey used P&R on most days, but in the second survey the equivalent value was less than 40%. Indeed, there were significant differences between the two sets (heterogeneity χ^2 = 37.76 and $\chi^2_{(0.01)}$ (4df) = 13.28), predominantly due to higher proportions of 'very frequent' (i.e. most days) or 'very infrequent' (i.e. less than once a fortnight) users of the P&R in the second survey.

Table 7: Frequency of use of P&R service

Frequency of use of P&R	Most days	2-3 days / week	Once a week	Once every 2 weeks	< every 2 weeks
% of respondents (1st survey)	66.5	11.4	3.6	2.4	16.2
% of respondents (2nd survey)	38.7	7.9	5.2	5.2	42.9

The respondents were asked if this was their first trip on the new bus. In the first survey, 65.5% said yes, and 34.5% said they had used the bus before. In the second survey, 85.0% said yes, and 15.0% said they had used the bus before. The second survey captured a significantly higher proportion of respondents who had not previously travelled on a hybrid bus (heterogeneity χ^2 = 18.57 and $\chi^2_{(0.01)}$ (1df) = 6.63).

The respondents were informed that the hybrid bus was significantly less polluting than the usual diesel buses operating on the P&R service and were asked if they agreed that local councils should invest in these less polluting buses. Not surprisingly, very high proportions of respondents agreed that local councils should invest in such buses (97% from first survey, and 98% in second survey). There were no significant differences between them (heterogeneity χ^2 = 0.37 and $\chi^2_{(0.05)}$ (1df) = 3.84).

The respondents were then informed that in terms of costs, a hybrid bus cost approximately twice as much to purchase and operate than a comparable bus powered by a normal diesel engine, and were asked if local councils should invest in these more expensive buses. In the first survey, 77.4% of

respondents agreed that local councils should still invest in the more expensive hybrid bus and only 7.3% said no. (The remainder did not have an opinion). In the second survey, 86.1% agreed and 5.6% disagreed (W12.1/Soc1a). There were no significant differences between the sets of results (heterogeneity χ^2 = 1.46 and $\chi^2_{(0.05)}$ (1df) = 3.84).

The respondents were asked to rate the comfort of their ride on the hybrid bus (compared to the usual P&R buses). 58.7% of respondents in the first survey and 66.1% in the second survey thought that the hybrid bus was more comfortable (see Table 8). The two sets of data were significantly different (heterogeneity χ^2 = 7.58 and $\chi^2_{(0.05)}$ (2df) = 5.99). A higher proportion of respondents in the second survey rated the new bus as being more comfortable and a lower proportion thought that it was more uncomfortable. However, several respondents in the second survey noted that the hybrid bus was smaller than a standard bus, with a smaller seating capacity, and commented that this could cause crowding problems during peak periods.

Table 8: Perceived comfort of hybrid bus ride

Perceived comfort	Much more comfortable	Slightly more comfortable	No difference	Slightly more uncomfortable	Much more uncomfortable	Don't know
% of respondents (1st survey)	23.1	35.6	25.6	11.9	1.3	2.5
% of respondents (2nd survey)	29.1	37.0	18.0	4.2	1.6	10.1

The respondents were asked to rate the noise levels of the hybrid bus. In the first survey, almost 85% rated the bus as very or fairly quiet (see Table 9), although a few respondents noted that they found the whining noise discomforting, particularly noticeable by those people who were sat at the back of the bus. The equivalent result from the second survey was almost 95%. These results were significantly different (heterogeneity χ^2 = 11.15 and $\chi^2_{(0.01)}$ (2df) = 9.21), with a lower proportion of respondents in the second survey rating the new bus as being quite/very loud.

Compared to the usual P&R buses, about 80% of respondents in the first survey and 82% in the second survey thought that the hybrid bus was quieter (Table 6). There were again significant differences between the two sets of results (heterogeneity χ^2 = 15.92 and $\chi^2_{(0.01)}$ (2df) = 9.21). As before, this was because a lower proportion of respondents in the second survey rated the new bus as being louder than the usual P&R buses.

Table 9: Perceived noise levels of hybrid bus

Perceived comfort	Very quiet	Quite quiet	Neither	Quite loud	Very loud	Don't know
% of respondents (1st survey)	35.2	49.4	6.2	8.6	0.6	0.0
% of respondents (2nd survey)	57.1	37.7	3.1	2.1	0.0	0.0
% compared to other buses (1st survey)	39.1	39.8	6.8	8.7	1.2	4.3
% compared to other buses (2nd survey)	47.4	34.9	7.3	0.5	0.0	9.9

The respondents were asked if the introduction of additional hybrid buses would make them use the P&R service more frequently. 23.5% of respondents in the first survey and 24.2% in the second

survey said it would, but the remainder thought it would not make any difference to their frequency of use. There were no significant differences between the two sets of data (heterogeneity χ^2 = 0.03 and $\chi^2_{(0.05)}$ (1df) = 3.84).

Although in each survey the questionnaire focused on the hybrid bus, the respondents were also asked their opinion on two more general aspects: air quality and noise levels in Winchester City Centre. Regarding air quality, about half thought that the quality was generally good (see Table 10), and about 15% that it was generally poor. The two sets of data were not significantly different (heterogeneity χ^2 = 0.49 and $\chi^2_{(0.05)}$ (2df) = 5.99).

Table 10: Perceived air quality in Winchester City Centre

Perceived air quality	Very good	Quite good	Neither	Quite poor	Very poor	Don't know
% of respondents (1st survey)	4.2	45.2	30.1	14.5	2.4	3.6
% of respondents (2nd survey)	14.4	35.1	26.8	11.9	2.1	9.8

Regarding road traffic noise, 65.7% of the respondents in the first survey thought that the city centre noise level was loud or very loud, but the equivalent value from the second survey was 47.4% (see Table 11). A chi-squared test revealed that these differences were significant (heterogeneity χ^2 = 19.70 and $\chi^2_{(0.01)}$ (2df) = 9.21). A significantly higher proportion of respondents in the second survey rated traffic noise levels in the city to be very/fairly quiet.

Table 11: Perceived noise levels in Winchester City Centre

Perceived noise levels	Very quiet	Fairly quiet	Neither	Fairly loud	Very loud	Don't know
% of respondents (1st survey)	0.0	7.2	25.3	53.0	12.7	1.8
% of respondents (2nd survey)	2.1	21.1	22.7	39.2	8.2	6.7

Overall, passengers found the both new hybrid buses more comfortable and quieter than the usual bus operating on the P&R service (Euro II with traps), although the Designline bus was rated slightly higher than the Electrocity bus.

Further data analysis (using chi-squared tests) was then undertaken to gain a greater understanding of any influencing characteristics of the results. The variables considered were: age of respondent, perceived air quality in Winchester city centre, perceived noise levels in Winchester, current frequency of use of P&R service, whether it was the respondent's first trip on the hybrid bus, comfort of hybrid bus ride, noise levels of hybrid bus, and potential future use of P&R service if more hybrid buses were introduced.

The two sets of survey data were analysed separately and the significant findings (at the 5% level) are shown in Table 9. A "√" denotes that the result was significant for that particular survey (and a "X" that it was not significant). For either of the two sets of survey results, there were no significant correlations between any other combinations of variables not shown in Table 12.

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses	**Project: MIRACLES**
Measure number: 12.1	**City: Winchester**

Table 12: Summary of influencing characteristics of the results

Statistically significant findings	1st Survey	2nd Survey
Older respondents were more likely to use the P&R service less frequently than the younger respondents. Consequently, older respondents were more likely to state that this was their first trip on the hybrid bus.	√	√
Not surprisingly, those respondents who used the P&R service less frequently were more likely to state that the day that the survey was undertaken was their first trip on the new bus.	√	√
Those respondents who currently used the P&R service less frequently were more likely to rate the new buses as being more comfortable.	√	X
Those respondents who rated the air quality in Winchester city centre as being poor were more likely to also consider the traffic noise levels in Winchester to be loud.	√	√
Those respondents who rated the air quality in Winchester city centre as being neither good nor poor were more likely to also rate the noise levels in the hybrid bus to be neither quiet nor loud.	√	√
Those respondents whom had travelled on the hybrid bus before were more likely to say that the ride was more uncomfortable than the usual P&R buses.	X	√
Those respondents who perceived the new hybrid bus ride to be uncomfortable were also more likely to rate the noise levels of the bus to be loud.	√	X
Those respondents who perceived the new hybrid bus ride to be uncomfortable were also more likely to rate the noise levels of the bus to be louder than the usual buses used in the P&R service.	√	√
Not surprisingly, those respondents who perceived the hybrid bus to be noisy were also more likely to state that it was noisier than the usual P&R buses.	√	√
Those respondents who currently used the P&R service less frequently were more likely to say that the introduction of more hybrid buses would mean they would use the P&R service more frequently.	√	√
Those respondents who stated that the introduction of more hybrid buses would mean they would use the P&R service more frequently were more likely to consider the air quality in Winchester city centre to be good.	X	√
Those respondents who stated that the introduction of more hybrid buses would mean they would use the P&R service more frequently were more likely to rate the hybrid bus ride as being comfortable.	X	√

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses | **Project: MIRACLES**

Measure number: 12.1 | **City: Winchester**

A summary of the measure indicators (as defined in the Local Annex of D4.1) is shown in Table 13.

Table 13: Summary of measure indicators for WP12.1

Indicator no. (Meteor no.)	Indicator name	Baseline 2002	Business as Usual 2005	MIRACLES 2005
W12.1/Econ1a	Purchase/loan and installation costs	N/a	N/a	£140,000/new bus
W12.1/Econ2a	Maintenance costs	Base (2002/3)	As base	-60% (new buses: see W7)
W12.1/Econ3a	Revenue generated	Base (2001/2)	8% – 19% (see WP7)	12% - 46% (see WP7)
W12.1/Econ4a (2)	Operating cost per passenger km	Base (2003/4)	No data available	-13% to -1% (see WP7)
W12.1/Econ4b	Change in fuel costs	Base (2002/3)	None	None but slightly lower for new buses – see Engy1a)
W12.1/Econ4c	Labour costs	Base (2002/3)	+19.1% (see WP7)	+19.1% (see WP7)
W12.1/Engy1a (3)	Vehicle fuel efficiency (miles per gallon)	Base (2002/3) 9 – 11 mpg	9 – 11 mpg	Re-powers: 9 – 11mpg; New: 7.5 mpg
W12.1/Env1a (8-11)	Emissions (NOx, PM10, CO, HC)	Base (2002/3)	No data available	X1: -47%, -64%, -50%, -56% X5: -32%, -55%, -37%, -44%
W12.1/Soc1a (14)	Acceptance rating (despite extra cost)	N/a	N/a	77.4% - 86.1%
W12.1/Soc3a	Operator confidence in technical parameters	N/a	N/a	See M14
W12.1/Tran1a	Reliability of vehicle (% of lost miles due to breakdown of total mileage)	Base (2002/3) 0.068%	0.068%	0.058%

This measure will continue after the end of the MIRACLES project.

Up-scaling / Emissions Modelling Results

The potential effects of up-scaling this measure were investigated using the Winchester Emissions Model for Inventory of Traffic (EMIT). This was a vehicle activity model used within a desktop study to examine the pollution reductions that could be achieved if the cleaner technology was rolled out to bus services operating on other routes within Winchester. Buses travelling through St Georges Street, a key street within the Winchester one-way system, were examined. A number of inputs were used to estimate the emissions:

1. Bus fleet – the Euro standard of buses operating on each of the routes passing through St. Georges Street were accounted for (e.g. in 2002 X5 was operated using Euro I vehicles whereas in 2005 the X5 fleet were all Euro III vehicles). Table 14 shows the buses (route, frequency and Euro specification) passing through St Georges Street on a typical weekday (based on timetable information).

MEASURE-LEVEL RESULTS	
Measure title: Cleaner vehicle buses	**Project: MIRACLES**
Measure number: 12.1	**City: Winchester**

Table 14: Route, frequency and Euro specification of St George Street buses

	2002		2005	
Bus route	Euro specification	Frequency	Euro specification	Frequency
P&R	Euro II	53	Euro II + CRT	53
1	Euro I	68	Euro III	57
2	Euro II	10	Euro II	10
4	Euro II	10	Euro II	10
5	Euro I	60	Euro III	82
6	Euro I	51	Euro III (re-power)	51
6A	Euro I	5	Euro III (re-power)	5
7/7A	Euro I	12	Euro III (re-power)	12
X25, 26, X26, X99	Euro I	5	Euro I	5
46	Euro II	9	Euro II	9
86	Euro I	12	Euro III	12
66/66A/X66	Euro I	17	Euro III (re-power)	17

2. Hourly speeds – to improve the temporal sensitivity of the modelled output to changing traffic speeds throughout the day, the speeds of vehicles were estimated on an hourly basis. Estimates of the speeds were derived from a floating car survey of link travel times in Winchester city centre undertaken in 2004. It has been assumed that the speeds in 2002 and 2005 were the same. The emission factors used were based on average link speeds (although account is made for variations around these average speeds) in their initial formulation by TRL.

3. Bus timetable – bus departures on St. Georges St were also divided into hourly periods to give more weight to those routes that operated at higher frequency at peak hours and for longer throughout the day. Only buses that were operated by Stagecoach and scheduled to travel through St. Georges Street were included. (This may exclude special services, such as school services, or buses in transit but not in service).

The above inputs were used to calculate a single estimated emission factor for CO, HC, NOx, PM, CO2 and fuel (all in g/km) for the whole considered bus fleet. This was undertaken for the fleet and timetable in operation in 2002 and 2005.

Important assumptions which should be considered:

- Average speeds were estimated from floating car surveys; the speeds achieved by buses are assumed to be the same.
- Emissions reductions resulting from retro fitting CRT to Euro II buses were estimated from industry/government agency figures. This brought the emissions rate below Euro III levels.
- A flat road was assumed. This differs from reality as St Georges Street is on a noticeable uphill gradient. However, no suitable emission/scaling factors could be found to weight for the extra power required.

The up-scaling considered the following four scenarios:

- 2002 – Actual fleet
- 2005 – Actual fleet
- 2005 – All Euro III
- 2005 – All Euro IV

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses	Project: MIRACLES
Measure number: 12.1	City: Winchester

Results

1. Comparing the 2005 emission factors to those of 2002, emissions of CO, HC, NOx, PM and CO_2 were all reduced by 44%, 42%, 26%, 53% and 2% respectively for St Georges Street. A very small increase in fuel consumption was observed (probably due to the increased frequency of the buses).

2. If all buses passing through St. Georges Street in 2005 were replaced by Euro III vehicles, there would be a slight increase in the fleet emission factor for CO, HC and PM. This is because Euro II + CRT actually gives CO, HC, PM and CO_2 emission factors which are lower than those for a Euro III bus. There is an improvement in NOx as the impact of CRT on reducing it is minimal. Very little change in CO_2 and fuel was observed. Further benefits could still be gained from retro fitting the current buses with CRT rather than reengaging or replacing them to a Euro III standard.

3. If the buses passing through St Georges Street were upgraded to Euro IV, there would be a reduction in all pollutants (CO (-19%), HC (-29%), NOx (-36%), PM (-76%) and CO_2 (-1.5%).

Figures 3, 4 and 5 show the results for the four scenarios.

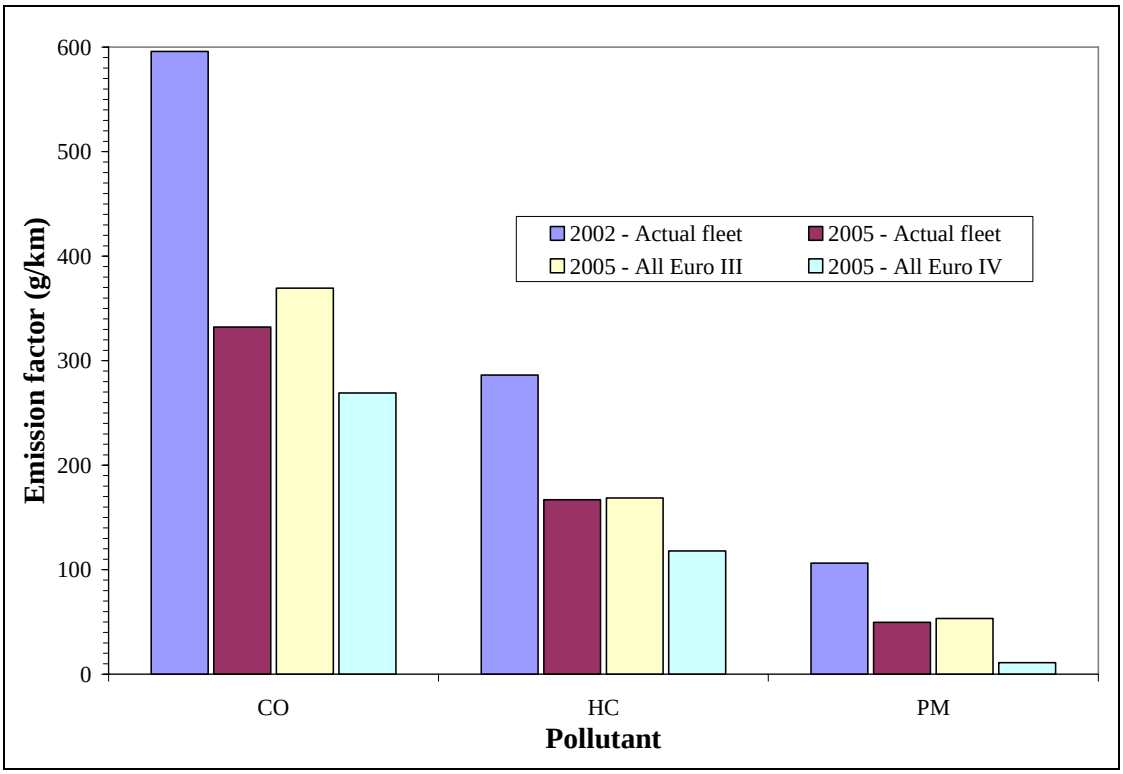


Figure 3: Combined emission factor for buses travelling through St Georges Street – CO, HC and PM

MEASURE-LEVEL RESULTS	
Measure title: Cleaner vehicle buses	**Project: MIRACLES**
Measure number: 12.1	**City: Winchester**

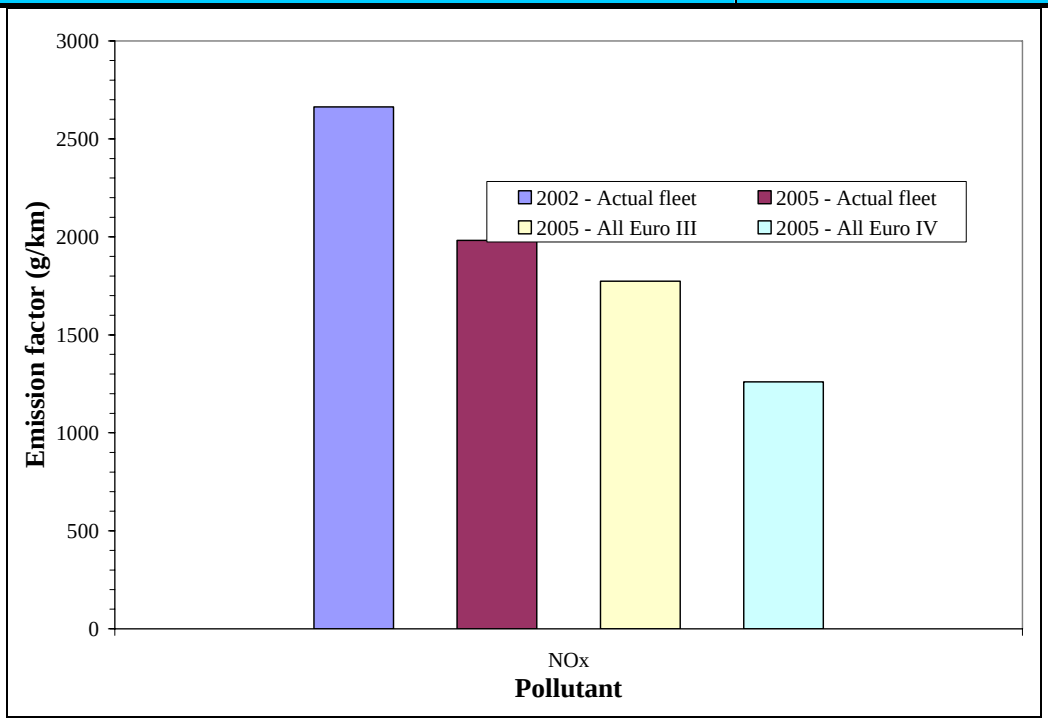


Figure 4: Combined emission factor for buses travelling up St Georges Street – No_x

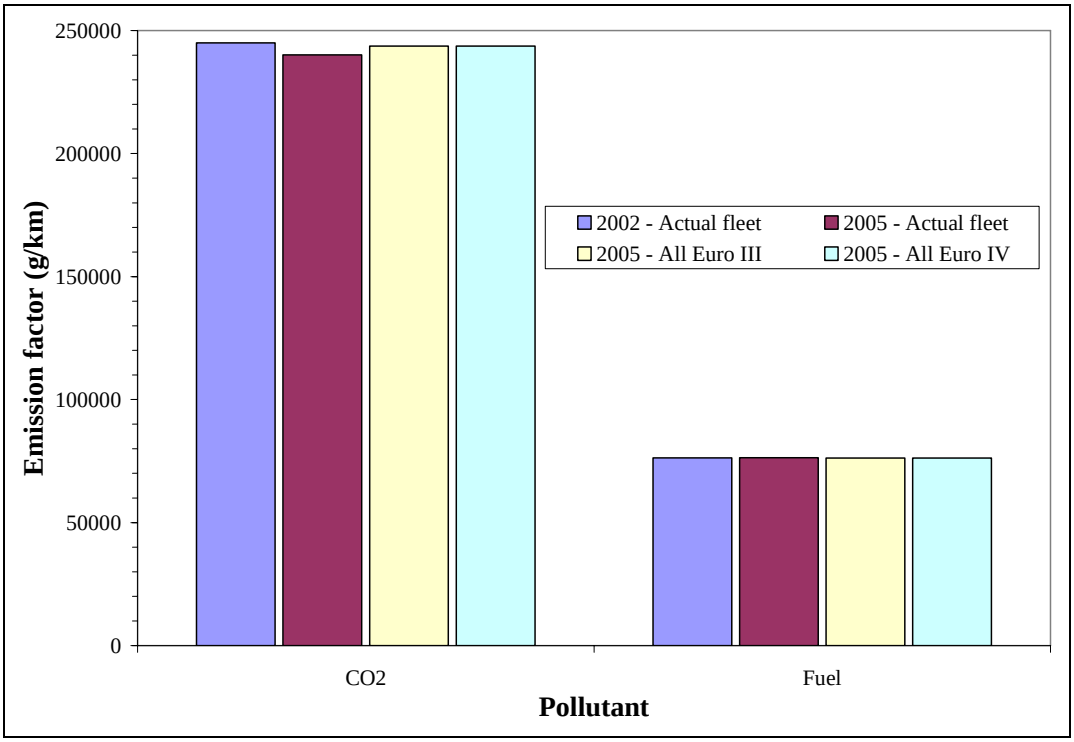


Figure 5: Combined emission factor for buses travelling up St Georges Street - CO_2 and fuel

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses	Project: MIRACLES
Measure number: 12.1	City: Winchester

In practice, it is currently uncertain whether the Winchester fleet of cleaner buses will be expanded in the near future. It should be noted that the Euro IV standard becomes relevant in 2006 i.e. the engine of any new bus built after 2006 will be compliant with the Euro IV standard.

Emissions from the vast majority of buses circulating in Winchester have been shown to be lower for 2005 compared to 2002 as a direct result of cleaning up the bus fleet. However, whilst the observed reduction in emissions from the buses is beneficial, it is important to put it in the context of the natural reduction in other vehicle emissions over the three year period. Emissions from cars, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) are currently decreasing mainly as a result of more stringent emissions standards required by the EC.

Emissions results produced by the EMIT model for St Georges Street are shown in Figures 6 to 9. Some parameters relating to fleet structure are specific to Winchester such as weekday hourly vehicle speeds, flows and basic vehicle type proportions (cars, LGV, HGV). Flow and speed have been left as constants within the model. Other more detailed fleet proportions in terms of fuel type and emissions standards are taken from UK wide estimates used for the National Atmospheric Emissions Inventory (NAEI). Speed based emissions factors are also those used in the 2002 NAEI. The model was run with no buses included in the fleet make up as they were later accounted for within a separate analysis and added to the final results.

Three different scenarios were modelled. These were:

- **baseline scenario** of 2002 - based on 2002 fleet details;
- **MIRACLES modelled scenario** for 2005; and
- **do-nothing scenario** - assumes that the bus emissions are the same as 2002 but all other vehicle emissions are those for 2005.

Figures 6 and 7 show how emissions of CO and HC changed in actual terms for the three different scenarios.

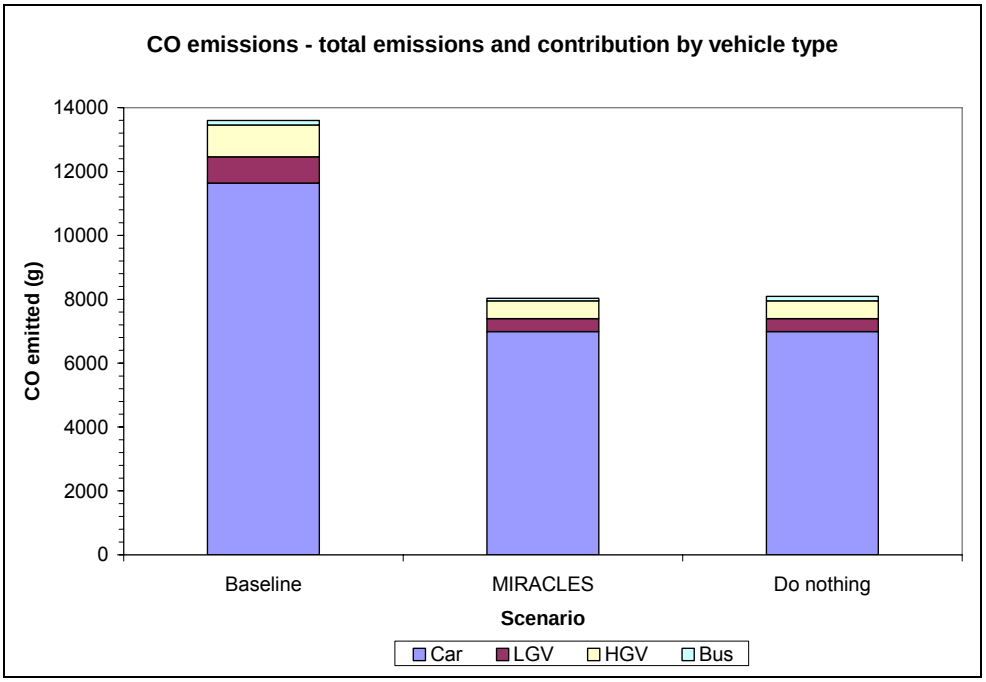


Figure 6: Total CO emissions split by vehicle type

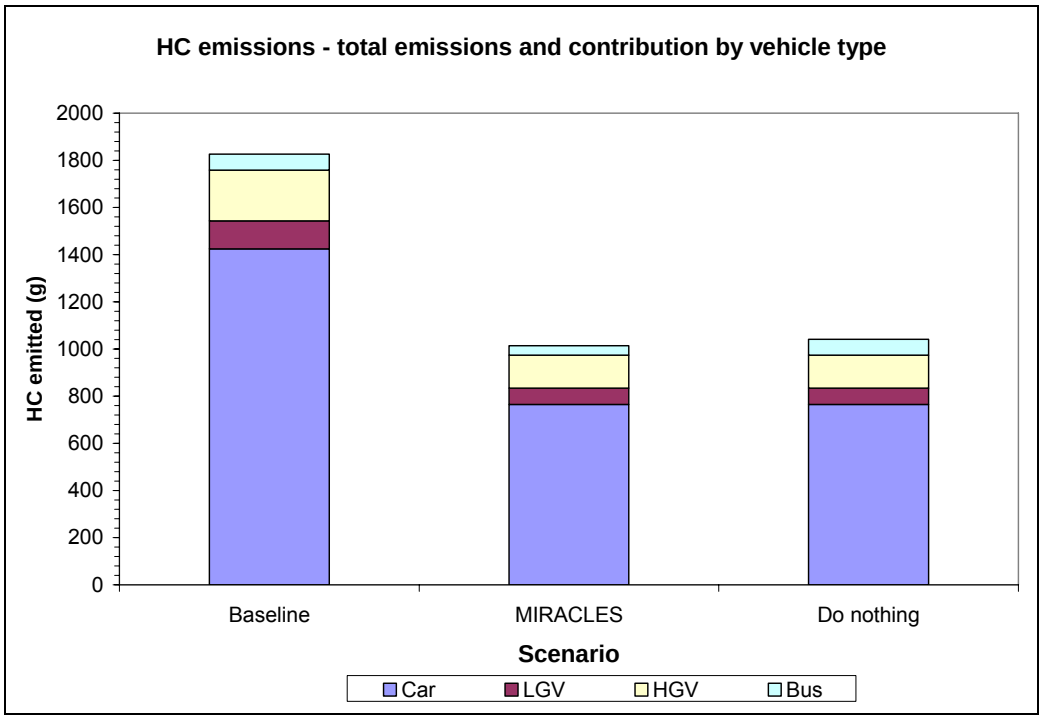


Figure 7: Total HC emissions split by vehicle type

There was a significant reduction in total CO emissions between the baseline and MIRACLES scenarios. Buses contributed very little to total CO (about 1%) and by comparing against the do-nothing scenario it was seen that the total reduction was mainly due to natural improvements in the emissions performance of the overall vehicle fleet rather than from changes exclusively in the bus fleet (although beneficial is small).

Similarly, buses contributed only a small fraction of the total HC emissions (about 3% – 5%). Whilst there has been a significant decrease in total HC emissions, the percentage contribution from buses remained approximately constant. This decrease in bus HC emissions occurred at the same rate as for the rest of the vehicle fleet. Cleaning up the bus fleet only had a marginal effect on the total HC emissions.

Figures 8 and 9 show how emissions of NO_x and PM_{10} changed in actual terms for the three different scenarios.

