Appendix 6

GOYT BRIDGE REVIEW

MEMO

TO: Laura Woodbyrne

FROM: Ian Crook

SUBJECT: Draft High Level Review of Bridge Options

DATE: 14 February 2017

High Level Review of Bridge Options

Site Location and Local Geography

The proposed highway alignment crosses the River Goyt in an approximately north-south direction at approximate scheme chainage 3985m.

The River Goyt is a Main River, with a channel width of approximately 25m and an associated Level 3 Flood zone. The road surface level proposed as part of the Design Freeze 4A alignment is approximately 19m above normal water level, and thus a bridge or viaduct structure will be required to cross the river.

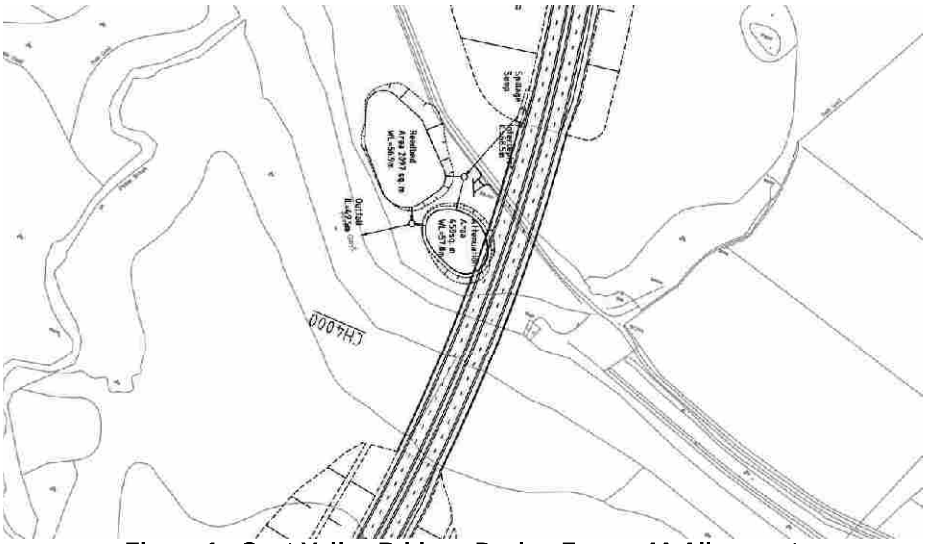
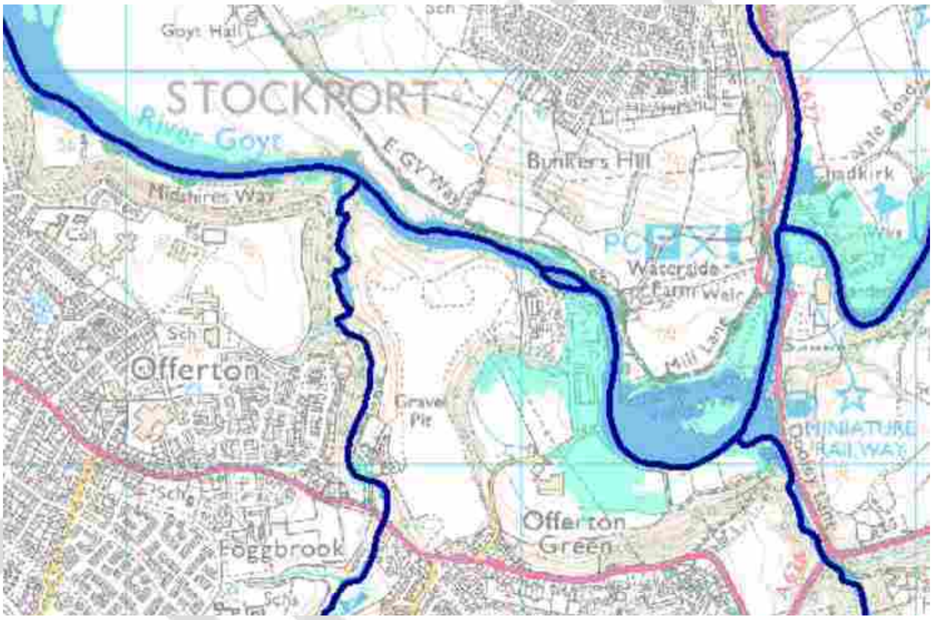


Figure 1 - Goyt Valley Bridge - Design Freeze 4A Alignment

Figure 2 - Aerial Image of Bridge/Viaduct Location



In order to minimise the impact on the river channel and associated flood plain, it assumed at this stage that the proposed highway will be supported on elevated structure over at least the plan area of the flood plain. In order to minimise the overall scale and cost of the structure, it is anticipated that a series of intermediate pier supports will be provided within the flood zone, the number and spacing of which will be driven by the selected structural form.

Structural Forms

Based on the currently proposed alignment, an overall bridge structure length of 200 is anticipated across the River Goyt and associated floodplain.

The table below sets out initial high level options that have been considered, and the subsequent text considers the various issues in more detail:

Table 1:

OPTION	COMMENTARY	ADVANTAGES	DISADVANTAGES
Extended earth embankment with minimised structural span.	This solution would provide an earthworks solution running right up to the river channel, with a single span structure crossing the river with a span of approximately 26m. This solution would considerably reduce the cost of the overall Goyt Valley crossing; however the environmental impact of such a solution would be extensive. Additionally, an embankment running across the floodplain would be wholly unacceptable from a hydrological perspective, with the potential for floodwaters to be retained upstream of the structure, exacerbating any localised flooding. For the above reasons, this solution has been **discounted** and will not be considered further.	• Low Cost.	• Significant adverse environmental impacts; • Significant increase to flooding risk with additional land for flood capacity mitigation likely required.
Multi span viaduct structure.	A multi-span viaduct structure would consist of a series of discrete spans supported on intermediate piers or columns. The span configuration and pier layout would require careful consideration at future design stages, but could consist of a series of regularly spaced viaduct spans, or a series of varying spans, for example with an increased span length over the river channel. A multi-span viaduct offers a good compromise between addressing the various constraints of the site, whilst minimising cost.	• Minimised overall impact on flood risk in comparison with extended earth option; • Reduced potential environmental impact in comparison with extended earth option; • More readily accommodates the road curvature.	• Increased construction works in river valley, particularly for construction of foundations and piers; and • Potential for adverse landscape, visual, ecological and potentially other environmental impacts with additional land for flood capacity mitigation likely required.
Single span structure.	A large single span structure across the Goyt Valley would minimise long term impacts on the river valley below. The elimination of intermediate piers would remove any potential obstruction to river flows, particularly in the flooded case, and would thus eliminate any concerns relating to scour.	• No impact on flood risk; • Reduced long term	• Significant cost increase; • Difficult to accommodate curvature of highway with a

OPTION	COMMENTARY	ADVANTAGES	DISADVANTAGES
	A large single span structure also opens up the opportunity for inclusion of a more iconic or landmark structure within the scheme.	environmental impact on river valley in comparison with other two options; • Opportunity for landmark structure.	single span; • Increased costs; • Significantly more complex construction; • Potential for an adverse landscape, visual, ecological and potentially other environmental impacts.

Multi Span Viaduct Solution

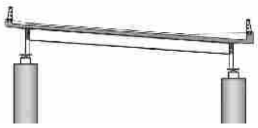
A multi-span viaduct structure would consist of a series of discrete spans supported on intermediate piers or columns.

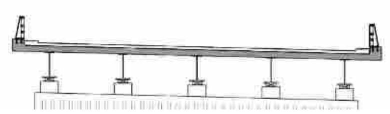
The span configuration and pier layout would require careful consideration at future design stages, but could consist of a series of regularly spaced viaduct spans, or a series of varying spans, for example with an increased span length over the river channel.

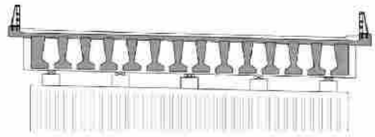
A variety of structural forms are available for a viaduct of this nature including steel composite box girders, steel composite ladder decks, and conventional beam and slab deck. All of these forms are commonly used on the UK highway network, and selection will depend on span lengths, which in turn will be driven by a variety of factors including aesthetics, constructability and pier positioning.

The following table sets out some of the key considerations for each of the main structural forms which might be considered, and lists advantages and disadvantages of each form:

Table 2:

STRUCTURAL OPTION	FEATURES	ADVANTAGES	DISADVANTAGES	FURTHER CONSIDERATIONS
Ladder Deck (Conventional)	Ladder deck bridge structures are one of the more common structural forms used in medium span structures. The ladder deck form typically comprises two longitudinal main girders, cross girders and an in-situ reinforced concrete deck acting compositely steel grillage beneath. For the purposes of the River Goyt crossing, with a dual 2 lane all-purpose (D2AP) carriageway and an overall structure width of approximately 28m, two ladder deck arrangements would be required running side by side. The option exists to run the in-situ reinforced concrete slab continuously across both ladder decks, or alternatively provide a longitudinal joint between the two. Supports are typically provided beneath the main longitudinal girders, so in this scenario 4no. supports would be required at each pier location (to accommodate 2no. parallel deck arrangements). 	• Efficient structural form, particularly for spans upwards of 35m; • Can readily accommodate the proposed highway radius (1020m); • The various spans can be made continuous, thus improving structural efficiency and allowing the superstructure to be installed using the incrementally launched method.	• Supports required beneath each main girder, potentially leading to a 'forest of columns' visual effect; • Long term maintenance of steelwork (although all superstructure options are likely to involve steel); • Reduced structural redundancy compared with multi-girder structures (although superstructure collision very unlikely over the river valley).	• Girders can be fabricated curved or faceted to accommodate the required curvature. Modern fabrication methods can accommodate curved sections with relative ease, and curved girders can more readily be installed using the incremental launching method. A constant curvature of viaduct is preferred for launching, which is achievable with the highway alignment as it currently stands; • In terms of constructability, the site of the proposed structure is relatively remote, with little in the way of road access. On this basis, and given the environmental sensitivity of the area, it is assumed that construction access will be along the route corridor. This scenario lends itself well to providing a structurally continuous superstructure, and incrementally launching the structure from one end of the viaduct. Launching has the benefit of minimising construction operations at ground level, however attracts significant additional complexity at the design phase, as numerous additional load scenarios must be considered; • Girders could be lifted from the valley floor. Crane positions, and lift weights, would need to be considered in conjunction with the relatively steep approach slopes to the site; • Haunched girders (curved soffit in elevation) could be utilised to both improve structural efficiency and enhance aesthetics. Haunched girders are however very difficult to install using the incrementally launched method, thus a decision to utilise haunched girders would most likely result in significant haulage and craneage requirements within the river valley during construction; • On multi-span continuous structures, uplift of ends spans must be considered, and it is usual to limit end spans to 70-80% of the adjacent internal span. End span uplift should be considered in detail during preliminary design exercises.
Ladder Deck (Ladder Deck with Integral Cross Head)	This structural form is very similar to a conventional ladder deck, however pier supports are provided inboard of the main girders, with a transverse diaphragm providing a load path to the main girders. The key benefit of integral cross heads is that only a single pier support is required beneath each ladder deck arrangement, hence for the two side by decks required for this scenario, only two supports are required at each pier position.	Advantages similar to a conventional ladder deck with the exceptions: • The number of pier supports beneath the viaduct is halved, reducing	Disadvantages similar to a conventional ladder deck with the exceptions: • A ladder deck with integral pier supports cannot be installed using the incrementally launched method, so installation	Further considerations similar to a conventional ladder deck with the exceptions: • Given that a ladder deck with integral cross heads cannot be installed using the launching method, construction impacts within the river valley are significantly increased, and future

STRUCTURAL OPTION	FEATURES	ADVANTAGES	DISADVANTAGES	FURTHER CONSIDERATIONS
		substructure construction programme and costs, whilst simultaneously reducing the overall visual impact.	of the steelwork over the river requires lifting, and potentially becomes much more onerous.	design stages would need to consider in detail how access to the river valley for haulage and craneage would be achieved.
Steel composite box girders	Steel composite box girders structures typically comprise one or more steel box sections, with a reinforced concrete deck slab acting compositely with the steel.	• Significantly increased span range compared with ladder decks or conventional beam and slab decks, allowing more flexibility in pier positioning and a potential reduction in pier supports overall; • Box girders can be trapezoidal (with inclined vertical webs), which, when combined a deck cantilever at the structure edges, can create the impression of a more slender structure; • Can readily accommodate the proposed highway radius (1020m); • The various spans can be made continuous, thus improving structural efficiency and allowing the superstructure to be installed using the incrementally launched method.	• Less structurally efficient in the medium span range, resulting in overall increased costs and fabrication/construction difficulties; • Limitations on deck cantilevers mean that at least 4no. box girders would likely be required to support the 28m wide carriageway; • Increased difficulty in long term inspection and maintenance (confined space access to box girders etc).	• In terms of constructability, the site of the proposed structure is relatively remote, with little in the way of road access. On this basis, and given the environmental sensitivity of the area, it is assumed that construction access will be along the route corridor. This scenario lends itself well to providing a structurally continuous superstructure, and incrementally launching the structure from one end of the viaduct. Launching has the benefit of minimising construction operations at ground level, however attracts significant additional complexity at the design phase, as numerous additional load scenarios must be considered; • Haunched box sections (curved soffit in elevation) could be utilised to both improve structural efficiency and enhance aesthetics. Haunched box sections are however very difficult to install using the incrementally launched method, thus a decision to utilise haunched sections would most likely result in significant haulage and craneage requirements within the river valley during construction; • On multi-span continuous structures, uplift of ends spans must be considered, and it is usual to limit end spans to 70-80% of the adjacent internal span. End span uplift should be considered in detail during preliminary design exercises.
Composite Beam and Slab Deck	A composite beam and slab deck comprises a number of steel longitudinal beams, with an in-situ concrete deck slab spanning transversely between. 	• Very common structural solution with reduced design complexity; • Can readily accommodate the proposed highway radius (1020m); • Spans can be made continuous, enabling an incrementally launched construction methodology.	• Leaf piers or cross-head piers required to support multiple girders, increasing the impact at ground level; • Extensive bracing required in the temporary case for launching, reducing overall efficiency.	• Multi beam structures typically comprise even numbers of beams to facilitate lifting in braced pairs. Any multi-beam proposal is therefore likely to comprise an even number of beams regardless of construction methodologies or other considerations; • For a launched structure, significant bracing (in addition to that required for a crane erected structure) would be required to provide both global sway stability and local buckling stability during the various design cases for the launch; • On multi-span continuous structures, uplift of ends spans must be considered, and it is usual to limit end spans to 70-80% of the adjacent internal span. End span uplift should

STRUCTURAL OPTION	FEATURES	ADVANTAGES	DISADVANTAGES	FURTHER CONSIDERATIONS
				be considered in detail during preliminary design exercises.
Pre-stressed beam and slab deck	A pre-stressed beam and slab deck comprises a number of pre-stressed pre-cast beams, acting compositely with an in-situ deck slab. 	• Very common structural solution with reduced design complexity; • Low maintenance (although see disadvantage relating to mechanical bearings);	• Increased construction depth compared with steel/concrete composite solutions; • Available span lengths reduced compared with steel composite solutions, thus requiring greater number of intermediate supports; • Potential heavy appearance of the viaduct; • Cannot be delivered to site in shorter lengths and spliced; • Significant design/construction complexity added if structure is made continuous across supports; • Mechanical bearings required if structure is made continuous across piers;	• For long term durability reasons, a continuous structure across the pier supports is likely to be a client requirement;
Post-tensioned concrete box girders	A post-tensioned box structure would typically comprise 2 or more post-tensioned boxes with deck cantilevers and an in-situ joint between units. 	• Potentially more economic if longer span lengths selected; • Low maintenance;	• Significant additional cost compared with other options; • Significant additional construction complexity compared with other options;	• Box sections can be either pre-cast or cast in-situ; • For spans of up to 60m, it is common for concrete to be cast in sections span by span supported by falsework from the ground or with a truss spanning between the piers; • Where the bridge alignment is straight or on a constant radius curve, launched single cell box girders may be used to overcome access problems or to avoid obstructions at ground level. Commonly used for spans of up to 60m, the technique has been used for longer spans of up to 100m with help of temporary piers placed to reduce the effective span during launching. Launching, however, creates further complexities of design and construction during generation of many intermediate stages; • Precast concrete segmental box girders are found to be very economical for long bridge lengths due to the savings associated with maximising repetition in factory conditions. They allow rapid construction with minimum on site work. They do have disadvantages including the costs of setting up the casting yard and the special erection equipment needed. Span lengths vary typically up to

STRUCTURAL OPTION	FEATURES	ADVANTAGES	DISADVANTAGES	FURTHER CONSIDERATIONS
				150m above which the segment weight becomes excessive; • The most common method of erecting segments is by the balanced cantilever technique, either with a gantry, or a crane or a special lifting frame fixed to the deck.

High Level Structural Alternative

As an alternative to the current highway alignment over the Goyt valley (Design Freeze 4A), an alternative alignment could be considered which places the highway alignment at a higher vertical level.

Under the present alignment (Design Freeze 4A), extensive cuttings are required on both approaches to the river crossing. A higher alignment would reduce magnitude of these cuttings, thus reducing the overall impact on the surrounding landscape and reducing land take for the scheme.

The trade-off for such an amendment is an increase in overall viaduct length across the river valley, although as no design alignment for such an option is available at this stage, it is not possible to provide an exact overall structure length.

Two principal options exist for such a high level structure:

1. Span the valley with a large single span, or a small number of spans;
2. Span the valley with a series of shorter spans, with supports provided to the valley floor.

Option 1:

Structural solutions exist for even the largest potential span lengths across the Goyt Valley. For example, steel arch solutions exist for spans in excess of 500m, and a cable stayed structure could comfortably achieve the required span lengths (although a large tower would need to be constructed).

The construction of a large scale structure across the Goyt valley would require considerable temporary support and staging from the valley floor beneath, and the complexity plus localised impact of the construction works would be significantly greater than other options. The cost of such a structure, both in terms of capital costs and whole life maintenance cost would also be significantly higher than other solutions.

It is considered unlikely that a very large scale structure would be visually appropriate within this setting, and this, combined with the overall cost of such a structure makes it unlikely to be an appropriate choice.

Option 2:

As an alternative to the option for a large scale structure as discussed above, a structure with a series of shorter spans could be considered.

Although higher in elevation than the structural forms considered for the Design Freeze 4A alignment, and with commensurately taller piers, a structural solution for such an alignment could be developed along much the same lines as the solutions considered Design Freeze 4A above.

The higher level structure, combined with the relatively difficult access across the river valley, would lend itself well to the incrementally launched method. The various considerations highlighted within Table 2 above relating to launching of the structure would also be applicable to this site.

In developing any highway alignment for a high level alignment across the Goyt Valley, attention should be paid to maintaining a constant horizontal and vertical curvature as far as possible, in order to accommodate any subsequent launching proposals.

Foundations

In the absence of detailed geotechnical information, and given the sensitivity of multi-span continuous structures to differential settlement, it is assumed at this stage that foundations will be piled to an appropriate depth (or bedrock).

Constructability

In general terms, construction of a four lane highway bridge across the Goyt Valley whilst minimising environmental impacts on the valley below will present a considerable challenge.

A large span structure at this location would generate significant construction complexities, which would inevitably require extensive temporary support and haulage routes to the river valley below.

In order to minimise localised environmental impacts during the construction phase, it is assumed that construction access would generally be made along the route corridor. The relatively steep slopes of the Goyt Valley at this location do not lend themselves to large haulage movements (for example large craneage equipment or delivery of bridge beams), and for this reason a construction sequence based around incremental launching of the bridge girders has been considered against each structural option. The use of the proposed alignment as a haul road for construction, would minimise disruption to the surrounding highway network, however careful programming and co-ordination with adjacent construction activities will be required.

Notwithstanding the above, a structure with smaller spans would require a series of intermediate pier or column supports across the river valley, which in itself would require construction access. It is likely then, that as the design develops, a pier solution will be adopted which minimises the requirement for large pre-cast or pre-fabricated structural elements, relying instead in in-situ methods.

Other aspects of constructability specific to the structural solutions considered are discussed within **Table 2**.

Maintenance

In the permanent case, access to the underside of the structure for inspection and maintenance using a ground based MEWP could not easily be made, due to the relatively steep sides of the valley and the mature woodland covering each bank.

Permanent access gantries are employed on some large structures to facilitate ready access; however these structures in themselves require ongoing inspection and maintenance. Furthermore, a multi-span solution would require an access gantry to be provided beneath each span, further increasing the installation and ongoing maintenance costs. For these reasons, it is anticipated that permanent access gantries would not be employed.

Underbridge inspection units are becoming increasingly popular for access to the underside of viaduct structures, and consist of a mobile temporary gantry which extends beneath the structure, mounted on a purpose built vehicle situated in the nearside lane or hard shoulder. As the design progresses, a number of factors should be considered in order to facilitate future use of underbridge inspection units:

- Avoid placing lighting columns on the outer stringcourse of the structure (otherwise an underbridge unit would need to be re-deployed between each pair of lighting columns);
- Minimise the depth of main girders, as excessively deep main girders can prevent touching distance access to the bridge soffit from underbridge units;
- Avoid closely spaced piers/columns/abutments along the span, as a minimum working length is required for an underbridge gantry to rotate into position beneath;
- Maintain a clearance envelope around the structure into which trees and other vegetation are not permitted to infringe.

In addition to specific considerations for underbridge units, the following more general considerations should be made with regards to inspection and maintenance access:

- Provide a hardstanding area around the base of each pier/column/abutment to facilitate future erection of scaffolding (for inspection, bearing replacement etc.);
- Provide jacking stiffeners and jacking points to substructures to facilitate future bearing replacement;
- Consider provision of permanent anchors to substructures to facilitate inspection via roped access;
- Design loading and fixing considerations for future scaffold and painting enclosures.

Materials

The primary construction materials for the proposed structure are likely to be high yield structural steel and reinforced concrete.

The combination of steel and concrete for the superstructure would provide a highly efficient structural solution, and concrete substructures provide an efficient and geometrically flexible solution whilst minimising long term maintenance.

For superstructures constructed from structural steelwork, it is typically possibly to split the beam lengths into smaller lengths and to then splice the steelwork elements together on site using bolted splices prior to erection, in order to reduce the steelwork lengths and weights for transportation.

Concrete substructures also afford the opportunity for bespoke ‘feature’ finishes, which could be explored at future design stages as part of ongoing stakeholder consultation. Carefully designed feature finishes can also inhibit the proliferation of graffiti.

A key consideration during material selection is corrosion protection to any structural steelwork. Modern paint systems can provide up to 25 years of protection before the first major maintenance (re-application), however the this does not account for any localised mechanical damage to the system (impact during inspection activities etc.). Re-application of the paint system to a structure in this location will inevitably incur major cost and disruption, however the choice of colour associated with a paint system can be a benefit in terms of aesthetic impact and stakeholder objection.

An alternative to a conventionally painted structure exists in Weathering Steel. Weathering steel is a high strength low alloy steel which has the ability to form a protective rust patina that inhibits further corrosion. Weathering steel is becoming an increasingly popular choice for steel structures for difficult access, as future maintenance associated with paint coatings is eliminated. Weathered steel structures exhibit a 'rusty' appearance, which darkens in colour with time to achieve a dark brown appearance.

Weathering steel, if selected would require very careful detailing to ensure water run-off from the steelwork does not lead to staining of reinforced concrete substructures. BD 7/01 Weathering Steel for Highway Structures provides further guidance on the use of weathering steel.

Cross Sections and Headrooms

The cross section of the Goyt Valley Bridge should be developed in line with the requirements of TD27/05 Cross-Sections and Headrooms. In practice, the proposed highway alignment is at least 18m above the River Goyt, so even accounting for relatively large construction depths, the headroom constraints above the river are unlikely to be a limiting factor.

To the north side of the river, the proposed alignment crosses an existing access track (Dark Lane). The proposed highway alignment at this location sits 8.7m above the existing track surface, so again, even for relatively large construction depths, appropriate headroom is achievable. The available headroom at this location should be monitored as the design develops to ensure required headrooms are maintained.

Design Standards

As a member of the European Union, the UK is required to comply with the Construction Products Directive (CPD) and the Public Procurement Directive (PPD), which mandate the use of European Standards in member states.

Any structural design undertaken as part of a publicly funded scheme should therefore be undertaken in accordance with the suite of structural Eurocodes.

In addition the above, HE (formerly HA) Interim Advice Note 124/11 (IAN 124/11) provides guidance and requirements for the use of Eurocodes for the design of highway structures on the strategic road network.

Safety

With regards to safe design, the following general points applicable to the whole scheme are noted:

- Structures should be safe by design, from construction, through maintenance to eventual demolition;
- The principle of prevention to eliminate, reduce and control risks in accordance with the CDM Regulations 2015 should be adopted (and is a legal requirement); and
- The safe construction and maintenance of the individual elements of a structure varies greatly by span arrangement, material and form. The individual impacts

associated with any design option choice need to be considered in relation to the overarching construction strategy and programme for the scheme.

Author's Name – Ian Crook
Author's Title/Role – Associate (Bridges)

Appendix 7

PEDESTRIAN AND CYCLE PROVISION REVIEW

SEMMMS A6-M60 RELIEF ROAD: STAGE 2 STUDY

REVIEW OF PEDESTRIAN AND CYCLE PROVISIONS - DRAFT

TECHNICAL NOTE NO 002: MARCH 2017

QUALITY MANAGEMENT

Job Number	Date	Author	Checked	Authorised
70019764	March 2017	Mark Hetherington	Laura Woodbyrne	Stuart Atkin

1 PEDESTRIAN AND CYCLE PROVISION REVIEW

1.1 INTRODUCTION

1.1.1 The development of Stockport Metropolitan Borough Council's cycle network is focused upon appropriately managing existing highway, right-of-way, permissive routes and creating new links within the existing network.