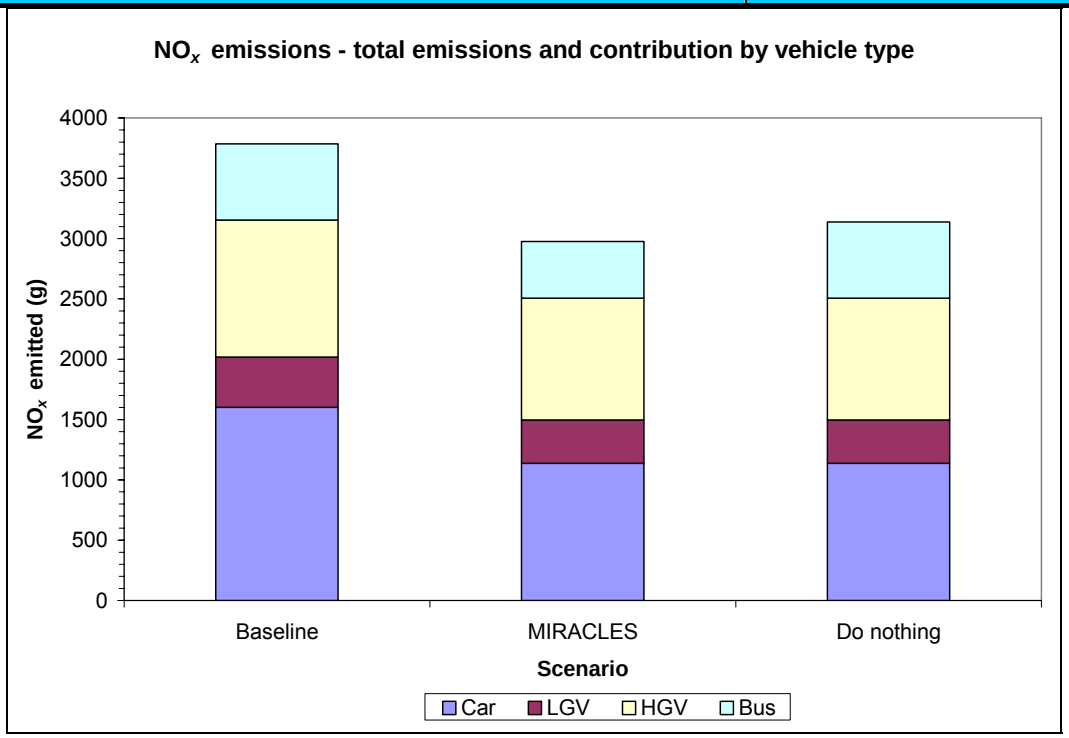


Figure 8: Total NOx emissions split by vehicle type

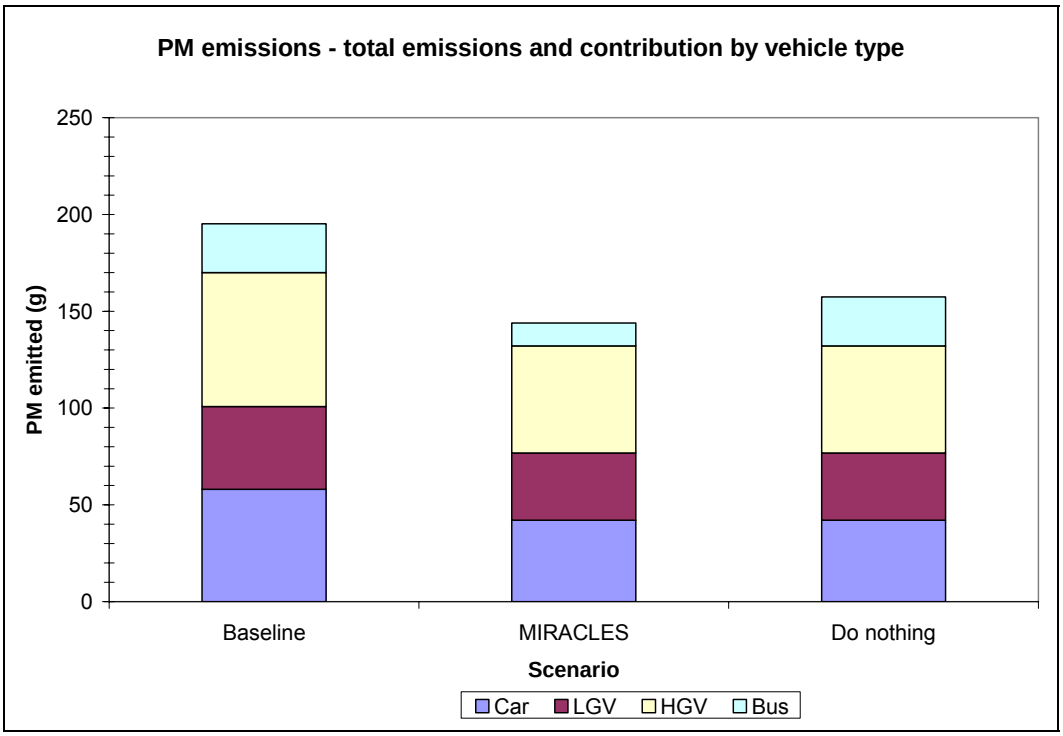


Figure 9: Total PM_{10} emissions split by vehicle type

MEASURE-LEVEL RESULTS

Measure title: Cleaner vehicle buses	Project: MIRACLES
Measure number: 12.1	City: Winchester

NOx emissions decreased, although not at the same rate as CO or HC. Relatively large reductions in NOx from both cars and buses were the main contributors to the observed decrease (buses contribute 16%-20% of total). It would seem that, in addition to ensuring that Winchester bus fleet emissions standards continue to improve at the same rate as the general car fleet, NO_x emissions savings could be made by focusing on strategies to remove HGV traffic from Winchester city centre.

As expected, total PM_{10} emissions also decreased. Buses have a greater influence in this overall reduction than is the case for CO, HC and NO_x (contribution of between 9%-15%). It would seem that LGV's and HGV's are the largest contributors to PM_{10} emissions with LGV's increasing their relative contribution between 2002 and 2005.

It should be noted that data regarding the Winchester car fleet indicated a higher than national average use of diesel cars in Winchester city centre. In this case, the contribution of cars to total NOx and PM is likely to be higher than that estimated by the model.

Overall, the estimated emission reductions from the buses were small, when placed in the context of reductions in the overall traffic emissions. Decreases in the proportion of NO_x and PM emissions from buses had the most noticeable impact. Further analysis based on emissions per passenger km would enable a fairer comparison to take place between buses and the rest of the vehicle fleet, but it would be difficult to estimate a weighting for the 'freight mileage' to enable goods vehicles to be compared to non-goods vehicles.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

As with Measure 7, the Bus Quality Partnership (BQP) was a major driver in implementing this Measure.

Technical problems meant that the number of Euro III buses fitted with SCR was limited. For any bus operator wishing to clean up their bus fleet, the lowest cost option is to re-power, but in some situations (i.e. when a new Euro standard is imminent) it may be more cost-effective in the longer term to purchase a new vehicle whose engine is compliant with the more recent emissions standard.

However, the higher cost of cleaner buses (particularly hybrid) is a negative factor for bus companies when considering their purchase. Financial support may need to be sought from a variety of sources in order for them to become viable.

M13: Interrelationships with other measures

This measure is closely related with Measure 7: Improving bus service quality and information.

M14: Lessons learned

1. The benefits of hybrid buses in terms of their emissions, noise levels and comfort are currently often outweighed by their cost, although they are preferred by passengers in terms of their quietness and comfort. (Even without using alternatively powered buses, the P&R service already requires a substantial cross-subsidy).
2. Re-powering buses to a higher Euro emissions standard is a cost effective and energy effective way of reducing the pollutants of city centre buses.
3. Re-powering a Euro II bus to Euro III standard is about five times more expensive than fitting CRT. As Euro II buses + CRT have lower emission factors than Euro III for all gases except NOx, it is not cost effective to re-power Euro II buses to Euro III standard unless reducing NOx is a major priority (as in the Winchester Air Quality Action Plan); it is better to wait until a re-power to Euro IV standard becomes available (assuming the engine suppliers provide such a service).
4. The percentage of lost miles decreased during 2002/3 to 2004/5. This was partly due to the introduction of the 13 new Euro III buses (and the re-powers), which were seen as far more reliable by the operator with less likelihood of breakdown.

MEASURE-LEVEL RESULTS	
Measure title: Cleaner vehicle buses	**Project: MIRACLES**
Measure number: 12.1	**City: Winchester**

5. The clean-up program succeeded in reducing the emissions of 27 buses in the Winchester fleet and produced significant reductions on a key city centre street in CO, HC, NOx, PM and CO_2 of 44%, 42%, 26%, 53% and 2% respectively. The up-scaling work showed that further significant emission reductions would occur if all the fleet were replaced or re-powered to Euro IV standard.
6. Adding SCR to Euro III vehicles was an untried process that experienced technical difficulties. This, in addition with the anticipated introduction of the Euro IV standard in 2006 means it became less economic to add SCR to Euro III engines in 2005 when they could be re-powered to Euro IV standard a year later (assuming this option is provided by suppliers and economically viable).
7. Receiving funding from the Energy Savings Trust can be problematic, particularly as eligibility rules can change in addition to EU laws regarding 'state aid'.
8. The estimated emission reductions from the buses were small, when placed in the context of reductions in the overall traffic emissions. Decreases in the proportion of NO_x and PM emissions from buses had the most noticeable impact. Further analysis based on emissions per passenger km would enable a fairer comparison to take place between buses the rest of the vehicle fleet, but it would be difficult to estimate a weighting for the 'freight mileage' to enable goods vehicles to be compared to non-goods vehicles.

Contact Point

.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

11. Measure 12.2

MEASURE-LEVEL RESULTS	
Measure title: Cleaner municipal fleets	**Project: MIRACLES**
Measure number: 12.2	**City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

The objective of this measure was to reduce the environmental impact of Council activity in the Winchester area and beyond.

M2: Measure description:

Hampshire County Council (HCC) purchased a fleet of new Euro IV vehicles for their company car fleet, setting an example that other companies would follow. In addition, HCC joined Transport Energy's "Motorvate" scheme to receive recommendations in reducing unnecessary business mileage and carbon dioxide emissions. The Motorvate scheme offers companies assistance in reducing the fuel consumption of their vehicle fleet. It was hoped that other companies in Hampshire would follow HCC's example in both cleaning up their company fleet and subscribing to Motorvate.

The Implementation – how was the measure implemented?

M3: Innovative aspects:

This measure provided a best-practice for companies establishing a new clean fleet purchasing programme. The drive to introduce vehicle efficiency management programmes was uniquely combined with using the services of the company Motorvate (as described above).

M4: Situation before CIVITAS:

HCC had established a green purchasing policy for a range of goods and services, but had yet to apply this policy to vehicles for corporate and individual use. HCC had introduced a few low emission vehicles with performance assessed against manufacturer's specifications. Vehicles fulfilled tasks such as courier services. Further take-up had been hindered by cost differentials between low emission vehicles and standard ones, insurance, reduction in grant assistance, and the need to find finance to meet this difference. Warranties could be invalidated by conversions and there were few incentives to staff to take up clean vehicle engine technology. HCC was also seeking to supply bio diesel, but there was (at that stage) insufficient source material in the UK to ensure sufficient and consistent supply. Few Euro IV vehicles were then available.

M5: Design of the measure:

This measure was designed in the following steps:

Step 1: The County Treasurers Department at HCC undertook a review of the emissions savings and cost analysis from the use of cleaner vehicles (e.g. LPG, Electric, Hybrid, new EURO IV diesel and petrol). This study was built upon by MIRACLES to produce a procedure for identifying what alternative fuel options were feasible for various vehicle operations. The review took data being collected from current alternative fuelled vehicles operated by HCC as well as up to date literature.

Step 2: Following the development of a new replacement procedure, a new replacement programme was drafted to cover the lifetime of the project. Where the cost differential was not too great, it aimed to recommend the purchase of cleaner vehicles and identify the most appropriate vehicle technology according to the operational characteristics of the vehicle. Once the new replacement plan was finalised, it was implemented for all new vehicles purchased or leased by HCC. To continually choose the best technology for the job, a periodic review was undertaken to ensure that new technologies were taken into account

MEASURE-LEVEL RESULTS

Measure title: Cleaner municipal fleets	Project: MIRACLES
Measure number: 12.2	City: Winchester

Step 3: Implementation of renewal plans with 27 Euro IV 1.7 Astra vehicles supported by the CIVITAS initiative. In addition, a further 3 Euro IV and 7 LPG vehicles were added to the fleet. A significant change was the introduction of new fleet management and fuel monitoring systems.

Step 4: The County Council signed up to the "Motorvate" scheme (a government sponsored best practice "green fleet" programme), partly for its own benefit and also as an example and stimulant to other local fleet operators. The Motorvate scheme offered companies incentives and assistance in reducing the fuel consumption of their vehicle fleet. This included a site visit to HCC by Motorvate followed by a report setting targets. After the case had been presented to members of the forum, invitations were given for them to participate in the scheme. Promotion of the scheme to local businesses via a one-day seminar followed HCC becoming full members of the scheme.

Step 5: In addition to the original plan, MIRACLES contributed to the purchase of four new library buses that were Euro III and fitted with CRT (Continuous Regenerative Trap).

M6: Actual implementation:

The measure was implemented in five stages as follows:

Stage 1: Review/cost analysis of uses of cleaner vehicles (March 2003)
Stage 2: Replacement programme drafted (May – October 2003)
Stage 3: Purchase of 27 Euro IV vehicles (March – August 2003)
Stage 4: HCC sign up to Motorvate and promote its benefits (April – December 2004)
Stage 5: Contribute to the purchase of four library buses (September 2005)

M7: Deviations from the plan:

In addition to the 27 Euro IV vehicles purchased in the MIRACLES project, a further three Euro IV and 7 LPG vehicles were purchased. Also, MIRACLES contributed to the purchase of four new library buses (or discovery centres) fitted to Euro III standard with CRT (see Figure 1).

Figure 1: Library bus

Two of the indicators originally defined for this Measure within D4.1 were not measured, as Motorvate did not make a second visit to HCC within the lifetime of the project. These indicators are listed below:

MEASURE-LEVEL RESULTS	
Measure title: Cleaner municipal fleets	**Project: MIRACLES**
Measure number: 12.2	**City: Winchester**

- W12.2/Engy2a – Fuel efficiency before and after Motorvate;
- W12.2/Tran2a – Vehicle km driven before and after Motorvate.

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

The data came from two main sources:

- **Hampshire County Council cost statements** – these detailed the hours worked on MIRACLES split by work package and staff grade along with any equipment/consumables bought. The figures came from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.

- **Hampshire Transport Management (HTM)** – the vehicle mileage/fuel consumption records from April 2004 – July 2005 was supplied electronically from the HCC on-site fuelling facilities. The amount of fuel drawn is automatically recorded directly from the pump. Errors in the reported fuel economy can occur when drivers incorrectly enter odometer mileage at the start of refuelling or refuelling has taken place somewhere other than the HCC facilities.

- **Motorvate report to HCC** – this report listed a number of recommendations and targets for HCC in reducing their annual mileage and therefore emissions.

M9: Achievement of quantifiable targets:

N/a

M10: Achievement of evaluation-related milestones:

All the evaluation related milestones (as in the Winchester Annex of D4.1) were achieved.

M11: Report on the measure results:

HCC cost data

The data from HCC came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3. Staff hours for Work package 12.2 for Years 1 – 3 were a total of 719 hours at a cost of £19,700 with Year 4 estimated at 34 hours at a cost of £1,200. In addition, HCC spent about £9,800 for each of the 27 Euro IV Astra vehicles that were about £300 more per vehicle than the Euro III equivalent (W12.2/Econ1a). In addition to the original plan, MIRACLES contributed £53,000 for the library buses (with an additional £10,500 for the fitting of CRT). Maintenance costs for the new vehicles remained similar as for the Euro III vehicles (W12.2/Econ2b). HCC paid £800 to initially join Motorvate.

Motorvate report to HCC

As part of the scheme, the current CO_2 emissions of HCC's transport operation were estimated. This included the Hampshire Transport Management (HTM) fleet as well as the 'grey fleet' of privately owned staff cars. In 2003/4, the HTM fleet (under 3.5 tonnes) travelled 1.03 million miles producing a total of 326 tonnes of CO_2. The grey fleet showed staff had travelled about 18.5 million miles (4% up from 2002/3 and 9.5% up from 2001/2) producing 4920 tonnes of CO_2. The Motorvate targets set were for a 12% reduction in CO_2 and 3% mileage reduction for both the HTM and the grey fleet. Other recommendations included to improve quality of fleet database including all vehicles, establish individual fuel consumption for each vehicle and establish a grey fleet database of staff vehicles which is linked to MOT certificate, insurance and driver records. No companies in Hampshire (or those who attended the one day seminar in December 2004) subsequently bought a clean fleet of vehicles or joined Motorvate (W12.2/Tran1a). The joining fee (on a rising scale up to £2000) was high particularly as more limited free advice is now also available at EST. In 2005, there were 31 members of

MEASURE-LEVEL RESULTS

Measure title: Cleaner municipal fleets	Project: MIRACLES
Measure number: 12.2	City: Winchester

Motorvate in the UK. In addition, a longer term commitment to sign up to the scheme is unlikely as potential benefits in reduced mileage and CO_2 emissions may be realised in the first few years. The Motorvate targets for HCC were re-assessed in March 2006 with results available only after the end of the MIRACLES project.

HTM fuel mileage/consumption records

During the early stages of the project, a number of HCC fleet vehicles were due for replacement. The additional contribution from MIRACLES enabled HCC to purchase more expensive, early production models of twenty-seven Euro IV diesel vehicles instead of cheaper Euro III models that were available at the time.

To estimate fuel and emissions savings as a result of purchasing Euro IV vehicles over Euro III vehicles, a simple comparison based on mileage and appropriate emissions factors was made. The percentage difference between total estimated emissions from a Euro IV and the equivalent Euro III vehicle (i.e. same make, model, engine size etc.) will only be as large as the percentage difference between the two vehicle types. This measure evaluation also sought to estimate the actual quantity of emissions and energy saved. The appropriate fuel consumption and emission factors as given by the UK Vehicle Certification Agency (VCA) are shown in Table 1. In addition, actual fuel consumption figures were collected for a number of the vehicles during the lifetime of the project. To improve the accuracy of the emission quantities predicted using the emissions factors, the actual fuel consumption relative to the VCA fuel consumption was used to weight the emissions calculated. Table 1 shows that fuel consumption for the new Euro IV vehicles was about 2% lower in comparison with the Euro III vehicles (W12.2/Econ2a, Econ2c, Engy1a, Env1a), which was the only cost that changed.

Table 1: Comparison of fuel consumption and emission factors of Euro III and IV standard vehicles of the same make and model

Vehicle	Fuel type	Engine size	Emission standard	Fuel consumption (l/100km)			Emissions (g/km)					
				Urban	Extra urban	Combined	CO_2	CO	HC	NOx	HC+ NOx	PM10
Vauxhall Astra estate	Diesel	1686cc	EURO IV	6.1	4.0	4.8	129	0.253	0.018	0.238	0.256	0.021
Vauxhall Astra estate	Diesel	1686cc	EURO III	6.2	4.1	4.9	132	0.101	0.021	0.429	0.450	0.031
% reduction of EURO IV compared to EURO III						-14.26	-2.27	150.5	-14.26	-44.52	-43.11	-32.26

Actual fuel economy values are produced automatically after every refuelling at HCC's onsite fuelling facilities. Some vehicles had clearly been used more than others and so had a far higher number of refuelling records. Errors in the reported fuel economy can occur when drivers incorrectly enter odometer mileage at the start of refuelling or refuelling has taken place somewhere other than the HCC facilities. The amount of fuel drawn is automatically recorded directly from the pump. Fuel economy values in the raw data which were suspiciously high or low, when compared to the VCA fuel consumption values, have been removed from the data. Only a small percentage (less than 2%) of entries for vehicles included in this analysis were removed and did not significantly alter the results presented below.

Two significant limitations of this approach lie in the drive cycle used to determined UK Vehicle Certification Agency (VCA) emission factors. Firstly, the VCA drive cycle is not particularly representative of 'real world' driving and as a result is likely to underestimate emissions from vehicles.

MEASURE-LEVEL RESULTS

Measure title: Cleaner municipal fleets	Project: MIRACLES
Measure number: 12.2	City: Winchester

Secondly, the drive cycle features disproportionate distances of 'urban and 'extra-urban' driving; the emission factors used are the overall emissions in g/km for the whole drive cycle. Without a detailed understanding of the type of driving (e.g. urban or motorway) or the driving style (e.g. an aggressive driver or a calm driver) it is impossible to know exactly how emissions over a particular distance will differ from the VCA drive cycle. The use of actual fuel consumption does add some greater accuracy to the predictions presented.

Whilst the energy and fuel savings presented are relatively crude estimates they represent the scale of savings made. Table 2 presents the estimated total volume/weight of fuel/pollutants saved as a result of the use of the Euro IV vehicle model over the Euro III. There was vehicle-to-vehicle variability in the amount of fuel/pollutant saved per kilometre.

Table 2: Estimated total volume/weight of fuel/pollutants saved as a result of the use of the Euro IV vehicle model over the Euro III.

Total distance driven (km)	Fuel (l)	Energy (GJ)	Pollutant (kg)					
			CO_2	CO	HC	NOx	HC+NOx	PM10
282726	354.10	-13.44	-1062.31	53.82	-1.06	-67.63	-68.70	-3.54

The results showed noticeable reductions in all pollutants apart from carbon monoxide (CO). There was a reduction in CO_2 (-2.3%), which will help in meeting the Motorvate target of a reduction of 12%. As Motorvate are comparing the old fleet with the new fleet (not just the contribution of MIRACLES), the reductions in CO_2 are likely to be higher. The reductions are less than could be expected at other companies as HCC was already in the process of buying Euro III vehicles. Companies with much older vehicles (pre-Euro, Euro 1 or Euro II) would see much greater reductions, particularly in CO_2 as well as the other pollutants.

MEASURE-LEVEL RESULTS

Measure title: Cleaner municipal fleets	Project: MIRACLES
Measure number: 12.2	City: Winchester

A summary of the measure indicators (as defined in the Local Annex of D4.1) is shown in Table 3.

Table 3: Summary of measure indicators for W12.2

Indicator no. (Meteor no.)	Indicator name	Baseline 2002	Business as Usual 2005	MIRACLES 2005
W12.2/Econ1a.	Purchase cost	N/a	£9,500/vehicle	£9,800/vehicle
W12.2/Econ2a	Cost per km	Base (2002/3)	No change	-2%
W12.2/Econ2b	Vehicle maintenance costs	Base (2002/3)	No change	No change
W12.2/Econ2c	Fuel costs	Base (2002/3)	No change	-2%
W12.2/Engy1a (3)	Vehicle fuel efficiency (new/old)	Base (2002/3)	No change	-2%
W12.2/Env1a (8-11)	Emissions (CO_2, NOx, PM10, CO, HC)	Base (2002/3)	No change	See Table 1
W12.2/Soc1a (14)	Business acceptance	N/a	N/a	59.4% with reducing car use (see WP10)
W12.2/Soc2a (13)	Business awareness	N/a	N/a	28% - clean vehicle trials (see WP10, 12.3)
W12.2/Soc3a	Operator confidence in technical parameters	N/a	N/a	See M14
W12.2/Tran1a	Number of businesses joining Motorvate	0	0	0

This measure will continue after the end of the MIRACLES project.

Up-scaling

No up-scaling for this measure was carried out as no other company followed HCC's example by replacing their company fleet with cleaner vehicles or by joining Motorvate.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

The Air Quality Action Plan for Winchester drove this measure. The main barrier was economical; generally, clean vehicles are more expensive than their petrol counterparts. In addition, there is a limited range of choice of vehicle and the technology is often perceived to be unproven. In addition, the promotion by Motorvate was limited and their joining fee can be a barrier to companies joining the scheme.

M13: Interrelationships with other measures

This measure is supporting by the raising awareness Measure 10 as well as Measure 12.3: Clean fuel support services.

M14: Lessons learned

1. No companies in Hampshire or who attended the one-day seminar subsequently joined the Motorvate scheme. As well as the high subscription cost (a rising scale up to £2000), other companies provide a 'fleet health check' free of charge. For the scheme to be a success, an initial

MEASURE-LEVEL RESULTS	
Measure title: Cleaner municipal fleets	**Project: MIRACLES**
Measure number: 12.2	**City: Winchester**

free consultation could have been provided which may have attracted more interest.

2. The Motorvate website was unavailable for several months in 2005 while it was being re-designed for a re-launch in 2006. Apart from the one-day seminar, there was little promotional material, either regarding HCC cleaning up its company fleet or about the benefits of joining the Motorvate scheme. This lack of information contributed to the limited success of the scheme. Findings from the project will be used to promote cleaner fleets and have already helped other public authorities benchmark their own local fleets.
3. The benefits of subscribing to such a scheme would only have a limited time-span. After making reductions in vehicle mileage in the first few years, there may be little scope for more improvement reducing the benefit of continuing to subscribe to the Motorvate scheme.
4. HCC set a good example in cleaning up its company fleet of vehicles as well as joining Motorvate but in order for other companies to follow their example, a more pro-active approach would be necessary.
5. The reductions in emissions for the HCC fleet are modest as the new Euro IV vehicles were compared to Euro III vehicles, which were about to be purchased by the County Council. Companies with much older vehicles (pre-Euro, Euro 1 or Euro II) in their fleet would see much greater emission reductions, particularly in CO_2 as well as the other pollutants.
6. The price differential between 'normal' and 'cleaner' vehicles is still high and is a major deterrent in companies purchasing such vehicles. In addition, the technology is still fairly new and it may take a while for companies as well as individuals to become more familiar with them. It was hoped that the clean vehicle trials in Measure 12.3 would improve familiarity and thus encourage more companies to consider purchasing these cleaner vehicles. However, gains can be made in fuel consumption and therefore fuel costs with less pollutants being emitted. Companies with Pre Euro, Euro I or Euro II vehicles would gain most by an upgrade to Euro IV vehicles in terms of their emissions (g/km).

Contact Point

💻.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

12. Measure 12.3

MEASURE-LEVEL RESULTS	
Measure title: Clean fuel support services **Measure number: 12.3**	**Project: MIRACLES** **City: Winchester**

The Measure – what is it about?

M1: Measure objectives:

The objectives of this measure were to:

- Establish a business case for the introduction of clean engine technology
- Overcome barriers to the introduction of new engine technologies.

M2: Measure description:

This measure attempted to break down current barriers to the use by businesses of alternative fuel vehicles. A fleet of six clean vehicles was purchased and one vehicle was loaned to each participating businesses for up to one month, to aid business community exposure to alternative fuelled vehicles. There were two LPG/petrol dual-fuel vehicles (Vauxhall Zafira and Volvo S40), two petrol/electric hybrid vehicles (Honda Civic and Toyota Prius) and two battery electric panel vans (both were Citroen Berlingo).

The Implementation – how was the measure implemented?

M3: Innovative aspects:

This was the first time that clean engine vehicles had been loaned to businesses in Winchester. This was coupled with involvement in the Winchester business forum to alleviate concerns and to enable an operational comparison of the existing fleet with cleaner vehicles.

M4: Situation before CIVITAS:

Clean engine technologies were largely restricted to local authority fleets and some very large businesses as part of a longer-term green strategy. The fuel blockades of September 2000 highlighted the benefits of a more diverse fuel mix with a range of vehicles able to continue operating. However, despite some marketing and economic benefits, clean fuel uptake has generally been slow in the UK, partly as a result of the gamble that companies perceive the switch to new fuels entails.

M5: Design of the measure:

This Measure involved the loaning of 6 demonstration vehicles over the project lifetime and the development of a business case for clean vehicle uptake. The three clean vehicle types trialled were as follows (see Table 14 for more details):

Hybrid electric vehicles are powered by a combination of petrol and electricity. Current models have a petrol engine and an electric motor powered by an energy storage device such as a battery pack. All hybrids use regenerative braking, which means that energy is put back into the battery when braking - this improves energy efficiency and reduces brake wear. They have a similar performance to conventional vehicles although the top speed and acceleration may be slightly lower. With regular maintenance the battery should last normally 5 to 8 years.

Dual fuel petrol/LPG vehicles can be bought purpose built or otherwise need to be converted from petrol vehicles. (It is possible, although expensive, to convert diesel vehicles to dual LPG / diesel use). LPG produces significantly less CO_2 or NOx than petrol but more CO and HC. Fuel costs are about 30% less than conventional petrol vehicles and the same as diesel vehicles making them good for high mileage vehicles. There are a limited number of petrol stations in the UK selling LPG (1,300 in the UK and two in Winchester) and so re-fuelling with LPG can be a problem. As these vehicles also operate on petrol, drivers can visit areas remote from LPG filling stations.

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services	Project: MIRACLES
Measure number: 12.3	City: Winchester

Battery electric vehicles use a battery and electric motor to power the vehicle so have no emissions at the point of use and are extremely quiet. Due to the capacity of the battery, their range is limited (usually to 60 miles or less) between recharges and as a result they are better suited for use as city-based cars and vans with set journey patterns or a limited range. There is a limited choice of models on the market and they have a lower maximum speed than conventional vehicles. This measure was designed in the following 4 steps:

Step 1: A short review of current fleet characteristics of employers in the area to develop an understanding of the key barriers and to encourage participation in the trial. A programme of vehicle loans was established to enable maximum coverage of the technologies to be undertaken.

Step 2: A total of six clean vehicles using a range of fuel types were purchased (two hybrid vehicles, two LPG vehicles and two electric battery vehicles). These vehicles were purchased by HCC according to the current models available at the time (see Figure 1).

Step 3 A pilot survey was undertaken with organisations in order to fully develop the final survey format. This survey then yielded information on the types of vehicles currently used by all interested businesses and gave insights into the current perceived barriers for businesses not using alternative fuelled vehicles. This exercise also allowed an allocation plan to be drafted to link the potential business with suitable vehicle type according to the required usage.

Step 4: The full demonstration resulted in significant exposure of various Winchester businesses to alternative fuelled vehicles. Surveys were carried out with all interested businesses as discussed in **Step 3**. The 6 clean vehicles were rotated through as many businesses and local groups as possible for periods of up to one month at a time to enable as wide a group as possible to experience the benefits of clean engine technologies and to perform cost-benefit analysis to inform future fleet purchasing decisions.

Vauxhall Zafira LPG/petrol dual fuel

Volvo S40 LPG/petrol dual fuel

Toyota Prius petrol/electric hybrid

Honda Civic petrol/electric hybrid

Citroen Berlingo battery electric panel van

Figure 1: Clean vehicles purchased by HCC for the trials

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services	**Project: MIRACLES**
Measure number: 12.3	**City: Winchester**

M6: Actual implementation:

The measure was implemented in 4 stages as follows:

Stage 1: Review of current business fleets in Winchester (start of project to February 2003)
Stage 2: Six clean vehicles purchased (March – July 2003)
Stage 3: Pilot survey undertaken (July – December 2003)
Stage 4: Clean vehicle trials undertaken (January 2004 – end of project)

M7: Deviations from the plan:

None

The Evaluation – how was it done and what are the results?

M8: Method of measurement:

The data came from six sources:

- **HCC cost statements** – these detail the man hours worked on MIRACLES split by work package along with any equipment/consumables bought. The figures come from Years 1 - 3 cost statements of MIRACLES, with an estimate included for Year 4.
- **Clean fleet trial questionnaire** – this was handed out to each participating business before the start of the trial. A total of 42 questionnaires were analysed.
- **Clean fleet driver questionnaire** – this questionnaire was handed out to each business at the end of the 1-month trial. A total of 53 questionnaires were analysed.
- **Telephone survey of businesses** – this was undertaken at the end of the project to see if any business had purchased a clean vehicle as a result of the trial. A total of 38 businesses were contacted.
- **Tracking data** – each vehicle had its own GPS receiver to collect data regarding mileage travelled and road type used.
- **UK Vehicle Certification Agency (VCA) fuel consumption and emission figures** – available for car models made since the year 2000 and providing the basis for the fuel and emissions savings made during the trials.

M9: Achievement of quantifiable targets:

N/a

M10: Achievement of evaluation-related milestones:

All the evaluation related milestones (as in the Winchester Annex D4.1) have generally been achieved, although the start of the full demonstration was delayed by about 6 months. This was because some of the clean vehicles took longer than expected to arrive after ordering due to delays in the manufacturers' delivery times.

M11: Report on the measure results:

Economy

The data from HCC came from their annual cost statements for the MIRACLES project for Years 1, 2 and 3. Staff hours for Work package 12.3 for Years 1 – 3 was a total of 830 hours at a cost of £21,660 with Year 4 estimated at 192 hours at a cost of £7,000. In addition, HCC spent the following amounts listed in Table 1. The main cost was the purchase of the six clean vehicles ranging from about £11,000 to £14,500 (W12.3/Econ1a).

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services
Measure number: 12.3

Project: MIRACLES
City: Winchester

Table 1: Equipment/consumables bought on Work package 12.3 during Years 1, 2 and 3 of the project

Equipment/consumables bought	Cost/value (£)
Dual-fuel Vauxhall (General Motors) Zafira	10,947
Bi-fuel Volvo S40	14,406
Battery Electric Citroen Berlingo 2 Van	14,235
Battery Electric Citroen Berlingo 2 Van	14,235
Hybrid Toyota Prius	13,971
Hybrid Honda Civic IMA (Hybrid) - Alan Day Honda Ltd.	11,390
Vehicle tracking installation	4,000
Livery - Graphics Unit	5,500
Vehicle tracking operation per year	1,500
Insurance of vehicles for trials per year	5,000
HTM – Repairs & maintenance per year	5,500
HTM - Supply of fuel per year	500

Energy/Emissions

The reductions in energy and emissions were quantified for a sample of 20 clean vehicle trials (Vauxhall Zafira 1, Volvo S40 3, Toyota Prius 6, Honda Civic 5 and Citroen Berlingo 5). Each trial vehicle was equipped with a tracking unit that recorded, amongst other data, the position of the vehicle every 10 minutes. The resultant latitudes and longitudes were then used by a vehicle routing computer program to assume a recommended 'quickest' route that the vehicle followed to move from one known location to another. The route plotting program was able to determine the type of road the vehicle was likely to be travelling on and so attribute a fuel or emission factor appropriate for the road type (i.e. urban or extra urban) which are derived from UK data on fuel consumption and emissions figures (VCA, 2000-2005). Since the VCA figures only begin from the year 2000, the analysis undertaken required the vehicles to have been made no earlier than 2000 to be included in the UK VCA 'new car fuel consumption and emissions figures' handbook. This meant that only usual vehicles less than five years old could be accurately compared for emission savings, resulting in more modest reductions. The usual vehicle driven by the driver was compared against the trial vehicle by assuming that the route travelled by the trial vehicle would have been the same travelled by the driver's usual vehicle. Table 2 lists the make and model of the usual vehicles along with the total mileage of the clean vehicle.