1.1.2 The A6 to M60 Relief Road Scheme will provide 8.5 km of new 2-lane 50mph dual carriageway on a north - south route from the M60 Junction 25 at Bredbury (north east of Stockport) to the A6 near Hazel Grove (south east Stockport). It will also provide a link road to Stepping Hill of 1.1km allowing improved access to Stepping Hill Hospital.

1.1.3 The initial scheme design was undertaken in 2003 since then the popularity of cycling/walking has increased, therefore the standards have changed and design will need to adhere to the latest TfGM – Stockport cycling guidelines.

1.1.4 The proposed scheme will allow road traffic to bypass the heavily congested routes to the M60 that presently pass through Hazel Grove , Stockport town centre, Offerton and Bredbury in both directions also bypassing local districts and centres. It will provide much needed connectivity for key strategic routes into the North, the North West, and the wider Greater Manchester conurbation and specifically to Manchester Airport; including traffic from the A6, A523 and A34 – all of which are key routes for business, leisure travel and freight.

REVIEW OF PEDESTRIAN AND CYCLE PROVISIONS - DRAFT

TECHNICAL NOTE NO 002: MARCH 2017

1.2 THE SCHEME PROVISIONS

1.2.1 A review of the provisions put forward in the current version of the design for pedestrian and cyclists is provided below. The design is subject to development at later stages in the scheme, therefore the provisions may be amended, developed or the detail changed from that discussed below. A plan indicating associated locations of the provisions is also shown in figure 1. An overview plan showing the locations at which pedestrian and cycle provisions are present is shown in Drawing no. A6-M60-WSP:PB-1-ZZ-DR-J-0003. Cross sections at some key points incorporating the shared cycleway/footways are shown in Drawing nos. A6-M60-WSP:PB-1-ZZ-DR-J-0004 to 0007.

A. The start of the route from Stockport Road West above the tunnel provides a 460m long 3m wide shared use facility along the alignment of the new road however adjacent routes are 2m wide with a cycle lane on the carriageway of Stockport Road West. Design refinement will be required to detail how cyclists travelling north to Ashton Road will cross the road to enter the cycle lane safely and how cyclists travelling north and turning left on to Stockport Road West will access the cycle lane with minimal conflict with pedestrians.

B. Where the route crosses Osborne Street/Kingsway, consideration to the crossing type will be required as the current proposed crossing appears to be uncontrolled with a refuge island in the centre of the carriageway. Also, no provision has been detailed for cyclists turning onto Osborne Street/Kingsway as the footways are 2m wide on both sides of the road and no cycle lane markings are shown on the carriageway.

C. The route along the alignment of the proposed road from the end of the tunnel to the junction for Marple Road provides a 2.3km long 3m wide shared use facility with a 2m verge between the carriageway and footway/cycleway. This excludes the section over the proposed Goyt Valley Bridge where the footway/cycleway is adjacent to the carriageway with a 1m wide hard strip only.

   On Marple Road Bridge the northbound approach for the footway/cycleway is 3m wide turning left onto Marple Road, this narrows to 2.2m wide with a cycle lane provided on the carriageway. A detailed proposal will be required for how cyclists will join the carriageway safely at this location.

   There is a bus stop located near the junction for Marple Road, where the footway/cycleway is 5m wide allowing for a shelter to be installed and providing the acceptable minimum width for cyclists to pass.

D. There is a bus stop proposed just north of the new junction for the Stepping Hill Link with a footway width of 5m then narrowing to 2m at the end of the lay-by. The 2m wide part of footway is 41m long but it is currently unclear if it is access for maintenance or whether it is superfluous. Stepping Hill link has a 3m wide footway/cycleway provision along the route adjacent to the junction for the supermarket car park, the footway narrows to 1.8m with a 1.5 wide verge. If the verge was removed, the 3m width for the shared use footway/cycleway could be maintained up to the junction.

E. On Offerton Road, the shared use footway/cycleway switches from the north side of the proposed A6 M60 road to the south side with access via a bridge with 3m wide shared use footway/cycleway.

F. The access from the proposed A6 M60 road to the Golf course access road is assumed to be for maintenance/inspections of structure only and not for general use.

The A6 MARR roundabout provides a shared pedestrian/cycle route across the western arm with the 3m wide shared route continuing along the A6 MARR road. The crossings in the current version of the design are shown as 3m wide.

The northern footway on the western arm of the A6 roundabout provides a 3m wide shared route for 300m where it then reduces to 2m wide, there is no provision provided on the southern side of the A6.

The current design does not show any pedestrian/cycle provisions along the eastern arm of the roundabout.

The pedestrian/cycle route on the western side of the A6 MARR road provides a 3m wide footway/cycleway for 205m from the crossing point at the roundabout, where it then widens to 5m adjacent to the layby of the A6 MARR road. The pedestrian/cycle provision south of the layby is 2.5m wide.

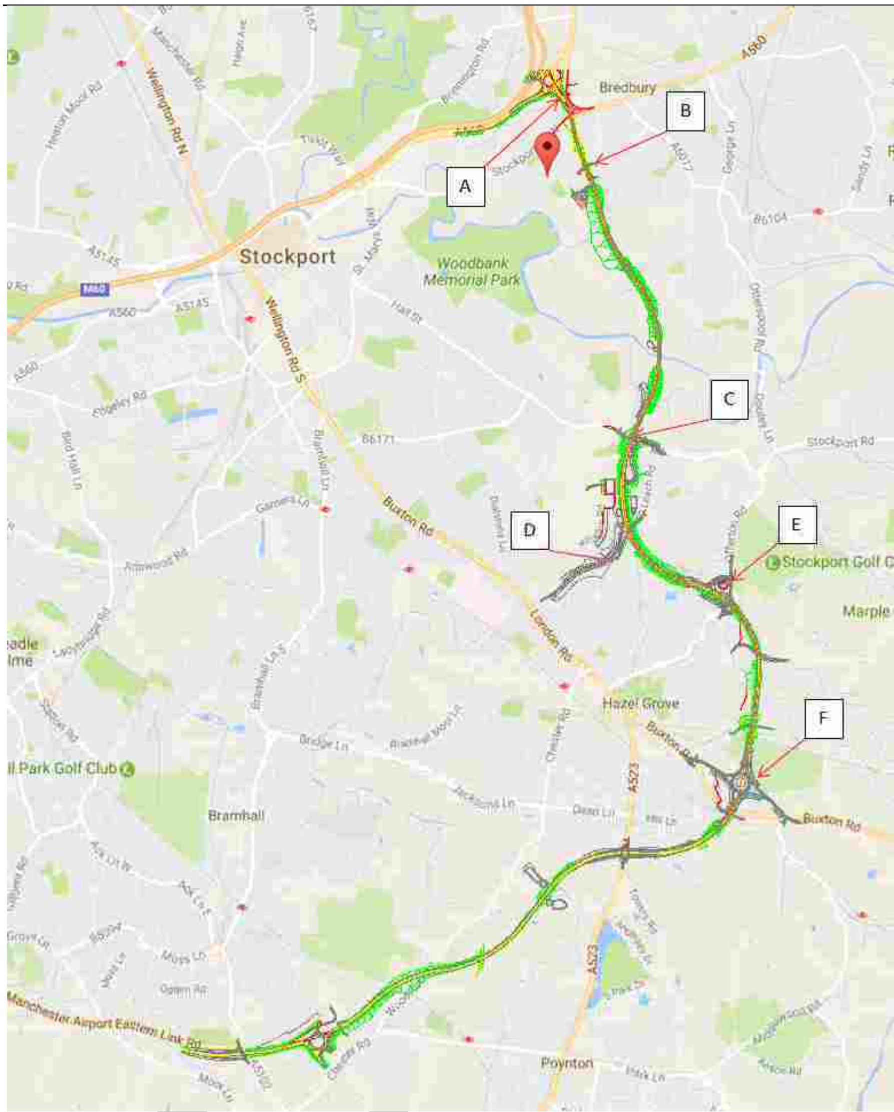
There is no continuous footway/cycleway provision provided on the eastern side of the A6 MARR road. There is a 2m wide footpath leading to a 90m long footway on the eastern side of the A6 MARR road however this does not connect to any other footway on the A6 MARR road.

Figure 1-1 Plan indicating associated locations of provisions – A6 – M60 Relief Road

SEMMMS A6-M60 RELIEF ROAD: STAGE 2 STUDY

REVIEW OF PEDESTRIAN AND CYCLE PROVISIONS - DRAFT

TECHNICAL NOTE NO 002: MARCH 2017



Legend	A - Stockport Road West	D - Stepping Hill Link
	B - Osborne Street/Kingsway	**E - Offerton Road**
	C - Marple Road	**F - A6 MARR tie in Roundabout**

1.3 GENERAL ISSUES

1.3.1 The majority of adjacent paths to the main A6 M60 relief road are 2m wide which is the acceptable minimum for off-carriageway route (TA90/05 para. 7.16). The main alignment provides a width of 3m which is the preferred width of a shared facility. A review of the cycle flow should be undertaken to determine if the 2m widths of the side routes is sufficient for the number of users.

1.3.2 Alignment; Assumed design speed lower than 30kph therefore transitions from one width to another should have a taper of 1:5 (TD90/05 para. 7.9). The minimum radius for 10kph design speed is 4m; the minimum radius used in the proposed design is 6m.

1.3.3 Crossing widths are 3m wide at all junctions. The ideal for toucan crossings is 4m as stated in LTN2/95. LTN2/95 also states that 3m wide crossing widths have been used, however a review of the pedestrian and cycle flow should determine the width proposed in this scheme.

Appendix 8

A6 TO M60 LOCAL MODEL VALIDATION REPORT

Client A6 to M60 Client Board

Project A6 to M60 Relief Road

Subject HFAS Report 1907: A6 to M60 Local Model Validation Report

This Report describes the production and validation of the 2015 A6 M60 Model. The model validation follows guidelines in Webtag Unit M3-1 Highway Assignment Modelling issued by the Department for Transport (DfT).

The Report describes the development of the highway networks and trip matrices, and presents the results of the link flow and journey time validation.

This Report HFAS_1906_A6 M60_LMVR_V0.3.doc

Originator Michael Reese

Version	Comments	Date	Check / Approve
V0.1	Draft For Comment	21/11/16	MR
V0.2	Incorporate WSP Comments	18/06/17	MR
V0.3	Add Appendices	30/10/17	MR
V0.4	Incorporate SMBC Comments	10/11/17	MR

Contact	HFAS:	E-mail	Tel:
	Michael.Reese	Michael.Reese@tfgm.com	+44 (0) 161 244 1414
	Riccardo Boncinelli	Riccardo.Boncinelli@tfgm.com	+44 (0) 161 244 1420

Issued	Organisation	FAO
21/11/16	SMBC/WSP/PB	Michael Reese
30/10/17	SMBC	Michael Reese
10/11/17	SMBC	Michael Reese

CONTENTS

1. Introduction

The Report

1.1 This report describes the development of the 2015 A6 to M60 SATURN model and presents the results of the link flow and journey time validation using the criteria set out in Webtag Unit M3.1).

1.2 The report has nine main sections:

Section 1 - Introduction and scheme background

Section 2 - Model background

Section 3 - Model zoning

Section 4 - Development of the 2015 (model) highway networks

Section 5 - Production of the prior trip matrices

Section 6 - Matrix estimation to enhance prior matrices and improve the fit between modelled and observed flows

Section 7 - Traffic flow validation results

Section 8 - Journey time validation results

Section 9 - Conclusions.

1.3 Further details of the validation are contained in the Appendices, including prior and estimated matrix comparisons by sector, and link flow validation results by vehicle type.

A6 M60 Scheme Background

1.4 The Government Transport Policy review in the late 1990s included consideration of the trunk road building programme; culminating in the "*New Deal for Trunk Roads in England*" report. The report recommended that the trunk road network, which is the responsibility of the Highways Agency (HA), should be greatly reduced. In the south east Greater Manchester, the A6 and A523 were recommended for de-trunking.

1.5 The "*New Deal*" also recommended that future road schemes associated with detrunked routes be withdrawn from the road building programme, as they were no longer a HA responsibility. In south east Greater Manchester (GM) such schemes were:

- A6 (M) Stockport North-South Bypass (including the Stepping Hill Link)
- A523 / A555 Poynton Bypass
- A555 Manchester Airport Eastern Link Road (MAELR)

- A555 Manchester Airport Link Road West (MALRW).

1.6 The schemes have been identified in plans dating to the 1930's and various residential and employment developments in the area have been predicated on their delivery. All three corridors are protected in respective local authority strategic plans. Progress included agreed preferred routes and, following a Public Inquiry in 1988, appropriate procedures for the A6 (M).

1.7 The central section of the A555 MAELR was constructed as part of a local authority A34 bypass scheme, with HA and developer contributions, and assuming that the remaining route would be built shortly afterwards; the HA having presented strong supporting evidence.

1.8 The final relevant recommendation of the *New Deal* was that a multi modal study should be conducted across south east Manchester to consider existing transport problems and develop a long-term (20-year) strategy for addressing them; the South East Manchester Multi Modal Study (A6 M60) was commissioned and managed by the Government Office for the North West (GONW), which created a Steering Group (including relevant local authorities and transport organisations) and a wider reference group (to reflect local interests). Consultants were appointed to undertake the study, which began in January 2000 and completed in September 2001 when a final report, including a recommended strategy, was published.

1.9 Within multimodal study process, the package of recommendations was assessed using the GOMMMS methodology and the potential options were assessed against the Strategy objectives before recommendations were made. The local authorities, AGMA, the North West Regional Bodies and the Government, supported the strategy. A number of public consultations were also held during the process, to identify issues. A final consultation on the proposed strategy showed it had strong public support

The Original A6 M60 Relief Road Scheme

1.10 The wider A6 M60 strategy included the concept for a Relief Road, comprising 21.5 kilometres of new road from M60 Junction 25 to M56 Junction 5, of dual carriageway standard and with two single carriageway link roads – the Stepping Hill Link and Poynton Bypass. The central 3.9 kilometres of the A6 M60 relief road has already been constructed as part of the A555 and A34 bypass scheme.

1.11 Three local authorities, Stockport, Manchester City Council and Cheshire (now Cheshire East) jointly produced a Major Scheme Business Case bid for funding the A6 M60 New Relief Road, which was formally submitted to the DfT in July 2004. Over the next few years, further information was submitted to the DfT, including an investigation into the possibility of Private Finance Initiative (PFI) funding.

1.12 In July 2007 the DfT's considered response stated that the Relief Road scheme provided value for money, but limited funding capabilities meant it could not funded as a single scheme, so consideration should be given to phased delivery. Three potential phases of the scheme were identified by the local authorities, and were submitted to the DfT for consideration in 2007/ 08:

- M60 to the A6, including the Stepping Hill Link
- A6 to Manchester Airport with Poynton Bypass

- A6 to Manchester Airport without Poynton Bypass (A6 M60 A6 to Manchester Airport Relief Road).

1.13 Local Authority officers examined the key policy drivers and transport problems in the area and decided that the A6 to Manchester Airport section was the priority scheme due to the potential economic impact on Manchester Airport (and therefore the City Region) of delaying access improvements, which in turn could constrain future growth.

1.14 Following the Eddington (Access to International Gateways) study, which highlighted transport's pivotal role in supporting the future economic success of the UK, reforms of the planning, funding and delivery of transport interventions were recommended. The study recognised the need to maximise sustainable returns from investment, whilst improving the environmental performance of transport.

1.15 Eddington also recognised the importance of connecting inter-regional routes as part of the network. This role is played by the A6, A523 and A34, linking Greater Manchester with Cheshire, Derbyshire and Staffordshire. Eddington considered a number of road schemes including the A6 M60 Relief Road and recognised that it provided good value for money. Application of the Eddington criterion for Benefit Cost Ratios (BCR) raised the A6 M60 Relief Road BCR slightly to 5.6.

A6 M60 Strategy Objectives

1.16 The A6 M60 strategy was developed and accepted in 2000/01. The original strategy was developed on a 20-year timescale to deal with the existing and predicted transport problems in the area.

1.17 Five core objectives were adopted in the strategy:

- The promotion of environmentally sustainable economic growth;
- The promotion of urban regeneration;
- The improvement of amenity, safety, and health;
- The enhancement of the regional centre, town centres and local and village centres and the Airport; and
- The encouragement of the community and cultural life of the neighbourhood and of social inclusion.

1.18 The five core objectives have clear linkages to transport issues that were identified within a series of defined sub-objectives. These were broken down into five priority themes:

- Improvements to public transport to promote sustainable economic growth, the improvement of neighbourhood community and cultural life, and the encouragement of social inclusion;

- Making better use of existing road space through the reallocation among transport users, to form part of the broader promotion of urban regeneration and improved amenity, safety and health;

- The encouragement and facilitation of behavioural change to enable people to reassess their transport needs and promote sustainable modes of transport. This element of the strategy had a wide-ranging focus, looking beyond immediate transport issues to examine the needs of schools and businesses and helping them to understand how they could benefit from a change in travel mind-set.

- The promotion of urban regeneration, to improve the streetscape and public realm, and address the impacts

- The development of the package of complementary highway works, in particular the major highway schemes identified in the A6 M60 strategy, was addressed fully in direct discussions between the DfT and the three authorities (Cheshire County Council, Manchester City Council, and Stockport Metropolitan Borough Council) charged by the Secretary of State with the development of the schemes. Other highway works included the longer-term objective of reducing the impacts of freight traffic on the A6 M60 area, through appropriate freight route designation and the promotion of alternative modes (e.g. rail).

Specific objectives for the A6 to Manchester Airport Relief Road scheme

1.19 Whilst transport policy has moved on since the A6 M60 strategy was developed, the underlying objectives and principles remain equally valid today as in 2001. The findings from Eddington and Stern strengthen the case as presented in the A6 M60 strategy, with its emphasis on sustainable economic growth, regeneration of deprived areas, reduced environmental degradation, and general improved quality of life. Sustainable transport and behavioural change – both of which were integral to the A6 M60 strategy – are seen as key tools in addressing current transport challenges.

1.20 Nevertheless, there are changes required to ensure that the objectives remain directly relevant to the current policy goals; most notably, the need to take explicit account of carbon emissions, and emphasise the importance of Manchester Airport as an international gateway and potential hub of economic development and regeneration in its own right.

1.21 Whilst the objectives for A6 M60 A6 to Manchester Airport Relief Road have been primarily developed around the existing problems, it is important to note that the A6 to M60 scheme is considered an integral part of the overall SEMMMS strategy. Just as important is the demonstration that the objectives of the current scheme closely mirror those of the original A6 M60 Relief Road scheme. With these issues in mind, the A6 to Manchester Airport Relief Road Scheme objectives are set out below:

- Promote sustainable economic development through the provision of efficient surface access to, from and between Manchester Airport, the Airport Enterprise Zone and the local, town and district centres and employment sites

- Reduce the productivity losses to business, and provide an improved route for freight, by limiting the conflict between local and strategic traffic

- Reduce the impact of traffic congestion on local air and noise pollution
- Regenerate the local communities and encourage community, cultural and social inclusion through reduced severance and improved accessibility to, from and between key centres of economic and social activity

Description of New Relief Road

1.22 The A6 to M60 Relief Road includes a new 2-lane dual carriageway connecting the A6 (at the end of the A6MARR scheme) to the M60 at Bredbury with a spur to Stepping Hill Hospital The scheme bypasses Stockport Town Centre,Hazel Grove, Offerton and Bredbury.

1.23 Through the connection to the A6MARR the scheme improves access to / from Manchester Airport and its employment areas as well as Hazel Grove, Newby Road, Bramhall Moor Lane, Poynton and Stanley Green employment areas. Access to a number of regeneration areas is also improved by the scheme, including Stockport Town Centre M60 Gateway, and Wythenshawe.

1.24 The proposed scheme consists of approximately 7.5km of new dual 2-lane carriageway and will include two new junctions and amendments to junctions at the A6 and at the M60/A560 roundabout at Bredbury as well as a new junction with the A6 at Stepping Hill.

1.25 The location and extent of the scheme is shown in Figure 1.1.

1.26 The scheme has been designed to Department for Transport standards and adheres to the Design Manual for Roads and Bridges (DMRB). Any departures from approved standards will be authorised by the Director of the Overseeing Organisation.

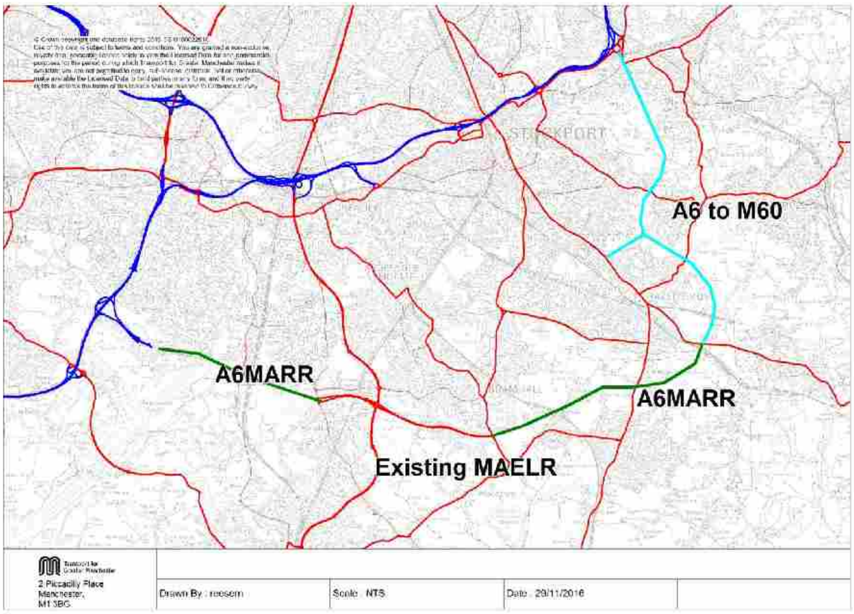


Figure 1.1 Location of Proposed Scheme

2. Modelling Background

Overview

2.1 The A6 M60 Relief Road SATURN model has been developed from the Greater Manchester SATURN Model (GM-SATURN). The GM-SATURN model was validated to a base year of 2014 and updated to 2015 using counts post 2013 factored to an average October weekday in 2015.

2.2 Geographically, the A6 to M60 model is focussed on the area surrounding the proposed scheme – namely Stockport, South Manchester (including Manchester Airport) and Cheshire East, (principally Wilmslow, Alderley Edge and Poynton) and an extension to cover the Bollington, New Mills, Disley and Whaley Bridge. It uses the GM-SATURN model area in full, but with the addition of a significant area of additional simulation network covering the northern part of Cheshire East. The model also incorporates a representation of the rest of Great Britain, albeit in less detail with increasing distance from the A6 M60 area.

2.3 Separate versions of the A6 M60 SATURN model have been built for the morning peak hour 0800-0900, the evening peak hour 1700-1800 and an average inter-peak hour for the time 09:30-16:00.

A6 M60 SATURN Model

2.4 The A6 M60 SATURN model has two main components comprising:

- The highway networks, which represent the roads and junctions used by traffic and bus services
- The trip matrices, which represent the demand for travel and the flow of vehicles between the zones in the model.

2.5 There are, however, a number of subsidiary files associated with the model, including:

- A 'KNOBS' data file, which contains additional data items for network links, such as the road class and number and the locations of zebra crossings
- A node-zone file, which is used for count-based validation, and gives details of the traffic zone in which each node lies
- A GIS file, used by SATURN to display links as curves rather than straight lines
- Inter-peak and PM peak 'X-files', to store supplementary link and turn data for the inter-peak and PM peak networks
- MapInfo node and link tables, to allow the network to be viewed in MapInfo.

2.6 Details of the highway networks and trip matrices are given below.

Highway Networks

2.7 The highway networks used within the model represent all roads of traffic carrying significance within the area through which the proposed scheme will run - Stockport, South Manchester and the north of Cheshire East - and the remainder of Greater Manchester, including all motorways, A-roads and B-roads. The networks also include all of the yellow coloured roads on the Ordnance Survey's Landranger maps of the area, and all roads carrying known bus services. The network outside the county is represented in much less detail, and becomes increasingly less dense with increasing distance from the county boundary.

2.8 The entire network within Greater Manchester and the northern part of Cheshire East and High Peak is coded in full SATURN simulation format, allowing the interaction of traffic at junctions and the resulting delays and queues to be accurately modelled. Outside of this area, the network is coded in SATURN buffer format, so that junction delays and queues are not explicitly modelled in this part of the network.

2.9 The information required for the simulation coding is much more detailed than buffer coding and includes, for example, the link length and cruise speed, the permitted movements at junctions, saturation flows and lane usage (including locations of bus lanes), details of traffic signals and settings, including stages, cycle times, green splits, inter-greens and off-sets. Details of traffic signal settings are obtained from information supplied by the Greater Manchester Urban Traffic Control Unit (GMUTC).

2.10 Buses are represented in the model as fixed loads, with routes defined as chains of nodes in the simulation and buffer networks.

Trip Matrices

2.11 The A6 M60 trip matrices contain representations of all vehicle trips with an origin or destination inside the A6 to M60 scheme area and the remainder of Greater Manchester, and all external-to-external trips that cross the county boundary. The matrices do not, however, represent intra-zonal trips that take place entirely within the same zone.

2.12 Separate matrices are maintained for car, Light Goods Vehicle (LGV) and Other Goods Vehicle (OGV) trips, for the morning peak hour (0800-0900), the evening peak hour (1700-1800) and an average inter-peak hour for the period 1000-1530.

2.13 For cars, matrices are available for 12 journey purposes (see Chapter 5 for details). For assignment purposes, however, the matrices are aggregated to form 5 ‘user classes’, comprising:

- Commuting cars (home-to-work plus work-to-home car trips)
- Employer’s business cars (home-based plus non-home-based employer’s business car trips)
- Other cars (all other car trips)
- LGVS (all purpose LGV trips)
- OGVS (all purpose OGV trips).