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services | **Project: MIRACLES**
Measure number: 12.3 | **City: Winchester**

Table 2: Make and model of usual vehicles along with total mileage for clean vehicle

	Make & Model		Euro standard	Fuel type	Estimated distance travelled by triallist (km)
Trial Vehicle	**Vauxhall Zafira**		**Euro IV**	**LPG/Petrol dual fuel**	
Usual vehicle	1	Audi A3	Euro II	Petrol	3378.0
				TOTAL	**3378.0**
Trial Vehicle	**Volvo S40**		**Euro III**	**LPG/Petrol dual fuel**	
Usual vehicle	2	Fiat Scudo	Euro II*	Diesel	1697.5
	3	Rover 420	Euro II*	Diesel	2238.3
	4	Volvo C70	Euro III	Petrol	84.6
				TOTAL	**4020.4**
Trial Vehicle	**Toyota Prius**		**Euro IV**	**Petrol/hybrid**	
Usual vehicle	5	Vauxhall Astra	Euro II	Diesel	502.2
	6	Ford Escort	Euro II	Petrol	2459.4
	7	Mercedes A-class	Euro II	Petrol	3742.4
	8	Rover 214	Euro II	Petrol	2323.1
	9	Porsche 911	Euro III	Petrol	2968.5
	10	Toyota Previa	Euro III	Diesel	1051.7
				TOTAL	**13047.3**
Trial Vehicle	**Honda Civic**		**Euro IV**	**Petrol/hybrid**	
	11	Audi A4	Euro III	Diesel	2895.4
	12	VW Golf	Euro IV	Diesel	4500.7
	13	Vauxhall Vectra	Euro III	Diesel	2022.0
	14	Audi TT	Euro III	Petrol	1091.7
	15	VW Polo	Euro II*	Petrol	542.8
				TOTAL	**11052.7**
Trial Vehicle	**Citroen Berlingo**		**-**	**Battery Electric**	
	16	Ford Transit	Euro III	Diesel	601.3
	17	Ford Transit	Euro III	Diesel	245.5
	18	Renault Kangoo	Euro III	Diesel	751.3
	19	Fiat Dolbo	Euro III	Diesel	62.7
	20	Ford Transit	Euro II	Diesel	1493.5
				TOTAL	**3154.4**

* Euro II petrol vehicle 'type approval' does not test for individual HC or NO_x limit so no HC or NO_x emission factors can be used for this vehicle. This has been accounted for in relevant calculations.

A cost calculation function within the route finding program was used to estimate total fuel consumption for each segment of a route, split into urban and extra urban portions depending on whether the vehicle was located in a polygon designated as an urban area. The cost function required urban and extra urban fuel consumption factors to be entered. Based on this approach, emissions were quantified using suitable emission factors.

VCA emission factors are an aggregate figure but using fuel consumption figures a fuel consumption weighted emission factor for urban and extra urban emissions was produced. Fuel based emissions factors are known to be reasonably accurate and are used in the US EPA emissions model 'MOBIL'. Further weighting needed to be given to urban emission factors for vehicles which were Euro I or Euro II to account for a change in the test drive cycle used to produce the emission factors (i.e. Euro II and IV vehicles were not allowed a 40 second warm up period prior to undertaking the test). Scaling factors for this were obtained from past EC research programs.

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services | **Project: MIRACLES**
Measure number: 12.3 | **City: Winchester**

Assumptions made

1. The fuel consumption and emission factors assume an idealised driving cycle where there is little or no variability in fuel consumption and emissions due to differences in driving styles, weather, road conditions etc.
2. The emissions factors are derived from a cold start. In reality, many urban trips are not from cold starts. Past research has shown that real world fuel consumption and emission factors are likely to be higher than the VCA emissions factors, resulting in an underestimation. However, the relative scale of change is still appropriate and absolute values give a baseline.
3. The 'quickest route' in the route-planning program is the actual route used. This may not always be the case but it still provides a fair basis for comparison between the clean trial and triallist's usual vehicle.

Table 3 shows the energy and emission analysis, grouped by clean vehicle type.

Table 3: Fuel and emissions comparison of usual and clean vehicle

	Distance (km)	Fuel (litres)	Energy (MJ)	CO_2 (grams)	CO (grams)	HC + NOx (grams)
Petrol/hybrid						
Usual vehicles	24100.0	1850.1	66708.6	4685853	14499.2	6961.7
Hybrids	24100.0	1197.5	41933.6	2828995	11580.1	2110.4
Amount saved	-	652.7	24775.0	1856858	2919.0	4851.3
% change	-	-35.3	-37.1	-39.6	-20.1	-69.7
LPG/petrol Dual fuel						
Usual vehicles	7398.5	593.8	21421.9	1532689	5836.3	2899.4
Dual fuel using Petrol	7398.5	580.5	20326.9	1393574	1292.9	1211.8
Amount saved	-	13.4	1095.0	139115	4353.5	1687.6
% change	-	-2.2	-5.1	-9.1	-77.8	-58.2
Dual fuel using LPG	7398.5	781.0	21141.4	1265000	4062.6	763.5
Amount saved	-	-187.2	280.5	267689	173.7	2135.9
% change	-	31.5	-1.3	-17.5	-30.4	-73.7
Battery electric						
Usual vehicles	3154.4	247.8	9400.5	653560	2437.0	1317.6

Overall, energy use by the clean trial vehicles was lower than that of triallist's usual vehicles, with the exception of the Volvo S40. (This anomaly was because of the relative 'clean nature' of their usual vehicles). Emissions were generally lower for the trial vehicles than that of the triallists 'usual vehicles', although some exceptions were for HC or NOx from a small number of usual vehicles. The electric Berlingo van had no tailpipe emissions and therefore resulted in the largest emission reduction. Only triallists usual vehicles which were included in the VCA vehicle database could be assessed (built after the year 2000 with an emission standard of at least Euro II). As a consequence, many trials could not be compared, although it is almost certain that if these trials had have been included the general savings described would have been greater.

Table 4 shows the fuel consumption and the cost per km for each type of clean vehicle trialled in addition to the usual vehicles trialled. The price of diesel, petrol and LPG per litre was assumed to be

£0.95, £0.85 and £0.40 respectively.

Table 4: Fuel consumption and cost per km of trial and usual vehicles

	Fuel consumption (mpg)	Fuel cost per km (£)
Petrol Hybrid	57	0.042
Dual fuel – petrol	36	0.067
Dual fuel – LPG	27	0.042
Usual vehicles	35 - 37	0.067 – 0.076

Hybrid vehicles provide the greatest environmental and economic benefits over the use of petrol/LPG dual fuel vehicles or usual vehicles. Over the duration of this project the range of hybrid models available on the market grew significantly. Hybrid vehicles are no longer hybrid specific models (e.g. Honda Insight or Toyota Prius) but are increasingly being integrated into conventional models e.g. the Honda Civic IMA replaced the Honda Insight. Given the low price of LPG fuel relative to petrol, dual fuel or LPG vehicles may become more popular due to the substantial fuel cost reduction from a typical petrol vehicle. Table 13 contains more general purchase, fuel and maintenance costs with regards to the clean vehicle trialled. The trial showed there were energy and emissions benefits to be gained from undertaking clean vehicle trial schemes of this nature.

Society

The cross-measure awareness/acceptance questionnaire asked people their views on their awareness of the electric vehicles and their agreement with the trial (see Measure 10). The results showed that 14% and 19% were aware of the Citroen Berlingo electric van and the Volvo S40 dual fuel petrol/LPG trial vehicles respectively (W12.3/Soc3a). 82.6% of respondents generally agreed with the objectives of this measure (see Figure 2) (W12.3/Soc1a).

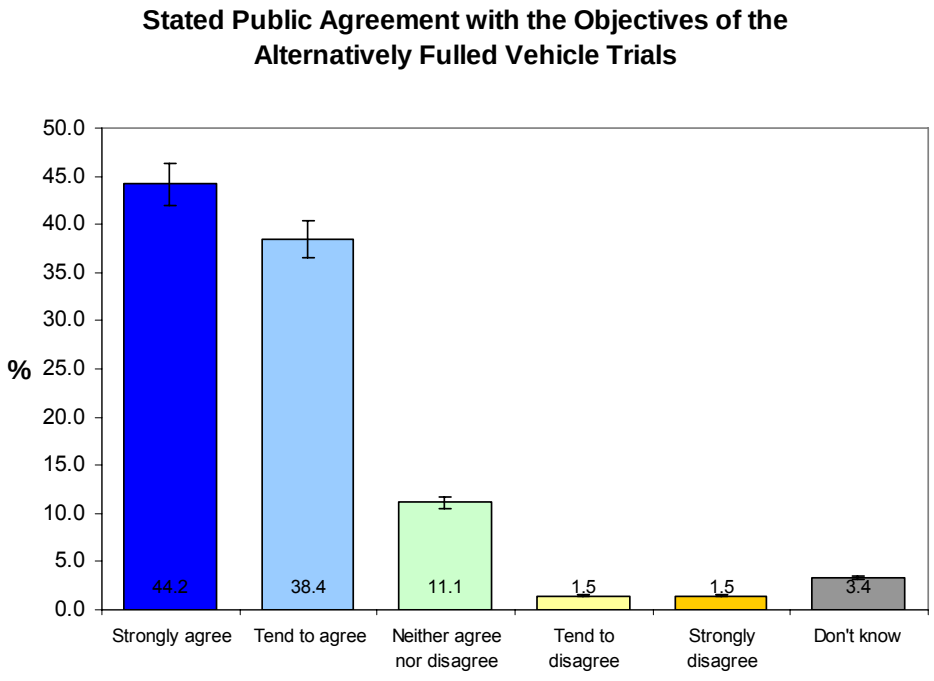


Figure 2: Percentage of valid responses stating their perceived level of agreement with the objectives of the alternative fuelled vehicle trials.

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services
Measure number: 12.3

Project: MIRACLES
City: Winchester

Clean Fleet Trial questionnaire

A wide mix of businesses were represented through this questionnaire, including construction, radio, estate agents, local authority, housing association, accountant, restaurant, Chinese Fish and Chip takeaway, doctor's surgery, civil engineering, architects, university college and zoological park. The respondent filling in the questionnaire on behalf of the company was normally the fleet manager. About half of the respondents were fully or partly responsible for all the fleet purchasing decisions either at a company level or site level. Nearly 60% of the companies had their company head office located in Winchester, 85% of them belonging to a national chain.

The majority of the businesses (about 60%) stated that there were no specific constraints on which vehicle they purchase such as using a particular supplier or following a central purchasing company policy. Nearly 70% renewed their vehicles every 2 – 4 years.

About 12% stated that they were extremely likely to purchase/lease a cleaner vehicle in the next 5 years; 32% stated very likely and 49% quite likely. However, only 5 companies had actually done so (purchasing 8 vehicles). Two companies stated that they had bought an LPG/petrol vehicle (Kimball Smith, Southern Water, Raynesway, Pierre Fabre pharmaceuticals). One had bought an electric vehicle (Raynesway) and three had bought a hybrid electric/petrol (Raynesway and Mott MacDonald/HCC). The reasons stated for the majority of companies who had not purchased/leased a cleaner vehicle included uncertainty about its reliability and performance, it was not financially cost-effective or concern over the small number of re-fuelling points (for LPG).

Companies were asked which three key factors (on a list provided) influenced, or would influence their decision to purchase a cleaner vehicle. Table 5 ranks the factors in order of importance to the respondents and it can be seen that three key factors were vehicle operating costs, vehicle reliability and purchase cost of vehicle.

Table 5: Most important factors in purchasing a cleaner vehicle

Ranking	Factor	Score
1	Operating costs	45
2	Reliability	43
3	Cost of purchase	33
4	Environmental factors	25
5	Engine performance	16
6	Availability of appropriate vehicles	13
7	Operating range	12
8	Direct experience of product	7
9	Information / feedback from other users	6
10	Availability of fuel	4

Clean Fleet Driver Questionnaire

On each occasion that a clean vehicle was lent to a company, a log was kept of the company name, contact member and duration. The log file showed that a clean vehicle was lent out on 97 occasions (up to March 2006) (W12.3/Soc2a), the majority of approximately one month duration, although 12 were only of durations of 1 or 2 weeks, and one (Dove Recycling) was of a period of several months. Table 6 shows the sample size of each type of clean vehicle represented in the questionnaire survey (up to June 2005). Problems with one of the Citroen vans reduced the time available for trials; hence the smaller sample size. The one Berlingo Van was lent to Dove Recycling from April 2005 until the end of the project (see Measure 9.2). HCC are considering selling this vehicle to Dove at the end of the project.

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services	Project: MIRACLES
Measure number: 12.3	City: Winchester

Table 6: Sample sizes for each of the clean vehicles

Clean vehicle	Fuel type	Sample (%)
Vauxhall Zafira	LPG/petrol dual fuel	16 (30.2%)
Volvo S40	LPG/petrol dual fuel	10 (18.9%)
Hondo Civic	petrol/electric hybrid	9 (17%)
Toyota Prius	petrol/electric hybrid	11 (20.8%)
Citroen Berlingo (two)	battery electric panel van	7 (13.2%)

Respondents were asked how often they had driven the vehicles during the trial period. The majority of the respondents used the vehicle 5 days a week with over 70% using it at least 3 days a week (see Table 7).

Table 7: How often the vehicle was driven during the trial.

1 day per week	2 days per week	3 days per week	4 days per week	5 days per week
11.5%	17.3%	7.7%	11.5%	51.9%

About 42% of respondents using one of the dual fuel vehicles used fuel from both tanks before refuelling. In addition, about 90% of respondent's used the LPG fuel for at least 75% of their journeys.

A comparison was made between the clean trial vehicle and the respondent's own fleet vehicle. Relevant questions concerning their opinions about the trial vehicle were compared with the corresponding questions concerning their own fleet vehicle. Chi-squared tests were undertaken to test for significant differences between the two samples (i.e. trial vehicles and own fleet vehicles). A summary is shown below. Note that due to the small sample size, responses of "very good" or "good" were aggregated as "good" and similarly, responses of "very poor" or "poor" were aggregated into a "poor" category.

The significant findings (at the 5% confidence level) are shown in Table 8. There were no significant correlations between any other combinations of variables not shown in Table 8.

Table 8: Key findings in comparing trial clean vehicle and respondent's own fleet vehicle

Vehicle acceleration - There were significant differences between the two sets of data (heterogeneity χ^2 = 7.85 and $\chi^2_{(0.05)}$ (2df) = 5.99). Respondents were less likely to rate the acceleration of the trial clean vehicle as "good".
Road handling in wet - There were significant differences between the two sets of data (heterogeneity χ^2 = 6.55 and $\chi^2_{(0.05)}$ (2df) = 5.99). Respondents were less likely to rate the road handling in the wet of the trial clean vehicle as "good".
Availability of alternative fuel type - There were significant differences between the two sets of data (heterogeneity χ^2 = 33.61 and $\chi^2_{(0.01)}$ (1df) = 6.63). Respondents were more likely to rate the availability of fuel for the trial vehicle as "poor".
Ease of refuelling / recharging - There were significant differences between the two sets of data (heterogeneity χ^2 = 4.62 and $\chi^2_{(0.05)}$ (1df) = 3.84). Respondents were more likely to rate the ease of refuelling / recharging the trial vehicle as "poor".
Overall fuelling - There were significant differences between the two sets of data (heterogeneity χ^2 = 12.09 and $\chi^2_{(0.01)}$ (1df) = 6.63). Respondents were more likely to rate the overall fuelling of the trial vehicle as "poor".

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services	Project: MIRACLES
Measure number: 12.3	City: Winchester

The comparison showed that the respondents generally perceived that their own fleet vehicle was better than the clean trial vehicle in terms of acceleration, road handling in the wet and availability and ease of refuelling. This may be in part due to their familiarity with the operation and performance of their own vehicle as opposed to the clean trial vehicle. In addition, there were only two garages in Winchester selling LPG fuel, and re-charging a battery for your vehicle is a relatively new concept.

Respondents were asked how they rated their experience of the alternative fuel vehicle. Overall, 81.7% rated the trial vehicle as very good or good (W12.3/Soc4a) (see Table 9).

Table 9: Overall rating of trial vehicle

Very good	Good	Satisfactory	Poor	Very poor
38.9%	42.9%	18.3%	0%	0%

Respondents were also asked how they compared the clean trial vehicle with their usual fleet vehicle (see Table 10). 55.1% thought it was better than their usual fleet vehicle; 20.4% thought it was worse than their usual fleet vehicle.

Table 10: Comparison with usual fleet vehicle

Very good	Good	Equal	Poor	Very poor
18.4%	36.7%	24.5%	20.4%	0%

Respondents were also asked whether they would consider using an alternative fuel vehicle for business use or private use in the future (see Table 11). 64.6% and 58.4% of respondents would be very likely or likely to purchase a clean vehicle in the future for business and private use respectively.

Table 11: Likelihood of using an alternative fuel vehicle for business use in the future

	Very likely	Likely	Neither	Unlikely	Very unlikely
Business	16.7%	47.9%	29.2%	4.2%	2.1%
Private	18.8%	39.6%	25%	12.5%	4.2%

Telephone survey

Thirty-eight businesses that had taken part in the trial were contacted at the end of the project to see whether the scheme had in any way encouraged them to purchase a new clean vehicle for business use. The results are shown in Table 12.

Table 12: Businesses response to the purchase of a clean vehicle after the trial

Have bought	Will buy	May buy	Will not buy	Don't know
1 (3%)	11 (29%)	13 (34%)	12 (31%)	1 (3%)

Only one business (Southern Water) had actually purchased a clean vehicle (Vauxhall Vectra LPG). They stated that the trial had been a major influence in its purchase. In addition, of the 11 other businesses that stated that they would buy a clean vehicle in the future, 8 said that the trial had been a major factor in coming to this decision. Three businesses stated that a member of their staff had purchased a clean vehicle for private use as a result of the trial. One business had mentioned the future purchase of a clean vehicle in their green travel plan; another business had added the Toyota Prius to the companies approved list of staff vehicles. The businesses stating that they would not purchase a clean vehicle gave reasons such as too expensive, not reliable enough and only a limited range to choose from. Businesses would normally renew their company fleet at set times (depending on the age of their current fleet) over cycles of several years. It is hoped that a significant number of businesses that stated that they would or may buy a clean vehicle in the future (63%) will renew their fleet with clean vehicles at the next possible opportunity.

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services	Project: MIRACLES
Measure number: 12.3	City: Winchester

Purchase, fuel and maintenance costs for the trial vehicles

Table 13 summarises the general differences between the three types of clean vehicles. Purchase and fuel cost as well as emissions are relative to a conventional 'petrol' car. Figures are taken from the Energy Savings Trust website (W12.3/Econ2c, Eng1a and Env3a) and predict higher emission reductions than the clean vehicle trial comparison as the usual vehicle was always less than 5 years old and had an emission standard of at least Euro II.

Table 13: Differences between the three types of clean vehicle trialled

	Hybrid electric	Dual fuel petrol/LPG	Battery electric
Purchase cost	+ £1,000 – £3,000	+ £900 – £1,700	+ £5,500
Fuel cost	-70%	-45% – 50%	Up to -90%
Battery cost	£10,000	N/a	£10,000
Battery life	5 – 8 years	N/a	5 – 8 years
Conversion cost to LPG	N/a	+ £1,700 - £2,700	N/a
Emissions	All gases: - No emissions unless engine is running)	$CO_{2:}$ -11% $NO_{X:}$ -25% CO: -80% $PM_{10:}$ -100%	All gases: -100% (No emissions)

The clean vehicle trial required a lot of staff time to operate it efficiently. Problems did occur with drivers losing keys, putting diesel in the electric hybrid vehicle, involved in accidents and receiving speeding/parking tickets. In addition, one of the Berlingo electric vans had a problem with its battery that took several months for Citroen to repair.

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services | **Project: MIRACLES**
Measure number: 12.3 | **City: Winchester**

A summary of the relevant indicators is shown in Table 14.

Table 14: Summary of measure indicators for W12.3

Indicator no. (Meteor no.)	Indicator name	Baseline 2002	Business as Usual 2005	MIRACLES 2005
W12.3/Econ1a.	Purchase cost	N/a	N/a	See Table 1
W12.3/Econ2a	Cost per vehicle km	N/a	N/a	See Table 4
W12.3/Econ2b	Vehicle maintenance costs	N/a	No change	No change
W12.3/Econ2c	Fuel costs	N/a	N/a	See Table 4 and 13
W12.3/Engy1a (3)	Vehicle fuel efficiency (new/old)	N/a	N/a	See Table 4 and 13
W12.3/Env3a (8-11)	Emissions (CO_2, NOx, PM10, CO, HC)	N/a	N/a	See Table 3 and 13
W12.3/Soc1a (13)	Acceptance rating of objectives	N/a	N/a	82.6%
W12.3/Soc2a	Number of businesses using service (different vehicles)	N/a	N/a	97
W12.3/Soc2b	Number of businesses purchasing clean vehicles after trial	N/a	N/a	3% bought 29% will buy 34% may buy
W12.3/Soc3a	Awareness rating	N/a	N/a	14% Citroen electric van 19% Volvo petrol/LPG
W12.3/Soc4a (14)	Acceptance rating of trial	N/a	N/a	81.7%
W12.3/Soc5a	Operator confidence in technical parameters	N/a	N/a	See M14

This measure will continue after the end of the MIRACLES project.

Up-scaling
Up-scaling was not carried out for this measure, as it was only a limited trial of clean vehicles loans.

Lessons Learned – what do other cities, other actors and the EC have to consider?

M12: Barriers and drivers of the measure implementation / Process evaluation

Problems with the reliability of the Citroen Berlingo van resulted in only five vehicles being available for a significant part of the project. Reliability problems with the tracking system resulted in the loss of some tracking data. By the end of the project, most businesses in Winchester had been asked to participate in a clean vehicle trial already, resulting in some difficulty in recruiting more triallists, although this did pick up again after December 2005. As with Measure 12.2, the main barrier to companies purchasing cleaner vehicles is economic given the price differential between cleaner vehicles and their petrol counterparts. In addition, there is still only a limited choice of makes and models available. Many fleet managers may still consider the purchase of such a vehicle risky and need to see the technology demonstrated for a reasonable time period before a purchase would be considered.

MEASURE-LEVEL RESULTS

Measure title: Clean fuel support services	Project: MIRACLES
Measure number: 12.3	City: Winchester

M13: Interrelationships with other measures

This measure supported the message of a shift to cleaner vehicles and differentiated parking charges based on environmental performance (see Measure 6). It was also linked to the awareness raising elements of Measure 10.

M14: Lessons learned

1. Running a clean vehicle trial requires a lot of manpower hours in order to clean and maintain the vehicles in a good working order. Problems such as lost keys, broken windscreens, damage to bodywork and vehicle breakdown can be a common problem.
2. The cost differentials for cleaner vehicles compared to a conventional 'petrol' vehicle are still considered too high for many companies, particularly non-commercial organisations.
3. Drivers/fleet managers can be reluctant to change their usual purchasing vehicle habits. Being familiar with a particular conventional vehicle can be more advantageous to the driver/fleet manager than the environment benefits of a cleaner vehicle, which may be seen as unknown and therefore risky.
4. Given the growing awareness of environmental issues, companies may wish to either own a clean vehicle or use one for deliveries/collections (e.g. Dove recycling in Measure 9.2) in order to have a good reputation among the public.
5. Battery electric vehicles are the most suitable clean vehicle for short trips within and around a city centre area, as they produce no tailpipe emissions. However, they are over £5,500 more expensive than a similar petrol vehicle and require a £10,000 battery every 5 – 8 years.
6. Hybrid electric vehicles provide greater energy and emission reductions than the dual fuel petrol/LPG. The fuel cost per km for LPG and hybrid electric was significantly lower than that of the usual vehicles (petrol or diesel) and could increase in popularity as fuel prices rise.
7. Refuelling issues with LPG and electric vehicles are still a deterrent to their more widespread use.
8. There is an increasing but still limited choice of models of hybrid electric and electric battery vehicles. With an increased demand, choice and purchase price should fall, although the public generally still perceive the technology to be unproven and costly.
9. Given that businesses tend to renew their company vehicles at set times over cycles of many years, the effect of the trial in encouraging businesses to purchase clean vehicles may not be evident for a number of years.

Contact Point

.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

13. City-level Results - Economy

CITY-LEVEL RESULTS	
Indicator Group: Economy	**Project: MIRACLES**
Evaluation Area: City Centre	**City: Winchester**

The Indicator – what is it about?

C1: Local objectives and quantifiable targets:

These indicators were used to investigate whether the MIRACLES measures had any effect on the economy of the city centre regarding business, tourism and travel. There were no specific targets for these economic indicators but it was hoped that improvements in sustainable transport and reduction in its environment impact would result in a more prosperous city, perhaps with an increase in employees, accommodation bookings and operating revenues of the local bus company (Stagecoach).

C2: Description of economy indicators:

The following economy indicators were used for the city centre area, all of which are self-explanatory:

Econ1a: The number of employees;
Econ2a: The number of hereditaments / amount of commercial floorspace;
Econ3a: The number of accommodation bookings;
Econ4a: The operating revenues of the bus company Stagecoach; and
Econ5a: The operating costs of the bus company Stagecoach.

These were used to provide an indication of the prosperity of Winchester city centre.

C3: Context and relevance:

These indicators gave a picture of the prosperity of the city during the lifetime of the project.

The Evaluation –what are the results?

C4: Method of measurement:

Econ1a: The number of employees – this was provided for each ward in Winchester and gave an indication of the profitability of businesses within the Winchester area, which otherwise was difficult to obtain as it was regarded as being commercially sensitive information. The values related to each ward in Winchester from 1998 to 2003 and were supplied by the Office for National Statistics.

Econ2a: **The number of hereditaments / amount of commercial floorspace** – this was provided for each ward in Winchester. The heriditaments (effectively separate premises) were sub-divided by premise type (i.e. retail, offices, factories and warehouses). They were sourced from the Office of the Deputy Prime Minister.

Econ3a: **The number of accommodation bookings** – this was supplied by the Tourist Information Centre's VISIT system, provided by the IT team at Hampshire County Council, which has excellent recording facilities. It recorded the number of actual bookings made through the Tourist Information Centre in Winchester. The data were presented in monthly totals from January 2002 to July 2005 and broken down into hotel and guesthouse bookings.

Econ4a & 5a: **The operating revenues and costs of the local bus company** - this indicator doubled as 'METEOR core indicators 1-2', and data were provided by Stagecoach as percentage changes from 2002/3 (due to the commercial sensitivity of the real data). Such information was provided for the two MIRACLES routes X1 and X5 as well as two non-MIRACLES routes X6 and X7 enabling a comparison to be made.

C5: Achievement of quantifiable targets:

N/a

C6: Report on results:

Econ1a: Table 1 shows the number of employees for each ward in Winchester from 1998 to 2003 (no data was available for 2004 or 2005). The data excludes self-employed and HM Forces uniformed

personnel and came from the Office for National Statistics.

Table 1: The number of employees for each ward in Winchester

Ward	1998	1999	2000	2001	2002	2003
St.Barnabas	1,200	1,100	1,200	1,200	1,500	700
St.Bartholomew	7,700	7,300	7,800	7,200	8,500	7,700
St.John and All Saints	3,500	3,000	4,300	3,600	4,000	3,200
St.Luke	3,600	4,700	4,200	4,600	4,700	1,300
St.Michael	10,500	8,700	8,700	8,400	9,100	13,000
St.Paul	6,400	6,200	6,400	6,600	6,900	8,100
Winchester City (Total)	32,800	30,900	32,500	31,600	34,700	34,000

The total of employees for Winchester increased during 2002 to about 34,000 people. This was mainly due to the noticeable rise in the St Michael Ward, which covers the city centre and its immediate area to the south.

Econ2a: Table 2 shows the number of hereditaments and the amount of floor space of the hereditaments. The data came from the Office of the Deputy Prime Minister. It can be seen that there was a slight reduction in the number of hereditaments in the Winchester area, but an increase in the floor space used. There was no evidence that MIRACLES measures influenced this data.

Table 2: Number, floor space and rateable value of hereditaments in Winchester

	2000	2002	2003	2004
Number of hereditaments	882	886	874	863
Floor space of hereditaments (1000m^2)	167	172	195	200

Econ3a: The accommodation bookings were broken down into hotels and guesthouses, and collected as monthly totals from January 2002 until July 2005. Figure 1 shows the results.

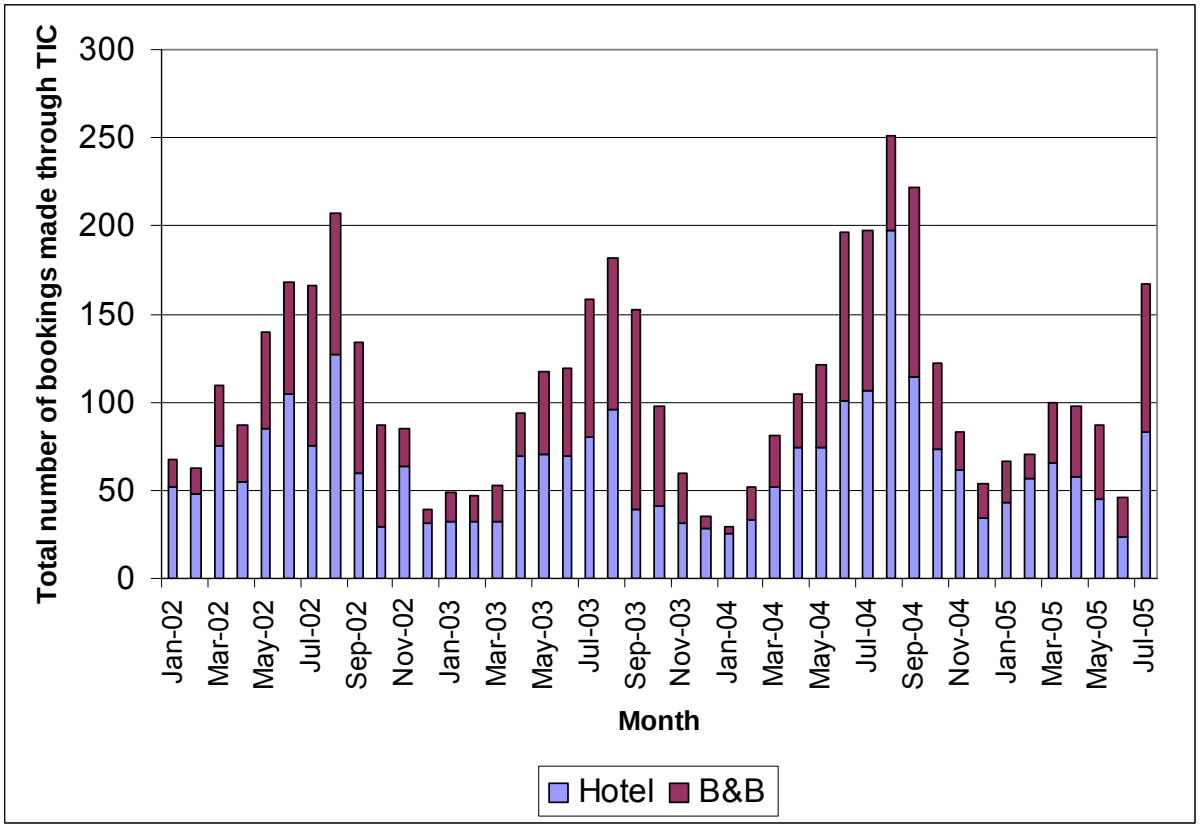


Figure 1: Accommodation bookings for Winchester

It can be seen that bookings peaked during the summer months of each year and that bookings in 2004 (particularly during the summer) increased by 12% compared to 2002 (1352 bookings in 2002 and 1513 in 2004). However, it should be noted that TIC bookings were not necessarily representative of the total number of accommodation bookings being made. It is possible that there was a steady decline in the number of bookings made through TIC's in general, as customers' book for themselves on-line. Winchester is hoping to pilot on-line bookings using the VISIT system in the near future. Generally, there was no evidence that MIRACLES measures changed the number of bookings in the Winchester area.

Econ4a: The operating revenues for 4 city centre bus services were obtained from Stagecoach (X1 and X5 being the MIRACLES routes) and are shown in Table 3 and Figure 2. They are expressed as percentage changes due to their commercial sensitivity.

Table 3: Operating revenues of four city centre bus services in Winchester

	2001/2	2002/3	2003/4	2004/5
X1		-1.4%	9.1%	3.9%
X5		2.2%	19.9%	19.1%
X6		2.9%	7.1%	8.1%
X7		-1.6%	4.5%	5.1%
Fare rise gross (net)	10.0 (7.0)	4.0 (3.0)	5.0 (4.0)	7.0 (5.0)

N.B 2003/4 had 53 weeks and fare rises were made in October of each year.