3. The A6 M60 SATURN Model Zoning

Background to Model Zoning

3.1 The zoning system for the new A6 to M60 SATURN Model had to fulfil several requirements.

3.2 Firstly, the zoning system for the whole modelling system was based on local authority areas and, within these, wards (as of 2001).

3.3 This was done to:

- Facilitate the compilation of input data, such as population and employment totals
- Provide a well-understood framework for summarising and reporting model outputs.

3.4 Secondly, there was a need to represent the actual origins and destinations of trips and traffic within the area surrounding the proposed scheme realistically and in detail. This was facilitated by developments in the demand modelling incorporated within the A6 M60 VDM that allowed more zones to be represented than in the “parent” GM-SATURN model. However, some caution was applied in defining zones to ensure that the usefulness of the model was not compromised by having so many zones that processing times became excessively long.

3.5 Finally, the focus of interest was the A6 to M60 area, and the zoning is therefore most detailed within this. The zones in that area are therefore smaller than or of a similar size to those in the remainder of Greater Manchester. Elsewhere, zone sizes increase with distance from the Greater Manchester boundary.

Derivation of A6 M60 SATURN Model Zoning

3.6 The original GM-SATURN model contained 993 analysis zones of which 864 are within Greater Manchester. The original GM-SATURN model zoning is shown in Figure 3.1.

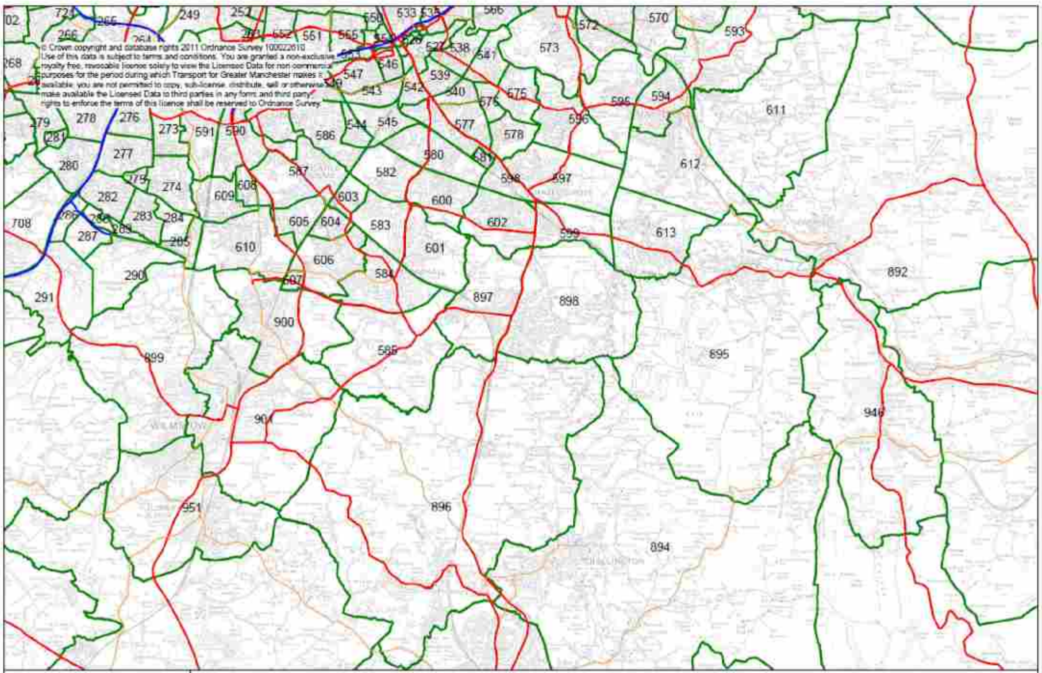
3.7 For the A6 M60 SATURN model, zoning both within and outside the county was reviewed. Within Greater Manchester, GM-SATURN zones within Stockport, South Manchester and East Trafford were checked and existing zones were disaggregated to better represent key generators and future development sites.

3.8 The area surrounding Manchester Airport was looked at in detail and the zoning in that area was reworked based on local knowledge and with reference to several documents. The latter included ‘Manchester Airport Masterplan’ (reference 2), ‘Manchester Airport Ground Transport Plan’ (reference 3) and Manchester Airport: The Need for Land’ (reference 4). Together, these outline Manchester Airport’s future development proposals and parking requirements in some detail.

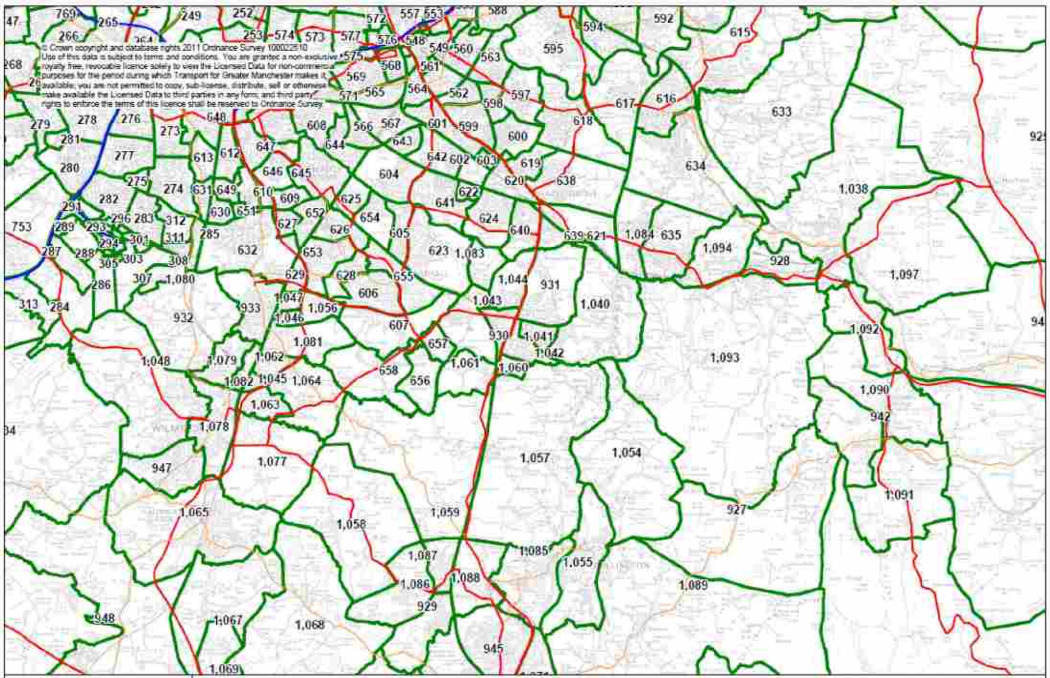
3.9 Outside Greater Manchester, in the original GM-SATURN model the zones in Cheshire East were significantly larger than those within GM. As a certain proportion of Cheshire East is now coded in simulation detail and is in close proximity to the proposed A6 to M60 scheme the zoning was reviewed and disaggregated.

3.10 In particular, the more built up areas around Wilmslow, Alderley Edge and Poynton required a more extensive rezoning to better reflect loading points on the network. As in Greater Manchester all zones in Cheshire East nest within ward boundaries.

3.11 The additional zoning within the Area of Influence and Cheshire has resulted in an increase in the number of zones in the A6 to M60 SATURN model to 1097 analysis zones. The revised zoning for the A6 to M60 SATURN model is shown in Figure 3.2.



Transport for Greater Manchester 2 Piccadilly Place, Manchester, M1 3BG	Greater Manchester SATURN Model - Zoning			
	Drawn By : Michael Reese	Scale : NTS	October 2011	Figure 3.1



Transport for Greater Manchester 2 Piccadilly Place, Manchester, M1 3BG	A6MARR SATURN Model - Zoning			
	Drawn By : Michael Reese	Scale : NTS	October 2011	Figure 3.1

4. A6 M60 SATURN Network Development

Overview

4.1 Within the A6 to M60 SATURN model, the A6 to M60 Area of Influence (see paragraph 4.11 on) is represented at detailed node-based 'simulation' level; roads represented include motorways, A/B-roads, and other roads of traffic significance.

4.2 The information required for simulation coding is detailed; it includes the following items for each link / turn:

- Link length and cruising speed, usually taken as the speed limit
- Permitted movements, and the saturation flows and priorities for each movement
- Lane usage and lane sharing
- Flare lengths and stacking capacity
- Gap acceptance for opposed movements
- For traffic signals, the staging, timings and offsets

4.3 The starting point for the A6 to M60 networks were the 2014 GM-SATURN networks. These networks represent the whole of Greater Manchester is in simulation detail. The simulation area was extended to include the northern part of Cheshire East and High Peak.

4.4 The coding for Cheshire East and High Peak within the A6 to M60 AOI was taken from work undertaken for A6 to Manchester Airport Relief Road and was added into the 2014 network in place of the previous buffer network. This extra simulation network broadly covers the area bounded by the GM Boundary to the north, the A523 to the east, the A537 to the south and the A34 to the west. HFAS reviewed the coding supplied for this area using recent aerial photographs undertaken in site visits, and amended the coding as required.

4.5 The GM-SATURN networks for 2014 were further enhanced to include all local traffic management schemes that HFAS were aware of that might affect network capacity (and consequently the routing and travel times of vehicles). These schemes were identified using information from a variety of sources including:

- Changes reported by Districts and HFAS staff
- Local knowledge
- Aerial photographs
- Discrepancies between the modelled and actual road system highlighted by the counts and accident validation procedures.

4.6 Those roads outside the A6 to M60 area (and the remainder of Greater Manchester) are represented by an extensive link-based 'buffer' network that represents surrounding motorways, A-and B-class roads, but with density diminishing with distance. The buffer network is represented by links, rather than as a series of junctions, with capacity restraint being modelled using flow-delay curves.

Spigot and Zone Centroid Coding

4.7 In accordance with best practice (to aid transparency of loading points), all zone centroids are connected to the model network via spigots. Spigots are links that join the centroid or centre of gravity of the zone to a node on the model network. In the case of point zones such as superstores accessed via a single junction, the spigot representation of a zone is realistic because the junction to which it connects exists and can therefore be coded as a simulation junction. However, in most cases, traffic for a zone joins / leaves the real network at many different points within the zone, and the centroid and spigot representation in the model is a simplification. In particular, the node to which it connects does not exist as a real junction.

4.8 Centroids for each zone were generated in HFAS's network information system (GMNIS) using MapInfo; the software can identify the centre of gravity of a bounded area, e.g., a SATURN zone. Then, for zones where in practice the traffic joins / leaves the coded network at a number of different locations but where the model had to use a single access point, spigot nodes were created on the model network to attach the link (i.e., the spigot) to / from the centroid. This was done where needed, i.e., for all zones except point zones across the network.

4.9 Note that the spigot nodes are junctions in the model, but most of them are not junctions on the real network. To avoid modelling delays at such nodes, they were coded using a template that included additional lanes and maximum saturation flows for the turns into and out of the spigot with no priority markers. For point zones, however, where the spigot represents the site access road, the spigot node represents a real junction, and is coded appropriately.

Area of Influence

4.10 The A6 to M60 model covers all of Greater Manchester and the northern part of Cheshire East and, in progressively decreasing level of network and zone detail, the remainder of the mainland UK. The A6 to M60 scheme in its current form on the section between M56 (at the airport) and A6 (at Hazel Grove) is intended to have relatively local influence, and is being designed as such.

4.11 The A6 to M60 modelling team set out to identify an 'Area of Influence' (AOI) for the scheme. Although checks will be made of wider model validation, the AOI will define the area over which detailed checks will be carried out to ensure that it represents traffic patterns and volumes within the area well. In particular, we will focus attention on aspects such as network coding and network density, explicit representation of significant traffic generators, and compliance to DfT criteria (including base assignment validation) within the AOI.

4.12 The AOI was initially identified using a 2032 forecast year based on the modelling undertaken for A6MARR, comparing assignments with and without the scheme added to identify significant flow changes. Although work to identify an AOI is typically carried out using a base year model, future year forecasts from the A6 M60 work were available in this case, allowing us to assess the AOI with the higher level of traffic that will be present in later years.

4.13 We used two measures to identify the AOI of the scheme:

- traffic flow changes equivalent to a GEH value of 5.0 or greater, which mirrors the Department for Transport criteria for flow validation, where a comparison of two flows that generates a GEH value of 5.0 or greater is considered to represent a significant flow difference

- Absolute flow changes; changes were analysed in steps of 50 pcus from 100 to 250 pcus).

4.14 The results of the analyses undertaken were examined by the modelling team and it was agreed that the AOI would be defined based on flow changes of +/- 250 pcus and a GEH of 5.0, which is consistent with the criteria used to define the AOI for the A6 M60 scheme. The resulting definition of the AOI was adjusted to follow highway model zone boundaries. In all cases, the AOI was extended outwards where identified impacts only extended a small distance into a zone to ensure that the resulting area fully encompasses the likely impacts of the scheme.

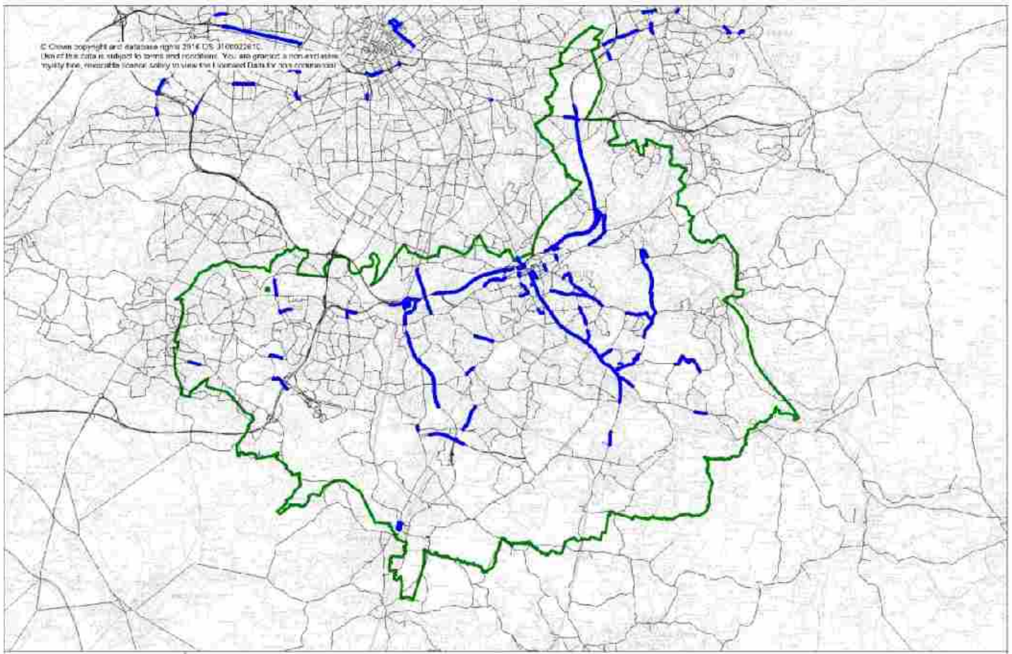
4.15 Two key points to note about how the AOI will be reflected in the model development and forecasting are:

4.16 For the purposes of model validation, we will use the full model as this will enable us to include screenlines and cordons across Greater Manchester to monitor the wider validation of the model and ensure that the patterns and volumes of traffic entering the AOI are realistic.

4.17 For forecasting, the model will be cordoned both to speed up model run times and to exclude the impacts of assignment 'noise' in areas of the model remote from the scheme that could adversely affect the reliability of results from the economic appraisal.

4.18 The AOI severs the M60, so we will also include an intermediate step in the forecasting process where a set of scheme forecasts will be produced based on a wider cordoned model that includes the full extent of the M60. This will allow us to understand and quantify any impacts on use of the M60, particularly any potential for longer distance traffic to switch between using the clockwise and anticlockwise routes around the M60. Based on our experience from other projects (and from this AOI work) we do not expect this to be a significant effect of the scheme, but running the intermediate forecast will provide us with evidence about its magnitude. Subsequently, the model can be cordoned down to the defined AOI for all appraisal main forecasts and sensitivity tests.

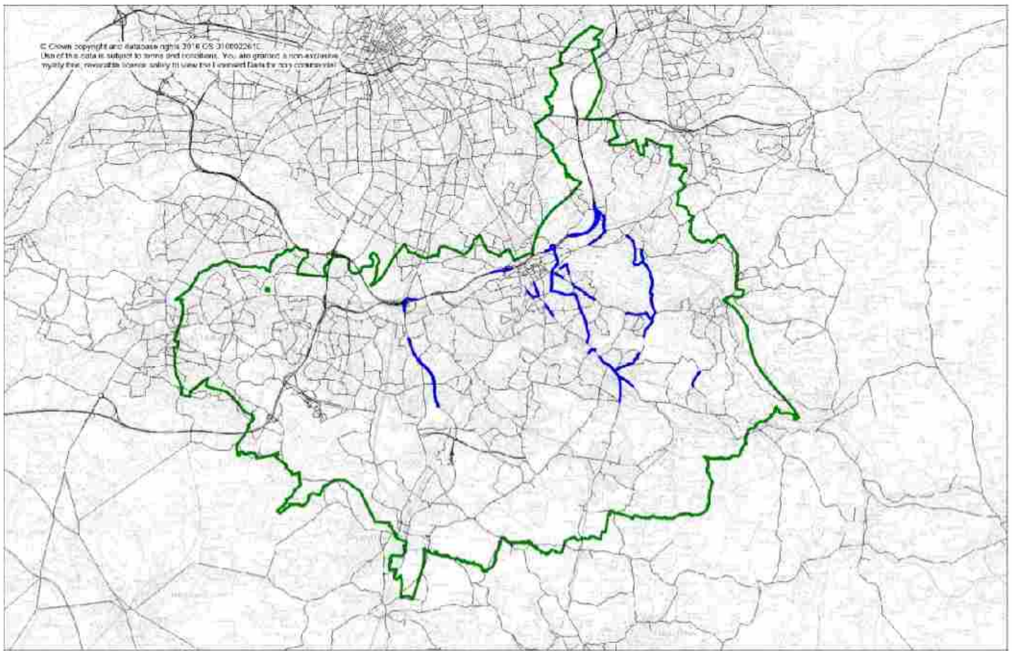
4.19 The AOI for the morning and evening peak hours are shown in Figures 4.1 and 4.2 respectively.



Transport for Greater Manchester
2 Piccadilly Place,
Manchester,
M1 3BG

Figure 1 - A6 to M60 Area of Influence - AM Peak

Drawn By : reesem



Transport for Greater Manchester
2 Piccadilly Place,
Manchester,
M1 3BG

Figure 2 - A6 to M60 Area of Influence - PM Peak

Drawn By : reesem

Traffic Signal Data

Overview

4.20 The traffic signal data in the A6 to M60 SATURN model is obtained using information supplied by the Greater Manchester Urban Traffic Control Unit (GMUTC) and Cheshire East Council.

4.21 The signal times at all junctions within the A6 to M60 AOI were reviewed in Spring 2010 and updated where required from the latest information available.

Pedestrian Crossing Data

4.22 Due to the number of individual crossings in the model and the time therefore required to monitor/source individual call data, model timings at pedestrian crossings were derived via a programme which identified the location of each pedestrian crossing in the simulation area and allocated green and inter-green (i.e. red to traffic) times which reflected the probable use of the crossing.

4.23 The crossings were split into groups using MapInfo. The locational criteria used varied by time period. In the AM peak crossings meeting one of three locational criteria were assumed to be called once every five minutes, namely:

- Those within 500m of a secondary school and 300m of a primary school
- Those within 500m of a hospital; and
- Those within 500m of a Census Special Output Area (SOA) zone centroid with greater than 500 employees.

4.24 In the inter-peak, crossings called once every five minutes were assumed to be those:

- Within 500m of a hospital
- Within 200m of a supermarket
- Within 200m of a health centre
- Within 500m of a university or college of further education.

4.25 In the PM peak, crossings meeting the following criteria were called once every five minutes:

- Within 500m of a hospital
- Within 200m of a supermarket
- Within 500m of a SOA zone centroid with greater than 500 employees
- Within 500m of a university or college of further education.

4.26 Crossings not meeting the five minute call criteria in the three time periods were assumed to be called once every 10 minutes.

4.27 The signal timings used were:

- For a five minute call interval, cycle time 300 seconds, green to traffic 277 seconds, inter-green time (green to pedestrians) 23 seconds
- For a 10 minute call interval, cycle time 600 seconds, green to traffic 577 seconds, inter-green time (green to pedestrians) 23 seconds.

4.28 These times are based on best-practice times for a Pelican crossing located on a 10-metre wide carriageway. They also assume that no vehicles proceed through the crossing during the flashing amber period.

4.29 During further calibration of the model, additional adjustments were made to various pedestrian crossings as required to reflect observed journey times.

SCOOT/MOVA Controlled Junctions

4.30 Within the Greater Manchester part of the AOI there are a significant number of signals and pedestrian crossings under SCOOT (Split Cycle Offset Optimisation Technique) operation.

4.31 SCOOT is a fully adaptive traffic control system that uses data from vehicle detectors and optimises traffic signal settings to reduce vehicle delays and stops. SCOOT provides a fast response to changes in traffic conditions and enables a response to variations in traffic demand on a cycle-by-cycle basis.

4.32 As the operation of SCOOT sites changes with traffic demand, signal timings at these junctions were obtained from GMUTC for an entire day in October 2015. The timings in each of the peaks were then averaged to give as accurate a representation as possible in the SATURN Network.

4.33 In addition to the SCOOT sites there are a number of signal-controlled junctions that are under MOVA operation. MOVA (Microprocessor Optimised Vehicle Actuation) is a well-established strategy for the control of traffic light signals at isolated junctions - i.e. junctions that are uncoordinated with any neighbouring signals.

4.34 MOVA is designed to cater for the full range of traffic conditions, from very low flows through to a junction that is overloaded. MOVA operates in a delay minimising mode; if any approach becomes overloaded, the system switches to a capacity maximising procedure.

4.35 Again signal timings at MOVA sites are changeable and therefore timings were derived by entering the flows as derived from counts into the SATURN model and optimising the signal times to best represent the most likely green times at each of the junctions.

Checks and Adjustments to Networks

4.36 A series of network checks were done after the network had been built and preliminary trip matrices had been assigned. For example, cases were investigated where the coded capacity was less than the traffic count and/or where modelled delays were above a threshold.

4.37 In addition, coding on journey time routes within the Area of Influence was checked to better simulate observed travel times and delays on the network. Further to this selected trees (routes from a zone (origin) within the A6 to M60 AOI to other zones (destinations) within the AOI) were followed and checked.

4.38 As part of the update from A6 to M60 a comprehensive network audit was undertaken focussing particularly on the key areas along the A6 corridor and Manchester Airport. The audit was informed by site visits and detailed inspection of recent aerial photography.

Link Length Crow Fly Checks

4.39 As part of the network build process a sample of crow-fly warning messages (1 in 10) was examined to check that there was no systematic error in link length measurement and to ensure that those errors that were 'flagged' were not significant. No systematic errors were identified and any significant errors were corrected.

4.40 Within the A6 to M60 Area of Influence the lengths of all simulation links in the final 'built' network were examined by comparison against OS mapping. Those with link length discrepancies in excess of 30m were checked in detail and the reasons identified. Of the 3,178 links in the AOI that were checked, 2,961 (93%) were within 10m of the mapped link length and only 59 (1.8%) were found to have a discrepancy in excess of 30m. 31 of these links were found to have the correct link length coded, the discrepancy being due to, for example, node coordinates being slightly incorrect. Of the remaining 28 links only 2 were found with an error in excess of 100m, while 8 had an error of 50m or less.

Bus Data

4.41 Buses are represented in the model as fixed link loads, with routes defined as chains of links in the simulation or buffer networks.

4.42 For the most part, information about bus services and frequencies in the A6 to M60 model is based on data from the TfGM bus service database, the Northwest Journey Planner website and bus timetables for North Cheshire.

Adjustments to Link Cruise Speeds

4.43 In the SATURN networks as originally coded, the link cruise speeds coded were set to the posted speed limit for the link in question. However, during development of GM-SATURN, the model was found to be running too fast during the early stages of calibration/validation.

4.44 To slow the network down, tests were carried out to assess the impact on speeds of calling all pedestrian crossings (as described above) and reducing link speeds. The rationale behind reducing link speeds was that in the peak periods in particular, there are considerable 'friction' effects acting on the network, such as vehicles loading and unloading, drivers making short stops at local shops, buses stopping more frequently than at other times of the day etc. These activities have an impact on the cruise speed and will tend to reduce it below the speed limit.

4.45 For A6 to M60, a number of sensitivity tests were undertaken to determine the appropriate adjustments to link cruise speeds to match observed travel times on the network in the Area of Influence.

4.46 For the morning and evening peak hours, it was found that factoring Regional and District centre speeds by 0.75 and all other simulation links (except those with limits of 60mph or more) regardless of location by 0.80 gave the closest approximation to observed travel times.

4.47 For the inter-peak, it was found that factoring Regional and District centre speeds by 0.85 and all other simulation links (except those with limits of 60mph or more) regardless of location by 0.90 gave the closest approximation to observed travel times.

4.48 No speed adjustments were applied to motorway links.

4.49 It was noted that travel times in the rural network within Cheshire were generally too fast in initial model runs. These roads are generally outside both regional and district centres and built up areas and therefore were not factored via the process described earlier.

4.50 The fast travel times on these roads was attributed to the nature of the network where many roads have sharp bends and where visibility is poor or where friction effects occur. As a result the speeds were reduced using local knowledge of the network and aerial photos to better match observed times on those routes.

Motorway Flow Delay Curves

4.51 In the development of GM-SATURN, it was noticed that speeds on the motorways appeared to be too fast in relation to observed journey times.

4.52 It was decided that flow delay curves would be added to motorway links in order to accurately model delays resulting from a reduction in motorway speeds when the link is reaching capacity

4.53 Motorway flow delay curves were derived from work undertaken by MVA with the Sheffield SATURN Model, using COBA flow delay curves for motorways and suburban roads.

4.54 The standard flow-delay curves are most commonly applied to an 'average' stretch of motorway, with a standard carriageway width, no sharp bends and a distance of greater than 2 miles between junctions.

4.55 The motorway network in Greater Manchester, and in particular the M60 and M56 that pass through the A6 to M60 AOI, have several 'non-typical' sections of motorway. These sections have one (or more) of the following features;

- A 50mph restriction due to a sharp bend;
- 2 or 3 narrow lanes;
- Several merges / diverges within close proximity; and
- Junctions within approximately 1 mile of each other.

4.56 These characteristics require some sections of motorway to have different flow delay curves from normal, to reflect slower free flow speeds.

4.57 Even following the application of these flow-delay relationships, in the A6 to M60 SATURN model it was found that particular sections of the motorway network were running too fast. Notably these were in areas with a 50mph restriction for design reasons and/or where junctions are very closely spaced. To better represent the delays on these sections of motorway the free flow speed and speeds at capacity were reduced as part of calibration.

Times in the External Network

4.58 In the SATURN model, travel times on links in the buffer network outside the A6 to M60 AOI and Greater Manchester are estimated using capacity restraint.

4.59 To determine the capacities the following processes were undertaken:

- All buffer links were coded with link capacities with 99,999 in all three time periods
- The network was converged
- Capacities were reset to be 1.2 times the demand flow using the maximum link flow in any time period which results in a single capacity used for each link across all time periods

4.60 The process of estimating capacities and calculating demand flows was iterative, and was repeated until there was no significant change in the calculated capacities from one assignment to the next. The overall change in link capacities was found to be less than 2% in five iterations.

Generalised Cost Parameters

4.61 The generalised cost parameters used in the assignment process are derived using an Excel spreadsheet prepared by Systra. They are consistent with data taken from TAG Unit 3.5.6 (November 2016).

4.62 In line with current guidance the values of time for employers business are separated for short and long distance trips. The values of time for employers business have been calculated using a weighted average as per the DfT spreadsheets.

4.63 User inputs to the spreadsheet consist of:

- Average network speed, used in the calculation of vehicle operating costs
- Proportions of distance travelled by each of three car-based user classes (i.e. commute, employers business and other) as output from a five user class assignment; these are used in the calculation of the cost parameters for the all-car user class (i.e. as a weight).

4.64 All other inputs (e.g. values of time, fuel consumption parameters and fuel costs, fuel price growth rates etc) were taken directly from the appropriate section of WebTAG.

4.65 The 2015 values of time (pence per minute – PPM) and distance (pence per kilometre – PPK) as output from the spreadsheet and used in the assignments are shown in Table 4.1 below.

4.66 A worked example showing a generalised cost calculation for PPM & PPK Employer's Business Car AM Peak Hour has been provided in Appendix 1.

Table 4.1 2015 Generalised Cost Parameters Used in the Assignments			
Period	User Class	PPM	PPK
AM Peak Hour	Commuting Car	20.20	6.38
	Employer's Business Car	30.17	14.18
	Other Car	13.95	6.38
	LGV	21.23	13.62
	OGV	21.67	53.10
Inter-Peak Hour	Commuting Car	20.56	5.86
	Employer's Business Car	30.97	12.90
	Other Car	14.85	5.86
	LGV	21.23	13.45
	OGV	21.67	51.79
PM Peak Hour	Commuting Car	20.38	6.26
	Employer's Business Car	30.71	13.89
	Other Car	14.60	6.26
	LGV	21.23	13.45
	OGV	21.67	51.79

Network Statistics

4.67 Table 4.2 shows the overall network statistics.

Table 4.2 A6 to M60 SATURN Model Network Statistics (Version 21)

Nodes	
Type	Number
Simulation Nodes	9,808
Of which:	
External Nodes	1,610
Priority Nodes	5,394
Roundabouts	378
Traffic Signals	1,393
Signalised Pedestrian Crossings	1,033
Buffer Nodes	1,791

Links		
Type	Number	Type
Real Simulation Links	19,766	Real Simulation Links
Spigot Connector Simulation Links	3,091	Spigot Connector Simulation Links
Buffer Network Links	5,410	Buffer Network Links
Total	28,267	Total

Notes

1. The figure for priority nodes includes a number of ‘exploded’ roundabouts i.e. large roundabouts broken down into a series of priority junctions.

1. The 2014 Saturn model was validated using SATURN Version 11.3.12U Level N3 (Multi-Core).

5. Development of the Prior Matrices

Overview

5.1 This report describes the production of the prior trip matrices developed for use with the Greater Manchester Saturn Model (GMSM). This model informs the development of transport and land-use policies within Greater Manchester, and provide inputs to support the appraisal of transport infrastructure schemes under different economic scenarios.

5.2 The assignment matrices were mainly built using origin destination (OD) data collected from mobile phones during the Greater Manchester Mobile Phone OD Data Project (Reference1). Other data sources that have been used for the matrix development include:

- 2011 census journey to work data, to infer mode of travel
- Movements from the pre-existing 2012 and 2013 highway and PT assignment matrices, to infill movements that were not observed in the mobile phone study
- Travel diary data
- Intercept data from the 2010 Greater Manchester Area Transportation Surveys (2010 GMATS) for PT modes.

5.3 The assignment matrices were built in two stages:

- First, initial matrices were formed from the mobile phone data.
- Next, movements from the mobile phone matrices were compared with movements from the pre-existing highway and PT matrices and were then assigned to the transport models to assess the accuracy of the link flow validation. The movements in the mobile phone matrices were adjusted as part of this process to correct for any perceived biases in the data and to improve the validation of the prior matrices.

Mobile Phone Data

5.4 The objectives of the Mobile Phone project were to obtain up-to-date information on trip making for use with the Greater Manchester Highway, Public Transport and Variable Demand Models. It was hoped that the study would provide a 'Proof-of-concept Dataset', which would provide information about trip making within the County which was as least as good as could be obtained from traditional intercept surveys, at a fraction of the cost.

5.5 The main points relating to the data are as follows:

- Data was collected for a four weeks period, comprising the weeks beginning Monday 13th May 2013, Monday 20th May 2013, Monday 10th June 2013 and Monday 17th June 2013
- Data was, however, only processed for 19 days, (due to data collection and storage problems), and has been averaged for weekdays, Saturdays and Sundays
- Data was collected for all movements within Greater Manchester and the surrounding area
- The weekday source data is based on a sample of over 69 million trips
- Data was anonymised, to protect privacy, with device IDs being re-set each day
- Data was zoned to a 631 zone sectoring system, (representing aggregations of transport modeling zones), comprising 503 sectors inside Greater Manchester and 128 sectors outside the County
- The start and end times of trips were aggregated to the nearest hour
- Intra-sector movements were only partially observed in the dataset and therefore have to be 'infilled' using information from pre-existing matrices or other sources.

Mode Allocation

5.6 Trips were allocated to 3 modes comprising:

- Highway modes, which includes cars, Light Goods Vehicles, Other Goods Vehicles, Buses/Coaches and Motor Cycles
- Rail, which includes Metrolink
- Slow modes (walk and cycle).

5.7 Movements were allocated to modes using information about:

- The speed of trips and trip lengths. (Devices travelling at slow speeds and making short journeys were assumed to be slow modes, other non-rail trips were classified as Highway).
- Rail/Metrolink trips were classified by identifying cell tower handover pairs that had patterns associated with groups of people on the same route travelling at nearly the same time and speed and identifying these as train lines. Devices that 'handed over' from one cell of such a pair to another were classified as train/tram trips.

Home Sectors

5.8 The home ends of trips were inferred based the time at which each device (mobile phone) was first 'seen':

- If the device was seen before 4pm, it was assumed that the location of the first point of observation was the home end
- If the device was not seen before 4pm, it was assumed that the location of the last point of observation was the home end.

Expansion Process

5.9 The mobile phone data was expanded using population data from the 2011 census. The expansion was carried out in two stages:

- Firstly, the population data was used to derive controls for the observed movements
- Next, 'person type' adjustment factors were applied, (to try to correct for any person type bias in the data), based on the characteristics of trips made by different individuals (mode or travel, time of first trip, trip length etc.)

Limitations of the Data

5.10 Whilst OD data collected from mobile phones has some strengths compared to data collected using traditional intercept surveys, including the ability to obtain very large sample sizes with a minimum amount of disruption to traffic flows and travelers, there are a number of known limitations with the data including:

- Difficulties defining what a trip is and identifying short distance trips
- Spatial accuracy - the accuracy with which phone locations can be determined is dependent on antenna/cell tower coverage. Locations should be most accurate in areas with a high density of cell towers, typically comprising town centres and areas with high population, but will be less accurate elsewhere.
- The data only provides limited information about travel mode (highway, rail, slow modes)
- Data does not provide any information about travel purpose
- Data is relatively cheap (and it is possible to obtain very large sample sizes), but we need to be aware of/learn about its shortcomings.

Overview of the Matrix Building Process

5.11 Assignment matrices were built for an average weekday for three time periods comprising:

- The AM peak hour (0800-0900)
- An average inter-peak hour (defined to be the average of the 1000-1600 time period)
- The PM peak Hour (1700-1800)

5.12 The key steps in the matrix building process are illustrated below in Figure 5.1. These involved:

- Checking the data and learning about its weaknesses
- Building the assignment matrices
- Making adjustments to the matrices to correct for apparent problems, to create the final set of matrices.

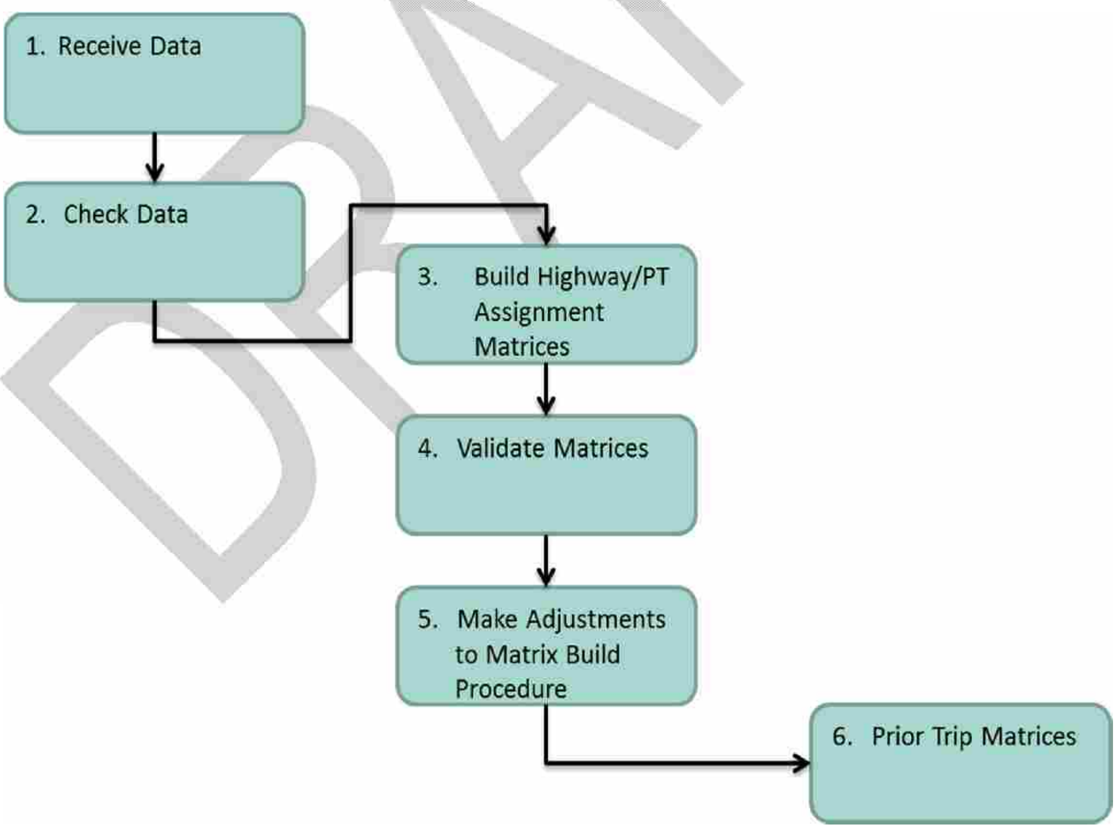


Figure 5.1 Matrix Building Process

Data Checks

5.13 Basic checks were carried out on the mobile phone data prior to building the assignment matrices to learn about its properties and to identify any issues that might be of concern. These included:

- Checks on hourly flow indices
- Checks on home versus non-home trips
- Checks on weekday trip totals and mode share proportions
- Checks on rail and Metrolink trip totals.

5.14 Figure 5.2 compares the proportions of trips in the mobile phone data beginning in each of the hours between 6 o'clock in the morning and 10 o'clock in the evening for the average weekday with similar profiles for ATC data.

5.15 The results appear to be sensible, with movements in the mobile phone data peaking between the hours of 7 and 10 o'clock in the morning and 4 and 6 o'clock in the evening. There also appears to be quite a good match between the two profiles, which have similar shapes, although it does appear that the mobile phone data might contain too many trips in the morning peak period and too few trips in the inter-peak period.

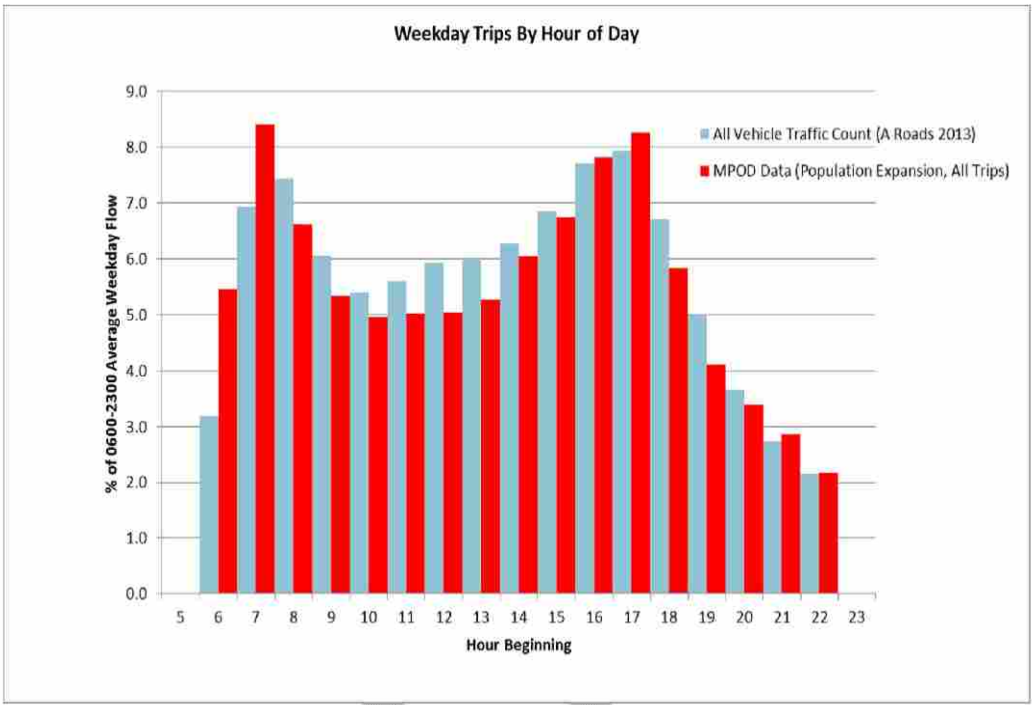


Figure 5.2 Weekday Average Hourly Flow Indices

5.16 Table 5.1 compares the proportions of weekday Home and Non-Home trips in the mobile phone dataset. Once again, the results appear to be plausible, with the majority of trips having an origin as home in the morning and a destination as home in the evening. The proportions of from home trips in the morning do, however, appear to be a little low. It also looks like there might be a lack of symmetry over the whole day, with approximately 43% of trips having an origin as home and only 32% of trips having a destination as home. It might be expected that these figures would be fairly similar.

Table 5.1 MPOD Data All Origins vs All Destinations (Weekday, All Modes)

Total Trips	AM Peak Period	Inter-Peak Period	PM Peak Period	All Day
Where Origin is Home	66 %	37%	25%	43%
Where Origin is Not Home	34%	63%	75%	57%
Destination is Home	14%	32%	52%	32%
Where Destination is Not Home	86%	68%	48%	68%

5.17 Table 5.2 shows weekday trip totals from the mobile phone data for the period 0700-1900 broken down by mode, for trips with an origin and destination inside Greater Manchester. The table shows that almost 98% of trips have been allocated to the highway mode. The percentages of rail and walk trips appears to be low, with only about 0.6% of trips in the Mobile Phone data being allocated to rail and 1.6% of trips to walk or cycle.

Table 5.2 MPOD Data 0700-1900 Weekday Trip Totals By Mode for Trips with an Origin and Destination Inside GM (Person Trips)

Mode	0700-1900	
	Trips	Percentage
Highway	4,874,522	97.7%
Rail	30,821	0.6%
Walk/Cycle	81,686	1.6%
Total	4,987,029	100.0%

Highway Matrix Building

5.18 The highway matrices were built to the 993 zone system used with the GMSM.

5.19 A summary of the matrix building procedure is presented in Figure 5.3. Briefly, it involved 8 steps, as follows:

i. First, movements for the Highway and Rail modes from the mobile phone data were combined and 631 zone matrices built (at the mobile phone data sector level) for the AM peak period 0700-1000, the PM peak period 1600-1900 and the inter-peak period 1000-1600.

ii. Next, the 631 zone matrices were disaggregated to the 993 zone system used with the Saturn model. (During this process, trips between sectors comprising several GMSM zones were allocated to their constituent Saturn zones on a proportional basis, using row/column weights calculated from all-purpose trip end totals derived from the 2012 Saturn model vehicle matrices, Reference 2).

iii. Next, the 993 zone all mode matrices were disaggregated into rail, bus and other highway trips. This was done on a cell-by-cell basis using information from TfGM's 2011 census journey-to-work matrices to estimate mode share.

The method was as follows:

If, for example, there were 100 trips between zones i and j in the disaggregated mobile phone matrix, and there were 50 car, (i.e. car driver plus car passenger), and 10 bus, (i.e. bus passenger) and 5 rail trips in the 2011 census matrix, then the estimated number of rail trips between zones i and j from the mobile phone data was calculated to be:

7.69 = 100 x [5 / (50 + 10 + 5)]

The estimated number of bus trips was calculated to be:

15.38 = 100 x [10 / (50 + 10 + 5)]

The estimated number of other highway trips, (which were assumed to comprise car, Light Goods Vehicle and Other Goods Vehicle trips), was calculated to be:

76.93 = 100 - (7.69 + 15.38)

iv. Next, vehicle occupancy factors were used to convert person trips to vehicle flows. For simplicity, average car, LGV and OGV values derived from WebTAG were used, as shown in Table 5.3.

v. Next, period to hour factors calculated from traffic counts were applied to convert the all vehicle flows for the chosen periods to modelled hours, as shown in Table 5.4.

vi. Next, the all vehicle flows were disaggregated into separate car, LGV and OGV flows, (on a cell by cell basis), using vehicle proportions from the existing 2012 GMSM assignment matrices.

The method was as follows:

If, for example, there were 100 highway trips between zones i and j in the disaggregated mobile phone matrix, and there were 70 car, 10 LGV and 5 OGV trips in the corresponding cells of the 2012 GMSM matrices, then the estimated number of car trips from the mobile phone data between zones i and j was calculated to be:

82.35 = 100 x 70 / (70 + 10 + 5)

The estimated numbers of LGV and OGV trips would be:

11.76 = 100 x 10 / (70 + 10 + 5) and

5.89 = 100 x 5 / (70 + 10 + 5) respectively.

vii. Finally, ‘marker matrices’ were used to zeroise cells corresponding to intra-sector movements in the mobile phone matrix, (which were only partially observed in the mobile phone dataset), and to update these cells with movements from the 2012 Saturn vehicle matrices.

Table 5.3 Highway Matrix Vehicle Occupancy Factors			
Time Period	Vehicle Occupancy Factor		
	Car	LGV	OGV
AM Peak Period	1.34	1.23	1.00
Inter-Peak Period	1.23	1.23	1.00
PM Peak Period	1.42	1.23	1.00

Table 5.4 Highway Matrix Period to Hour Factors	
Time Period	Factor
AM Peak	0.37
Inter-Peak	0.167
PM Peak	0.36

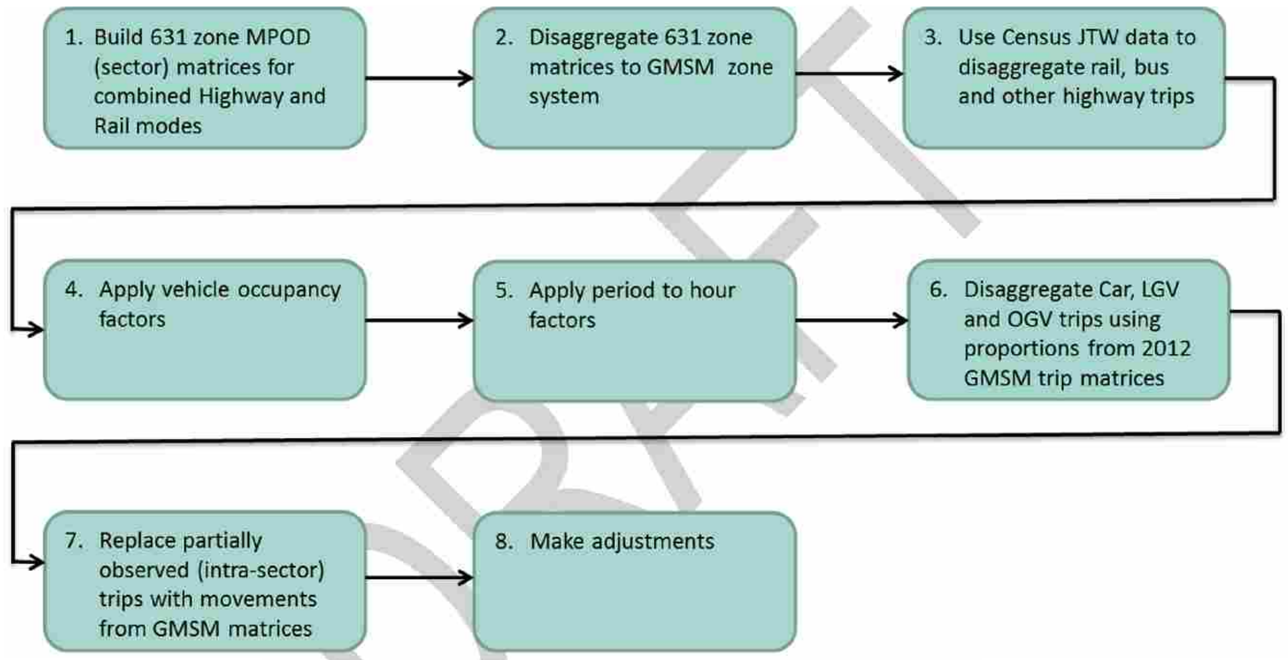


Figure 5.3 Highway Assignment Matrix Building Procedure

Highway Matrix Adjustments

5.20 Following the production of the initial matrices, the matrices were assigned to the 2014 GMSM highway networks. Comparisons of link flows with counts were then made for each vehicle type and time period to assess the performance of the model. Comparisons were also made with movements from the pre-existing 2012 GMSM matrices to compare trip totals, sector-to-sector movements and trip length distributions. A series of adjustments were then made to the mobile phone matrices to try to improve the validation, comprising:

- Adjustments to point zone trips
- Adjustments to trip length distributions
- Trip distribution and journey purpose adjustments

Point Zone Trips

5.21 The GM Saturn model contains approximately 100 'point zones', representing large developments such as superstores, hospitals and industrial estates.

5.22 To try to ensure that the point zone entry and exit volumes in the prior trip matrices were as accurate as possible, it was decided to apply row and column adjustment factors to the 2014 car matrices, (separately by time period), to reproduce the trip end totals from the 2012 GMSM matrices. (Information about point zone trip end totals in the 2012 matrices had been derived from traffic count data for zones where vehicle counts were available and trip rates from the TRICS database for zones where counts were not available, as described in Reference 2. Traffic counts were available for approximately 40 sites).

Trip Length Distributions

5.23 The charts in the left hand side of Figures 4.3 - 4.5 compare the trip length distributions for the Mobile Phone matrices with the trip length distributions for the 2012 GMSM matrices for the AM peak, inter-peak and PM peak hours respectively, for car, LGV and OGV trips with an origin or destination inside Greater Manchester. The comparisons appear to show that the mobile phone matrices under-estimate short distance trips and over-estimate medium and longer distances trips, especially in the inter-peak hour.

5.24 A second series of adjustments factors were therefore applied, (by distance band), to improve the fit between the mobile phone and 2012 GMSM trip length distributions, as shown in Table 5.5.

Table 5.5 MPOD Highway Matrix Trip Length Adjustment Factors

Travel Distance (km)	AM Peak Hour			Inter-Peak Hour			PM Peak Hour		
	Car	LGV	OGV	Car	LGV	OGV	Car	LGV	OGV
0 - 7.5	1.00	0.93	0.71	1.22	1.22	0.95	1.06	0.86	0.62
7.5 - 15.0	0.79	1.00	0.55	0.80	1.07	0.72	0.85	0.86	0.44
> 15.0	0.75	1.82	1.13	0.65	2.00	1.60	0.77	1.33	0.91

5.25 These factors served two purposes:

- Firstly, they helped to improve the fit between the trip length distributions
- Secondly, they helped to correct for discrepancies between the numbers of trips in the two sets of matrices, by controlling the trip totals in the mobile phone matrices to match those in the 2012 GMSM matrices, by travel distance band.