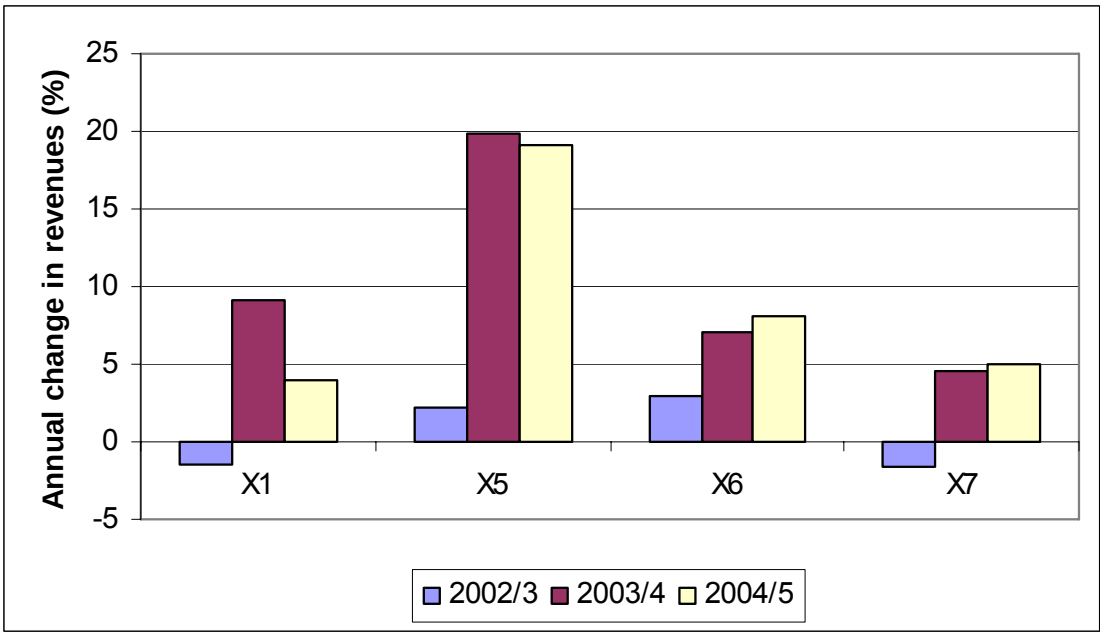


Figure 2: Annual changes in operating revenues

With the exception of X1 and X7 for 2002/3, revenue increased for all years and all four routes. However, of the two MIRACLES routes (X1 and X5), there was a noticeable increase in revenue for service X5 in 2003/4 and 2004/5 (19.9% and 19.1% respectively). These years corresponded to an increase in frequency to every 10 minutes and the introduction of new low-floor, Euro 3 buses on the route. Of the four commercial services, only X5 saw an increase in passenger numbers during the project. However, it was considered that a fare increase of 20% during the project timescale, the grant from HCC to purchase the new cleaner buses, and the other relevant MIRACLES improvements regarding the quality and information of the services all contributed to the increase in operating revenues (see Measure 7).

Econ5a: Operating costs for each route were also obtained from the Stagecoach bus company and were expressed as a percentage change comparing 2004/5 to 2003/4. Service X1 increased by 7.2%, X5 by 12.4%; X6 by 7.8% and X7 by 11.5%. The largest increase in operating costs was for service X5, and this was mainly attributable to the increased frequency of service (from every 15 minutes to every 10 minutes), which consequently led to increased driver and fuel costs. However, the purchase of the new Euro III buses which operated on X1 and X5 meant that maintenance costs reduced by 60%. It was unclear why the increase in operating costs for service X7 was higher than for X1 and X6 (see Measure 7 for more details).

Lessons Learned – what do other cities, other actors and the EC have to consider?

C7: Lessons learned:

1. Generally, there was no evidence that the MIRACLES measures influenced the number of employees, hereditaments/amount of commercial floorspace or accommodation bookings in the Winchester area.

2. Revenues for the bus company increased due to fare rises, the grant from HCC to purchase the new cleaner buses (also resulting in lower maintenance costs), and the other MIRACLES improvements made to the quality and information of the services. These improvements should be continually built upon and refreshed in order to meet existing passengers rising expectations and attract new passengers to the service (see Measure 7 for more details).

Contact Point

💻.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Created on Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

14. City-level Results - Energy

CITY-LEVEL RESULTS	
Indicator Group: Energy	**Project: MIRACLES**
Evaluation Area: City centre	**City: Winchester**

The Indicator – what is it about?

C1: Local objectives and quantifiable targets:

The local objectives and quantifiable targets were to:

- Reduce energy consumption from traffic in the city centre
- Increase the diversification of the types and quantities of fuels used in the city centre.

C2: Indicator description:

Engy2a: **Car fleet split by engine size and fuel type** - this indicator also doubled as 'METEOR core indicator 4'.

Engy2b: **Fuel volume sales from local petrol stations** - this indicator related to 'METEOR core indicator 4'.

C3: Context and relevance:

International problems such as global warming and energy security mean that reduced energy consumption is a pertinent objective for transport related projects. Worldwide, the transport sector consumes more than 60% of oil products, which constitute about 98% of transport energy use (OECD, *Working Group on the State of the Environment*, Oct. 1999). The structure of energy consumption by transport is directly related to the composition of pollutant emissions. Furthermore, growth in road transport is the main cause of the increase in energy use up to 1997 (*EEA*, *Uptake of Cleaner Fuels,* 2001): the increasing use of heavier, more powerful cars and trucks, together with low occupancy rates and load factors, have offset improvements in fuel economy – mostly related to engine technology.

Despite efforts at the EU level to promote alternative (electricity, natural gas, fuel cells) and renewable energy sources (bio-fuels) for transport, these still have a low penetration. The consumption of all petrol sold in the EU, expressed in oil equivalents, increased by 2.5% per year between 1985 and 1998. The consumption of LPG and natural gas for transport increased less rapidly (about 1.8% and 2.0% per year, respectively, between 1985 and 1998). The share of LPG and natural gas in total energy consumption by road transport has thus decreased (from 1.5% in 1985 to 1.4% in 1998). However, this share was lowest in 1992 (1.2%) and has since increased (except for a minor decline in 1996). Although alternative fuels still account for only a small fraction of total fuels sold, their usage is increasing.

The Evaluation –what are the results?

C4: Method of measurement:

Engy2a: Number plates for cars entering Winchester during weekday morning peak periods were collected for 2004 and 2005. The resultant number plate lists were enriched by DVLA data on year of first registration and engine size. For vehicles first registered since March 31st 2001, data was also provided on grams of CO_2/km, and other emissions rates. Using the data of the car fleet entering Winchester, it is possible to compare Winchester fleet statistics with those used by the National Atmospheric Emissions Inventory (NAEI) in forecasting the future car fleet of the UK. This car fleet is treated as standard within many Local Authority Air Quality assessments. The supporting indicator (Engy2b) helped to estimate relative use of LPG whilst measure specific evaluations also contributed to the overall picture.

Engy2b: Volume of fuel sales data was collected from local petrol stations for different grades of fuel. These data were used to provide supporting information on the proliferation and use of vehicles by

fuel type (including LPG). Records were available from one of Winchester's major petrol stations (one of only two in Winchester that currently sell LPG) with an additional petrol station in the nearby city of Southampton used as a control. It should be noted that people living outside Winchester generate much of the traffic in Winchester and their fuel purchase decisions were not reflected in this dataset. Due to the potentially commercially sensitive nature of the sales data, it was agreed that no actual volumes would be published and that the sales would be indexed to the first year of data supplied (i.e. data from 2002 would be treated as 100 and yearly changes reported as relative to 100). The collected datasets showed relative and actual changes in market share.

C5: Achievement of quantifiable targets:

N/a

C6: Report on results:

Engy2a:

Tables 1 and 2 show the proportions of vehicles broken-down by engine size for petrol and diesel vehicle respectively. Table 3 shows the total car fleet split by fuel type for 2004 and 2005.

Engine size	NAEI fleet projections	Winchester Sample - 2004	Winchester Sample - 2005
<1.4l	47.3	40.9	39.3
1.4l-2.0l	46.0	49.3	50.9
>2.0l	6.7	9.8	9.7

Table 1: Engine size proportions in petrol portion of car fleet

Engine size	NAEI fleet projections	Winchester Sample - 2004	Winchester Sample - 2005
<2.0l	84.3	80.7	80.9
>2.0l	15.7	19.3	19.1

Table 2: Engine size proportions in diesel portion of car fleet

Engine size	NAEI fleet projections - 2004	Winchester Sample -2004	NAEI fleet projections - 2005	Winchester Sample - 2005
Petrol	84.8	76.9	84.3	71.7
Diesel	15.2	23.0	15.7	28.3

Table 3: Fuel type proportions of car fleet

Based on the sampled datasets, it would seem that the Winchester car fleet has a higher proportion of large engine vehicles for both petrol and diesel, when compared to the national forecasted fleet structure. It would also seem that the proportion of diesel vehicles in the Winchester car fleet is considerably higher than the projections for the national fleet. It is possible that the differences between the NAEI projected vehicle fleets and that of Winchester were due to sampling phenomena. The close nature of the 2004 and 2005 datasets, when considering engine size, indicate that this relationship is true for the fleet as a whole but the relatively large difference between the proportion of the diesel cars in the 2004 and 2005 raised some questions that a sampling effect may be present. Some uncertainty was partly confirmed by considering the consistency of the two samples using a fuel type split for individual years. The results are given in Table 4 and it can be seen that for vehicles first registered in 2001 to 2003 the proportions of diesel vehicles in the car fleet were much higher than previous years; this was apparent in both the 2004 and 2005 samples.

Year first registered	Fuel type			
	Petrol		Diesel	
	2004 sample	2005 sample	2004 sample	2005 sample
2003	67.0	66.3	33.0	33.7
2002	71.2	59.7	28.8	40.3
2001	72.7	69.9	27.3	30.1
2000	80.3	79.2	19.7	20.8
1999	77.5	81.5	22.5	18.5
1998	80.3	77.7	19.7	22.3
1997	81.9	80.2	18.1	19.8
1996	78.0	74.7	22.0	25.3
1995	81.6	77.6	18.4	22.4
1994	77.2	72.7	22.8	27.3
1993	82.3	79.2	17.7	20.8

Table 4: Comparison for consistency of fuel type split by year of first registration

The distributions of these proportions were compared for significant differences using non-parametric Wilcoxian Signed Ranks test and the Sign test. Both gave significance values of less than 0.05 (0.026 and 0.012 respectively) indicating the 2004 and 2005 fuel type distributions were significantly different. Some differences in fuel type proportions were probably due to sampling errors. However, that is not to say it was applicable for the whole fleet data, only to the analysis of fuel split. Considering all the evidence presented above, it is still likely that the Winchester fleet has a greater proportion of diesel vehicles compared to the NAEI projections. Further investigation is required to determine the exact proportion.

Econ2b: Fuel sales

Figure 1 shows the relative change in fuel sales per year (using 2002 as the baseline) from Winnall Shell petrol station in Winchester. The fuel types shown are Lead Replacement Petrol (LRP), diesel, AUTOGAS (LPG), 'Optimax' (superior unleaded) petrol and ULG (unleaded) petrol, respectively. Figure 2 shows the percentage of total fuel sales represented by each fuel grade at this petrol station.

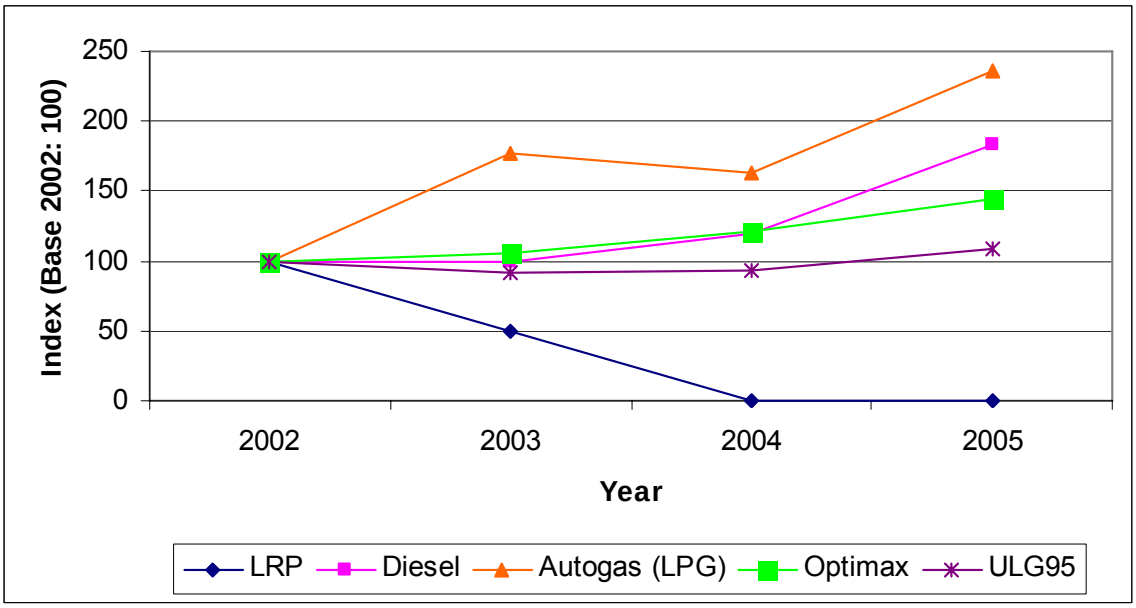


Figure 1: Yearly changes in fuel volume sales (indexed to 2002)

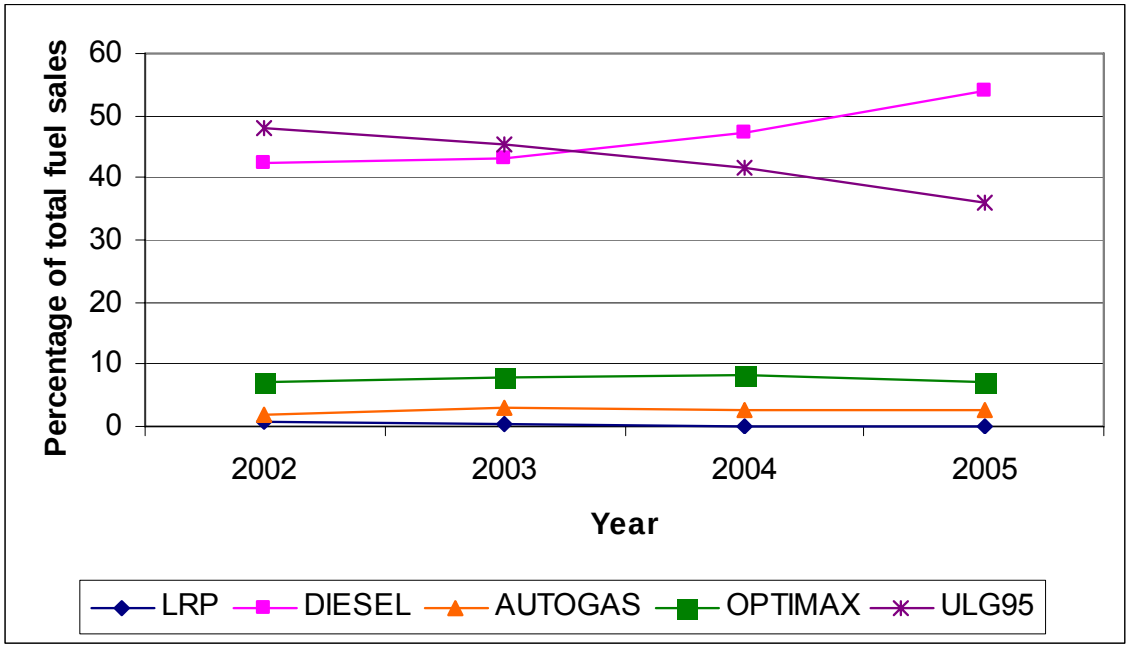


Figure 2: Percentage of total fuel volume sales for various fuel grades for 2002, 2003, 2004 and 2005

It can be seen that fuel volume sales increased since 2002 for all grades with the exception of LRP. This ceased to be sold at this petrol station from September 2003 onwards. Diesel has become the most popular fuel grade with a 50% increase in sales since 2002, and it represented about 54% of all fuel sales in 2005. Diesel has many benefits over petrol. Diesel cars consume 30%-40% less fuel than petrol cars resulting in a reduction of 30% in fuel costs. They also produce up to 40% less CO_2, no CO and less Hydrocarbons (although they do produce more particulates). Unleaded petrol sales (ULG95) increased by only 8% whilst sales in Optimax unleaded petrol (which is marketed as being more beneficial for an engine than standard unleaded petrol) increased by 45%. Shell Winnall was one of only two garages in Winchester that sold LPG fuel. Sales of LPG increased by 136%, although this still only represented about 3% of the total fuel volume sales. The results showed a shift towards more environmental-friendly fuels, with diesel being the most popular fuel sold as well as significant increases in sales of Optimax and LPG. This may be because diesel (being approximately the same price as unleaded) provides a more economical fuel consumption rate than unleaded petrol. In addition, LPG is less than half the price of either diesel or unleaded and so may become more attractive in the longer-term, particularly if fuel prices in general increase substantially. Some of the increase in the volume sales of LPG could be due to the two dual fuel (petrol/LPG) clean vehicles bought by Hampshire County Council to loan out to businesses for up to 1 month at a time (see Measure 12.3). After the trial, one company bought a Vauxhall Vectra LPG.

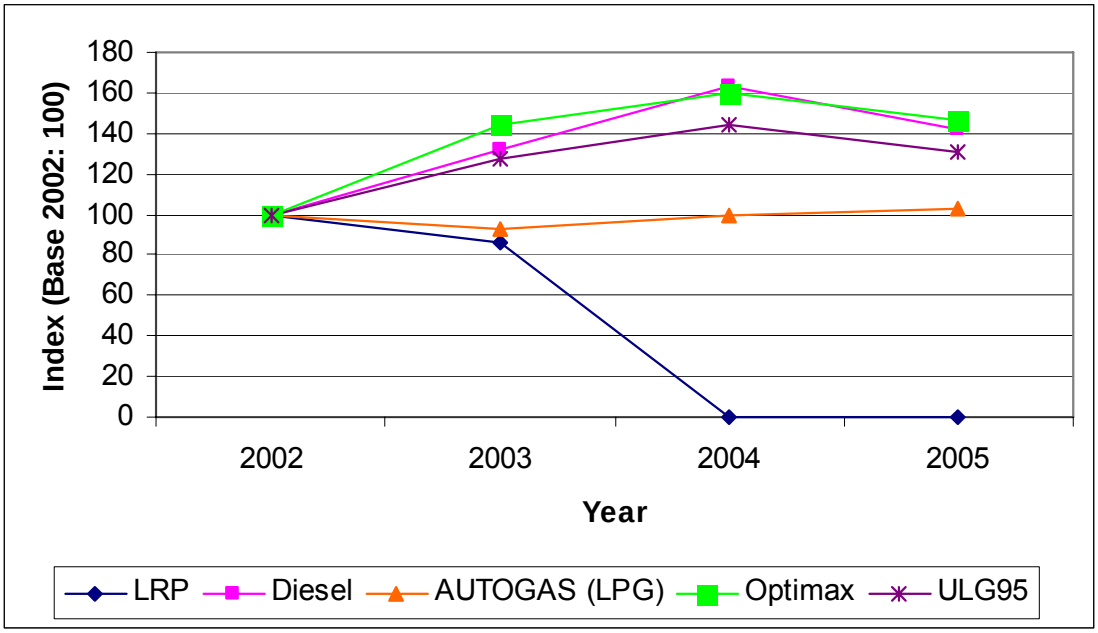


Figure 3: Yearly changes in fuel sales at a control garage in Southampton (indexed to 2002)

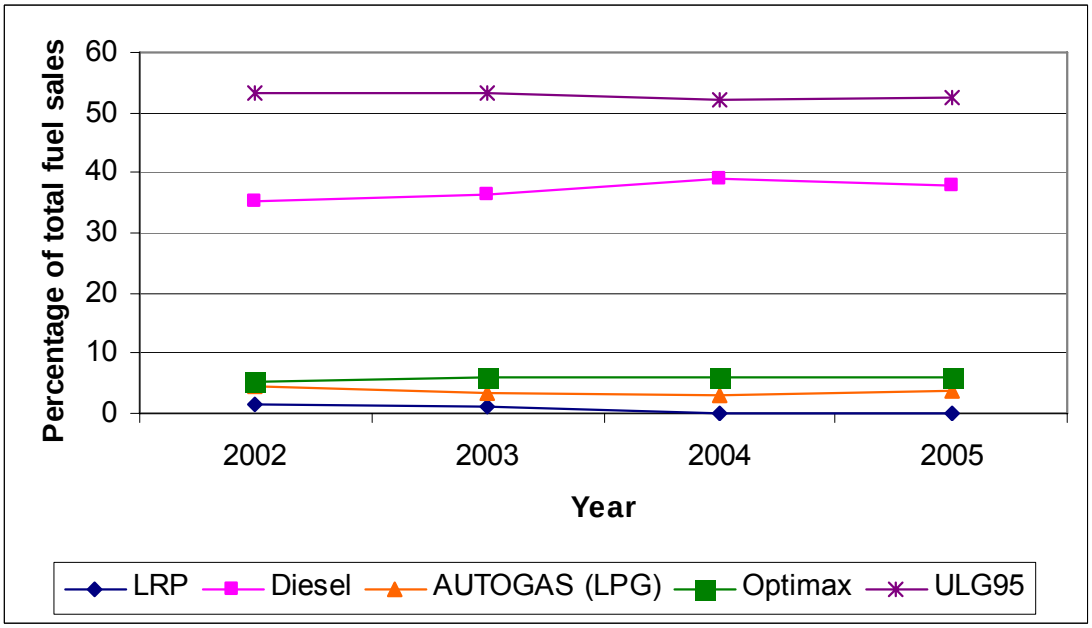


Figure 4: Percentage of total fuel sales for various fuel grades at a control garage in Southampton

For comparative purposes, fuel sale figures were collected from a garage in Southampton. Figures 3 and 4 show the respective results, and can be directly compared with Figures 1 and 2, respectively.

As at the Winchester filling station, fuel volume sales at the Southampton control garage increased since 2002 for all grades (with the exception of lead replacement petrol which ceased to be sold from November 2003 onwards). Unleaded petrol remained the most popular fuel since 2002, and each year represented over 50% of all fuel sales. Diesel represented nearly 40% of the total fuel sales in 2004 and 2005. This contrasts to the data from the Winchester garage where diesel was the most popular fuel. From the journey speed survey (Tran3b), an analysis of the DVLA records for 2004 and 2005

showed that Winchester had a higher than average percentage of diesel vehicles in its fleet. The sale of LPG fuel increased by about 3% since 2002 and represented about 4% of all fuel sales. In Southampton, there are three garages that currently sell LPG fuel.

Lessons Learned – what do other cities, other actors and the EC have to consider?

C7: Lessons learned:

1. The fuel sales data from the Winchester petrol station showed a shift towards more environmentally-friendly fuels. Although the cheaper price of LPG compared to both diesel and unleaded petrol makes it an attractive option for motorists, it may be that drivers are reluctant to converting their vehicle to LPG due to the limited number of garages that presently sell the fuel.
2. The proportion of diesel vehicles in Winchester is higher than the national average. An increase in the use of diesel fuel (compared to petrol) should provide economic benefits for the driver in terms of reduced fuel costs as well as environmental benefits.

Contact Point

.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Created on Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

15. City-level Results - Environment

CITY-LEVEL RESULTS	
Indicator Group: Environment	**Project: MIRACLES**
Evaluation Area: City centre	**City: Winchester**

The Indicator – what is it about?

C1: Local objectives and quantifiable targets:

The local objectives and quantifiable targets were to:

- Improve the air quality (actual and perceived) in the city centre area
- Reduce the perceived noise levels in the city centre area
- Reduce the vehicle emissions (CO_2, CO, NOx and PM_{10}) in the city centre area.

C2: Indicator description:

Env1a: Air pollution levels (CO_2, NOx, PM_{10}) – this indicator doubled as 'METEOR core indicators 5-7'. The number of instances that the UK government thresholds were exceeded annually during 1999 – 2004 was also investigated. The monitoring stations were capable of monitoring CO, NO_x and PM_{10}.

Env1b: Public perception rating of air quality - this indicator also related to 'METEOR core indicators 5-7'. Whilst measured air quality values may indicate a problem, the public perception of air quality may be very different as many of the pollutants cannot be smelt or seen. Raising the awareness of air quality problems and their health impacts is crucial to educate the public about the health and environmental benefits of reduced car use. The indicator was based on results from 'before and after' questionnaire surveys that were used to evaluate a number of transport related issues including the perception of air quality in the city centre.

Env2a: Perceived levels of noise - this indicator doubled as 'METEOR core indicator 12'. Continuing research into the effect of noise on human health supports a growing call for traffic related noise to be reduced. The public perception of noise in Winchester city centre in general was assessed within the 'before and after' questionnaire survey.

Env3a – Total assessed emissions (CO_2, CO, NOx, PM_{10}) - this indicator doubled as 'METEOR core indicators 8-11'. See section M11 for the Measure template 12.1.

C3: Context and relevance:

Env1a & 1b - many of the measures included in the CIVITAS projects aimed to reduce the emission and the level of air pollutants. This process could either be undertaken directly (e.g. through incentives to promote the use of cleaner fuels for vehicles) or indirectly (e.g. congestion reduction and access restriction measures). In such a context, assessment of the success or the failure of the measures must take into account air quality indicators.

Exposure to air pollution is associated with adverse health effects, most acute in children, asthmatics, and the elderly (WHO/EEA, 1997), and can damage vegetation (foliar injuries and reductions in yield and seed production) and materials (notably, the cultural heritage). Within the transport sector, road traffic is the most important contributor to urban air pollution. National and EU regulations aimed at automobile emission reductions (such as the introduction of catalytic converters or unleaded petrol) have resulted in considerably lower emissions per vehicle, but the continuous expansion of the vehicle fleet is partly offsetting these improvements.

Winchester City Council has the responsibility of monitoring air quality in Winchester and mitigating any arising exceedance problems. As part of their responsibilities to UK government regulations, they were required to monitor a total of eight pollutants, of which seven were subject to statutory regulations. Since the beginning of the MIRACLES project, air quality research in Winchester has

shown that the city centre exceeds the statutory level for the annual mean NO_2 value objective and PM_{10} 24-hour mean objective. In the case of transport related NO_2 diesel engines are the main producer of this pollutant.

Env2a - Noise affects people physiologically and psychologically: noise levels above 40 dB can influence well-being, with most people being moderately annoyed at 50 dB and seriously annoyed at 55 dB. Levels above 65 dB are detrimental to health (WHO, 2000). Overall, the external costs of road and rail traffic noise have been estimated at some 0.4 % of GDP (ECMT, 1998). About 120 million people in the EU (more than 30 % of the total population) are exposed to road traffic noise levels above 55 dB. More than 50 million people are exposed to noise levels above 65 dB. In large urban agglomerations, the effect of noise is further aggravated by high concentrations of people living together. It is estimated that 10% of the EU population are exposed to rail noise above 55 dB. The measurement of noise level can be made only for very small areas and it is unlikely to be properly modelled. Perception (scales of values, total, day/night) is much more suitable to point out contingent changes in the level of noise.

Env3a - Emissions from the transport sector represent a high proportion of overall man-made emissions in industrialized countries. Most of these emissions are directly related to the consumption of energy by transport activities: world-wide, the transport sector consumes more than 60 per cent of oil products, which constitute about 98 per cent of transport energy use. They are further influenced by a number of factors, including type and size of engine, type and quality of fuel used, average fuel efficiency, age of vehicle, etc. (*Working Group on the State of the Environment*, OECD, 1999).

One of the main CIVITAS objectives was to increase public transport (PT) patronage (to the detriment of the "car mode") thus increasing the occupancy rates of PT vehicles. In such a context, assessment of the success or failure of the measures must take into account emission indicators.

The Evaluation –what are the results?

C4: Method of measurement:

Env1a - Winchester City Council (WCC) are the authority in Winchester to whom air quality responsibilities devolves. As part of these responsibilities WCC must monitor air quality and record events that exceed UK air quality standards (which in turn are directed by EU legislation). Winchester has two permanent monitoring stations, one to provide 'background' measurements and one to provide 'worst case roadside' measurements. Since air quality measurements are governed by numerous factors other than vehicle emissions (e.g. meteorological conditions) reporting the number of exceedances per month may present a misleading picture. Instead, results were presented as number of exceedances per annum.

Env1b & Env2a - Public opinions regarding air quality in the city centre of Winchester were assessed using the Winchester Travel questionnaires. The first question asked: "*In general, how good do you consider the air quality in Winchester city centre to be*" (Env1b) with potential responses as "*very good*", "*quite good*", "*neither good nor poor*", "*quite poor*", "*very poor*" or "*don't know*".

An additional question asked: "*Thinking of road traffic, how noisy do you consider Winchester city centre to be*" (Env2a) with potential responses as "*very quiet*", "*fairly quiet*", "*neither loud nor quiet*", "*quite loud*", "*very loud*" or "*don't know*". Table 1 provides details of the Winchester Travel questionnaires.

Table 1: Details of the Winchester Travel questionnaires

	Name of survey	Date of survey	Sample size	Purpose
1	Winchester Travel Baseline	July/August 2003	4495	Establish a baseline of data before implementation of measures
2	Winchester Travel Final	July/August 2005	1771	Assess how the MIRACLES measures have altered the baseline of data

Env3a – See Measure level template 12.1.

C5: Achievement of quantifiable targets:

N/a

C6: Report on results:

Env1a: Table 1 below presents the number of recorded exceedances each year from 1997 to 2004 for PM_{10}, NO_x and CO.

Table 1: The number of reported exceedances for PM_{10}, NO_x and CO

Year	PM_{10}		NO_x		CO	
	50ug/m3 (24 Hr Mean)		200ug/m3 (1 Hr Mean)		10mg/m3 (8hr running mean)	
	Background	Roadside	Background	Roadside	Background	Roadside
1997	4	20	0	**299**	0	0
1998	4	10	0	6	0	0
1999	1	3	0	8	0	0
2000	1	14	0	15	0	0
2001	3	15	0	12	0	0
2002	2	16	0	**161**	0	0
2003	15	19	0	**70**	0	0
2004	Not enough data	15	0	0	0	0
	Pass = < 35 failures/year		Pass = < 18 failures/year		Pass = No failures	

Numbers in bold failed the short term mean air quality objectives

Table 2 shows the compliance with annual mean air quality objectives for PM_{10}, NO_x and CO.

Table 2: Compliance with annual mean air quality objectives

Year	PM_{10}		NO_x		CO	
	Mean PM10 in ug/m3 40ug/m3 (Annual Mean)		Mean NO2 in ug/m3 40ug/m3 (Annual Mean)		Mean CO in mg/m3 No annual objective	
	Background	Roadside	Background	Roadside	Background	Roadside
1997	17.7	25.4	35.30	**82.7**	0.7	1.3
1998	16.5	21.0	39.7	**58.1**	0.5	1.3
1999	17.1	19.9	31.1	**60.2**	0.5	1.2
2000	15.8	20.3	33.0	**68.6**	0.5	1.2
2001	14.2	26.2	33.4	**50.8**	0.3	1.2
2002	19.0	27.7	27.3	**65.5**	0.3	1.0
2003	24.7	30.3	**41.1**	**55.8**	0.3	1.0
2004	Not enough data	28.6	29.4	**52.1**	0.3	0.8

Numbers in bold failed the short term mean air quality objectives

Tables 1 and 2 show that WCC met their air quality objectives for PM10 and CO. However, NOx at the roadside was a particular problem. January 1997 had an exceptionally long period of very cold still air resulting in the highest number of exceedances. The year 2002 also contained a period of poor air quality that was reflected across the UK. Most of the failures for 1997, 2002 and 2003 occurred between October and February when there was cold still air with pollutants not dispersing that resulted in poor air quality. Traffic emissions are the only source of NOx in Winchester and so any measures to

reduce traffic flows or clean up vehicles in the city centre area would contribute to an improvement in air quality. The data showed that weather conditions are a major factor in whether the pollutants are dispersed.

Env1b: Figure 1 illustrates the public perception of air quality, as measured from the questionnaire surveys. The percentage of the public perceiving air quality to be generally good reduced slightly (but not statistically significantly) from 49% to 45%. The level of skew shown in the responses suggested that the general public did not perceive there was an air quality issue in Winchester city centre. However, such a perception was contrary to the measured air quality values, which were known to be a health risk (see WMBE/Env1a).

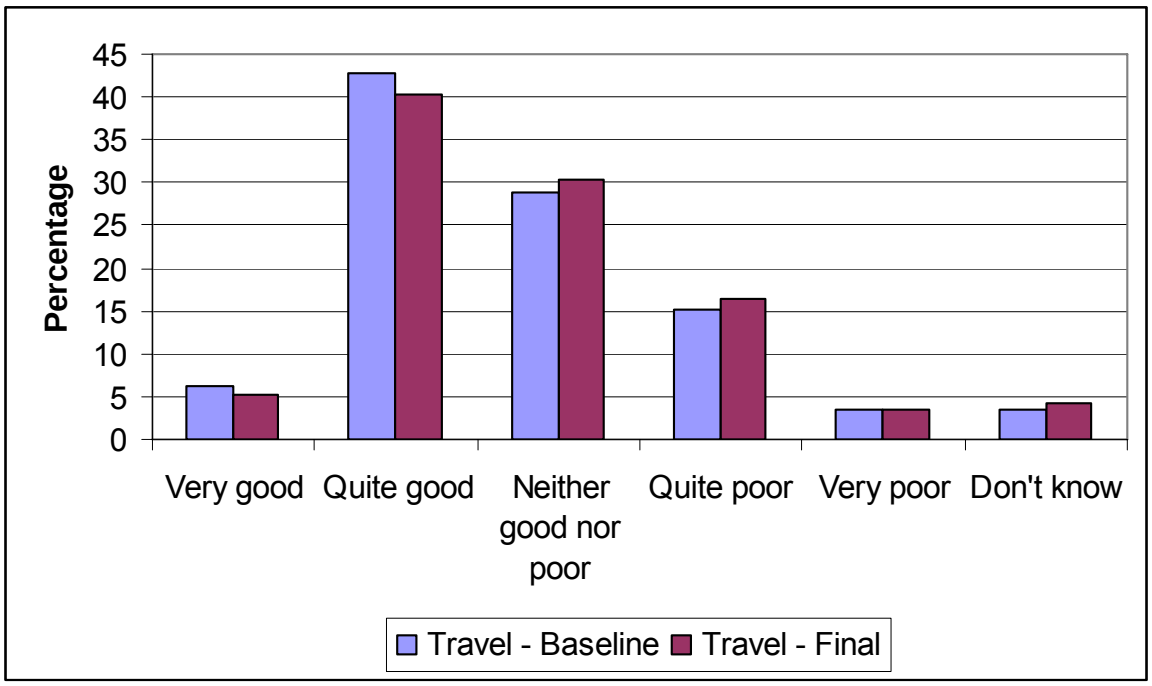


Figure 1: Public perception of air quality

Env2a: Figure 2 shows the public perception of road traffic noise in Winchester city centre. The percentage of the respondents that perceived road traffic noise to be generally quiet decreased significantly from 15% to 13%. In contrast to the responses for air quality perception, there was a skew of responses towards the negative end of the noise perception scale.

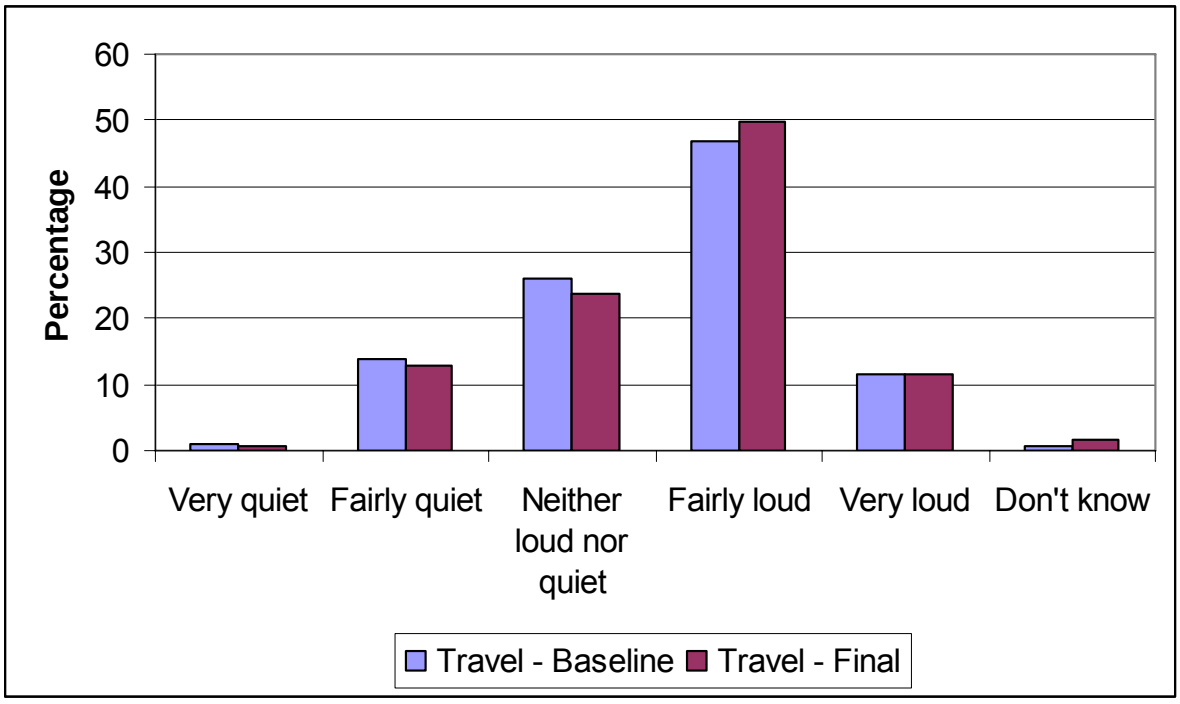


Figure 2: Public perception of road traffic noise

Env3a: See Measure Level template 12.1.

Lessons Learned – what do other cities, other actors and the EC have to consider?

C7: Lessons learned:

1. Air pollution levels are generally greatly affected by weather conditions. This meant that any reductions due to the MIRACLES measures were very difficult to measure.
2. Winchester city centre has had a problem with the levels of NOx that have exceeded the mean and maximum air quality objectives. NOx is not measured in the annual MOT test but is recorded by the RSD equipment used in Measure W5.1. Reducing the number of high polluting NOx vehicles entering the city centre area would improve the air quality and help to achieve the objectives set by National Government.
3. Generally, there was no evidence that the MIRACLES measures changed people's perceived view of the air quality, although there was a significant reduction in the percentage of respondents that perceived road noise to be generally quiet. Both sets of data were collected from the questionnaire survey, but it should be emphasised that these perceptions were subjective and do not always reflect the trends in the objective data. It is unclear what affect MIRACLES had on road noise in the city centre.

Contact Point

.www.winchestermiracles.org

Andy Wren, Project Manager, Intelligent Transport Created on Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

16. City-level Results - Society

CITY-LEVEL RESULTS	
Indicator Group: Society	**Project: MIRACLES**
Evaluation Area: City centre	**City: Winchester**

The Indicator – what is it about?

C1: Local objectives and quantifiable targets:

The local objective was to increase citizen awareness of the need, potential and ability to change to more sustainable transport patterns through increased awareness and acceptance of MIRACLES.

C2: Indicator description:

Soc1a: **Public awareness** - this indicator doubled as 'METEOR core indicator 13' and reported on the percentage of respondents who stated that they were aware of MIRACLES.

Soc2a: **Public acceptance** - this indicator doubled as 'METEOR core indicator 14' and reported on the percentage of respondents that stated their acceptance of the aims of the project.

Soc3a: **Perceived ease of access to city centre** - this indicator doubled as 'METEOR core indicator 15' and reported on the percentage of respondents who stated how easy they perceived it was to access their nearest form of public transport and the ease of travelling around Winchester.

Soc4a: **Business perception of improvements** - this indicator reported on the awareness and acceptance of the MIRACLES project by a range of businesses in the city centre.

Soc5a: **Public perception of security** - this indicator reported on a respondent's perceived level of personal security in a variety of given situations.

Soc5b: **Number of reported criminal incidents** - this indicator reported on the level of crime in the Winchester area during the lifetime of the project. It was related to transport related crime (such as vehicle crime) where possible.

C3: Context and relevance:

These indicators related to the other more subjective Society indicators reported within the evaluation of those work packages that sought to obtain public and business awareness, knowledge and acceptance of the MIRACLES project, mainly by undertaking various questionnaire surveys. The public perception of security was supplemented by the objective crime figures supplied by Hampshire Police.

The Evaluation –what are the results?

C4: Method of measurement:

Soc1a, Soc2a, Soc3a and Soc5a: Five acceptance/awareness questionnaire surveys were carried out during the project to assess the awareness and acceptance of MIRACLES measures. These were targeted at residents and non-residents of Winchester as well as local businesses (see Table 1).

Table 1: Details of the five acceptance/awareness questionnaires

	Name of survey	Date of survey	Sample size	Purpose
1	Winchester Travel Baseline	July/August 2003	4495	Establish a baseline of data before implementation of measures ('before')
2	Winchester Transport	January/February 2005	914	Acceptance of specific measures within MIRACLES
3	MIRACLES Awareness	January/February 2005	850	Awareness of specific measures within MIRACLES
4	Business	May 2005	96	Awareness/acceptance of MIRACLES measures
5	Winchester Travel Final	July/August 2005	1771	Assess how the MIRACLES measures have altered the baseline of data ('after')

Soc5a: Crime figures (where possible relating to transport related crime) were obtained from the Hampshire Constabulary website.

C5: Achievement of quantifiable targets:

N/a

C6: Report on results:

Soc1a: In the 'Winchester Travel questionnaire', people were asked: "*Do you recognise any of the following logos (shown in Figure 1)?*" The only possible responses were "yes" or "no". Figure 2 shows the results.

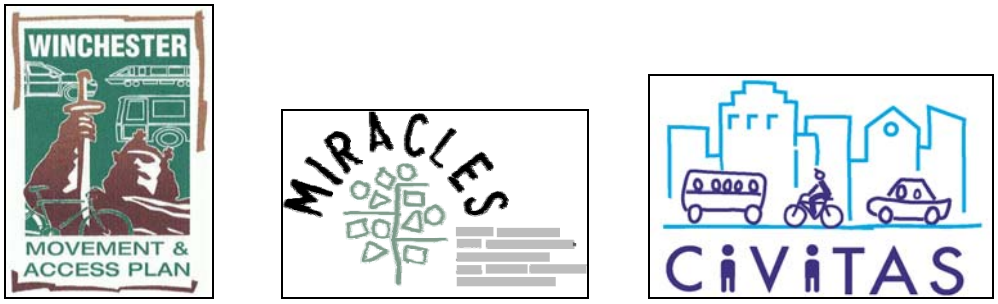


Figure 1: WMAP, MIRACLES and CIVITAS logos

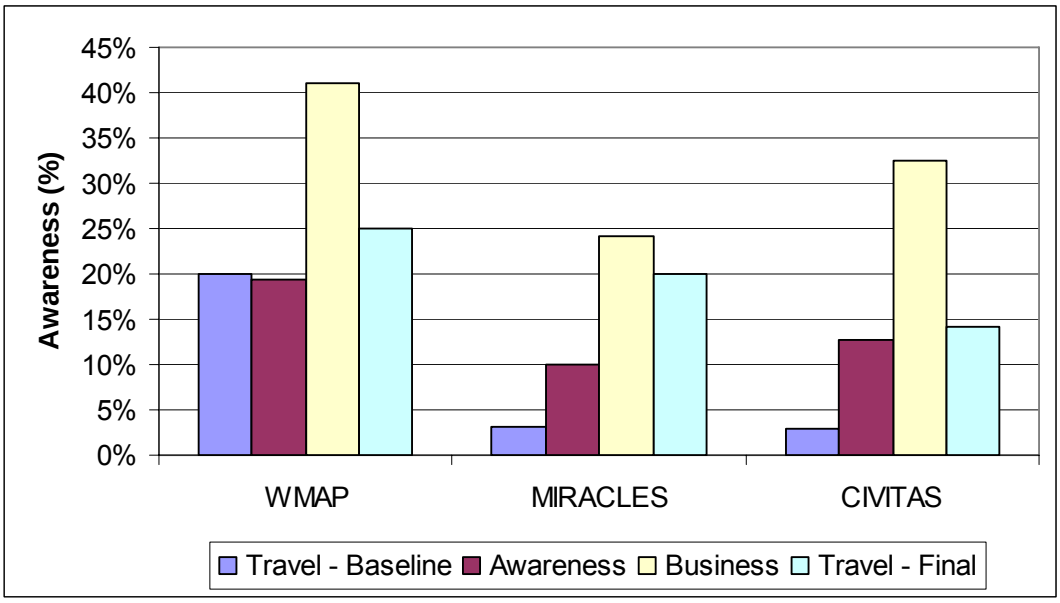


Figure 2: Awareness of WMAP, MIRACLES and CIVITAS from the four questionnaire surveys

Although only a minority of respondents were aware of the respective logos, awareness of MIRACLES among the general public increased from 3.2% in July/August 2003 to 20.0% in July/August 2005. There were significant differences between these 'before' and 'after' sets of results (heterogeneity χ^2 = 17.72 and $\chi^2_{(0.01)}$ (1df) = 6.63). Awareness of CIVITAS (3% to 14%) and WMAP (20% to 25%) also increased significantly during the project timescale. Before MIRACLES, the Winchester Movement and Access Plan (WMAP) was the major programme in Winchester to make people aware of sustainable transport issues and had been in place for about 10 years. This may explain why awareness of WMAP was much higher than that of MIRACLES. Business awareness was noticeably higher for all three logos, which indicated that initiatives such as the clean vehicle trials (where many businesses had been contacted directly) had raised awareness of the project. Awareness of MIRACLES among bus passengers also increased during the project (10% in the Interim survey to 25% in the Final bus passenger survey – see Measure 7).

Soc2a: The public's level of agreement with Hampshire County Council's (HCC) and Winchester City Council's (WCC) sustainable transport policy, and the principle behind the MIRACLES project, was assessed using the Winchester Travel and Awareness questionnaires. However, the result should be viewed with caution, as the public did not know how HCC or WCC were planning to encourage the use of more sustainable transport (i.e. the MIRACLES measures). People were given the following statement to read: "*Hampshire County Council and Winchester City Council are trying to persuade people to reduce the number of journeys they make by car, and encouraging them to shift to more environmentally friendly forms of transport (e.g. walking, cycling and public transport)*". They were then asked "*To what extent do you agree with what Hampshire County Council and Winchester City Council are trying to do*" with possible answers being "*strongly agree*", "*tend to agree*", "*neither agree or disagree*", "*tend to disagree*", "*strongly disagree*" or "*don't know*".

The percentage of people answering with each of the 6 possible responses is shown in Figure 3. There was substantial support for this statement, which increased over the duration of the project (Travel Baseline: 68.9%; Awareness: 69.6%; Business: 59.2%; Travel Final: 70.9%). Respondents in the Final Travel survey were significantly less likely to disagree with the statement. The result from the business questionnaire was lower at 59.4%, and perhaps reflected the view that they may consider themselves to be affected negatively by the implementation of certain environmental policies.

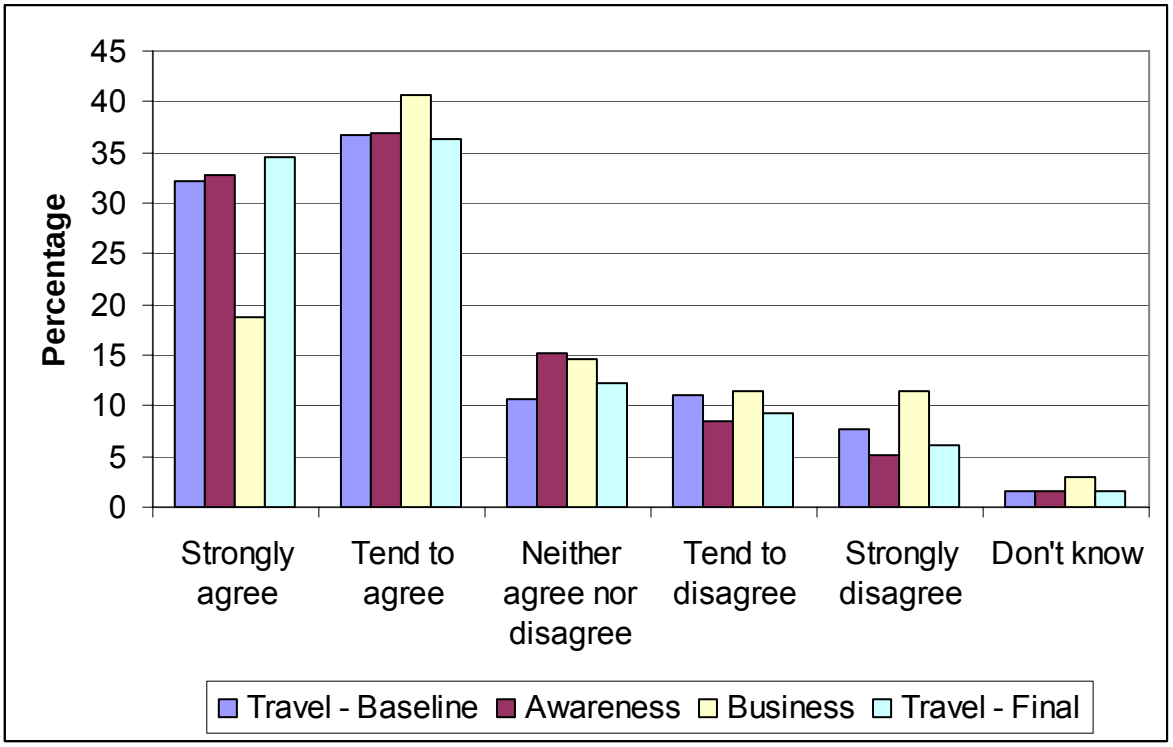


Figure 3: Public acceptance of the aims of MIRACLES

Soc3a: The public opinion regarding ease of access to their nearest form of public transport was questioned using the Winchester travel questionnaires. The question posed was: "*Thinking of distance and convenience, how easy do you consider it to be, to reach your nearest form of public transport i.e. bus or train*". Possible answers were "*very easy*", "*quite easy*", "*neither easy nor difficult*", "*quite difficult*", "*very difficult*" or "*don't know*". This question was only asked to those respondents who were Winchester residents. The responses showed that the vast majority of respondents (85%) found it very or quite easy to access their nearest form of public transport, as shown in Figure 4. It is likely that this form of public transport was a bus, since Winchester has only one train station, which is located in the city centre. The results show that access to public transport was not perceived to be a problem by over 90% of those surveyed and so this factor can be discounted when considering why more people do not travel by public transport. Compared to the 'before' scenario, 'after' respondents were significantly less likely to state that they found it difficult to access public transport.

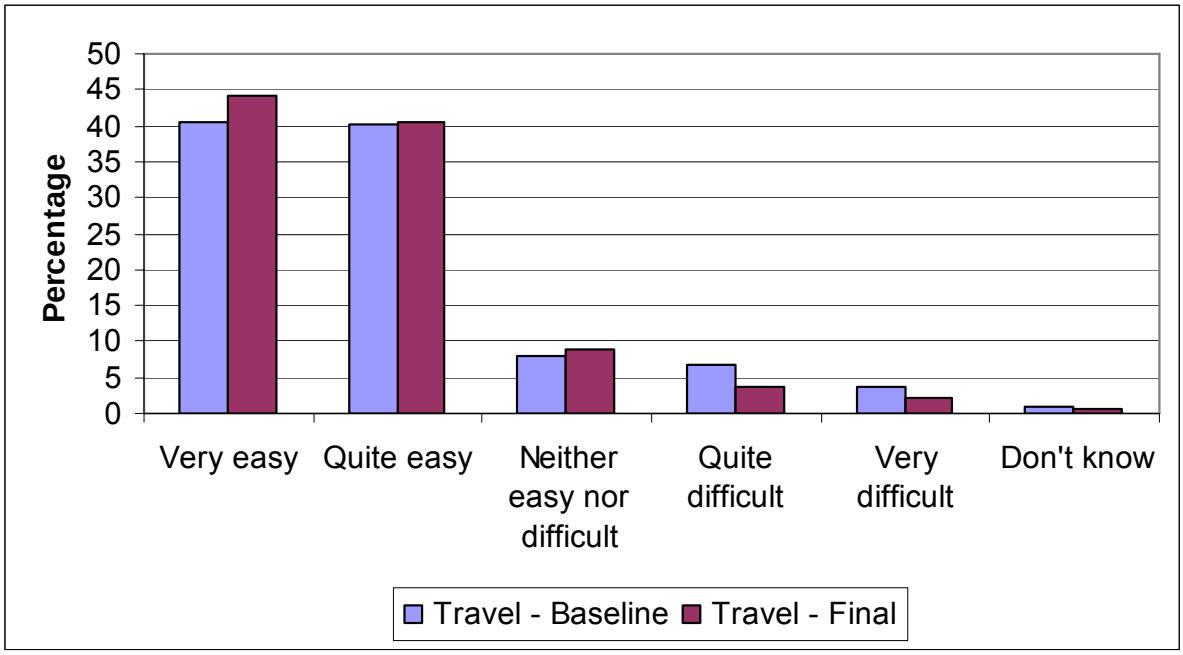


Figure 4: Public perception of ease of access to public transport

More specific questions were asked to determine relative perceptions of ease of travel into, around and out of Winchester city centre by various modes of transport. Both residents and non-residents were considered in this analysis. The percentage of respondents that stated that access was generally easy (i.e very easy or quite easy) was plotted for each transport mode. Figures 5, 6 and 7 show the respective results regarding ease of access travelling into, around, and out of Winchester.

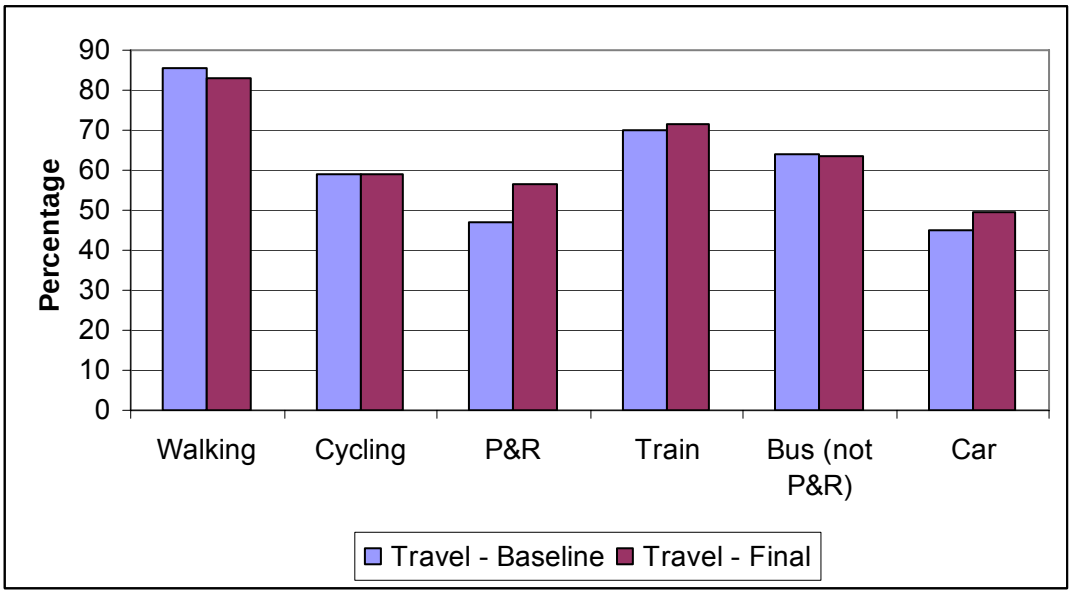


Figure 5: Public perception of ease of access into Winchester

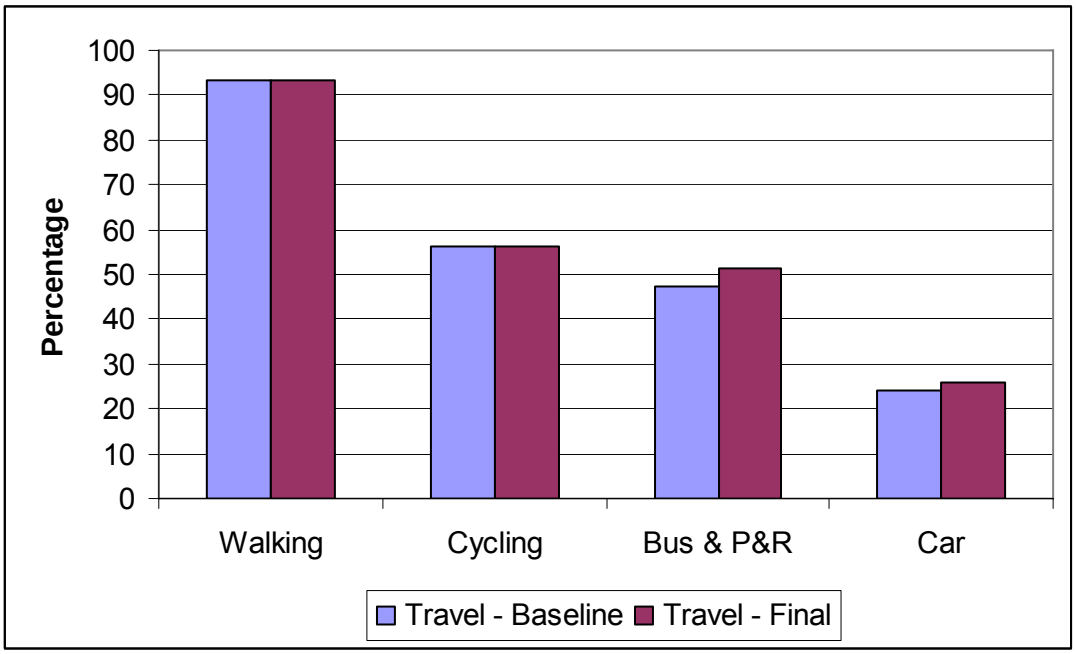


Figure 6: Public perception of ease of access around Winchester

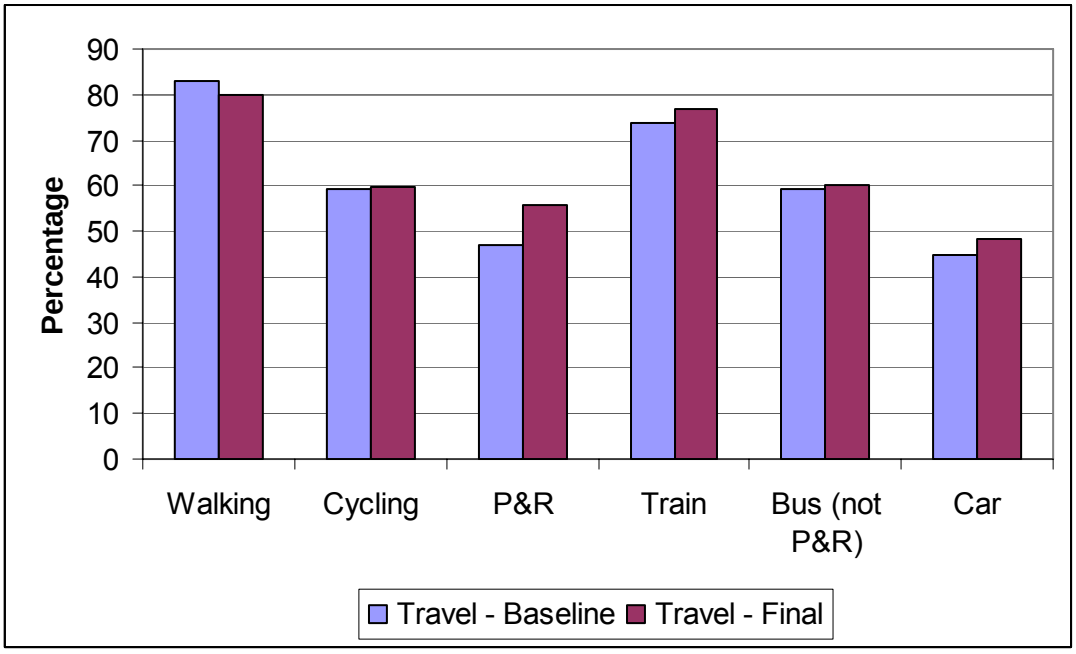


Figure 7: Public perception of ease of access out of Winchester

Compared to the 'before' scenario, a significantly higher percentage of respondents in the 'after' scenario stated that they rated access into, around, and out of Winchester by Park and Ride or car as generally easy. This issue was investigated in more detail by comparing responses of those respondents who were aware of MIRACLES with those who were not aware of MIRACLES. It was found that the ease of travelling into and out of Winchester by car was not influenced by MIRACLES but those travelling by P+R had possibly been influenced by MIRACLES. (i.e. whether a subject was aware of MIRACLES did not influence their response to the question regarding ease of access by car, but there was an indication that a subject who was aware of MIRACLES was more likely to rate it was easy to access Winchester by P+R).

In addition, it was considered that the change in perceived access was due partly to Winchester City Council's parking/charging policy of encouraging more use of the P&R by increasing the capacity of St Catherine's car park as well as keeping the daily charge low relative to city centre parking (see Measure 6).

Soc4a: The business awareness and acceptance results are shown in Figure 2.

Soc5a: The public's perception of security when in a number of transport situations in Winchester was questioned using the Winchester Travel Questionnaire. The question posed was: "*Thinking of crime, how secure do you feel when in the following situations during the daytime or after dark*" with possible answers "*very secure*", "*fairly secure*", "*neither secure nor insecure*", "*fairly insecure*", "*very insecure*" and "*not applicable*"? The situations listed were using or waiting to use a variety of modes of transport.

The percentage of respondents that stated they felt generally secure in the day or after dark for each transport situation is shown in Figure 8. It can be seen that the majority of people felt secure from crime in all transport situations during the daytime but, as expected, people generally felt much less secure after dark. In addition, the perceived security 'after dark' was more dependent upon the specific transport mode being considered. Compared to the 'before' scenario, there were significant increases in the percentage of respondents that felt secure when either waiting for a train, travelling on a train or driving a car after dark. However, the contribution that MIRACLES made to this increase was unclear. Further analysis compared those respondents that were aware of MIRACLES with those unaware of MIRACLES. No difference was found in the scenario 'waiting for a train after dark' but a significant difference was found for those travelling on a train or driving a car after dark. It was concluded that security after dark in Winchester was possibly influenced by MIRACLES, although it was difficult to interpret which specific measures may have influenced these results.

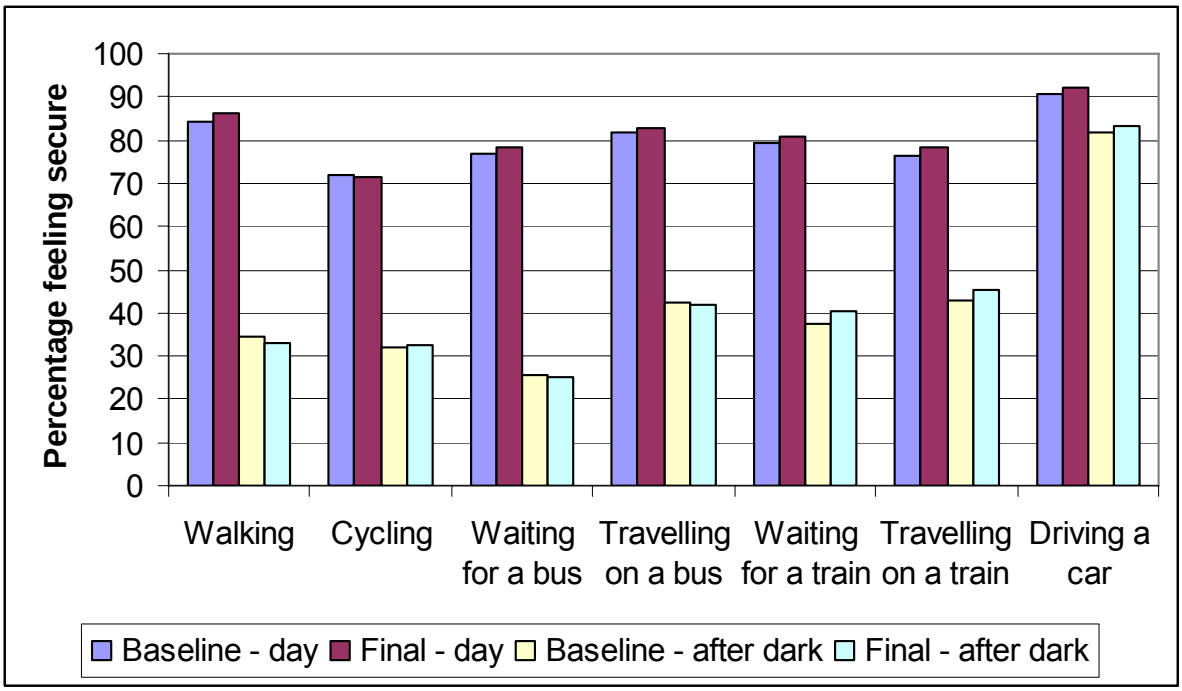


Figure 8: Public perception of feeling secure in using various forms of transport

Soc5b: Crime figures for Hampshire were taken from the Hampshire Constabulary website (www.hampshire.police.uk). Figures for Winchester city centre were not available but were available for Central Hampshire, which includes 59 central parishes such as Badger's Farm, Hursley, Kings Worthy, New Alresford, Oliver's Battery as well as 17 wards such as the Winchester wards of St.Barnabas, St.Bartholomew, St.John and All Saints, St.Luke, St.Michael and St Paul. This area of Central Hampshire has a population of 162,307 (9% of the Police area) with 225 Police Officers (from 1 April 2000) out of an overall population for Hampshire and the Isle of Wight of 1,771,375, which is

served by 2578 Police Officers. The population of Winchester is around 30,000.