5.26 The trip length distributions for the adjusted matrices are shown in the right hand side of Figures 5.4 – 5.6.

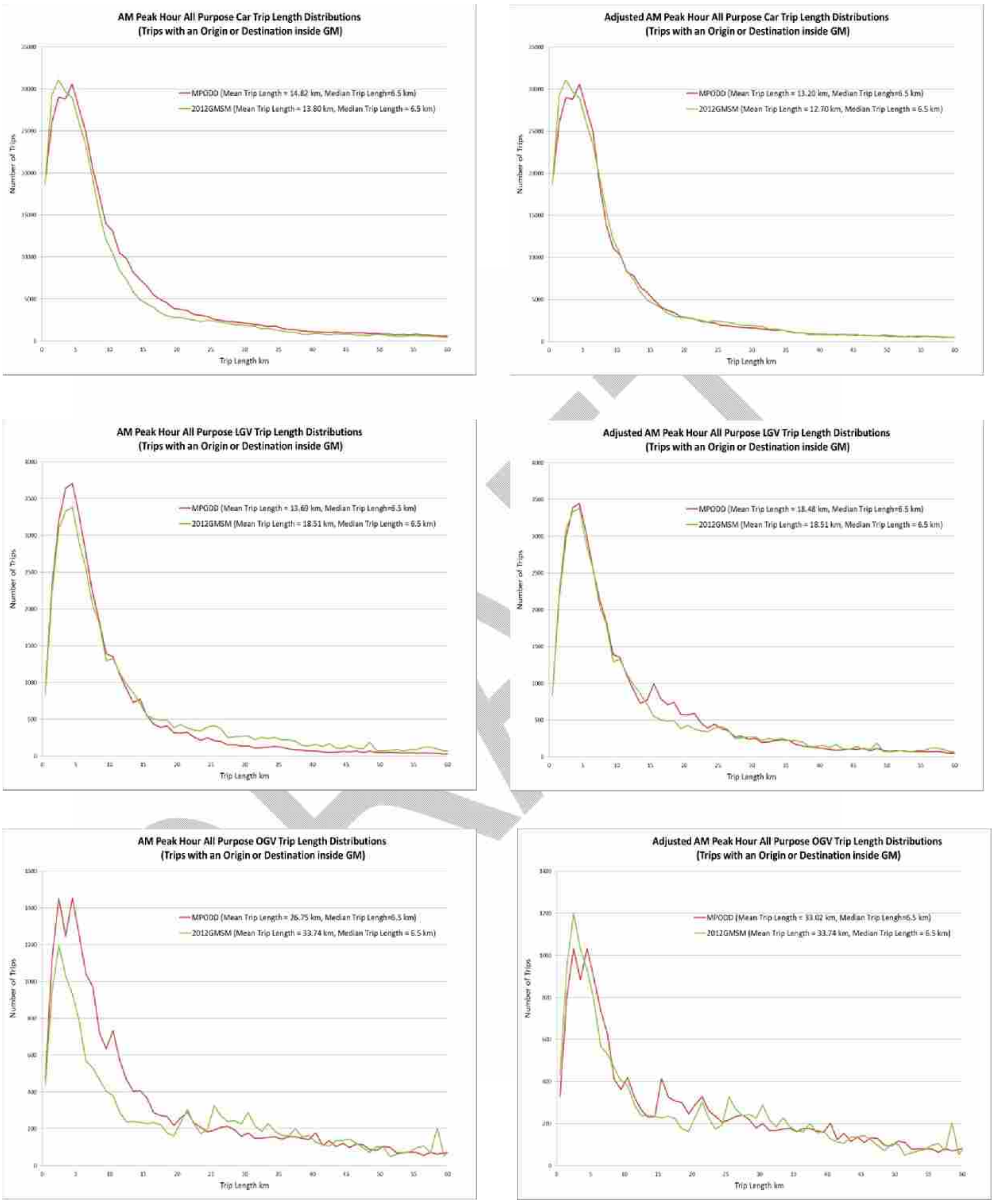


Figure 5.4 AM Peak Hour Trip Length Distributions

Note: The charts in the left hand side of the Figure show the un-adjusted trip length distributions. The charts in the right hand side of the figure show the adjusted trip length distributions.

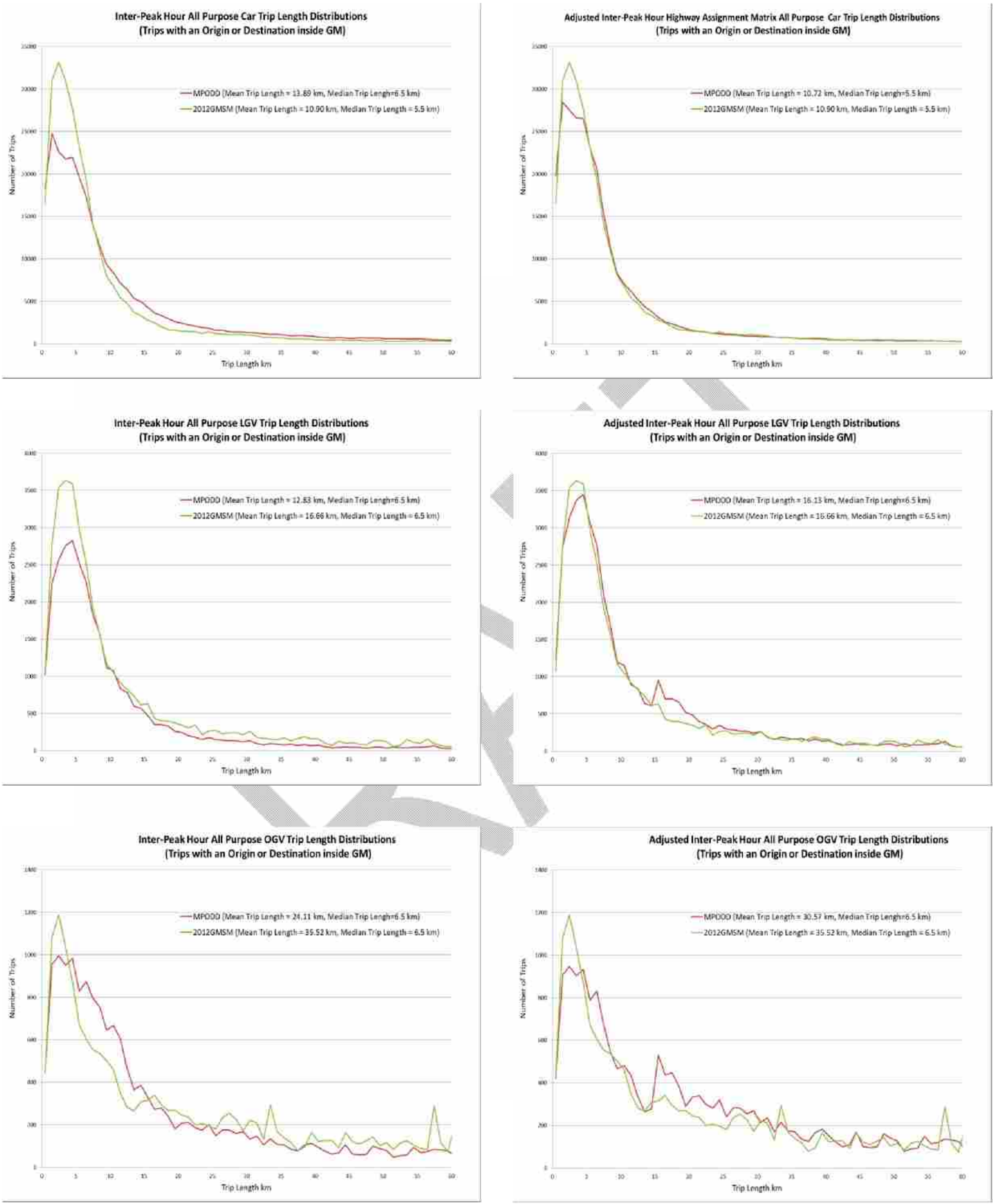


Figure 5.5 Inter-Peak Hour Trip Length Distributions

Note: The charts in the left hand side of the Figure show the un-adjusted trip length distributions. The charts in the right hand side of the figure show the adjusted trip length distributions.

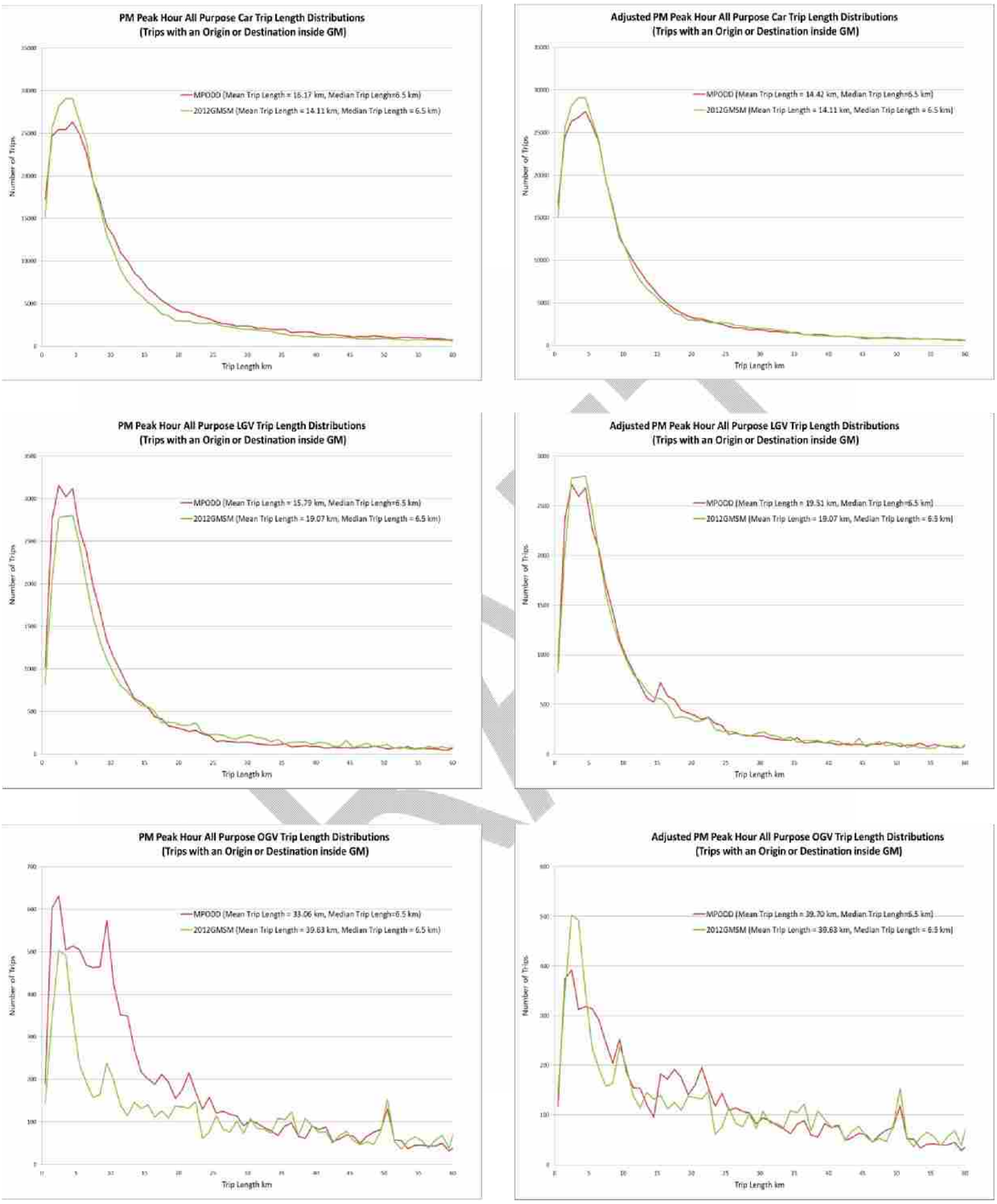


Figure 5.6 PM Peak Hour Trip Length Distributions

Note: The charts in the left hand side of the Figure show the un-adjusted trip length distributions. The charts in the right hand side of the figure show the adjusted trip length distributions.

Journey Purpose Adjustments

5.27 The final step in the matrix building procedure involved disaggregating the all-purpose car matrices to form separate purpose matrices for modelling. Separate matrices were formed for 12 car journey purposes comprising:

- Home-to-work
- Work-to-home
- Home-to-education
- Education-to-home
- Home-to-shopping
- Shopping-to-home
- Home-to-employers' business
- Employers' business-to-home
- Home-to-other
- Other-to-home
- Non-home-based employers' business
- Non-home-based other

5.28 For assignment, however, the separate purpose matrices were aggregated to form 5 'user classes' comprising:

- Commuting cars (home-to-work plus work-to-home car trips)
- Employers' business cars (home-based plus non-home-based employers' business car trips)
- Other cars (all other car trips)
- LGVs (all purpose LGV trips)
- OGVs (all purpose OGV trips).

5.29 Initially, a simple approach was adopted, which involved using the purpose splits from the 2012 GMSM car matrices to disaggregate the all-purpose mobile phone trips on a cell-by-cell basis.

5.30 If, for example, there were 100 car trips between zones i and j in the mobile phone matrix, and there were 70 car trips in total in the corresponding cells of the 2012 GMSM all-purpose car matrix, and there were 10 home-to-work trips in the GMSM home to work car matrix, then the estimated number of trips between zones i and j in the disaggregated home to work mobile phone matrix was calculated to be:

$$14.2 = 100.0 \times (10.0 / 70.0)$$

Average default proportions calculated across the whole matrix were used to disaggregated movements between cells where there were no trips in the GMSM matrix but where trips did exist in the all-purpose mobile phone matrix.

5.31 The procedure was repeated for each OD pair and journey purpose category in turn to build up the disaggregated matrices. A cumulative rounding procedure was adopted when implementing the process to preserve matrix totals.

5.32 Basic checks were carried out to ensure that the journey purpose mixes were plausible. A regression analysis was also performed to compare the relationship between the number of from home trips beginning in each zone and the number of residential address. The correlation coefficients were lower than had been expected, however, with R^2 values of 0.73 for the AM peak hour, 0.59 for the inter-peak hour and 0.54 for the PM peak hour. By comparison, the corresponding figures for the 2012 GMSM car matrices were 0.72, 0.78 and 0.71 respectively, which suggested that the distribution of trips in the mobile phone matrices was different to that in the existing GMSM matrices, and that the spatial accuracy of the trip origins and destinations might not be as good as hoped at the transportation zone level.

5.33 In the light of these results it was decided to investigate a slightly different approach to allocating journey purposes to the mobile phone matrices, which involved compressing the matrices back to the mobile phone sector level before applying the GMSM purpose splits. The compressed (separate purpose) matrices were then expanded back to the transport zone level by using the number of residential addresses in each zone as weights to disaggregate home based trips between GMSM zones and weights calculated from the all-purpose trip end totals from the 2012 Saturn vehicle matrices for other trip purposes, similar to the procedure described in Section 4.3.

5.34 The steps in carrying out the procedure were as follows:

i. Compress the adjusted mobile phone matrices 4.4.7 back to the 631 zone mobile phone sector level

ii. Compress the separate purpose 2012 GMSM car matrices to the mobile phone sector level

iii. Use the purpose splits from the compressed GMSM matrices to disaggregate the all-purpose mobile phone trips between journey purposes, at the sector level

iv. Disaggregate the separate purpose 631 zone (sector) matrices back the 993 zone system by allocating trips to their constituent GMSM zones on a proportional basis, using row/column weights calculated from the number of residential addresses in each zone to apportion trips where the trip origin or destination purpose is home, or the number of all-purpose trip end totals derived from the 2012 Saturn car matrices as weights where the trip origin or destination purpose is not home.

5.35 The regression analysis for the updated matrices confirmed that there was a stronger relationship between the number of from home trips beginning in each zone and the number of residential address, with R^2 values of 0.85, 0.83 and 0.84 for the AM peak, PM peak and inter-peak hours respectively.

5.36 Table 5.6 shows trip totals for movements with an origin or destination inside Greater Manchester for the adjusted mobile phone matrices and the percentage differences between the corresponding totals for the 2012 GMSM post matrix estimation matrices by user class, vehicle type and time period.

Table 5.6 Adjusted Highway Matrix Totals

User Class	AM Peak Hour			Inter-Peak Hour			PM Peak Hour		
	2014 MP	2012 GMSM	% Diff	2014 MP	2012 GMSM	% Diff	2014 MP	2012 GMSM	% Diff
Commute Car	173,708	164,798	+5%	38,912	34,965	+11%	142,739	138,442	+3%
EB Car	16,915	16,304	+4%	28,372	27,487	+3%	20,086	18,798	+7%
Other Car	153,737	165,017	-7%	212,303	220,402	-4%	190,840	196,609	-3%
All Car	344,360	346,120	-1%	279,588	282,854	-1%	353,665	353,848	0%
LGV	42,356	40,678	+4%	40,931	39,534	+4%	34,242	33,628	+2%
OGV (PCU)	19,372	18,841	+3%	20,874	20,079	+4%	9,205	8,765	+5%
Total (PCUS)	406,088	405,639	0%	341,393	342,468	0%	397,112	396,241	0%

Expansion from 993 Zone to 1097 Zone System

5.37 The 2014 matrices from the GM SATURN Model are based on a 993 zone system. The zoning system utilised for the A6MARR model and subsequently the A6 to M60 Model is a more detailed and the number of zones is increased to 1097 zones.

5.38 The zones in the 1097 A6 to M60 model nest within the 993 zone GMSM zoning system. As such the trips allocated in the 993 zone system were split pro rata as per the splits in the A6 MARR model to produce a revised 1097 zone matrix.

6. Matrix Estimation

Introduction

6.1 The validation results for the prior PCU matrices indicated that only about 24% of the counted links across Greater Manchester had a GEH value of less than 5 in the AM peak hour. The corresponding figures for the PM peak and inter-peak hours were 23% and 21% respectively, indicating that matrix estimation using counts would have to be used if the assignment validation was to be significantly improved.

6.2 Separate matrix estimation runs were carried out for the car, LGV and OGV matrices for each of the modelled time periods. A total of four rounds of matrix estimation were carried out for each run, to ensure that the updated matrices did not change significantly between successive iterations, and that he procedure was satisfactorily converged. The method was as follows:

- Assign the prior matrix to the highway network to produce paths
- Run matrix estimation to produce a revised (estimated) demand matrix
- Assign the estimated demand matrix to produce revised paths
- Re-run matrix estimation using the prior matrix and the revised paths from above to produce a further estimate of the demand matrix
- Repeat
- Matrix Estimation stops once a degree of matrix 'stability' is reached

Traffic Count Data

6.3 The traffic count data for the matrix estimation runs was obtained from five sources:

- Manual classified counts from HFAS's traffic counts database (GMCounts)
- Automatic Traffic Counts (ATC) from HFAS's counts database
- ATC counts from the Highways Agency's TRADS database
- ATC and manual counts supplied by Cheshire East Council; and
- Entry and exit counts for car parks at Manchester Airport supplied by AECOM.

6.4 All counts were checked to exclude counts affected by known 'unusual' events such as accidents, road works, adverse weather conditions, holidays etc.

6.5 Where manual counts were used, separate counts were obtained for car, LGV, OGV and PCU flows for each of the modelled hours. Where ATC counts were used, all vehicle flows were obtained. These were converted into separate car, LGV, OGV and bus flows using vehicle composition factors calculated from manual counts at the same locations.

6.6 The counts were allocated to links in the highway network using an automatic count matching procedure developed by HFAS, based on the count OSGRs and the coordinates of the link polylines. The count and link direction and the count and link road class and number were also used as additional match criteria, to minimise the possibility of transcription errors.

6.7 For matrix estimation and validation purposes, all of the counts that were used in the validation were factored to a 2015 October average weekday using locally derived factors.

Count Checks

6.8 Matrix estimation procedures require accurate and consistent traffic counts if they are to work successfully. As matrix estimation strategies were developed, inconsistent counts were identified and eliminated from this process. Reasons for counts being eliminated included:

- Day-to-day variations in traffic flows
- Enumerator errors; and
- Other errors, such as count transcription errors, where counts are allocated to the wrong links or the wrong direction on a link.

6.9 Inconsistent counts were also identified through an automatic checking procedure within the SATURN programme, where counts violated 'Kirchoff's rule'. (These violations occur, for example, when two counts that are physically separated by intervening links are not equal, but where the assignment pattern indicates that all flows that pass through the first count site must also pass through the second).

6.10 Where it was thought that the discrepancies may have been caused by a counting error, or where the count might have been affected by unusual events that had not been picked up in the filtering exercise described above, then the counts were discarded. In situations where the inconsistencies were small, (such as might be caused by day-to-day variations in traffic flows), the counts were automatically averaged using the AVERK option in SATURN's SATPIJA program.

Cordons and Screenlines

6.11 To provide reassurance that the validation of the base year model was acceptable over a wider area counts on cordons and screenlines across Greater Manchester were included in the validation process. Overall, 908 counts were selected for matrix estimation and validation purposes across Greater Manchester. For the purposes of this report only cordons and screenlines within the A6 to M60 Area of Influence have been reported in detail but results for other cordons and screenlines within Greater Manchester are available on request from HFAS.

6.12 Overall, 1241 counts were selected for matrix estimation and validation purposes across Greater Manchester. For the purposes of this report only cordons and screenlines within the A6 to M60 Area of Influence have been reported in detail but results for other cordons and screenlines within Greater Manchester are available on request from HFAS.

6.13 In total, 516 of these counts were in the A6 to M60 AOI comprising of 373 counts input to the matrix estimation runs and 143 counts providing an independent check on the calibrated model.

6.14 Where possible, the matrix estimation counts were combined to form a series of cordons and screenlines within the study area, to intercept movements between local centres, and in those areas where the scheme benefits are most likely to occur.

6.15 In total, 20 (two-way) cordons and screenlines in the A6 to M60 AOI were formed for use in matrix estimation, as illustrated in Figure 6.1.

6.16 Two independent routes were formed running parallel to the A34and north of the M60 that was not used in matrix estimation, but which was set aside to provide an independent check on the calibrated model.

6.17 The remaining counts that were not used to form cordons and screenlines were divided into three groups comprising:

- TRADS counts on motorways for use in matrix estimation (approximately 40)
- Independent TRADS counts on motorways, (that were not used in matrix estimation), which were set aside to provide an independent check on the calibrated model (8); and
- Other Independent (ad hoc) counts on local roads in the study area, that were also set aside to provide an independent check on the calibrated model (approximately 60).

Point Zone Counts

6.18 In addition to the 'standard' zones representing areas with similar land use and travel patterns, the A6 to M60 SATURN model also includes a number of 'point zones', representing developments such as large superstores, hospitals and industrial estates.

6.19 Where point zone counts were available, the entry and exit flows at the point zone sites were used as zonal constraints in the matrix estimation runs.

6.20 Point zones within the Area of Influence include:

- Car Parks at Manchester Airport
- Retail Parks such as Cheadle Royal and Handforth Dean
- Individual superstores such as TESCO in Didsbury; and
- Business Parks/Trading Estates such as Stockport Trading Estate.

Manchester Airport Car Park Counts

6.21 The Manchester Airport car park counts were also used as zonal constraints in the matrix estimation runs, to ensure that movements within the airport site were modelled as accurately as possible.

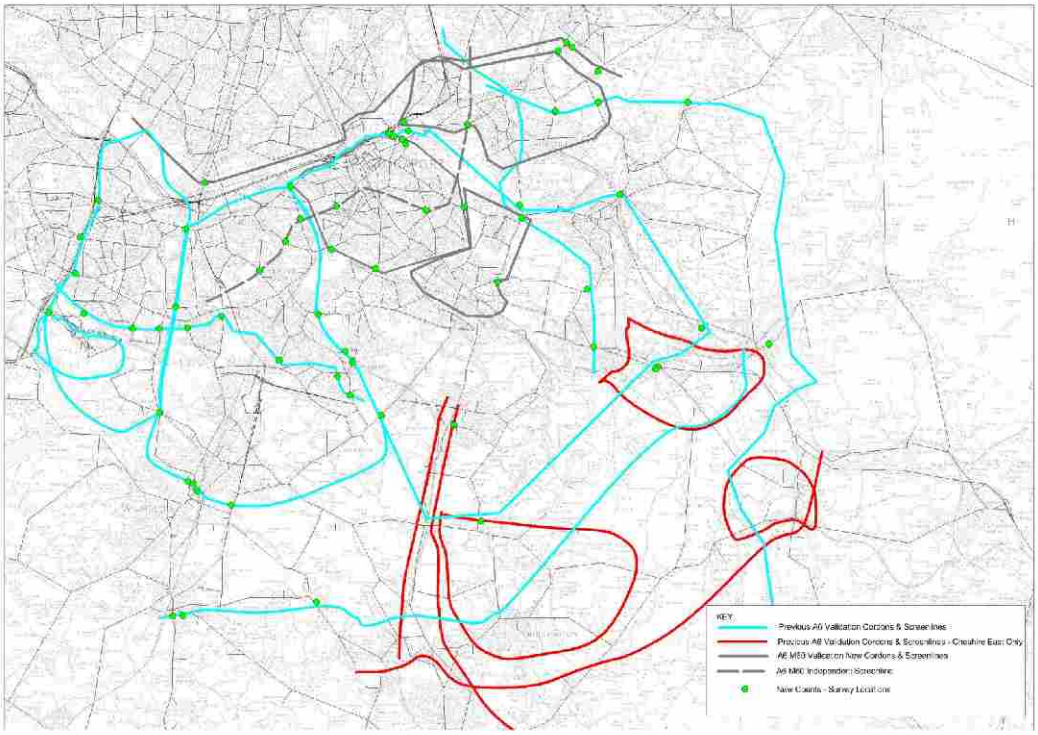


Figure 6.1 Cordon and Screenline Locations

Matrix Estimation Results

6.22 This section summarises the changes brought about by matrix estimation. It is divided into five parts describing:

- Changes to matrix totals
- Changes to zonal trip ends
- Changes in GEH frequency distributions for the prior and estimated matrices
- Changes in trip length distributions.