The crime figures included vehicle crime i.e. the taking or theft of a motor vehicle, vehicle interference and criminal damage of a motor vehicle. Table 2 shows the number of vehicle crimes and total crimes (with the detection rates) for Central Hampshire and Hampshire and the Isle of Wight respectively for 2001/2, 2002/3, 2003/4, and the first 6 months of 2004/5. The figures show that the area of Central Hampshire had a lower crime rate than Hampshire and the Isle of Wight as a whole, with only about 5% of vehicle crime and 7% of all crime occurring in this region. Generally, there was no evidence that MIRACLES measures influenced the number or type of crimes in the Winchester area.

Table 2: Vehicle and total crime figures from 2001/2 to Oct 2004

	Vehicle crimes Cent Hants (detection %)	Vehicle crimes Hants & IOW (detection %)	Total crimes Cent Hants (detection %)	Total crimes Hants & IOW (detection %)
2001/2 crimes	951 (9%)	21590 (9%)	8844 (31%)	135961 (30%)
2002/3 crimes	1192 (8%)	22021 (11%)	10959 (28%)	152664 (30%)
2003/04 crimes	1120 (9%)	20561 (11%)	11278 (28%)	178543 (27%)
Apr 2004 – Oct 2004	533 (9%)	9878 (9%)	6848 (30%)	104392 (26%)

Lessons Learned – what do other cities, other actors and the EC have to consider?

C7: Lessons learned:

1. Awareness of the MIRACLES project increased to 20% during the project lifetime. It is important that this increased public awareness in MIRACLES is also associated with an increased awareness of sustainable transport issues in general, and that it continues to increase after the end of the project.
2. In parallel to MIRACLES, the Winchester Movement and Access Plan (WMAP) has been a local sustainable transport initiative, ongoing for the last 10 years. Awareness of WMAP increased from 20% in 2003 to 25% in 2005 (41% in the business survey). This indicates that although awareness of sustainable transport issues should increase in the longer term, even then it may not produce 'high' ratings.
3. The acceptance of the MIRACLES aims increased slightly from 68.9% to 70.9% during the project lifetime. However, there is a difference between accepting the objectives of an initiative in a theoretical way and being prepared to change travel behaviour as a result. The majority of the public were in favour of reduced car use but it is doubtful that they would support radical measures to implement it, particularly if it restricted the usage of their own car (particularly at the work place).
4. Businesses were generally more aware of MIRACLES than the general public but were less accepting of the MIRACLES aims. This may be because they consider that some of the measures may adversely affect their business financially.
5. Generally, there was no evidence that the MIRACLES measures affected the crime figures.
6. Generally, for most considered scenarios, there was no evidence that the MIRACLES measures affected public perception of security. However, the public perceived that security had improved regarding a small number of specific scenarios such as waiting for a train, travelling on a train or driving a car after dark. The contribution made by MIRACLES to this was unclear.
7. There was a significant increase in the perceived ease of access in, around and out of the city centre by P&R and car. It was considered that this was partly due to the city centre parking charges / policy of encouraging more use of the P&R and discouraging long stay city centre parking (see Measure 6).

Contact Point

💻.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Created on Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT

17. City-level Results - Transport

CITY-LEVEL RESULTS	
Indicator Group: Transport	**Project: MIRACLES**
Evaluation Area: City centre	**City: Winchester**

The Indicator – what is it about?

C1: Local objectives and quantifiable targets:

The local objectives and quantifiable targets were to:

- Reduce the overall level of car traffic by 2%;
- Reduce peak period car travel by 7% on the key arterial routes;
- Improve the satisfaction rating of public transport by 8%;
- Increase walking by 20%; and
- Increase the level of cycling by 30%.

C2: Indicator description:

The following transport indicators were used for the city centre area, all of which are self-explanatory:

Tran1a: Average modal split
Tran2a: Traffic flow on city network
Tran3a: Peak period traffic flow on key arterial routes into city centre
Tran3b: Travel speeds in the peak period on key arterial routes
Tran4a: Cycle flows on Winchester network
Tran4b: Cycle parking in Winchester
Tran5a: Level of car ownership
Tran5b: Average age of car fleet in Winchester
Tran6a: Number of road traffic accidents in Winchester
Tran6b: Public perception of safety
Tran7a: Footfall within Winchester city centre
Tran8a: Average vehicle occupancy
Tran9a: Daily parking flows (including Park and Ride (P&R))
Tran10a: Accuracy of timekeeping of bus routes X1, X5 and P&R
Tran11a: Quality of the bus service
Tran12b: Average vehicle speeds in peak and off-peak in the city centre
Tran13a: Total number of goods vehicles within Winchester

C3: Context and relevance:

These indicators gave a picture of the transport modal breakdown within the city centre area. In order to reduce car traffic (both off-peak and peak), good quality alternatives have to be available and encouraged, such as the bus service which has been improved through the introduction of a Bus Quality Partnership. Other modes were also encouraged, such as walking and cycling (with the help of Bikeabout and other cycling facilities).

The Evaluation –what are the results?

C4: Method of measurement:

Tran1a: **Average modal split** - this indicator doubled as 'METEOR core indicator 26-27'. Modal split was determined using a question in the Winchester Travel questionnaires. Respondents were asked: **"***Please indicate your usual daily means of travel, within Winchester, to work or place of study***"** with possible answers "*car (driver)*", "*car (passenger)*", "*bus*", "*train*", "*bicycle*", "*motorbike*", "*car + bus*", "*car + train*", "*bus + train*", "*walking*" or "*other*". The results were presented for all respondents (residents and non residents) and for residents only.

Tran2a: **Traffic flow on city network** - due to the nature of the one-way traffic system in Winchester city centre, it was planned to observe any changes in flows using only a small number of strategic

locations. The UTC/SCOOT data in Winchester, however, was only retained for a rolling six-month period before being deleted. Some data was collected (during 2004) but overall there was insufficient data for the other years of the project to enable an accurate comparison to be made.

Tran3a: **Peak period traffic flows on key arterial routes into city centre** – these were monitored by collecting data from permanent dedicated vehicle count sites on eight of the major radial routes in Winchester.

Tran3b: **Travel speeds in the peak period on key arterial routes** - this indicator doubled as 'METEOR core indicator 23-24'. The travel speeds between fixed points on five major links leading into the city centre of Winchester were monitored in the morning peak period from 07:30 – 09:15 on 23rd – 25th March 2004 and 7th – 8th June 2005. Camera numbers and their respective locations on each link are given in Table 1 and Figure 1. The 2004 survey used high-speed video cameras by the roadside whereas the 2005 survey used data from video cameras for links 1, 2 and 3 and the new ANPR system for links 4 and 5 (see Measure 11.2).

Table 1: Original and destination of link

Link Number	Upstream	Downstream
1	Camera 1 Romsey Road	Camera 2 Romsey Road
2	Camera 3 Badger Farm	Camera 2 Romsey Road
3	Camera 4 St. Cross Road	Camera 5 Southgate Street
4	Camera 6 Bar End Road	Camera 7 Bar End Road
5	Camera 8 Easton Lane	Camera 9 Durngate Place

The resultant tapes were analysed using number plate matching software. All vehicles monitored by cameras at upstream locations were crosschecked with the vehicles passing the downstream camera for the appropriate link. The time stamps of two matching number plates were noted as was the resultant journey time (N.B. all cameras were synchronized before the surveys with each other and the ANPR system). For those links, where very low matching rates were obtained, manual input of vehicle registration number was undertaken.

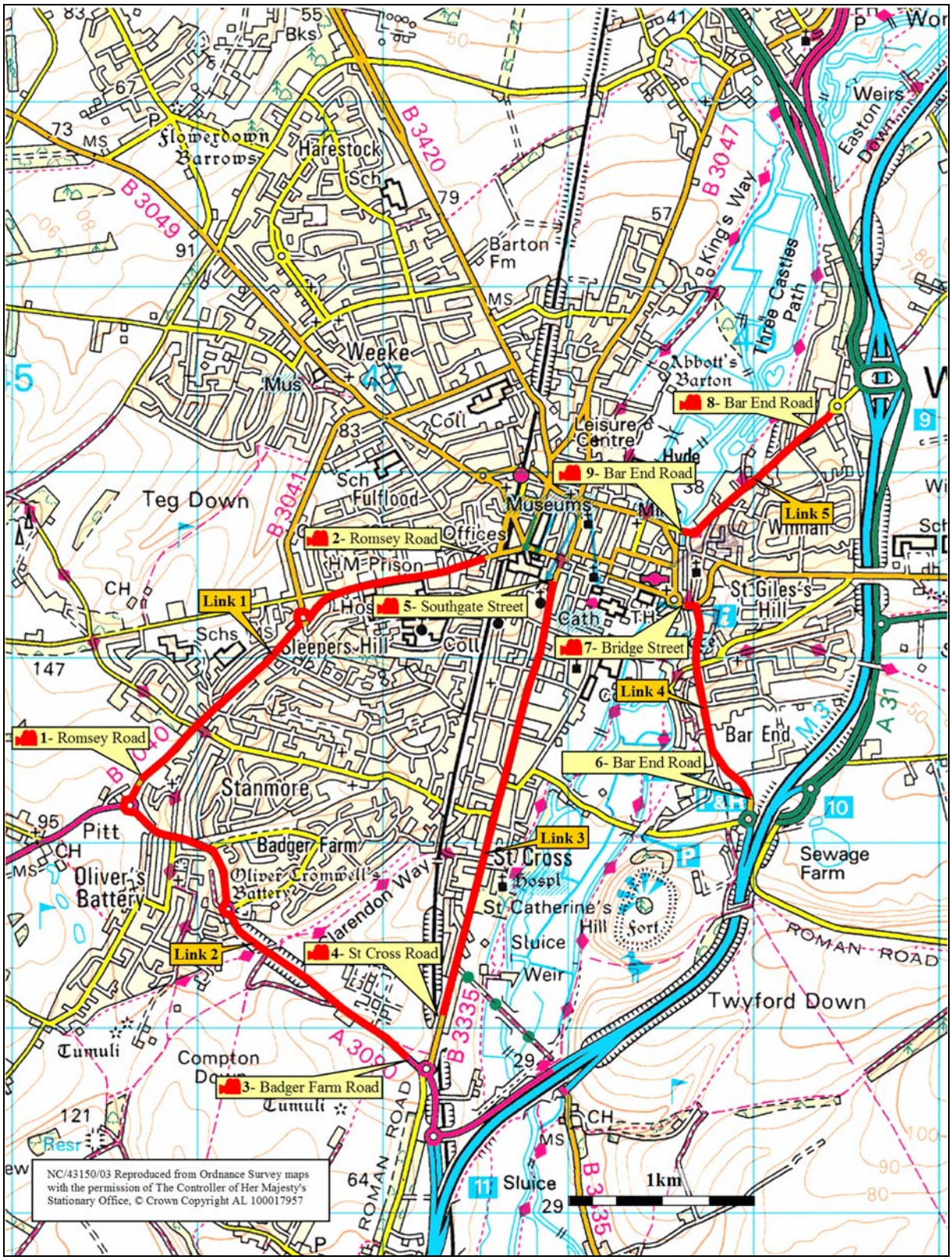


Figure 1: Camera numbers and their respective locations

Tran4a: **Cycle flows on Winchester network** - cycle flows on arterial roads leading into Winchester city centre were monitored by collecting data from permanent dedicated vehicle count sites at eight city centre locations. The cycle flow data was collected on weekdays for the years 2002-2004. The data

was aggregated to give the average number of bicycles passing over the detectors within a 12 hour period (7am – 7pm) over 5 days.

Tran4b: **Cycle parking in Winchester** - in addition to the cycle flow data on the Winchester network, data showing the level of cycle parking in Winchester was collated in order to show the distribution of bicycles around the city. Cycle parking surveys undertaken from 2002-2005 were carried out at locations throughout Winchester. The main types of cycle parking found within Winchester were Sheffield stands, CycleVice and Hoops. The survey also accounted for the use of some non-official cycle parking facilities such as fences at various sites. The survey provided a useful estimate of the number of bicycles in Winchester as flow data on the network did not account for a single cyclist crossing several count sites during the day.

Tran5a: **Level of car ownership** - the number of cars available in households was questioned using the 'Winchester travel questionnaire'. The question posed was: "*How many cars does your household own or have continuously available for private use*" with the possible answers being "*none*", "*one*", "*two*", "*three or more*".

Tran5b: **Average age of car fleet in Winchester** - using the ANPR surveys undertaken as part of indicator Tran3b (travel speeds), the number plates were used to infer the date of the vehicles first registration. Due to the links used, only vehicles known to be entering Winchester city centre were considered. A spreadsheet macro was written to automate the process of assigning a year to a particular registration mark. The macro firstly determined what format of registration mark was present (three different formats have been in use in the UK over the last 30 years); it then used look-up tables specific to the format of the registration mark according to the critical characters which distinguish the vehicle's year of first registration. The macro filtered out all plates that were likely to have been privately owned registration marks, although this number is thought to have been insignificant on the overall result.

To ensure errors in the number plate recognition software were minimised (i.e. assignment of an incorrect registration mark) only matched registration marks were used in the analysis for this indicator. This had the effect of the two camera locations verifying each other and thus matched registration marks were used with a high level of confidence. Duplicate registration marks were removed from all datasets and so only unique vehicles were considered. From these captured vehicle registrations, more detailed information on the vehicles such as engine size, fuel type and year of first registration was purchased from the UK Driver and Vehicle Licensing Agency (DVLA).

By subtracting the year a vehicle was first registered from the year in which the survey was undertaken, the 'relative age' of each vehicle was determined (relative to survey year). To normalise the distributions, the percentage contribution to the total fleet for each age was calculated. In order to compare the two data sets a very small number of vehicles over 20 years old were removed (4 in total).

Tran6a: **Number of road traffic accidents in Winchester** - this indicator doubled as 'METEOR core indicator 20'. The casualty data figures quoted used road injury accident casualty data, courtesy of the Chief Constable, Hampshire Constabulary. The data was collated by Hampshire Constabulary, who permitted the County Council to use the data for the authority's road safety programmes. The data related to 2002 and 2003 and were obtained from the Road Safety section of the Hampshire County Council website (accessed at http://www.hants.gov.uk/roadsafety/statistics/index.html). No data for 2004 was available.

The casualty data related to the Hampshire County Council administrative area (a population of 1,240,103) and the district of Winchester (a population of 107,222). This administrative area excluded the cities of Portsmouth and Southampton, together with the Isle of Wight. The data therefore varies in this important respect from data that would apply to the Hampshire Constabulary force area. The data did include, however, results for the motorway and trunk road network, which remain the responsibility of the Government's Highways Agency. The datasets did not contain details of damage-only accidents, which were not comprehensively recorded by the Chief Constable. The data was collected by the location of the personal injury accident, not by the postal addresses of those individuals involved.

By 2010, the Government wishes to achieve, compared with the average for 1994-98:

- A 40% reduction in the numbers of people killed or seriously injured in road accidents;
- A 50% reduction in the numbers of children killed or seriously injured; and
- A 10% reduction in the slight casualty rate, expressed as the number of people slightly injured per 100 million vehicle kilometres.

Tran6b: **Public perception of safety** - public opinion of their perception of road safety in Winchester was questioned using the 'Winchester travel questionnaire' in 2003 and 2005. The question posed was: "*Thinking of road safety and accidents, how safe do you feel when using the following forms of transport (walking, cycling, bus, car) in Winchester*" with the possible responses being "*very safe*", "*quite safe*", "*neither safe nor unsafe*", "*quite unsafe*", "*very unsafe*" and "*not applicable*".

Tran7a: **Footfall within Winchester city centre** - to monitor the number of pedestrians walking at strategic points within Winchester city centre, a survey was carried out by Hampshire County Council on the 6th September 2002 and the 4th October 2002 at 3 different strategic locations as shown in Figure 2. Location 1 is at the library (20 Jewry Street); location 2 is at the start of the western entrance to the precinct near Dixons (53 – 54 High Street) with location 3 at the start of the precinct at the eastern entrance near Pizza Hut (8 High Street). These figures were compared with an earlier survey carried out in 2000. The data collected was aggregated to give the average number of pedestrians per hour passing three strategic points. No data after 2002 was available.

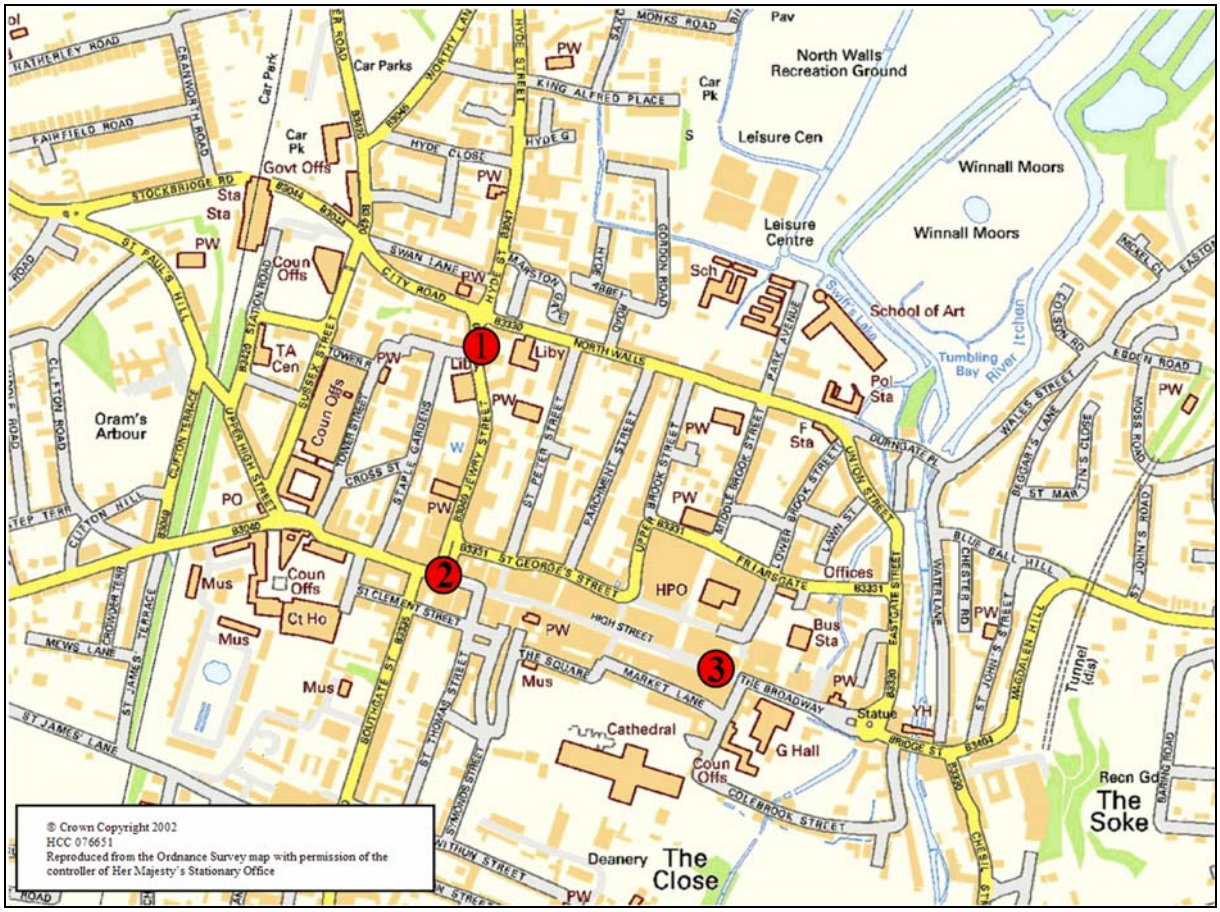


Figure 2: The three locations for the pedestrian survey within Winchester

Tran8a: **Average vehicle occupancy** - this indicator doubled as 'METEOR core indicator 28'. Occupancy rates for cars travelling within Winchester were monitored as part of the Winchester

Movement and Access Plan, with the survey taking place on July 15th 2003. Two sites were used: St. Cross Road (B3335) and Chesil Street (B3330). Data was collected for each hour from 07:00 hrs to 19:00 hrs, in order to determine variation in occupancy according to the time of day. No corresponding data for 2004 and 2005 was available.

Tran9a: **Daily parking flows (including Park and Ride (P&R))** - ticket sales and revenue generated were analysed for the seven most popular (in terms of ticket sales) city centre car parks. These were The Brooks, Middle Brook Street, Tower Street, Friarsgate, Jewry Street, St Peters and Chesil Multi-storey. These were compared with data from the two P&R car parks to see whether there had been any change in yearly totals since the start of the project.

Tran10a: **Accuracy of timekeeping of bus routes X1, X5 and P&R** - this indicator doubled as 'METEOR core indicator 18'. Stagecoach recorded the number of "lost miles", which included external reasons (such as weather, diversion, accident, incident/delay and other) and internal reasons (such as no driver, no vehicle, breakdown, congestion or other). The figures also included buses that ran early (more than 1 minute early) or late (more than 5 minutes late) for the whole of the bus fleet in Winchester for 2002/3, 2003/4 and 2004/5. (The data were not available on a route by route basis).

Tran11a: **Quality of the bus service** - this indicator doubled as 'METEOR core indicator 19'. The quality of the bus service was assessed through a bus passenger questionnaire as part of the data collection requirements of Measures 7 (Improving bus service quality and information), targeting bus users on Routes 1, 5 and P&R. The first (interim) survey was carried out in June 2004 on X1, X5 and P&R with a subsequent (final) survey carried out in April and May 2005. This enabled a direct comparison of perceived bus quality before and after the implementation of a series of bus service improvement measures to be obtained. As part of this questionnaire, respondents were asked questions regarding their perception of bus service quality across a range of factors.

Tran12b: **Average vehicle speeds in peak and off-peak in the city centre** - this indicator doubled as 'METEOR core indicators 23-24'. Link specific travel speeds around Winchester city centre were recorded over a two-day period (20th – 21st July 2004) using two floating cars. Figure 3 shows the links on which journey speeds were measured.

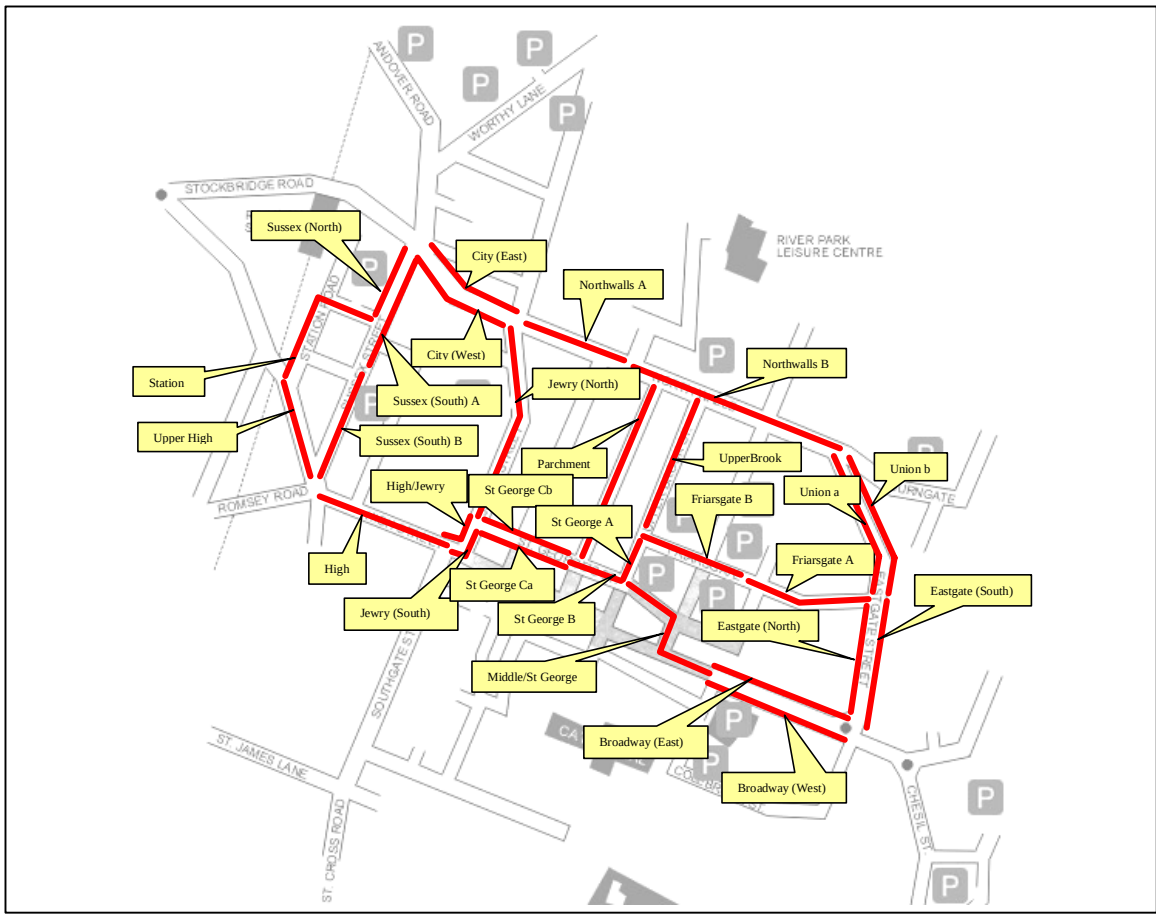


Figure 3: City centre links on which journey speeds were measured

Tran13a: **Total number of goods vehicles within Winchester** - this indicator doubled as 'METEOR core indicator 25'. Manual classified HGV counts were undertaken on the eight major radial routes entering Winchester. The counts were undertaken at eight sites in July 2002 and two sites in July 2003. No data for 2004 was available, but due to the re-design of Measure 9.2, this indicator became less important.

Data for indicators Tran1a, Tran5a and Tran6b were obtained from the two Winchester Travel Questionnaire surveys whose details are shown in Table 2.

Table 2: Details of the Winchester Travel questionnaires

	Name of survey	Date of survey	Sample size	Purpose
1	Winchester Travel Baseline	July/August 2003	4495	Establish a baseline of data before implementation of measures
2	Winchester Travel Final	July/August 2005	1771	Assess how the MIRACLES measures have altered the baseline of data

C5: Achievement of quantifiable targets:

- Reduction in arterial traffic flows of 1.4% from 2002 to 2004;
- Cycle parking increased by 46% from 2002 to 2005;
- Cycle arterial flows reduced by 12% from 2002 to 2004;
- Increase in bus passenger satisfaction rating of 4% from 2003 to 2005; and
- Pedestrian flows at three strategic city centre locations increased by 11% from 2000 to 2002.

C6: Report on results:

Tran1a: Figure 4 shows the modal split for travelling to work in Winchester for the two questionnaire surveys (Baseline and Final). These figures include Winchester residents and non-residents. There were significant differences between the two sets of data (heterogeneity χ^2 = 34.17 and $\chi^2_{(0.01)}$ (10df) = 23.2). Respondents in the Final survey (i.e. 'after' respondents were less likely to state that they travelled to work by walking or a by a combination of car and train, and more likely to travel by train, bicycle, or motorbike.

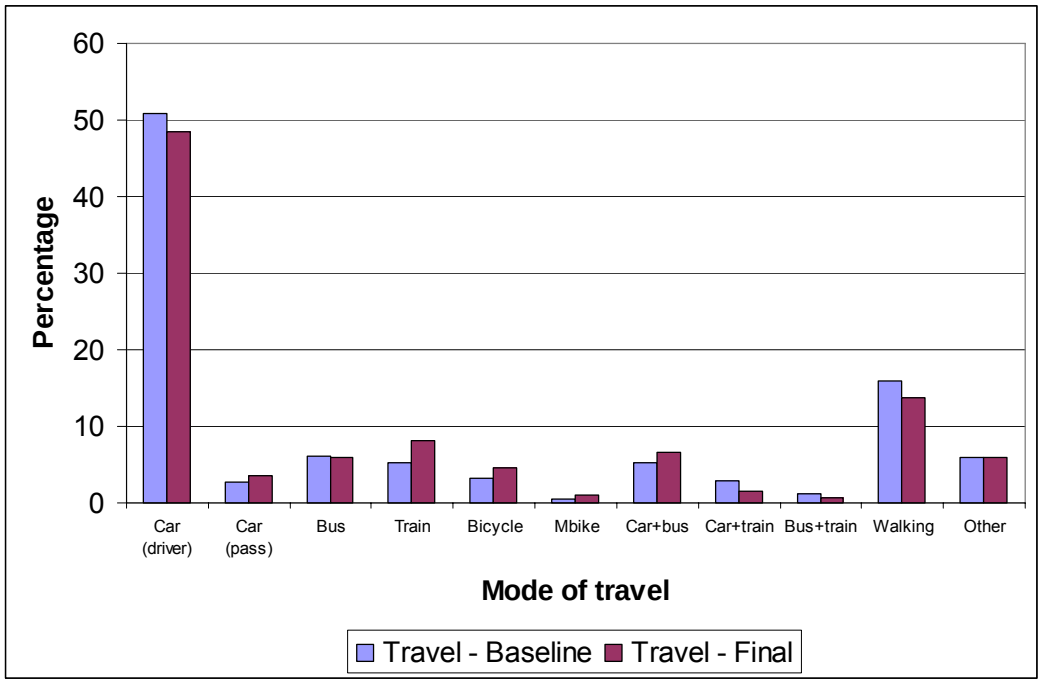


Figure 4: Modal split travelling to work (residents and non-residents)

Figure 5 shows similar results to Figure 4 except it represents Winchester residents only. There were significant differences between the two sets of data (heterogeneity χ^2 = 44.87 and $\chi^2_{(0.01)}$ (8df) = 20.1). Respondents in the Final survey were less likely to travel to work in Winchester by car or a combination of car and train, and more likely to walk or go by bicycle.

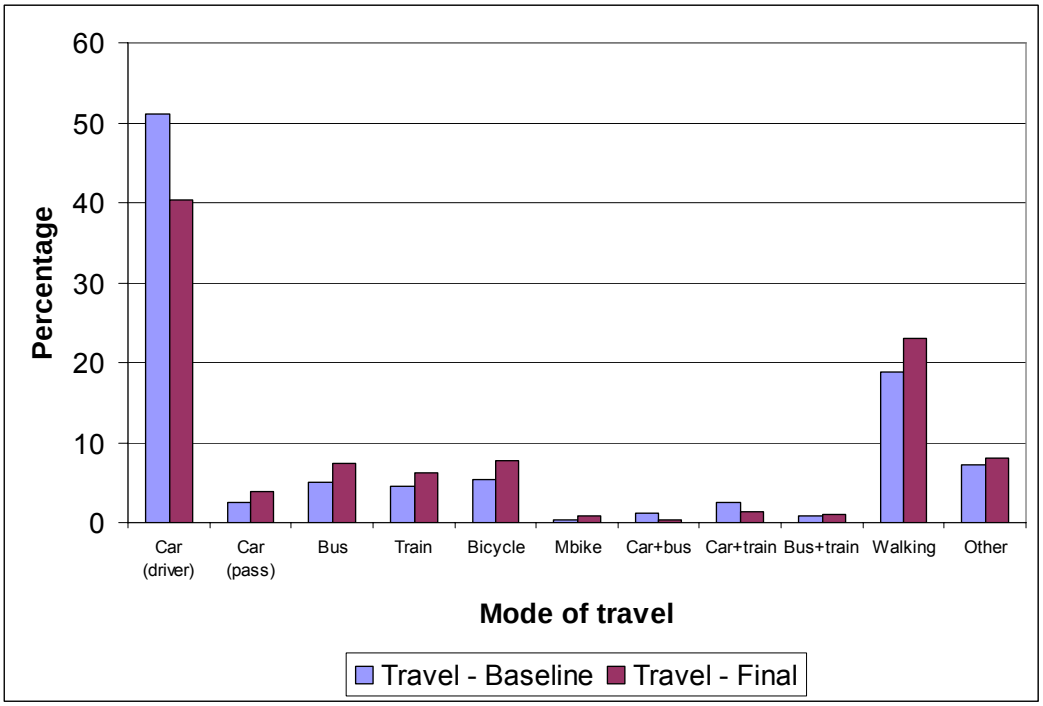


Figure 5: Modal split travelling to work (residents only)

The modal split results for Winchester residents were encouraging. There was a statistically significant reduction of the number of people travelling to work by car (as driver). However, this reduction was partly biased because the average journey length made by car in the 'after' survey was significantly shorter than in the 'before' survey. The Local Transport Plan for Winchester reported that 40% of residents walked to walk. The figure in the survey is much lower and may be due to the higher proportion of car drivers represented in the sample.

Tran3a: The data, collected for weekdays only (i.e. Monday–Friday), was aggregated to derive the average number of vehicles passing over the detectors within 12-hour time periods. Data was collected from 2002 to 2004 to see whether any changes were part of natural background changes in traffic levels. Figure 6 shows the total flow (inbound and outbound) from the eight sites for 2002, 2003 and 2004.