6.23 Table 6.1 shows the total trips in the estimated matrices and the percentage change from the prior matrices by vehicle type and time period for trips in the model.

Table 6.1 Total Trips in Estimated Matrices and Percentage Change from Prior Matrices

Vehicle Type	Time Period					
	AM Peak		Inter-Peak		PM Peak	
	Trips	% Change	Trips	% Change	Trips	% Change
Car	1096353	-1.12%	837751	-1.08%	1087589	-0.89%
LGV	48175	3.41%	46374	0.63%	39968	1.94%
OGV	29333	5.53%	32607	2.93%	15706	4.70%
Total (PCUS)	1173862	-1.06%	916733	-1.06%	1246597	-0.84%

6.24 For cars, the total numbers of trips have reduced in all three time periods, by approximately 1.1% in the AM peak hour, 1.0% in the inter-peak and 1.0% in the PM peak hour. For LGVs the total trips have increased in all three time periods, ranging from an approximate 3% increase in LGV trips in the AM peak hour to an approximate 1% in the interpeak and evening peak. For OGVs the total trips have decreased in the AM and PM peak hour ranging from an approximate 1.0% decrease in OGV trips in each time period.

6.25 Overall, the total change in PCU trips is relatively small, with a reduction of approximately 1% in each modelled hour

6.26 Appendix 2 gives a more detailed comparison of the prior and estimated matrices based on the aggregation of the 1097 A6 to M60 zones to the 12 sectors shown in Figure 6.2. Any sector that changes by greater than 5% and 250 pcu's are highlighted in grey.

6.27 In the morning peak the majority of changes in sector to sector movements are within 5% of 250 pcu's. However, the greatest changes in the prior to post sector to sector movements are as follows;

- Trafford (Outside M60) to Manchester West of A34 with a decrease of 572 pcu's – this would not use the proposed scheme;

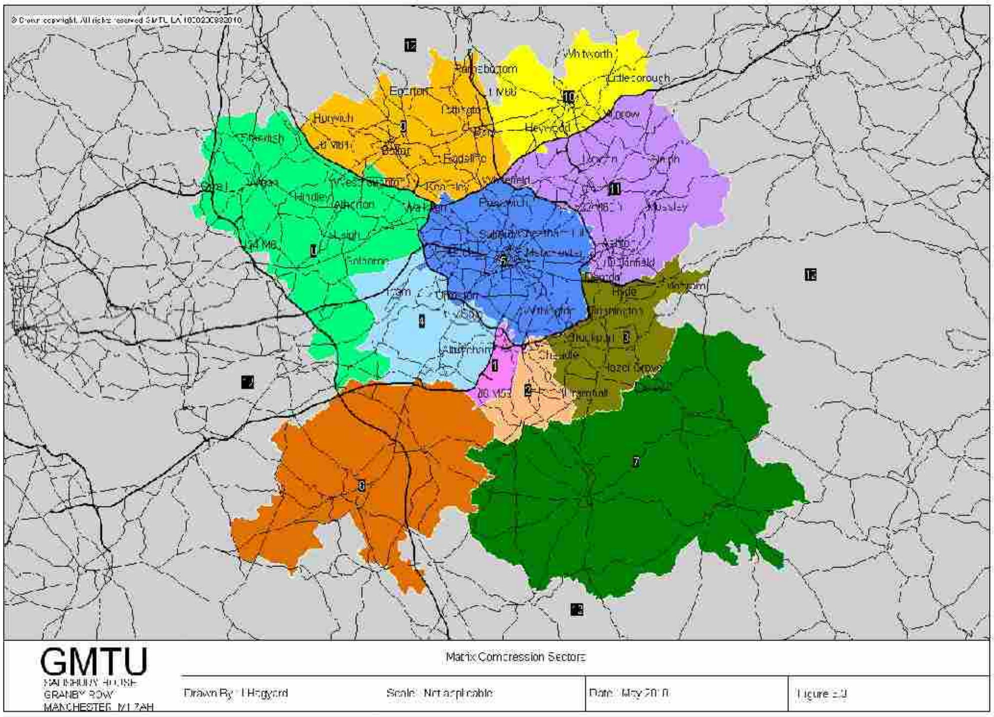
- Trafford (Outside M60) to Wigan with a decrease of 720 pcu's – this would not use the proposed scheme;
- Wigan to Trafford (Outside M60) with a decrease of 809 pcu's – this would not use the proposed scheme;
- Rochdale to Manchester Within M60 with a decrease of 739 pcu's – this would not use the proposed scheme;
- Rochdale to Manchester Within M60 with a decrease of 739 pcu's – this would not use the proposed scheme.

6.28 In the interpeak the majority of changes in sector to sector movements are within 5% of 250 pcu's. However, the greatest changes in the prior to post sector to sector movements are as follows;

- East of A34 to West of A34 –with an increase of 924 pcu's these are local trips that are unlikely to use the proposed scheme
- Trafford (Outside M60) to Wigan with a decrease of 506 pcu's – this would not use the proposed scheme;
- Wigan to Trafford (Outside M60) with a decrease of 581 pcu's – this would not use the proposed scheme.

6.29 In the evening peak the majority of changes in sector to sector movements are within 5% of 250 pcu's. However, the greatest changes in the prior to post sector to sector movements are as follows;

- Trafford to Manchester (East of M46) with an increase of 630- pcu's - these would shorter distance trips that are unlikely to use the proposed scheme.
- Trafford to Manchester Within the M60 with an increase of 1500 pcu's – the majority of these movements would be to the North and West of the proposed scheme and as such would not be route via the scheme
- Trafford to Wigan with an decrease of 600 pcu's – the majority of these movements would be to the North and West of the proposed scheme and as such would not be route via the scheme
- Manchester Within the M60 to Cheshire East with an increase of 773 pcu's but as this zone encompasses the majority of the district district and given the location of the scheme to the South of the district only a marginal amount of this reduction in trips would have used the proposed scheme. Overall, this would slightly increase the forecast benefits of the proposed scheme;
- Wigan to Trafford with an decrease of 600 pcu's – the majority of these movements would be North to South movements and as such would not be route via the scheme


Whitworth
Littleborough
Heywood
Horwich
Egerton
Ramsbottom
Wigan
Hindley
Atherton
Leigh
Walkden
Prestwich
Partington
Altrincham
Hyde
Stockport
Hazel Grove
GMTU
GRANBY ROW
Matrix Compression Sectors
Scale: Not applicable

Changes to Zonal Trip Ends

6.30 Table 6.2 shows regression statistics (slopes, intercepts and R-Squared values) for the best fit line obtained by regressing trip end totals from the estimated matrix against the prior matrix. Separate results are presented for the car, LGV, OGV and all vehicle PCU matrices, for each of the modelled hours. TAG suggests that the slope of the regression line should fall within the range 0.99 to 1.01, that the intercept should be near to zero and that the R-squared value should be in excess of 0.98, but notes that these figures may be difficult to achieve in large scale strategic models. The values of the regression statistics will, for example, be dependent on zone sizes, the numbers of trips generated in each zone and the number of movements that are updated by the matrix estimation procedure.

Table 6.2 Summary of Matrix Estimation Zonal Trip End Changes

Time Period	Matrix	Slope	Intercept	R-Squared
Weekday AM Peak	Car	1.00	19.98	1.00
	LGV	1.00	-2.75	0.94
	OGV (PCU)	1.08	-0.95	0.93
	All Vehicle (PCU)	1.00	16.35	1.00
Weekday Inter-Peak	Car	1.00	14.57	1.00
	LGV	1.00	-0.58	0.94
	OGV (PCU)	1.04	-0.58	0.95
	All Vehicle (PCU)	1.00	14.66	1.00
Weekday PM Peak	Car	1.01	1.07	1.00
	LGV	0.99	-0.60	0.93
	OGV (PCU)	1.05	-0.13	0.94
	All Vehicle (PCU)	1.01	-0.49	1.00

6.31 The R-Squared values for the weekday car matrices meet the TAG criteria in all time periods. The values of the slope statistics also meet the benchmark figures in all time periods. The values of the intercepts range from 1.07 for the evening peak matrix to 20 for the morning peak matrix. As noted above, however, the size of the intercept value will be dependent on the number of trips generated in each zone, and is likely to be greater for matrices with large cell values.

6.32 The regression statistics for the weekday LGV and OGV matrices fail to achieve the TAG criteria, with R-squared values ranging from 0.93 to 0.95, and slopes ranging from 0.99 to 1.08. This is probably related to the small number of trips in the commercial vehicle matrices, and difficulties obtaining robust regression statistics for small sample sizes. The results for the all-vehicle PCU matrices are very good, however, with the R-squared and slope values achieving the benchmark criteria in all time periods.

6.33 In the morning peak the absolute difference for origins ranges from -223 pcu's to 147 pcu's but most of these are located in the external network remote to the proposed scheme and Trafford Park which was updated with new Origin Destination data from another study . For destinations changes in total number of trips ranges from -451 pcu's to 540 pcu's but these are located in the external network remote to the proposed scheme and Trafford Park which has been recently updated with new count data.

6.34 In the interpeak the absolute difference for origins ranges from-211 pcu's to 235 pcu's the majority of which are remote to the proposed scheme or external to the study area and Greater Manchester and again zones associated with Trafford Park. For destinations two zones have increases in total number of trips ranges from -667 pcu's to 434 pcu's but the majority are located in the external network remote to the proposed scheme and Trafford Park which has been recently updated with new count data. In the area of the scheme two zones show larger decreases of approximately 300 pcu's and these are located in Cheadle Heath Retail Park and Roundthorn Industrial Park which have updated count data.

6.35 In the evening peak the absolute difference for origins ranges from-930 pcu's to 2438 pcu's (external zones)the majority of which are remote to the proposed scheme or external to the study area and Greater Manchester and again zones associated with Trafford Park. For destinations two zones have increases in total number of trips ranges from -1142 pcu's to 534 pcu's but these are located in the external network remote to the proposed scheme and Trafford Park which has been recently updated with new count data.

Changes to GEH Frequency Distributions

6.36 Tables 6.3 to 6.5 show GEH[1] frequency distributions from the assignment of the prior and estimated matrices for the AM peak, inter-peak and PM peak hours. The tables give an indication of the way in which the estimated matrices improve the assignment validation. Separate results are presented for the independent counts, the matrix estimation counts and for all counts combined.

6.37 Considering the results for the AM [1]peak hour, approximately 89% of the counted links used in Matrix Estimation have a GEH value of less than 6 for the prior matrix, for all counts combined. This figure increases to almost 85% for the updated matrix, demonstrating how matrix estimation has improved the assignment validation.

[1] GEH is an error statistic incorporating both relative and absolute errors. The form of the statistic is defined in Paragraph 7.9 of this report.

Table 6.3 AM Peak Hour GEH Cumulative Frequency Distributions for the Prior and Estimated Matrices

GEH Range	Prior Matrix			Estimated Matrix		
	Independent Counts	Matrix Estimation Counts	All Counts	Independent Counts	Matrix Estimation Counts	All Counts
0 - 2	3.4%	13.0%	12.8%	21.8%	64.0%	58.7%
0 - 4	13.8%	28.3%	28.0%	38.2%	79.9%	74.6%
0 - 6	20.7%	41.1%	40.7%	52.7%	89.9%	85.2%
0 - 8	24.1%	53.0%	52.4%	65.5%	94.2%	90.5%
0 - 10	27.6%	62.1%	61.4%	67.3%	97.9%	94.0%

6.38 The results for the inter-peak and PM peak hours follow a similar pattern, with approximately 47% of the counted links for the inter-peak prior matrix having a GEH value of less the 6, and an equivalent figure of 42% for the PM peak matrix. The link flow comparisons for the updated matrices indicate that approximately 91% and 88%of the counted links have a GEH value of less than 6 for the inter-peak hour and the PM peak hour respectively.

Table 6.4 Inter-Peak Hour GEH Cumulative Frequency Distributions for the Prior and Estimated Matrices

GEH Range	Prior Matrix			Estimated Matrix		
	Independent Counts	Matrix Estimation Counts	All Counts	Independent Counts	Matrix Estimation Counts	All Counts
0 - 2	13.8%	16.4%	16.3%	38.2%	72.8%	68.4%
0 - 4	27.6%	32.9%	32.8%	52.7%	85.0%	80.9%
0 - 6	58.6%	47.4%	47.7%	69.1%	91.5%	88.2%
0 - 8	62.1%	58.4%	58.4%	76.4%	94.7%	92.4%
0 - 10	69.0%	68.2%	68.2%	85.5%	98.9%	97.2%

Table 6.5 PM Peak Hour GEH Cumulative Frequency Distributions for the Prior and Estimated Matrices

GEH Range	Prior Matrix: Independent Counts	Prior Matrix: Matrix Estimation Counts	Prior Matrix: All Counts	Estimated Matrix: Independent Counts	Estimated Matrix: Matrix Estimation Counts	Estimated Matrix: All Counts
0 - 2	3.4%	20.7%	15.0%	18.2%	58.8%	53.7%
0 - 4	17.2%	28.4%	28.6%	67.3%	80.5%	74.9%
0 - 6	27.6%	53.0%	42.7%	76.4%	87.6%	82.3%
0 - 8	31.0%	64.0%	53.4%	81.8%	90.8%	85.7%
0 - 10	31.0%	68.1	64.7%	83.6%	95.0%	89.4%

Changes to Trip Length Distributions

6.39 Table 6.6 compares mean trip lengths for movements with an origin or destination in GM and the extended A6 to M60 Area of Influence in the prior and estimated matrices by vehicle type and time period.

6.40 For cars, the mean trip lengths have reduced in the morning and evening time periods, with a reduction of approximately 4.6% in the AM peak hour and 5.3% in the PM Peak hour. The inter peak hour has an increase of 8.14%.

6.41 Although the changes in peak period car trip lengths slightly exceed guidance, they are broadly in line with similar changes for other versions of the Saturn model (References 3 and 10). The changes that have been made to the matrices have also brought about a significant improvement in the link flow validation, as described above.

6.42 The LGV matrices exhibit decreases in mean trip lengths the morning and evening time periods, of approximately 8% and an increase in the inter peak hour of 4%.

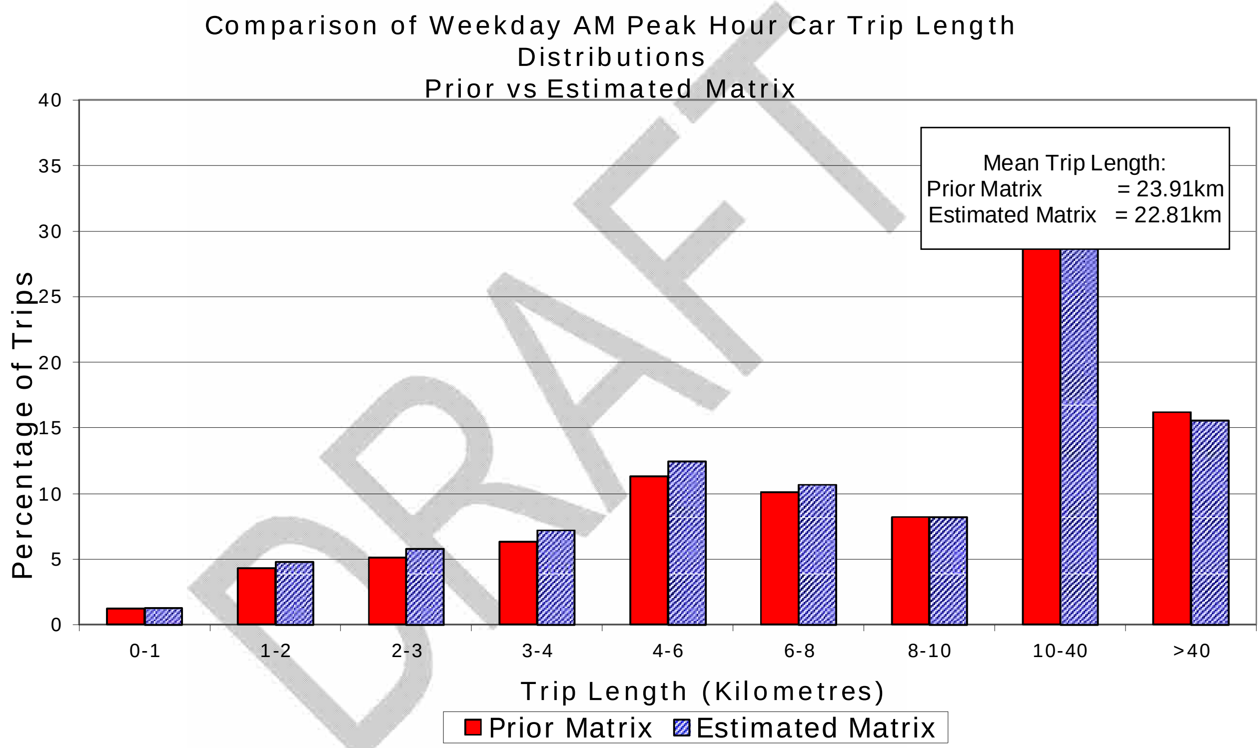
6.43 However, the numbers of LGV trips are relatively small, so that these changes are modest in terms of overall network kilometres.

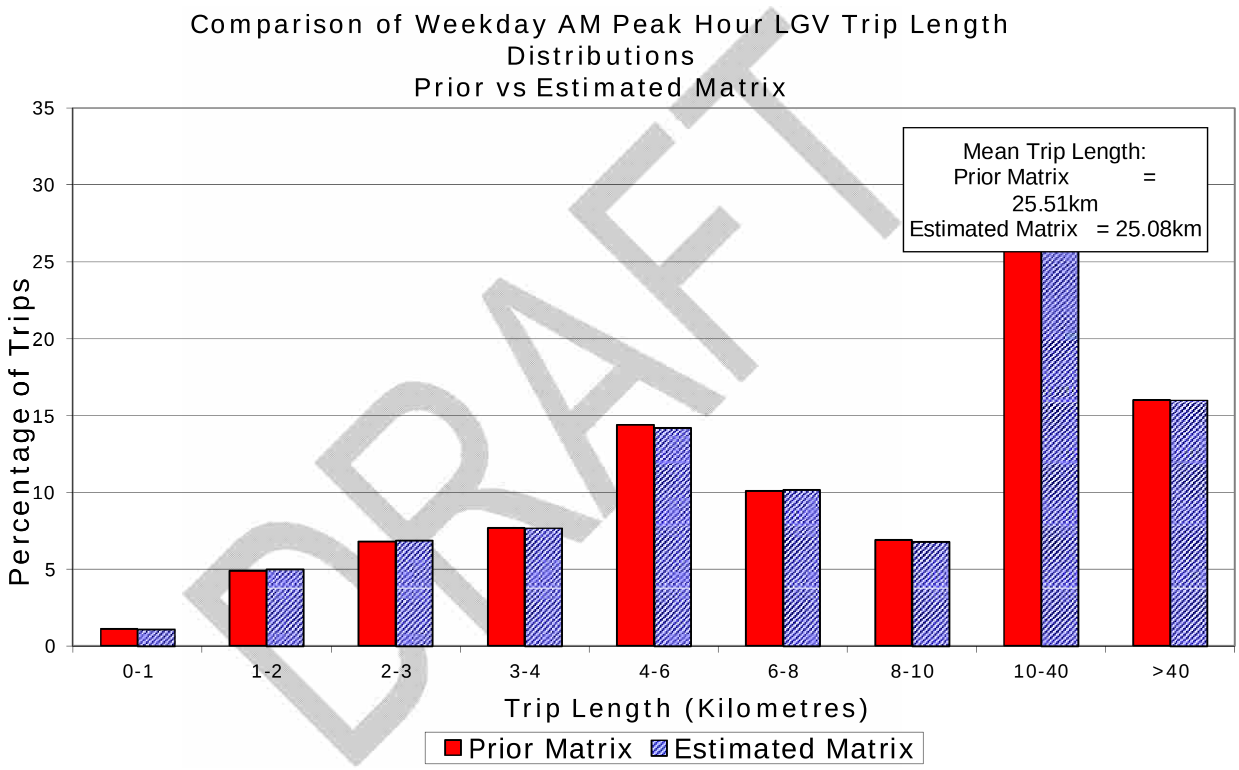
Table 6.6	Comparison of Mean Trip Lengths in the Prior and Estimated Matrices for Trips with an Origin or Destination in GM and Extended A6 to M60 Model					
Vehicle Type	Time Period					
	AM Peak		Inter-Peak		PM Peak	
	Mean (km)	% Change	Mean (km)	% Change	Mean (km)	% Change
Car	22.80	-4.62	21.60	8.14%	23.58	-5.29
LGV	25.00	-1.70	24.37	4.36%	24.78	-1.66
OGV	37.49	-12.82	38.01	-8.94%	48.35	-10.12%

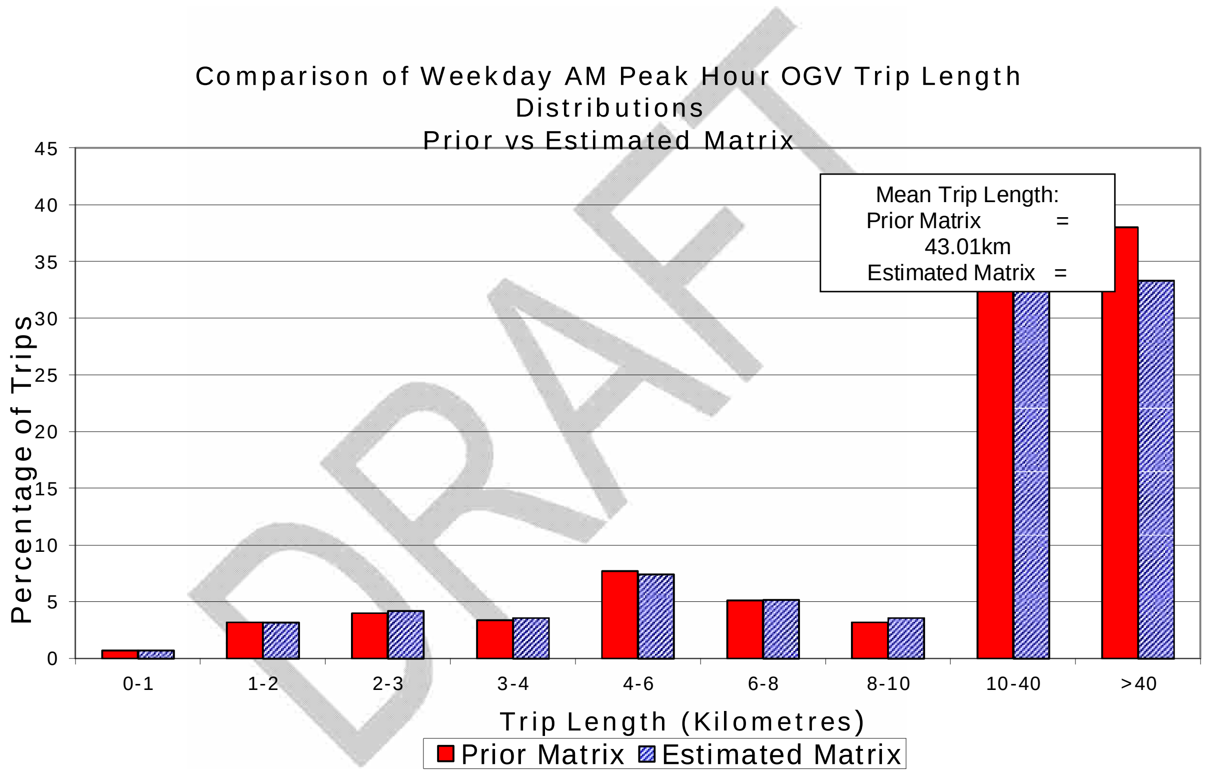
6.44 The OGV matrices exhibit the greatest changes in mean trip lengths, with decreases in all three time periods, ranging from approximately 13% in the AM peak, 9% in the inter peak hour to 10% in the PM peak hour. As noted earlier, however, the numbers of OGV trips are relatively small, so these changes are modest in terms of overall network kilometres.

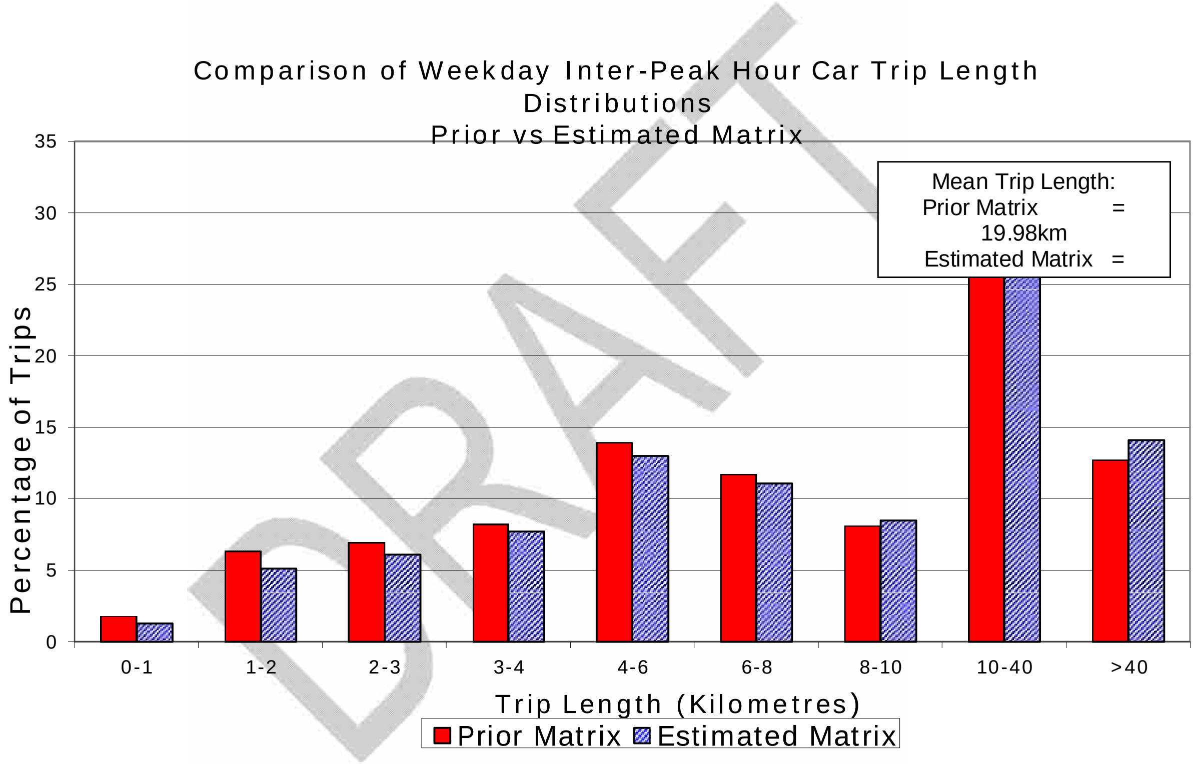
6.45 In summary, the changes to car and LGV trip lengths in all periods are fairly small. Changes in OGV trip lengths are more significant, particularly in the inter-peak and PM peak hours when the numbers of longer distance trips increase. However, the numbers of OGV trips are relatively small. We therefore consider the changes to be acceptable.

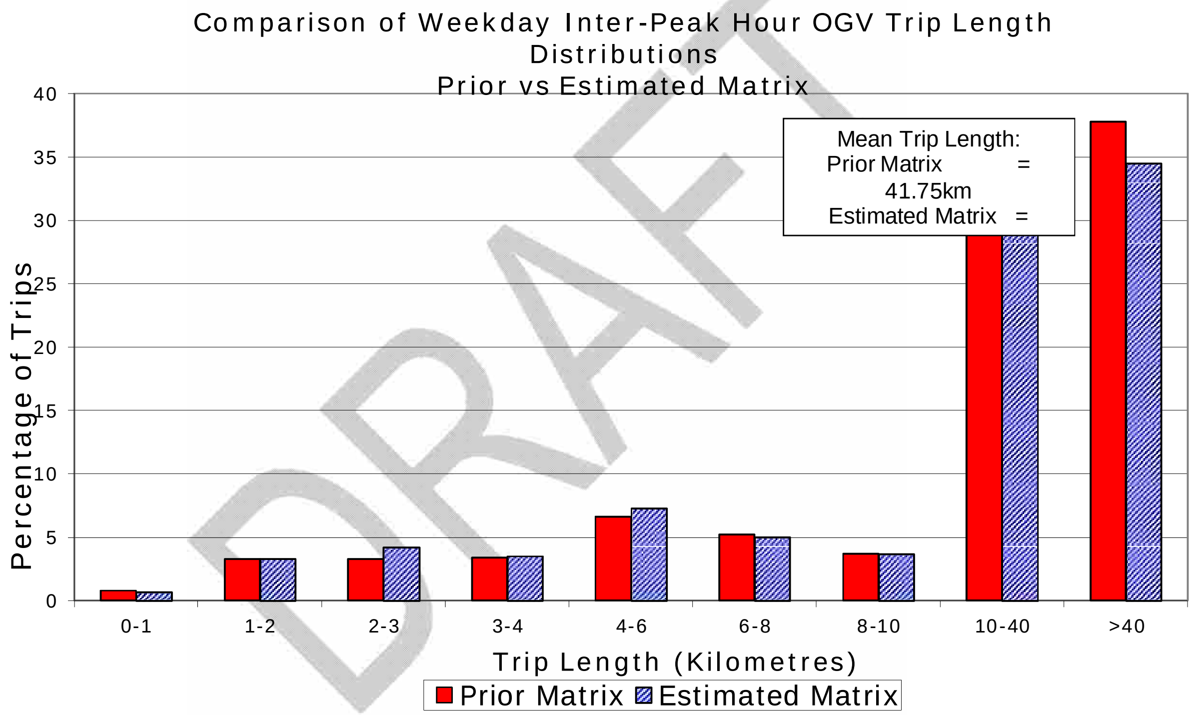
6.46 The changes in the trip length distributions are illustrated graphically in Figures 6.3 - 6.11, for the weekday and Saturday models, for each of the modelled hours.

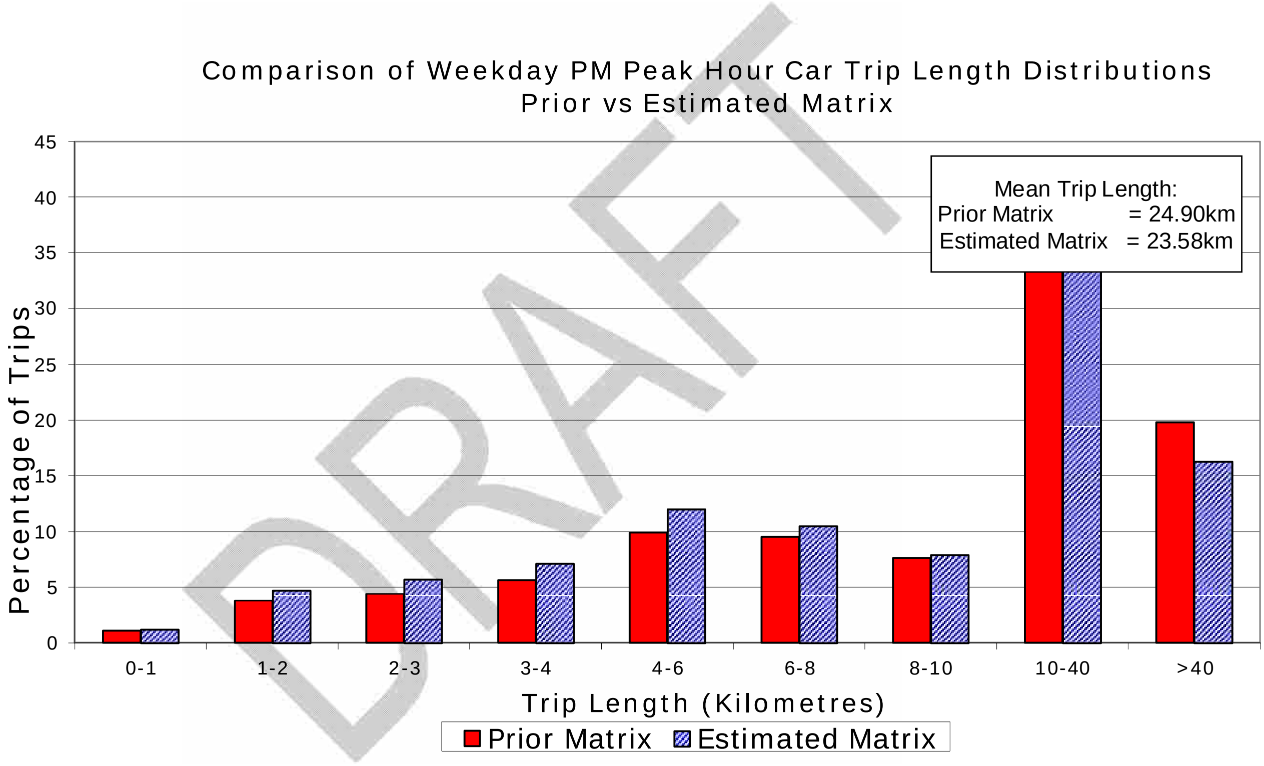

Comparison of Weekday AM Peak Hour Car Trip Length Distributions
Prior vs Estimated Matrix
Mean Trip Length:
Prior Matrix = 23.91km
Estimated Matrix = 22.81km
Percentage of Trips
40
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-6
6-8
8-10
10-40
>40
Trip Length (Kilometres)
Prior Matrix
Estimated Matrix

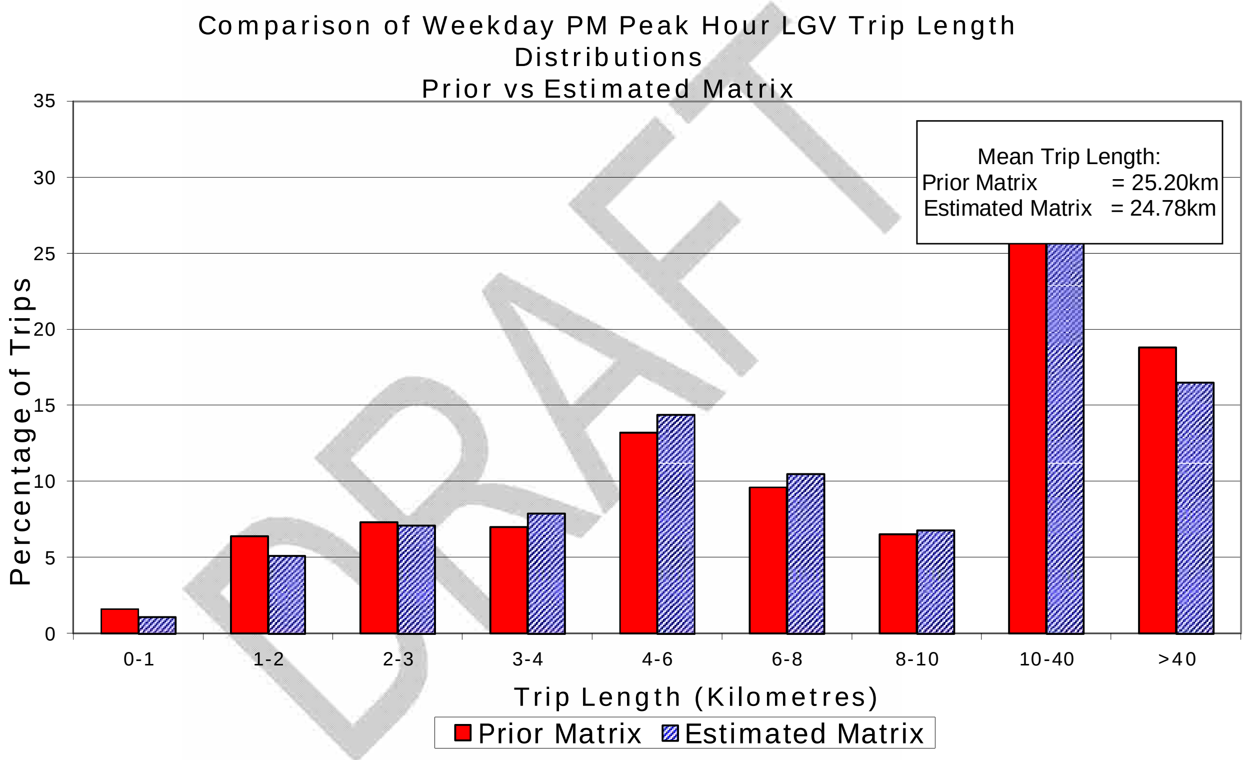

Comparison of Weekday AM Peak Hour LGV Trip Length Distributions
Prior vs Estimated Matrix
Mean Trip Length:
Prior Matrix = 25.51km
Estimated Matrix = 25.08km
Percentage of Trips
0
5
10
15
20
25
30
35
0-1
1-2
2-3
3-4
4-6
6-8
8-10
10-40
>40
Trip Length (Kilometres)
Prior Matrix
Estimated Matrix
DRAFT

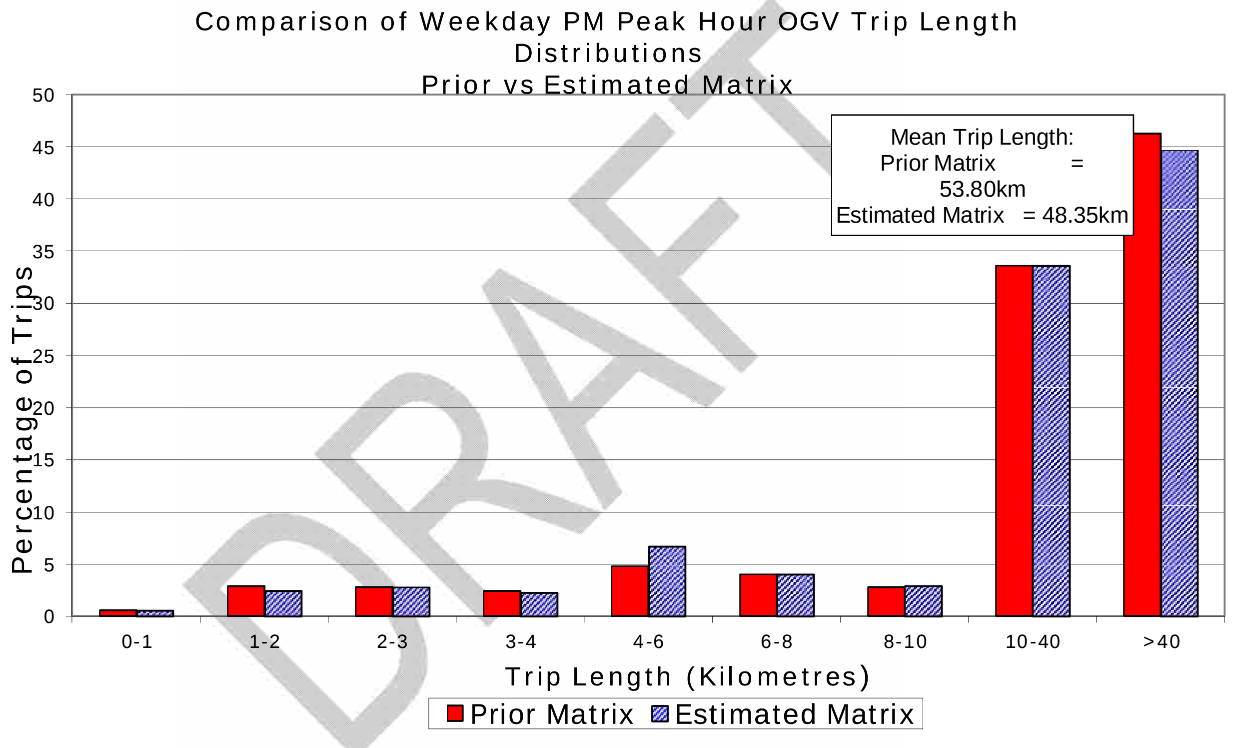

Comparison of Weekday AM Peak Hour OGV Trip Length Distributions
Prior vs Estimated Matrix
Mean Trip Length:
Prior Matrix = 43.01km
Estimated Matrix =
Percentage of Trips
45
40
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-6
6-8
8-10
10-40
>40
Trip Length (Kilometres)
Prior Matrix
Estimated Matrix
DRAFT


Comparison of Weekday Inter-Peak Hour Car Trip Length Distributions
Prior vs Estimated Matrix
Mean Trip Length:
Prior Matrix = 19.98km
Estimated Matrix =
Percentage of Trips
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-6
6-8
8-10
10-40
>40
Trip Length (Kilometres)
Prior Matrix
Estimated Matrix
DRAFT


Comparison of Weekday Inter-Peak Hour OGV Trip Length Distributions
Prior vs Estimated Matrix
Mean Trip Length:
Prior Matrix = 41.75km
Estimated Matrix =
Percentage of Trips
40
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-6
6-8
8-10
10-40
>40
Trip Length (Kilometres)
Prior Matrix
Estimated Matrix


Comparison of Weekday PM Peak Hour Car Trip Length Distributions
Prior vs Estimated Matrix
Mean Trip Length:
Prior Matrix = 24.90km
Estimated Matrix = 23.58km
Percentage of Trips
45
40
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-6
6-8
8-10
10-40
>40
Trip Length (Kilometres)
Prior Matrix
Estimated Matrix
DRAFT


Comparison of Weekday PM Peak Hour LGV Trip Length Distributions
Prior vs Estimated Matrix
Mean Trip Length:
Prior Matrix = 25.20km
Estimated Matrix = 24.78km
Percentage of Trips
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-6
6-8
8-10
10-40
>40
Trip Length (Kilometres)
Prior Matrix
Estimated Matrix
DRAFT


Comparison of Weekday PM Peak Hour OGV Trip Length Distributions
Prior vs Estimated Matrix
Mean Trip Length:
Prior Matrix = 53.80km
Estimated Matrix = 48.35km
Percentage of Trips
50
45
40
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-6
6-8
8-10
10-40
>40
Trip Length (Kilometres)
Prior Matrix
Estimated Matrix

7. Traffic Flow Validation

Introduction

7.1 This section presents the link flow validation results for the updated matrices output from the matrix estimation procedure. It summarises the level of network convergence and compares assigned and observed link flows for each of the three modelled time periods using the criteria set out in the Webtag Unit M3.1. Separate results are presented for the matrix estimation counts, for the independent counts and for all counts combined.

Network Convergence

7.2 Webtag guidance states that 'convergence is the key to robust economic appraisal' because, with a poorly converged base and/or test network, it is impossible to distinguish scheme effects from assignment 'noise'. Consequently, particular efforts were made to ensure that the networks were as highly converged as possible. This was achieved, but at the cost of protracted run times.

7.3 The Webtag criteria for an acceptable level of network convergence are that:

- Delta should be less than 1% on the final assignment; and
- More than 90% of links should have a flow that changes by less than 5% on the final 4 iterations. Note, however, that HFAS normally adopt stricter criteria, that more than 99% (98.5% prior to rounding) of links should have a flow change of less than 2% on the final four iterations.

7.4 Table 7.1 shows the above values for each of the modelled hours. The table indicates that the model meets DMRB convergence criteria, and that the model was well converged in all time periods, with Delta values well below 1% and the percentage of links with flows changing by less than 2% being over 98% in all cases.

Table 7.1 2015 A6 to M60 SATURN Model Network Convergence Statistics

Criterion	Target	AM Peak	Inter Peak	PM Peak
Delta	<1%	0.0111	0.0079	0.0210
Percentage of links with <2% flow change on final iteration	>99%	99.37	99.81	99.59
Final iteration –1		99.42	99.80	99.52
Final iteration –2		99.53	99.75	99.61
Final iteration –3		98.31	99.81	99.55

Assignment Validation Guidelines

7.5 The DMRB Volume 12 (reference 1) Table 4.2 sets out validation guidelines for comparing modelled and observed traffic flows based on the level of flow in vehicles per hour (vph). These are:

- For observed flows less than 700 vph, at least 85% of model flows should be within 100 vph of observations

- For observed flows of between 700 and 2700 vph, at least 85% of model flows should be within 15% of observations; and

- For observed flows greater than 2700 vph, at least 85% of model flows should be within 400 vph of observations

These criteria are referred to as the DMRB flow criteria in the text, and as ‘All DMRB’ in the tables.

7.6 Given that SATURN matrices are generally in units of PCUs per hour, the above criteria are assumed to apply to PCU flows.

7.7 In addition to the flow criteria described above, the DMRB also refers to the GEH statistic, where the guideline is that greater than 85% of counted links should have a GEH value of less than 5.

7.8 DMRB also requires that for any cordons and screenlines, the GEH value calculated over the cordon or screenline as a whole should be less than 4 in nearly all cases.

7.9 Finally, the DMRB requires that, taking all counts together, the slope of the best fit regression line should lie in the range 0.9 to 1.1, and the corresponding R-squared value should be greater than 0.95.

GEH Statistic

The GEH error statistic is a form of the Chi squared statistic incorporating both relative and absolute errors. The DMRB Volume 12 (reference 1) refers to the GEH statistic, where;

$$GEH = \sqrt{\frac{(M-C)^2}{(M+C) \;/2}}$$

and, M is the modelled flow

C is the observed flow (count).

Link Flow Comparisons for Matrix Estimation Counts

7.10 This section presents the validation results for sites in that were used during matrix estimation. Results are presented for the sites comprising the 10 cordons/ screenlines used as constraints during the matrix estimation, and for adhoc (TRADS) sites on the M56/M60 Motorways.

Matrix Estimation Cordons and Screenlines

7.11 In total, counts on 18 (two-way) cordons and screenlines were used during matrix estimation, as illustrated in Figure 6.1 and described below in Table 7.2.

Table 7.2 Matrix Estimation Cordons and Screenlines

Cordon/Screenline Number/Name		Direction	Number of Sites
1	A6 M60 RSI Cordon 1	Inbound Outbound	10 10
2	A6 M60 RSI Cordon 2	Inbound Outbound	20 20
3	A6 M60 RSI Cordon 3	Inbound Outbound	22 22
4	Manchester Airport Cordon	Inbound Outbound	5 5
5	Stockport Cordon	Inbound Outbound	14 14
6	Hazel Grove and Offerton Cordon	Inbound Outbound	8 8
7	Romiley -and Brinnington Cordon	Inbound Outbound	9 9
8	Bollington and Adlington Cordon	Inbound Outbound	6 6
9	Disley and Newton Cordon	Inbound Outbound	6 6
10	Whaley Bridge and Horwich Cordon	Inbound Outbound	5 5
11	Tameside Manchester Stockport North of M60 Screenline	Northbound Southbound	13 13
12	Bredbury to High Lane screenline	Eastbound Westbound	7 7
13	North of A6 M60	Northbound Southbound	10 9
14	A523 East Screenline	Eastbound Westbound	7 7
15	A523 West Screenline	Eastbound Westbound	5 5
16	Alderley Edge To New Mills Screenline	Northbound Southbound	11 11
17	Prestbury to Whaley Bridge Screenline	Northbound Southbound	10 10
18	Romiley to Kettleshulme Screenline	Eastbound Westbound	8 8
Total sites		-	351

7.12 The validation results for the matrix estimation cordons and screenlines are shown below in Tables 7.3 to 7.5. Results are presented for each of the three time periods for all vehicle types combined as PCUs. For each screenline and direction of travel, the tables show the number of count sites, the total observed flow, the total modelled flow, the difference between the modelled and observed flows and the percentage difference between the modelled and observed flows. The tables also show the screenline GEH value, which the DMRB recommends should be less than 4 in nearly all cases. The percentage of all individual count sites with a GEH value of less than 5 is shown at the bottom of the tables, together with the percentage of sites meeting either the DMRB1, DMRB2 or DMRB3 link flow criteria.

7.13 Table 7.3 compares modelled and observed flows in the AM peak hour. 28 out of 36 (two way) cordons/screenlines having a screenline GEH value of less than 4 and of these 3 marginally exceed 4.0. At the site level, approximately 89% of the sites have a GEH value of less than 5, and meet the combined DMRB link flow criteria, which satisfies the DMRB requirements.

Table 7.3 Comparison of AM Peak Hour Modelled and Observed Cordon and Screenline Crossing Flows for Counts used During Matrix Estimation (Actual Flows, All Vehicle Types)

Cordon	Direction	Number Of Sites	Observed Flow	Modelled Flow	Difference	% Difference	Screenline GEH
1	Inbound	10	7028	7007	-21	-0.3%	0.3
	Outbound	10	6672	6432	-240	-3.6%	3.0
2	Inbound	20	14446	14251	-195	-1.3%	3.9
	Outbound	20	14968	15063	95	0.6%	0.8
3	Inbound	22	11489	11207	-282	-2.5%	2.6
	Outbound	22	11596	11334	-262	-2.3%	2.4
4	Inbound	5	2277	2244	-33	-1.5%	0.7
	Outbound	5	1285	1190	-95	-7.4%	2.7
5	Inbound	14	10633	10003	-630	-5.9%	6.0
	Outbound	14	8037	8116	79	1.0%	0.9
6	Inbound	8	5264	4900	-364	-6.9%	5.5
	Outbound	8	5326	4950	-376	-7.1%	6.2
7	Inbound	9	9760	9755	-5	-0.1%	0.1
	Outbound	9	10169	10009	-160	-1.6%	1.6
8	Inbound	6	877	973	96	11.0%	3.2
	Outbound	6	999	1148	149	14.9%	4.5
9	Inbound	6	1456	1420	-36	-2.5%	0.9
	Outbound	6	1582	1524	-58	-3.7%	1.5
10	Inbound	5	1229	1085	-144	-11.7%	4.2
	Outbound	5	1216	1228	12	1.0%	0.3
11	Northbound	13	11107	10685	-422	-3.8%	4.0
	Southbound	13	11301	10842	-459	-4.1%	4.4
12	Eastbound	7	3017	3031	14	0.5%	0.3
	Westbound	7	4697	4770	73	1.6%	1.1
13	Northbound	10	9975	9688	-287	-2.9%	2.9
	Southbound	9	9594	9482	-112	-1.2%	1.1
14	Eastbound	7	1317	1314	-3	-0.2%	0.1
	Westbound	7	2145	1887	-258	-12.0%	4.0
15	Eastbound	5	1653	1653	0	0.0%	0.0
	Westbound	5	2030	1946	-84	-4.1%	1.9
16	Northbound	11	3275	3421	146	4.5%	2.5
	Southbound	11	3363	3342	-21	-0.6%	0.4
17	Northbound	10	4032	3800	-232	-5.8%	6.0
	Southbound	10	4461	4123	-338	-7.6%	5.5
18	Eastbound	8	2058	1975	-83	-4.0%	1.8
	Westbound	8	2587	2522	-65	-2.5%	1.3

Notes:

Percentage of all sites with GEH < 5 = 89.3%
Percentage of all sites meeting DMRB flow criteria = 89.1%

7.14 Table 7.4 compares modelled and observed screenline crossing flows in the inter-peak hour in PCUs. Overall, the comparisons are good, with 28 out of 36 (two way) cordons/screenlines having a screenline GEH value of less than 4 and of these 4 marginally exceed 4.0. At the site level, approximately 90% of sites have a GEH value of less than 5 and meet the combined DMRB link flow criteria, which is well within the DMRB guidelines.