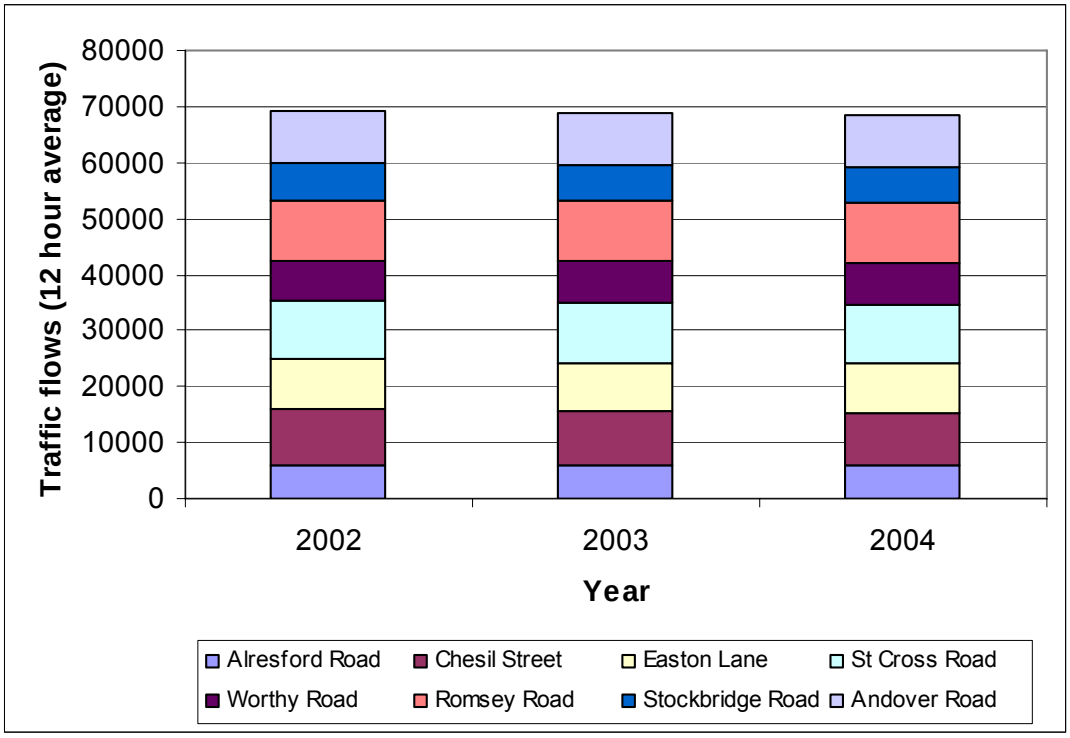


Figure 6: Total arterial flows from eight sites for 2002, 2003 and 2004

Total flows for the eight arterial roads decreased slightly by 1.4% from 2002 to 2004. There was a significant decrease (at the 95% Confidence Interval using a matched t-test) to the outbound flow on Chesil Street (reduced by 16%). This was perhaps partly due to the fact that this arterial road was on the P&R route, which saw a 34% increase in ticket sales since the start of MIRACLES because of the extension of the P&R St Catherine's car park. There was also a significant increase (11%) to the inbound flow on Worthy Road, although it was considered this was unlikely to be due to MIRACLES. Overall the reduction in total flow of 1.4% was small and not significant.

Tran3b: The results In Figures 7-11 show the averaged measured journey speeds of vehicles in five-minute periods (along with their error range) on links 1- 5 for 2004 and 2005 for the time period 07:30 – 09:15.

Link 1- Romsey Road: Figure 7 shows that average journey speeds for the same time interval from day to day on link 1 remained similar, although the average speed reduced slightly from 15.4 kph in 2004 to 14.8 kph in 2005.

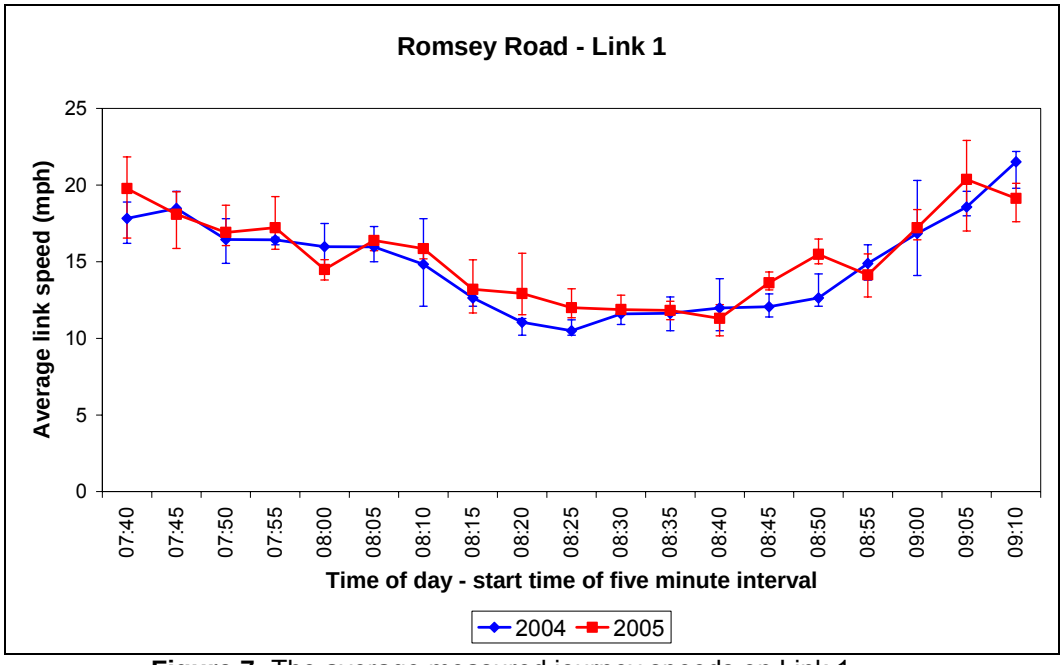


Figure 7: The average measured journey speeds on Link 1

Link 2- Badger Farm Road:. Figure 8 shows that congestion affected the journey speeds for 2004 on link 2 between 08:20 and 08:50. As a result of this, there was an overall increase in journey speeds from 21.4 kph in 2004 to 24.9 kph in 2005.

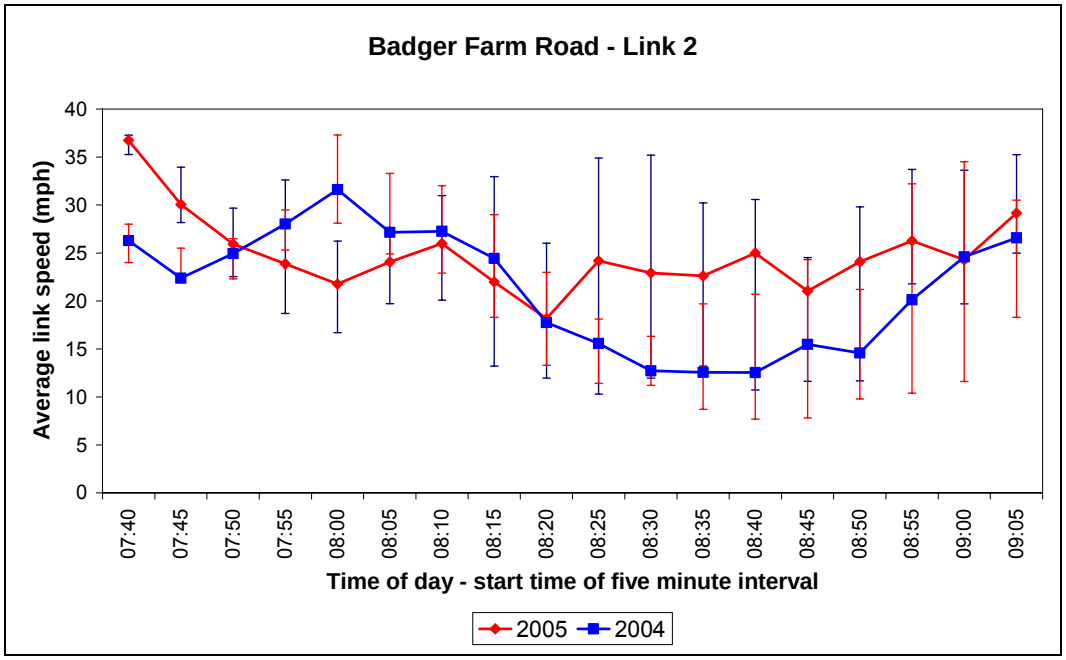


Figure 8: The average measured journey speeds on Link 2

Link 3 – St Cross Road: Journey speeds on link 3 for 2004 and 2005 remained similar (13 kph in 2004 and 13.8 kph in 2005) with the exception of the period 08:50 – 09:10 where speeds were much quicker to recover in 2004 (see Figure 9).

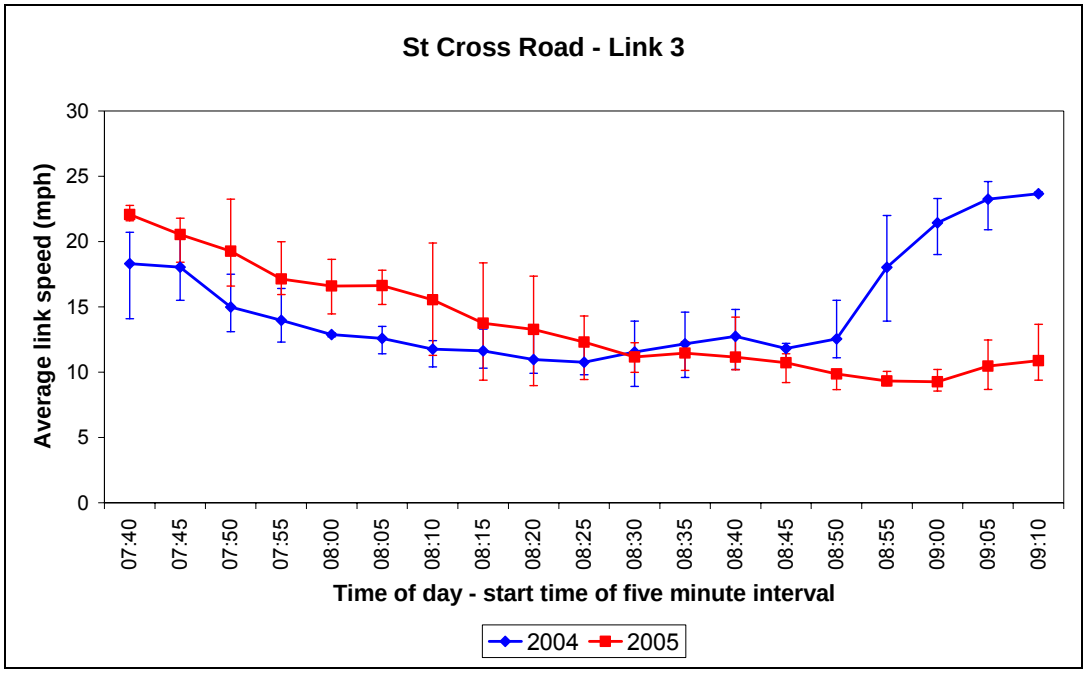


Figure 9: The average measured journey speeds on Link 3

Link 4 – Bar End Road: Journey speeds on link 4 for 2005 were noticeably higher than for 2004 throughout the morning peak period (average of 14.8 kph for 2004 and 17.6 kph for 2005) (see Figure 10). This was perhaps partly because this link was on the P&R route that saw an increase in the use of St Catherine's car park of about 70% from 2003/4 to 2004/5 following an increase of 420 spaces in its capacity in February 2004.

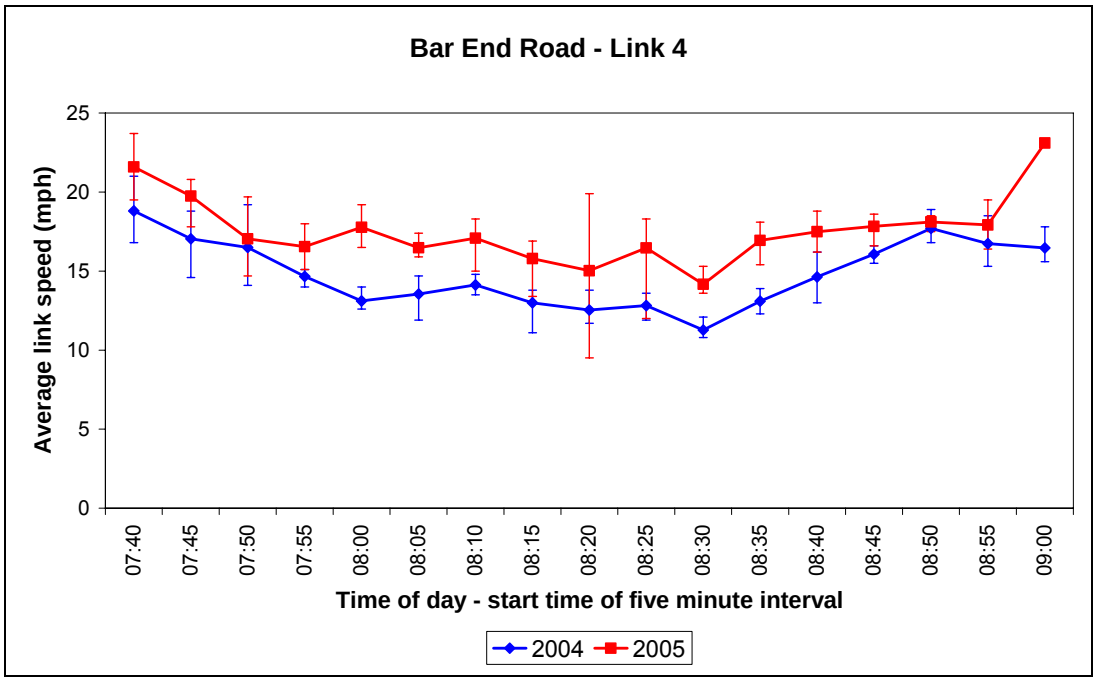


Figure 10: The average measured journey speeds on Link 4

Link 5 – Easton Lane: Journey speeds for link 5 reduced slightly from an average of 24.5 kph in 2004 to 23.8 kph in 2005 (see Figure 11).

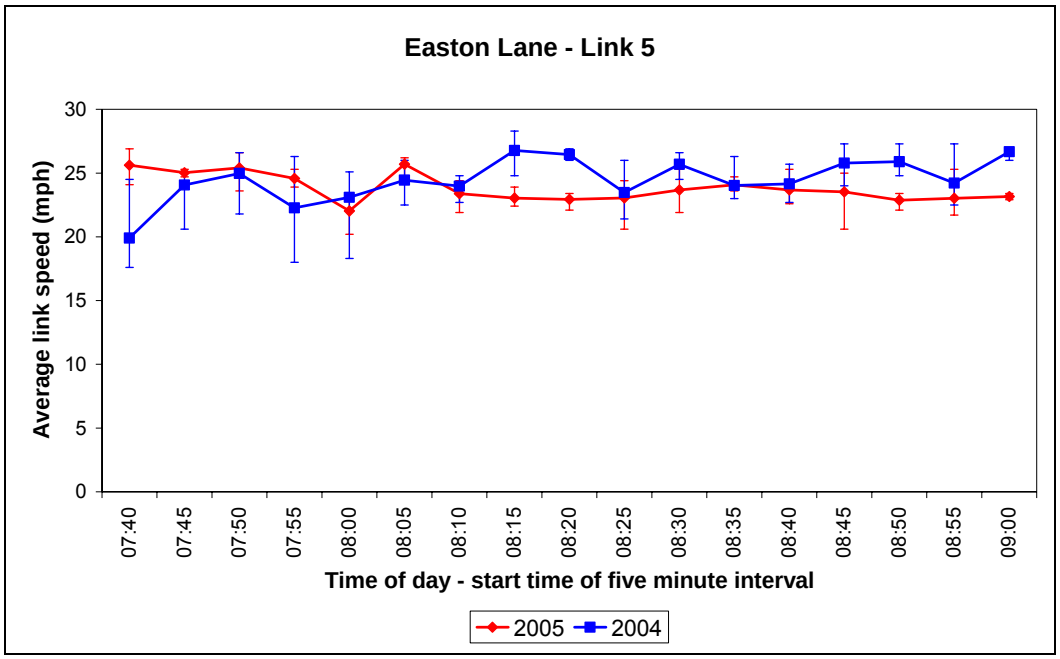


Figure 11 The average measured journey speeds on Link 5

The results showed that the journey speeds on links 1 and 5 did not change significantly, changed (probably because of abnormal congestion) on links 2 and 3, and increased on link 4, which was considered partly attributable to the increase in capacity of the P&R St Catherine's car park and subsequent use of the service. In addition, random variations in journey speeds probably accounted for many of the differences.

Tran4a: Cycle count data measuring the cycle flows on Winchester's network is displayed in Figure 12 (cyclists in Winchester by year 2002 - 2004). The surveys were undertaken in July for each year and over a 24-hour 5-day mean period and were an aggregation of inbound and outbound traffic.

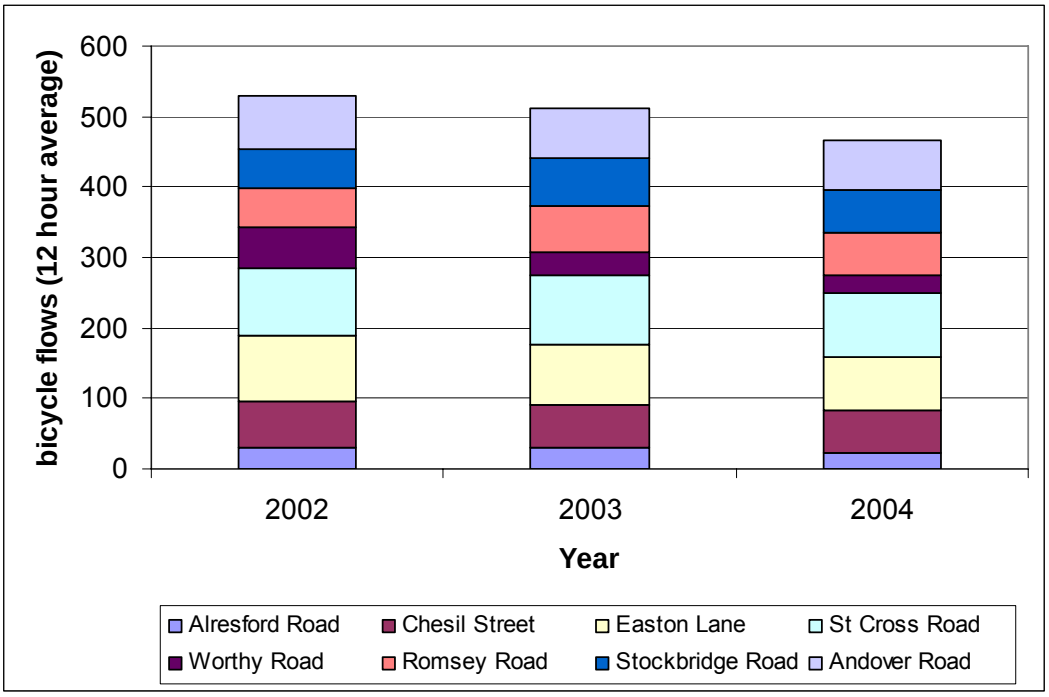


Figure 12: Total bicycle flows on eight strategic arterial roads

Overall, there was a 12% decrease in the 12-hour average cycling flows on the arterial routes from 2002 to 2004 (from 529 to 467). The reduction was greatest for inbound flows (-16%) compared to outbound flows (-9%). The largest significant reduction was on Worthy Road, where cycling flows decreased by 58%. This may be a result of the corresponding increase in traffic flows on this route of 6%. As the maximum number of bicycles parked in the city centre increased from 2002 to 2005 (see Tran 4b), it was considered that the MIRACLES initiative Bikeabout (see Measure 8.2) may have helped to increase cycle flows specifically within the city centre area rather than on the arterial roads.

Tran4b: There was an increase in the peak number of bicycles parked in Winchester in a given month over the past four years, where peak numbers recorded are shown in Figure 13. These results showed a 46% growth from 2002 to 2005. This was partly attributable to the presence of 50 extra Bikeabout bicycles in the city centre area.

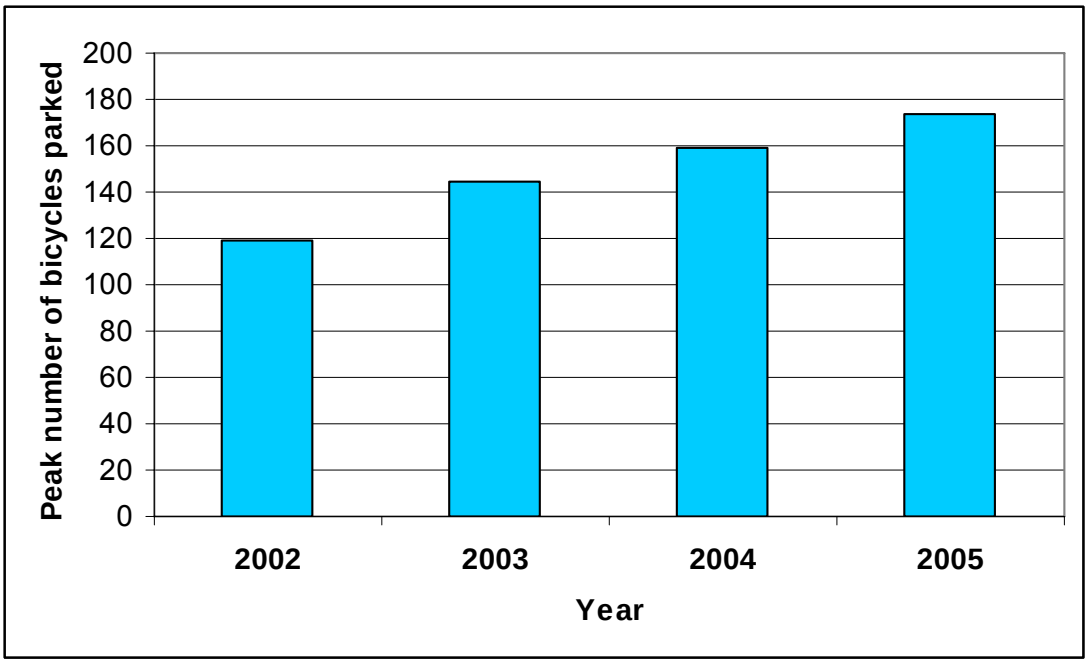


Figure 13: Peak Number of Bicycles Parked in Winchester (2002-2005)

Tran5a: Figure 14 shows the number of cars in the households of respondents in the questionnaire surveys. Note that the 'two cars' and 'three cars or more' were combined. These results were also compared to 2001 census statistics for Winchester and it was found that there was a significant increase in the number of households owning at least two cars. The average number of cars per household was 1.29 in 2003 and 1.44 in 2005 (NB: this assumed that all respondents stating '3 or more cars' only had 3 cars in their household).

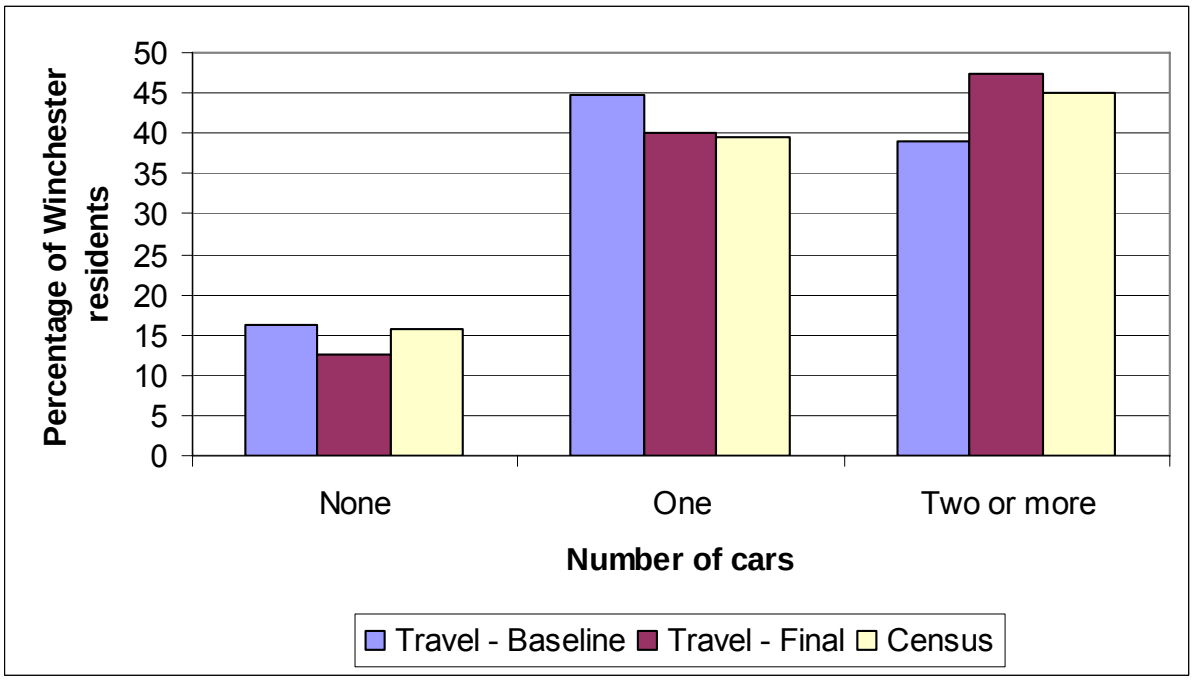


Figure 14: Number of cars per household in the Travel surveys and 2001 National Census

Tran5b: Figure 15 shows the relative frequency distribution of the 2004 and 2005 datasets. The average age of the Winchester fleet increased slightly from 5.42 to 5.58 years from 2004 to 2005. There were also some small observable differences in the two distributions although a Wilcoxian Signed Ranks test indicated the difference was not significant.

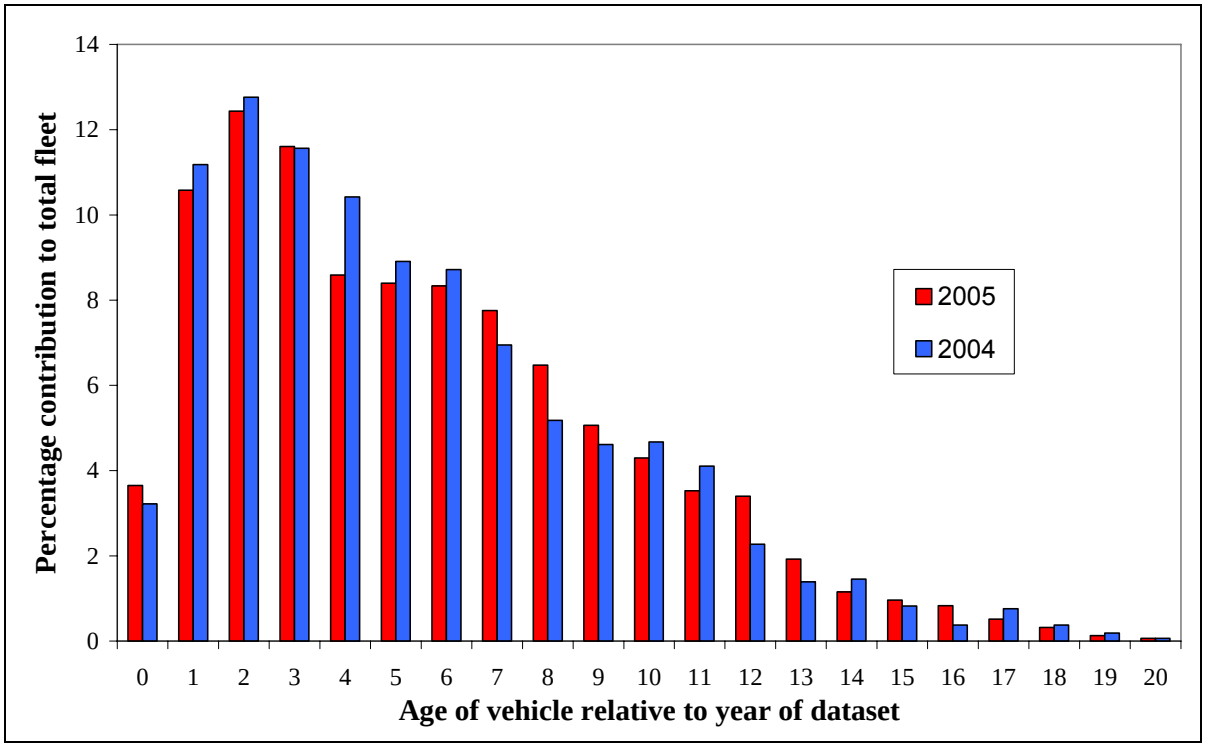


Figure 15: Relative age of car fleet entering Winchester in 2004 and 2005

There was a small increase in the percentage of vehicles less than 1 year old in 2005 compared to 2004; this was most likely due to the 2005 survey being undertaken slightly later in the year (approximately two months later). Although a completely fair analysis would account for variations in the purchasing habits to more regional or national trends, it was not thought MIRACLES has significantly altered vehicle-purchasing habits at a citywide level.

Tran6a: Table 3 is a summary of all the casualties for 2002 for the Hampshire County Council administrative area and Winchester district. More detailed information is available from the Police accident database that can split each of the casualty groups into age and districts. In general, it was considered unlikely that MIRACLES had any effect on the number of casualties.

Table 3: Casualties by class for 2002 and 2003

Class	Number of casualties (Hampshire CC area)		Number of casualties (Winchester)	
	2002	2003	2002	2003
Drivers	2920	2686	321 (11%)	289 (10.8%)
Children	608	559	48 (7.9%)	46 (8.2%)
Pedestrians	514	442	59 (11.5%)	46 (10.4%)
Pedal cyclists	411	438	23 (5.6%)	27 (6.2%)
Powered two wheelers	740	776	66 (8.9%)	82 (10.6%)

Tran6b: A chart showing the level of response to each option for people's personal perception of road safety when travelling by different modes of transport is given in Figure 16. It can be seen that the

majority of people felt safe from road traffic accidents by all modes except for cycling where there was a large spread of responses. There was a statistically significant increase in the public's perception of road safety by car. However, further investigation found that there was no statistical difference in this proportion between those respondents who were aware of MIRACLES and those who were unaware. The results therefore implied that the MIRACLES measures did not influence people's perception of road safety using the car or any other mode of travel.

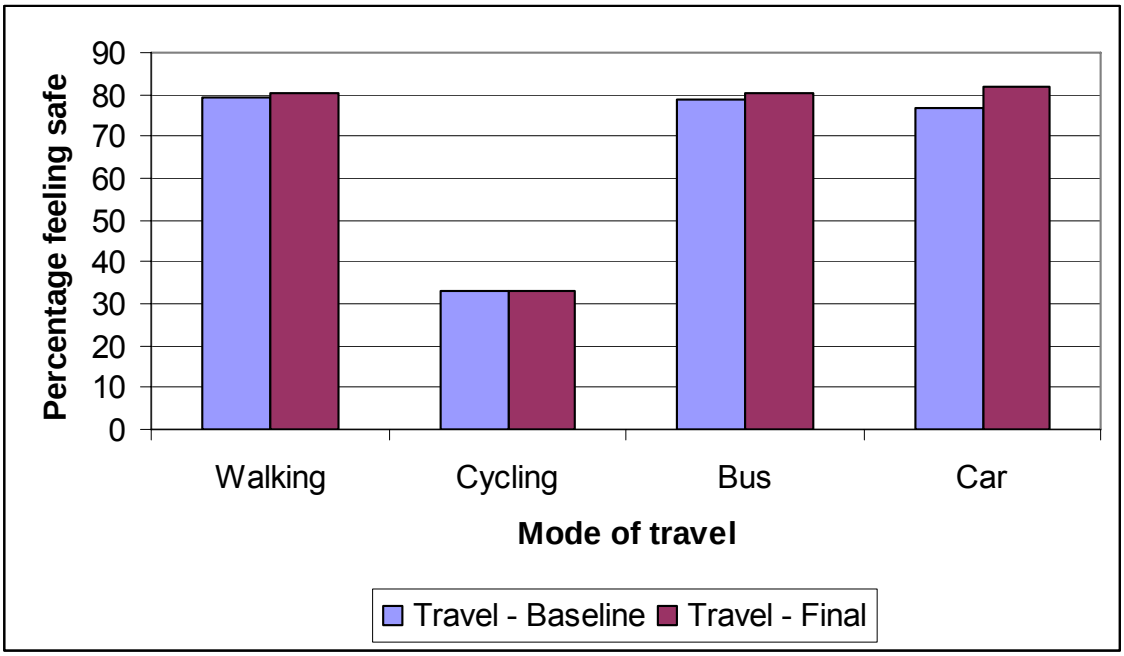


Figure 16: Public perceptions of road safety in Winchester when travelling by various modes

Tran7a: Table 3 below shows the average pedestrian flows per hour at the three locations in the city centre. Overall, the total pedestrian flows increased by 11% from 2000 to 2002.

Table 3: Pedestrian flows at strategic city centre locations

	Library	Dixons	Pizza-hut
2000	597	1427	1940
2002	726	2208	1462

Figure 17 shows a graph of the pedestrian flows throughout the day of the survey at the three locations for 2000 and 2002. Given the extremely small dataset, it was considered that the changes were due to random variations in pedestrian flow data rather than as a direct result of any MIRACLES measure.

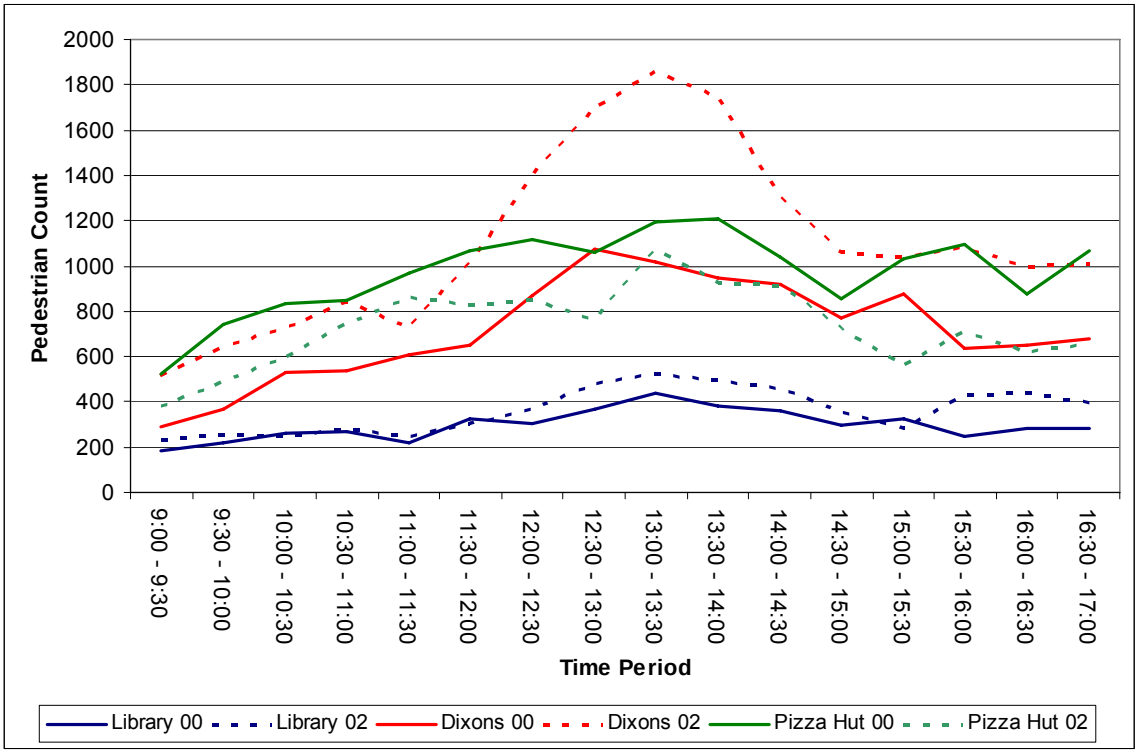


Figure 17: Pedestrian flows at the three locations in 2000 and 2002

Tran8a: Data from the July 2003 survey for St. Cross Road (B3335) and Chesil Street (B3330) are shown in Tables 4 and 5 respectively. It can be seen that average occupancy across the whole day for both sites was similar for St Cross Road and Chesil Street at 1.26 and 1.24. This is shown graphically in Figure 18. No data for 2004 and 2005 was available.

Table 4: Vehicle occupancy (B3335 - St Cross Road, Winchester)

Date: Tuesday July 15, 2003								
	occupants/car							
Time	1	2	3	4	5	6+	Total	persons per car
7.00-8.00	669	114	4	1	0	6	794	1.20
8.00-9.00	1085	175	9	3	0	5	1277	1.18
9.00-10.00	679	115	3	1	1	4	803	1.18
10.00-11.00	343	121	9	5	0	4	482	1.36
11.00-12.00	339	96	3	0	0	5	443	1.29
12.00-13.00	340	63	1	0	0	2	406	1.18
13.00-14.00	296	89	16	3	1	3	408	1.37
14.00-15.00	324	78	8	2	2	6	420	1.33
15.00-16.00	290	103	13	5	1	5	417	1.41
16.00-17.00	295	99	9	7	2	5	417	1.41
17.00-18.00	354	75	4	4	0	1	438	1.23
18.00-19.00	349	107	11	5	1	1	474	1.32
Total	5363	1235	90	36	8	47	6779	1.26
Total occupants	5363	2470	270	144	40	282	8569	

Table 5: Vehicle occupancy (B3330 - Chesil Street, Winchester).

Date: Tuesday July 15, 2003								
	occupants/car							
Time	1	2	3	4	5	6+	Total	persons per car
7.00-8.00	355	76	10	1	0	1	443	1.23
8.00-9.00	440	107	10	5	0	2	564	1.27
9.00-10.00	440	102	12	6	0	0	560	1.26
10.00-11.00	312	67	5	1	0	1	386	1.22
11.00-12.00	323	34	10	1	0	0	368	1.15
12.00-13.00	212	91	6	3	0	0	312	1.36
13.00-14.00	247	62	17	7	0	0	333	1.35
14.00-15.00	233	73	11	2	0	2	321	1.35
15.00-16.00	275	17	4	0	0	0	296	1.08
16.00-17.00	232	48	6	3	0	0	289	1.24
17.00-18.00	260	27	4	1	0	0	292	1.13
18.00-19.00	211	26	3	0	0	0	240	1.13
Total	3540	730	98	30	0	6	4404	1.24
Total occupants	3540	1460	294	120	0	36*	5414	

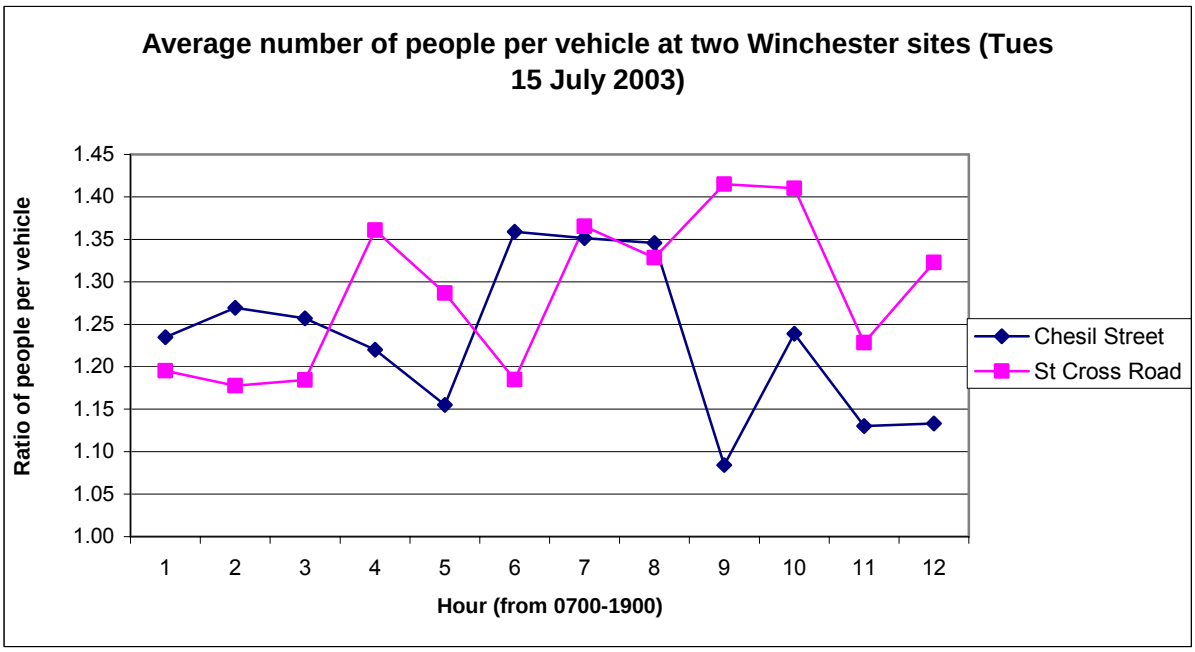


Figure 18: Average vehicle occupancy for Chesil Street and St. Cross Road, Winchester

Tran9a: The seven most popular city centre car parks in terms of ticket sales were The Brooks, Middle Brook Street, Tower Street, Friarsgate, Jewry Street, St Peters and Chesil Multi-storey. Ticket sales generated at these seven car parks, as well as the two P&R car parks, are shown in Table 6. It can be seen that all the city centre car parks showed a decrease in ticket sales over the lifetime of MIRACLES (an average of about 16%). Between 2001/2 and 2004/5, there was an overall decrease in the numbers parking in the city centre (about 235,000). In contrast, there was an increase of about 37,000 people parking at the P&R car parks. This was attributable to the St Catherine's P&R site extension in February 2004, which increased its capacity by 420 spaces (see Measure 7). Some of the decrease in

ticket sales could have been due to drivers parking, on average, for longer periods of time resulting in the car park occupancy remaining high.

Table 6: Ticket sales for Winchester city centre and P&R car parks

	2001/2	2002/3	2003/4	2004/5	Percentage change
The Brooks	363,605	341,906	335,696	331,574	-8.8
Middle Brook St	315,849	287,086	236,733	236,128	-25.2
Tower Street	237,929	232,322	198,418	196,598	-17.4
Friarsgate	214,614	192,929	193,407	183,417	-14.5
Jewry Street	138,524	140,327	143,633	121,114	-12.6
St Peter's	119,515	113,787	115,510	94,064	-21.3
Chesil MSCP	91,693	99,321	96,644	83,353	-9.1
Barfields P&R	54,471	55,065	57,425	53,859	-1.1
St Catherine's P&R	53,593	47,525	53,795	91,141	70.1
Total - City centre car parks	1,481,729	1,407,678	1,320,041	1,246,248	-15.9
Total – P&R car parks	108,064	102,590	111,220	145,000	34.2

An alternative method of presenting the results is illustrated in Figure 19, where the total annual percentage changes in ticket sales are presented.

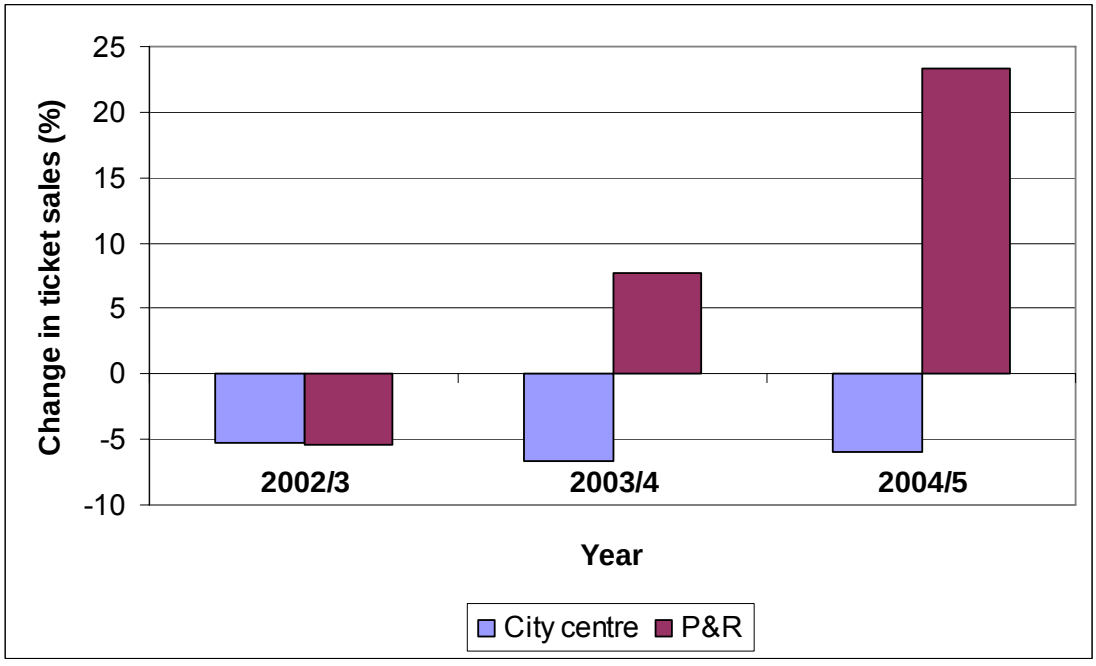


Figure 19: Percentage changes in ticket sales for the city centre car parks and the P&R car parks

Table 7 shows the equivalent results for the seven city centre car parks and two P&R sites in terms of revenue generated. There was an average revenue rise across the city centre car parks of about 11%, which can be explained by the increase in car park charges during the project duration. Charges at the city centre car parks were increased on 1st June 2002 by about 20% and on 4th April 2005 by about 25% (although all-day parking at Middle Brook Street rose by 50% from £10 to £15). The St Catherine's P&R site saw a 48% increase in revenue, largely due to the increase in parking capacity. The Barfields P&R car park remained unchanged in the number of spaces it offered and saw a reduction in revenue of 37%. This was due to the daily charge of £1.50 per vehicle remaining unaltered

during the lifetime of MIRACLES as well as the introduction of cheaper smart cards (£1.20) in January 2003. In April 2003, 40% of P&R users bought their ticket via the smart card; this increased to about 60% by March 2005.

Table 7: Revenue generated from Winchester city centre and P&R car parks

	2001/2	2002/3	2003/4	2004/5	Percentage change
The Brooks	346,032.70	381,833.70	427,686.45	439,551.95	27.0
Middle Brook St	266,490.50	280,301.35	253,789.05	255,835.70	-4.0
Tower Street	504,983.05	557,018.55	561,824.35	549,239.15	8.8
Friarsgate	244,654.65	248,079.20	256,403.25	247,577.05	1.2
Jewry Street	120,071.55	137,492.65	143,928.85	126,275.15	5.2
St Peter's	187,254.45	196,555.30	203,690.30	182,294.35	-2.6
Chesil MSCP	154,342.30	185,221.85	218,289.80	215,795.00	39.8
Barfields P&R	57,736.10	55,768.95	46,707.20	36,413.40	-36.9
St Catherine's P&R	58,506.75	57,350.75	54,449.45	86,341.50	47.6
Total - City centre	1,823,829.20	1,986,502.60	2,065,612.05	2,016,568.35	10.6
Total – P&R	116,242.85	113,119.70	101,156.65	122,754.90	5.6

An alternative method of presenting the results is illustrated in Figure 20, which presents the total annual percentage changes in ticket revenue.

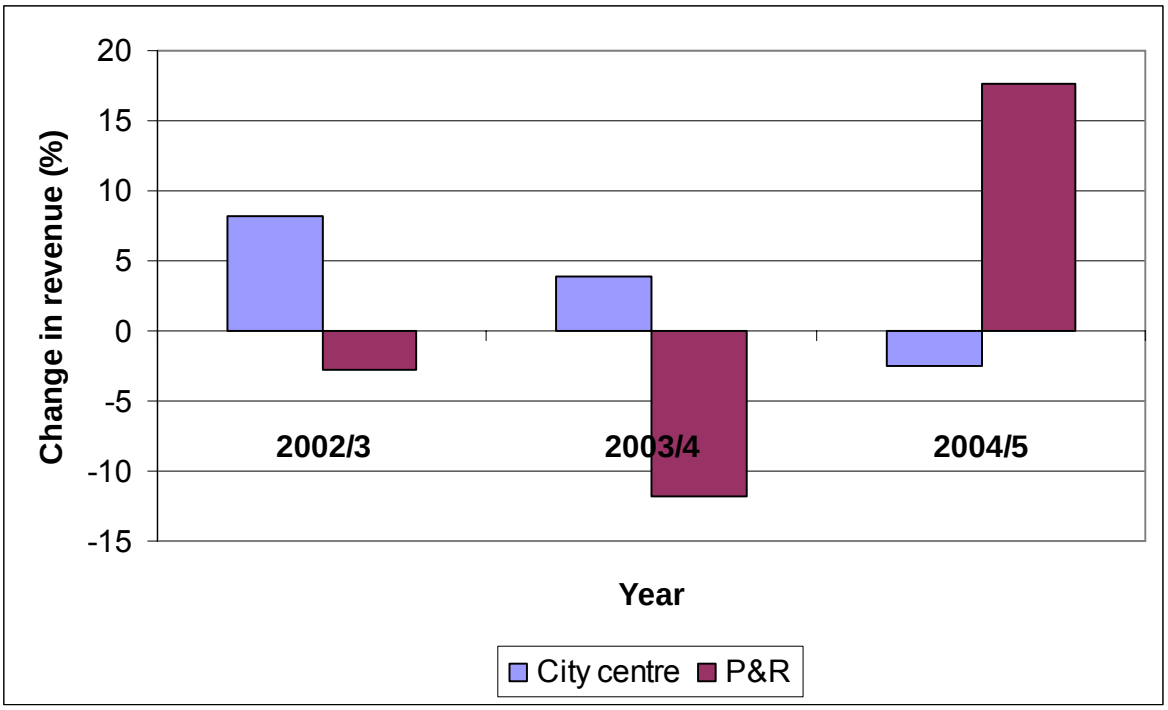


Figure 20: Percentage changes in revenue for the city centre car parks and the P&R car parks

The results show that there was some success in deterring drivers from parking in the city centre (the number of tickets sold reduced by 16%) and instead switching to use one of the P&R car parks (the number of tickets sold increased by 34%). Parking charges can be an effective tool in encouraging/deterring parking behaviour although political agreement is necessary. While a reasonably large price differential between the P&R and the city centre car parks remains, more drivers would be

parks (which are expected to be at capacity by the end of 2005), the parking charging policy will not have the desired effect (see Measure 6.2 for more details of WCC parking policy to deter long stay city centre parking).

Tran10a: Of all miles lost within the bus fleet, the vast majority were for internal reasons (99.2%, 93.8% and 94.0% for 2002/3, 2003/4 and 2004/5 respectively). This was mainly due to congestion, breakdowns or no driver being available. Table 8 shows that the total number of failures (and their percentage) reduced from 2030 in 2002/3 to 705 in 2004/5.

Table 8: Numbers of buses in the Winchester fleet running early or late

	Scheduled trips	Number of early running	Number of late running	Total number of failures
2002/3	213956	127	1612	2030 (0.95%)
2003/4	221866	103	408	566 (0.26%)
2004/5	204910	36	512	705 (0.34%)

Figure 21 shows the number of late running buses each week during 2002 - 2005. The number of late running buses in 2002/3 was particularly high between weeks 28 and 32 (July/August 2002) due to congested conditions as a result of extensive road works in the city centre area. However, even if this data was removed from the analysis, the percentage of failures (buses not running to schedule defined to be more than 1 minute early or 5 minutes late) is 0.68%, still noticeably higher than the two subsequent years. The data provided was not detailed enough to distinguish between the particular bus routes X1, X5, X6 and X7, as the data covered the whole Winchester bus fleet. However, it does highlight the problem of how congestion in the city centre can adversely affect the punctuality and frequency of the bus service, minimising the positive effects of the improvements made.

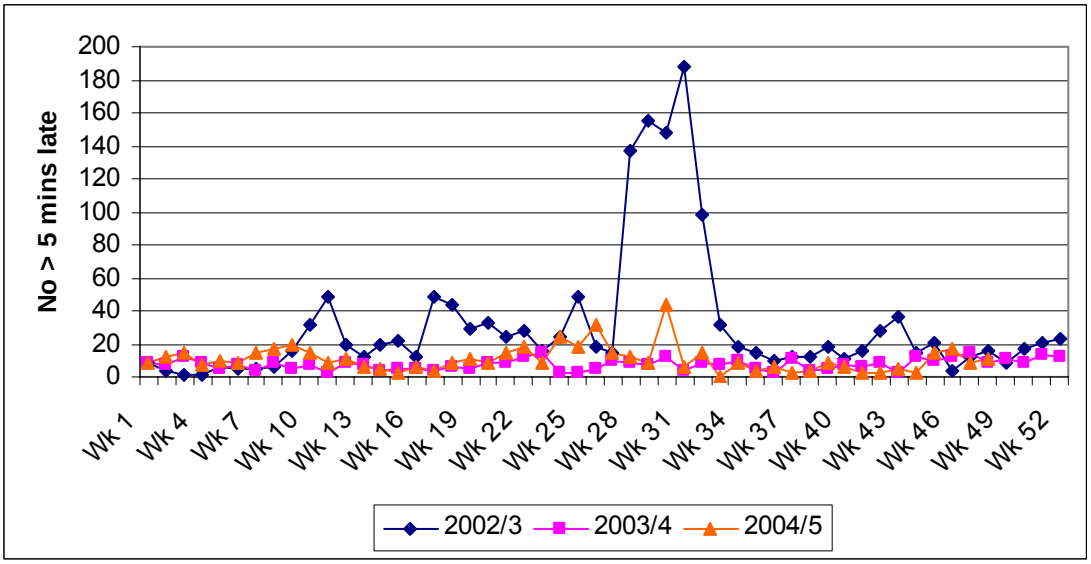


Figure 21: The number of buses in the Winchester fleet running late

Tran11a: Table 9 shows the results of how passengers rated each bus service in the Interim survey (June 2004) and the Final survey (April/May 2005). No 'before' survey was carried out.

Table 9; Percentage of passengers rating the bus service good

	X1	X5	P&R
Interim	75%	81%	92%
Final	78%	87%	92%

Table 9 shows that overall passenger (satisfaction) rating of very good or quite good increased from the interim survey in 2003 to the final survey in 2005 by 3% for X1, by 6% for X5 and remained unchanged for P&R (overall an increase of 4% for all routes from 83% to 87%). The results showed that the implemented bus measures helped to improve the service (see Measure 7).

Tran12b: Table 10 illustrates the journey speeds for each link within the city centre area from 7am – 10am and 3pm – 6pm. Those surveys were not repeated in 2005 and so no 'after' data was available.

Table 10: Journey speeds (kph) on links within the city centre area in July 2004

Link	7am	8am	9am	10am	3pm	4pm	5pm	6pm	Average
Sussex (North)	11.9	3.8	3.6	9.9	3.7	2.1	2.8	5.4	5.4
Jewry (South)	11.9	5.6	9.8	8.7	3.1	7.0	3.5	9.2	7.3
City (West)	14.2	4.8	9.8	5.9	3.8	10.1	5.3	8.2	7.8
Upperbrook	17.5	16.8	17.0	11.8	15.4	17.0	17.9	17.5	16.8
Parchment	20.0	20.4	18.7	17.2	15.7	16.6	10.7	18.7	17.2
St George A	29.5	22.2	24.6	16.0	14.9	14.3	14.9	24.0	20.1
City East	27.8	25.4	16.7	15.5	15.2	23.8	19.0	21.9	20.7
St George Ca	34.3	19.8	26.0	25.3	8.5	16.2	15.0	27.9	21.6
St George B	31.1	26.3	18.0	19.1	20.1	20.9	19.1	25.7	22.5
Broadway (East)	31.6	23.3	24.4	23.2	27.5	20.0	27.4	25.5	25.4
Jewry (North)	31.6	26.8	26.6	24.6	26.1	23.5	20.7	30.1	26.8
High Street	28.9	27.9	27.2	26.8	24.9	25.8	26.2	33.1	27.6
St George Cb	36.2	33.2	26.2	22.9	24.2	25.2	22.6	32.4	27.9
Northwalls A	32.7	32.4	27.8	27.7	26.2	30.4	26.1	33.5	29.6
Northwalls B	40.5	33.4	31.0	26.3	30.6	28.2	32.1	31.4	31.7
Eastgate (North)	35.9	31.9	29.5	34.7	34.8	24.6	36.7	32.8	32.6
Upper High	34.1	36.4	31.7	33.3	30.8	29.1	30.3	35.6	32.7
Station	36.3	39.1	32.1	37.5	33.6	28.3	26.1	38.4	33.9
Friarsgate B	44.7	37.1	31.1	30.8	31.5	27.1	32.5	37.5	34.1
Sussex (South A)	36.8	32.6	35.9	34.1	35.9	35.1	35.7	35.9	35.2
Friarsgate A	39.6	35.2	31.3	33.4	35.7	32.0	36.9	39.5	35.4
Sussex (South B)	39.0	37.3	35.9	36.5	35.8	35.6	32.5	37.8	36.8
Eastgate (South)	42.3	38.9	39.9	39.0	37.1	35.7	29.8	39.6	37.8
Union a	41.9	39.6	36.8	35.9	38.5	39.1	40.4	40.0	39.0
Union b	45.2	41.1	45.2	41.6	40.0	41.3	32.1	41.9	41.0

Figure 22 shows the variation in journey speeds for the fastest and slowest three links. The lowest speeds were Sussex (North), City (West) and Jewry (South). Sussex (north) and City (West) are links leading to the City Road/Andover Road signalised junction where queues and delays are common during the peak periods. Jewry (South) also approaches a pelican crossing and a signalised junction on High Street/Southgate Street. These two areas tend to be hotspots for congestion in the city centre. The fastest links (Union Street a, Union Street b and Eastgate (South)) are located on the east side of the city centre which tends to be less congested and where no traffic signals are present. The survey was only carried out in 2004 and so no comparable data was available.

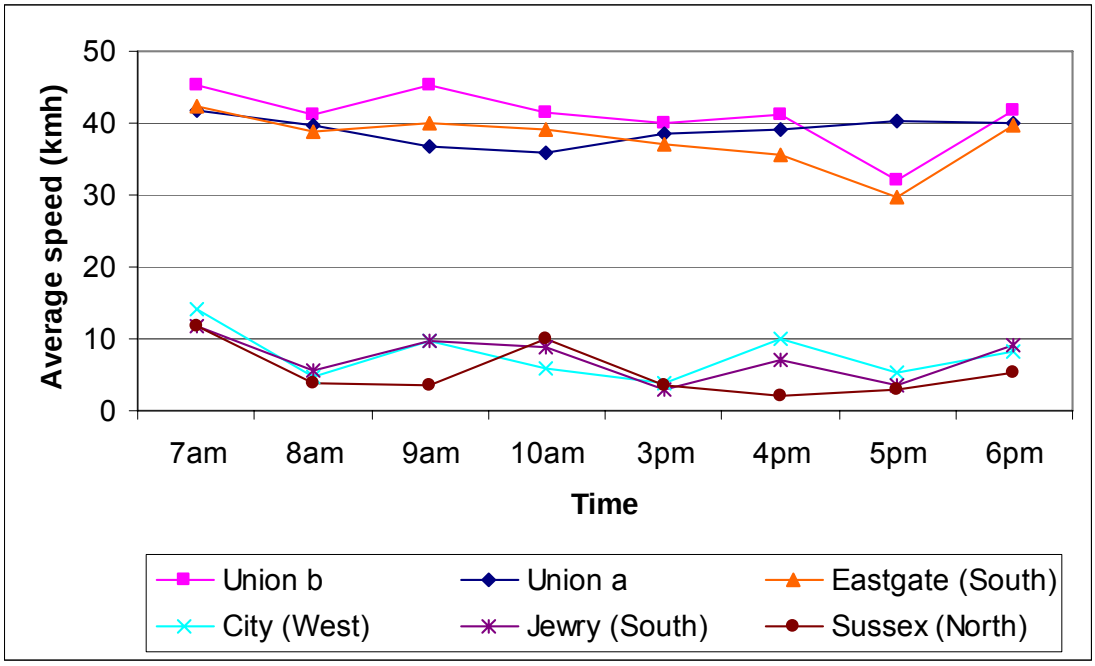


Figure 22: Journey speeds for the three fastest and slowest links in the city centre

Tran13a: The results presented for HGV percentage in 2002 and 2003 (two sites only) in Figure 23 were aggregated values. 'HGV' includes rigid and articulated heavy goods vehicles. It can be seen that Chesil Street (near J10 M3) and Easton Lane (near Winnall Industrial Estate) carried a higher proportion and number of goods vehicles than the other routes. A freight distribution centre for Winchester was not seen to be economically viable and so was not implemented (see Measure 9.2); it was therefore unlikely that HGV flows were affected by any MIRACLES measure.

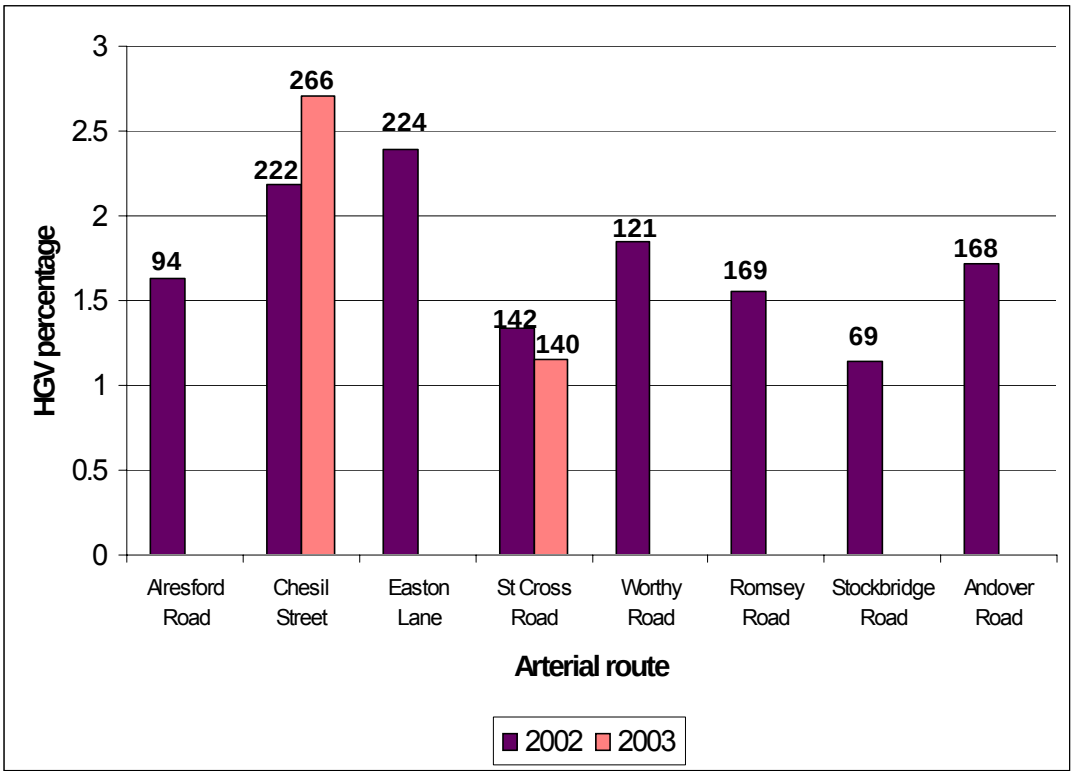


Figure 23: Percentage and numbers of HGV's on arterial routes

Lessons Learned – what do other cities, other actors and the EC have to consider?

C7: Lessons learned:

1. The extension of the St Catherine's P&R car park enabled ticket sales to increase by 34% during the lifetime of MIRACLES. This was associated with a significant decrease of 16% in the outbound traffic flows on Chesil Street (on the P&R route). The associated parking charging policy also helped to encourage the use of more sustainable transport (P&R) and deter city centre parking.

2. Although a limited number of cycle surveys showed that flows on the arterials decreased by 12%, cycle parking saw an increase of 46% during MIRACLES. This implied that the Bikeabout initiative (Measure 8.2) had some success in encouraging more cycle use, specifically within the city centre area.

3. MIRACLES did help to increase the bus passenger satisfaction rating by 4% and significantly improve bus punctuality in the Winchester fleet (see Measure 7).

4. The MIRACLES measures had little effect in reducing overall traffic flows on the arterial roads in Winchester. However, there was an encouraging significant reduction of 10% in the percentage of residents travelling by car (from a stated preference question within the Winchester Travel survey). It is thought that the P&R service may have contributed to this result.

5. Traffic congestion hotspots still exist within the city centre, particularly at traffic signal junctions (e.g. City Road/Andover Road and Jewry Street/High Street). This reduces journey speeds on these links for all vehicles (including buses) as well as producing more emissions. A re-assessment of these junctions may lead to a more optimal design, which could reduce queues and delays.

6. Generally, there was no evidence MIRACLES influenced average age of car fleet or public perception of safety.

7. A lack of data prevented an assessment of whether MIRACLES had affected pedestrian flows, HGV flows, number of road traffic accidents, city centre flows, average vehicle occupancy or average city centre journey speeds. However, if such data had been available, it is anticipated that these parameters would not have been affected by MIRACLES.

8. The results show that although people are generally aware and accept the MIRACLES measures; this does not necessarily translate into a change in travel behaviour. Consequently, impacts on the network are small.

9. Although there is little evidence that MIRACLES had a measurable effect on many of the transport indicators during the lifetime of the project, changes may become apparent over a much longer time frame. Therefore, a longer term evaluation of the measures would be beneficial.

Contact Point

.www.winchestermiracles.org

✉ Andy Wren, Project Manager, Intelligent Transport Created on Systems Group, Environment Department, Monument House, 5 Upper High Street, Winchester, SO23 8UT