7.15 The screenline with the greatest difference in modelled flow to counts is the Prestbury to Whaley Bridge screenline. This screenline is remote to the proposed scheme and there are difficulties identifying short distance trips particularly in more rural areas. Furthermore, the spatial accuracy which phone locations can be determined is dependent on antenna/cell tower coverage. Locations should be most accurate in areas with a high density of cell towers, typically comprising town centres and areas with high population, but will be less accurate elsewhere particularly in more rural areas.

Table 7.4 Comparison of Inter Peak Hour Modelled and Observed Cordon and Screenline Crossing Flows for Counts used During Matrix Estimation (Actual Flows, All Vehicle Types)

Cordon	Direction	Number Of Sites	Observed Flow	Modelled Flow	Difference	% Difference	Screenline GEH
1	Inbound	10	5744	5794	50	0.9%	0.7
	Outbound	10	5772	5713	-59	-1.0%	0.8
2	Inbound	20	12023	11970	-53	-0.4%	0.5
	Outbound	20	11971	11979	8	0.1%	0.1
3	Inbound	22	11716	11120	-596	-5.1%	3.9
	Outbound	22	11990	11419	-571	-4.8%	4.1
4	Inbound	5	1550	1432	-118	-7.6%	3.1
	Outbound	5	1393	1265	-128	-9.2%	3.5
5	Inbound	14	9511	9090	-421	-4.4%	6.0
	Outbound	14	9585	9222	-363	-3.8%	4.4
6	Inbound	8	5357	5158	-199	-3.7%	2.7
	Outbound	8	5512	5333	-179	-3.2%	4.1
7	Inbound	9	10238	10666	428	4.2%	4.2
	Outbound	9	10182	10314	132	1.3%	1.3
8	Inbound	6	602	701	99	16.5%	3.9
	Outbound	6	638	697	59	9.3%	2.3
9	Inbound	6	1798	1692	-106	-5.9%	2.5
	Outbound	6	1823	1704	-119	-6.5%	2.8
10	Inbound	5	998	825	-173	-17.3%	4.7
	Outbound	5	981	874	-107	-10.9%	3.5
11	Northbound	13	11033	10827	-206	-1.9%	2.0
	Southbound	13	10947	11053	106	1.0%	1.0
12	Eastbound	7	4049	4113	64	1.6%	1.0
	Westbound	7	4207	4153	-54	-1.3%	0.8
13	Northbound	10	9067	9123	56	0.6%	0.6
	Southbound	9	8509	8466	-43	-0.5%	0.5
14	Eastbound	7	1485	1391	-94	-6.3%	2.5
	Westbound	7	1476	1407	-69	-4.7%	1.8
15	Eastbound	5	1332	1154	-178	-13.4%	4.0
	Westbound	5	1307	1181	-126	-9.6%	3.6
16	Northbound	11	2678	2627	-51	-1.9%	1.0
	Southbound	11	2630	2560	-70	-2.7%	1.4
17	Northbound	10	3296	2435	-861	-26.1%	16.1
	Southbound	10	3192	2470	-722	-22.6%	13.6
18	Eastbound	8	2218	2277	59	2.7%	1.2
	Westbound	8	2276	2256	-20	-0.9%	0.4

Notes:

Percentage of all sites with GEH < 5 = 89.9
Percentage of all sites meeting DMRB flow criteria = 91.0

7.16 Table 7.5 compares modelled and observed screenline crossing flows in the PM peak hour for all vehicles combined as PCUs. In total, 26 out of 36 of the (two way) cordons/screenlines have a GEH value of less than 4 but of these 5 marginally exceed 4.0. At the site level, approximately 88% of the sites have a GEH value of less than 5, with 91% of the sites meeting the combined DMRB link flow criteria.

Table 7.5 Comparison of PM Peak Hour Modelled and Observed Cordon and Screenline Crossing Flows for Counts used During Matrix Estimation (Actual Flows, All Vehicle Types)

Cordon	Direction	Number Of Sites	Observed Flow	Modelled Flow	Difference	% Difference	Screenline GEH
1	Inbound	10	7626	7463	-163	-2.1%	1.9
	Outbound	10	8452	8043	-409	-4.8%	4.5
2	Inbound	20	17440	16990	-450	-2.6%	3.4
	Outbound	20	16281	16634	353	2.2%	2.8
3	Inbound	22	14736	14176	-560	-3.8%	4.7
	Outbound	22	15094	14579	-515	-3.4%	4.2
4	Inbound	5	1686	1625	-61	-3.6%	1.5
	Outbound	5	2758	2525	-233	-8.4%	4.0
5	Inbound	14	10712	10365	-347	-3.2%	3.1
	Outbound	14	12691	12002	-689	-5.4%	3.8
6	Inbound	8	6313	6001	-312	-4.9%	4.1
	Outbound	8	6857	6665	-192	-2.8%	3.5
7	Inbound	9	13095	14173	1078	8.2%	3.0
	Outbound	9	14337	13551	-786	-5.5%	4.1
8	Inbound	6	1164	1347	183	15.7%	5.2
	Outbound	6	1011	1093	82	8.1%	2.5
9	Inbound	6	2339	2136	-203	-8.7%	3.7
	Outbound	6	2198	2195	-3	-0.1%	0.1
10	Inbound	5	1477	1312	-165	-11.2%	3.8
	Outbound	5	1453	1251	-202	-13.9%	3.7
11	Northbound	13	15391	14510	-881	-5.7%	4.1
	Southbound	13	14573	14111	-462	-3.2%	3.8
12	Eastbound	7	5680	5714	34	0.6%	0.5
	Westbound	7	4573	4544	-29	-0.6%	0.4
13	Northbound	10	11305	11466	161	1.4%	1.5
	Southbound	9	11680	11375	-305	-2.6%	2.8
14	Eastbound	7	2403	2176	-227	-9.5%	4.7
	Westbound	7	1653	1567	-86	-5.2%	2.1
15	Eastbound	5	1948	1828	-120	-6.2%	2.8
	Westbound	5	1829	1708	-121	-6.6%	2.9
16	Northbound	11	4101	4191	90	2.2%	1.4
	Southbound	11	3748	3889	141	3.8%	2.3
17	Northbound	10	5123	4777	-346	-6.8%	6.0
	Southbound	10	4355	4085	-270	-6.2%	7.0
18	Eastbound	8	3390	3406	16	0.5%	0.3
	Westbound	8	2830	2830	0	0.0%	0.0

Notes:

Percentage of all sites with GEH < 5 = 87.1
Percentage of all sites meeting DMRB flow criteria = 87.6

Matrix Estimation Motorway Sites

7.17 Table 7.6 compares modelled and observed flows for the matrix estimation sites on the M56 and M60 motorways for all vehicles combined as PCUs, for each of the modelled time periods. The table shows the number of sites, the total observed flow, the total modelled flow, the difference between the modelled and observed flows and the percentage difference between the modelled and observed flows. The table also shows the percentage of sites with a GEH value of less than 5. The figures in the column headed 'All DMRB' give the percentage of counted links that meet either the DMRB1, 2 or 3 link flow criteria.

7.18 In general, the comparisons are good, with greater than 89% of the sites having a GEH value of less than 5 in all time periods. The comparisons against the DMRB link flow criteria are also very good, with 93% of sites achieving the required standard in the AM peak hour, and 90 % and 89%% of the sites meeting the standard in the inter-peak and PM peak hours respectively.

Table 7.6 Link Flow Comparisons for Motorway Counts used During Matrix Estimation (Actual Flows, All Vehicles)

Time Period Period	Number Of Sites	Observed Flow	Modelled Flow	Difference	% Difference	% GEH < 5	% All DMRB
AM Peak	227	472310	476761	4451	0.9	91	93
Inter Peak	227	594274	588793	-5481	-0.9	89	90
PM Peak	227	709903	709113	-790	-0.1	89	89

Link Flow Comparisons for All Matrix Estimation Counts

7.19 Table 7.7 compares modelled and observed flows for all of the matrix estimation counts for each of the modelled time periods. These counts comprise the matrix estimation cordon and screenline counts plus the 36 TRADS counts on the M56 and M60 motorways in the A6 M60 area. It should be noted that where a cordon or screenline uses the same count, that count is only included once in the overall number of sites.

7.20 As a whole, the comparisons are very good, with 89% of the sites having a GEH value of less than 5 in the AM peak hour, and 89% of sites meeting the DMRB flow criteria. The results for the inter-peak hour are slightly better, with approximately 90% of sites having a GEH value of less than 5 and 91% meeting the DMRB flow criteria. The PM peak hour has approximately 87% of sites having a GEH value of less than 5 and approximately 88% meeting the DMRB flow criteria.

7.21 At an aggregate level, the modelled flows are within 1.3% of the counted flows in the AM peak and 1.9% inter-peak hours, and are within approximately 1.7% of the counted flows in PM peak hour.

Table 7.7 Link Flow Comparisons for All Matrix Estimation Counts (Actual Flows, All Vehicles)

Time Period Period	Number Of Sites	Observed Flow	Modelled Flow	Difference	% Difference	% GEH < 5	% All DMRB
AM Peak	1235	960895	948236	-12569	-1.3	89	89
Inter-Peak	1235	1055282	-19470	-19470	-1.9	90	91
PM Peak	1235	1324582	1302865	-21897	-1.7	87	88

Link Flow Comparisons for Independent Counts

7.22 This section presents the assignment validation results for the independent counts that were reserved to check the accuracy of the calibrated model. Separate results are presented for the A34 screenline, the adhoc counts in the Area of Influence of the scheme and for all counts combined.

Independent Screenline North of M60

7.23 Table 7.8 compares modelled and observed flows for the A34 screenline, which south of the M60 from Bredbury to Heald Green to intercept movements likely to use the proposed scheme. Results are presented for all vehicles combined for each of the modelled time periods.

7.24 The table shows a reasonable agreement between modelled and observed flows.

7.25 The percentage difference between the modelled and observed flows ranges from +2.2% in the southbound direction in the inter peak hour to –4.5% in the southbound direction in the evening-peak hour.

Table 7.8 Link Flow Comparisons for the A34 Screenline (Actual Flows, All Vehicles)

Time Period	Direction	Observed Flow	Modelled Flow	Difference	% Difference	Screenline GEH
AM Peak	Northbound	8742	8749	7	0.1%	0.1
	Southbound	7082	6912	-170	-2.4%	4.4
Inter-Peak	Northbound	7591	7470	-121	-1.6%	1.4
	Southbound	7831	8002	171	2.2%	4.8
PM Peak	Northbound	9102	8885	-217	-2.4%	5.0
	Southbound	11304	10800	-504	-4.5%	4.8

7.26 The overall validation across the independent screenline is reasonable in both directions with the screenline GEH under 5.0 in all time periods

All Independent Counts

7.27 Table 7.9 compares modelled and observed flows for all of the independent sites combined. Separate figures are presented for each of the modelled hours, for all vehicle flows expressed in PCUs.

Table 7.9	Link Flow Comparisons for All Independent Counts (Actual Flows, All Vehicles)						
Time Period Period	Number Of Sites	Observed Flow	Modelled Flow	Difference	% Difference	% GEH < 5	% All DMRB
AM Peak	110	102790	100866	-1924	-1,9	64	66
Inter-Peak	110	81076	82274	1198	1.5	72	75
PM Peak	110	100353	100366	13	0	66	72

7.28 Overall, the comparisons are fair in the morning and interpeak, with the percentage of sites with a GEH value of less than 5 range from 72% in the interpeak period to approximately 65% in the remaining time periods. The percentage of links meeting the combined DMRB link flow criteria ranges from 66% in the AM peak hour , 72% in the PM peak hour to 75% in the inter-peak. The percentage differences between the range from an under-assignment of 2% in the AM peak hour, to an over-assignment of 1.5% in the inter peak.

Regression Analysis

7.29 The regression parameters for the line y=ax are shown in Table 7.11. As noted in earlier, the DMRB recommends that the slope of the line should lie in the range 0.9 to 1.1, and the corresponding R-squared value should be greater than 0.95.

7.30 The table shows that the slopes of the regression lines and the R-squared values are comfortably within the guideline ranges specified in the DMRB for all three time periods.

Table 7.11	Regression Line Statistics for All Counted Links (All Vehicles)		
Time Period	Parameter	Y=x	Within DMRB Range
AM Peak Hour	Slope R-squared	1.012 0.988	Yes Yes
Inter-Peak Hour	Slope R-squared	0.978 0.996	Yes Yes
PM Peak Hour	Slope R-squared	0.926 1.002	Yes Yes

7.31 Regression Plots of modelled versus observed flow for the matrix estimation and the independent count set are shown in Figures 7.1 to 7.6.

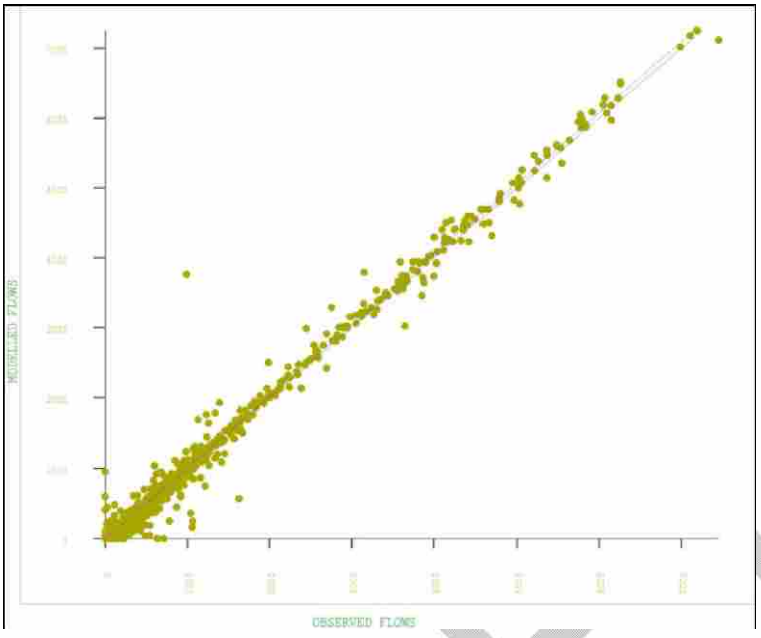


Figure 7.1: AM Peak Regression Analysis of Modelled Versus Observed Flow – Matrix Estimation Count Set

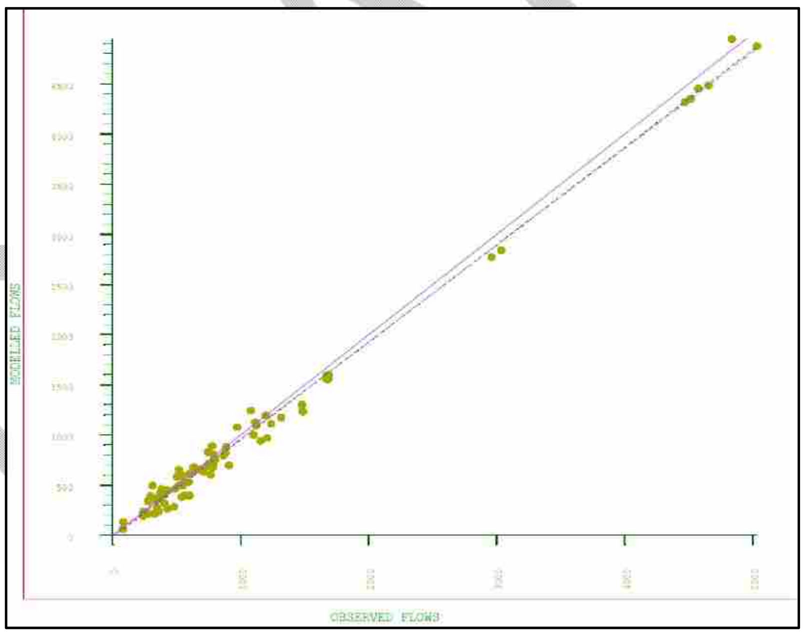


Figure 7.2: AM Peak Regression Analysis of Modelled Versus Observed Flow – Independent Count Set

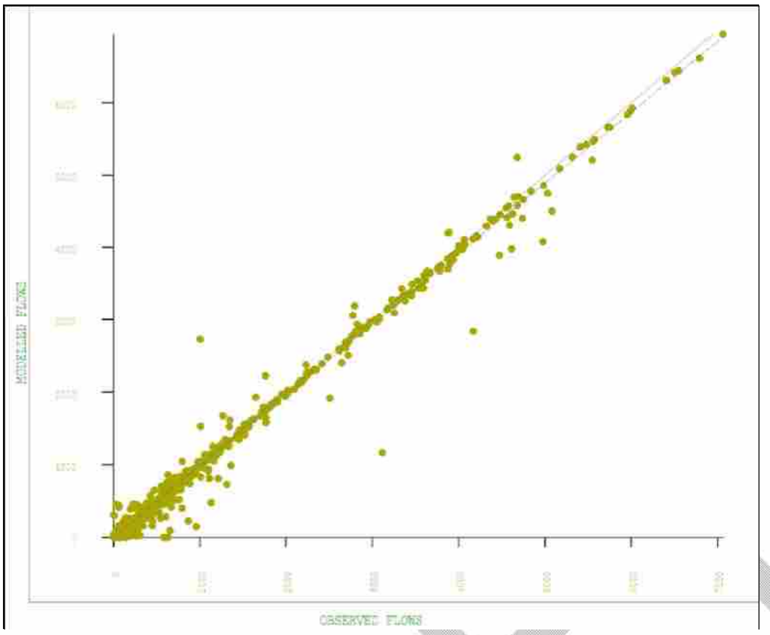


Figure 7.3: Inter-peak Peak Regression Analysis of Modelled Versus Observed Flow – Matrix Estimation Count Set

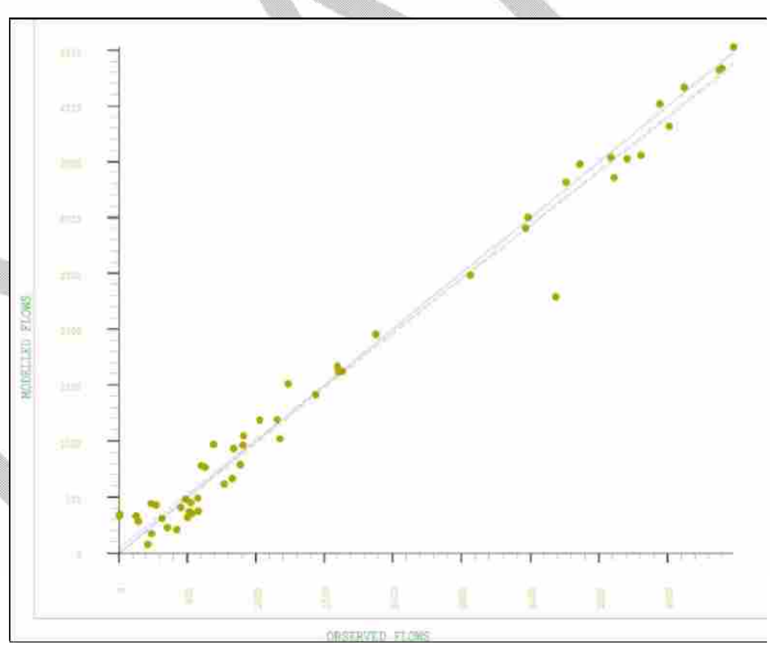


Figure 7.4: Inter-peak Peak Regression Analysis of Modelled Versus Observed Flow – Independent Count Set

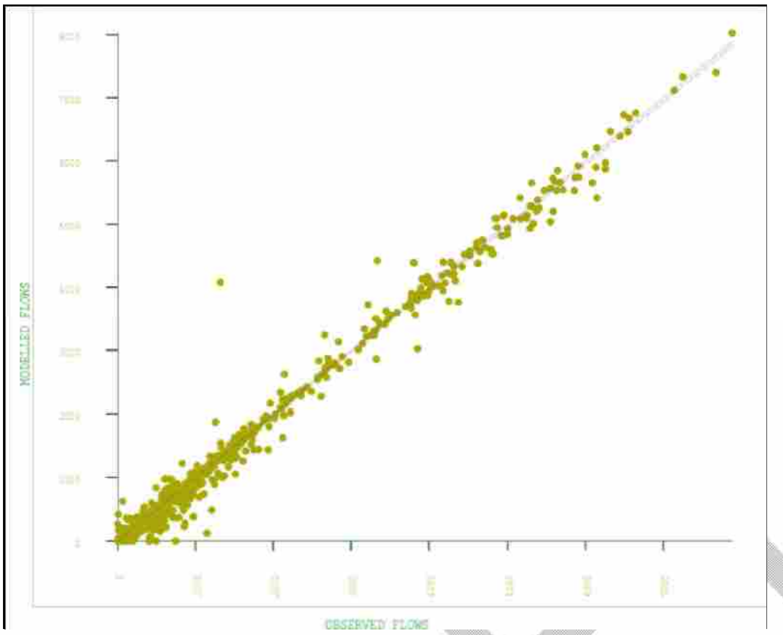


Figure 7.5: PM Peak Regression Analysis of Modelled Versus Observed Flow – Matrix Estimation Count Set

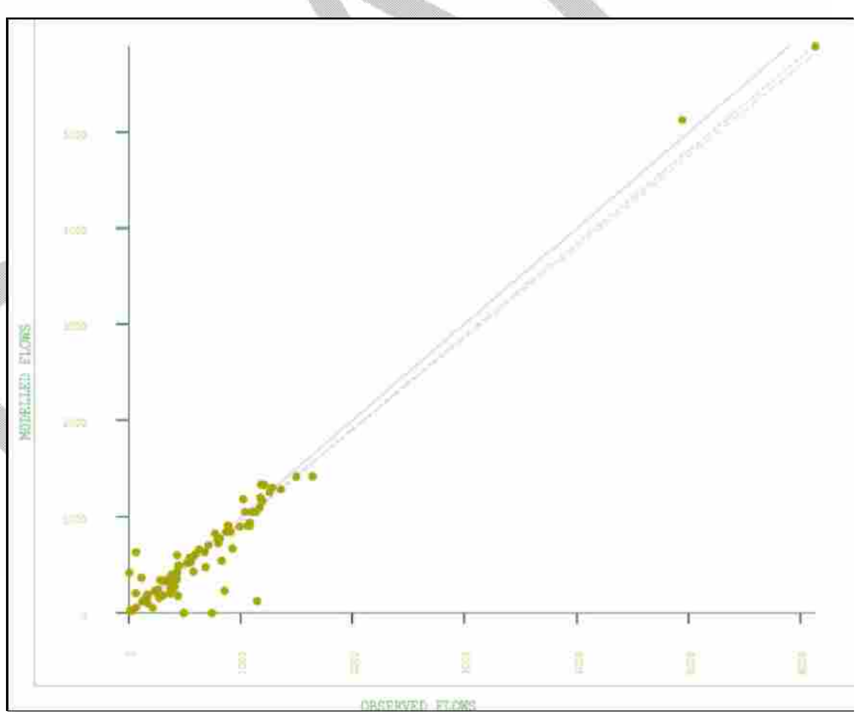


Figure 7.6: PM Peak Regression Analysis of Modelled Versus Observed Flow – Independent Count Set

8. Journey Time Validation

Introduction

8.1 Modelled and observed journey times have been compared on a selection of radial and orbital routes within the study area, as shown in Table 8.1 and illustrated in Figure 8.1. The routes are designed to replicate typical journeys within the Area of Influence of the scheme.

8.2 The observed journey times have been estimated using GPS data for 2015/16 from the Trafficmaster database. This information is collected on behalf of the Department for Transport by Trafficmaster PLC, and provides information about average vehicle speeds on roads across the UK for vehicles fitted with GPS devices. The information in the database has been processed by HFAS to exclude observations collected during school and national holidays, and to calculate average times for non-stopping vehicles (i.e. excluding buses and taxis) for standardized time periods. For the purpose of this analysis, the modelled times have been compared with observed times collected during for the morning peak hour 0800-0900, the evening peak hour 1700-1800 and the inter-peak period 0930-1430.

8.3 Taken together, the journey time routes cover approximately 590km of the highway network in the A6 to M60 Area of Influence.

Journey Time Validation Guidelines

8.4 The DMRB requirement for journey time validation is that modelled times should be within 15% (or 1 minute if this is higher) of the observed time on more than 85% of routes.

8.5 It should be noted, however, that paragraph 11.4.9 of the Traffic Appraisal Manual Volume 12) (reference 1) states:

"In congested conditions, where the journey times are flow dependent, the assignment package will provide estimates of link speeds and journey times for different times of day. These are not as accurate as the predictions of flows, as they are based on theoretical speed/flow relations that may not be the most appropriate for all parts of the network, and the standards for acceptance will generally be lower. Research has shown that, as long as the estimation of total travel time is unbiased, an empirically determined 95% confidence interval of +/- 20% can be taken to signify that the journey times are adequately modelled."

This range is also used for comparison in the following paragraphs.

8.6 Finally, it should also be noted that the modelled times represent the sum of the link travel times comprising each route, and therefore include flow-weighted delays for each of turns at the downstream ends of the constituent links. As a consequence, the route times do not necessarily represent the time taken to travel from the start point of the route to the routes end point, (as would be calculated using the SATURN 'Joy Ride' facility, for example), as this would only include the turn delays for a specific set of movements. Any differences should, however, be small. (This approach has been adopted for compatibility with the Trafficmaster data, and its procedure for allocating turning delays to links.)

Table 8.1 Journey Time Route Descriptions

Route No.	Description	Direction	Route Length Modelled KM
1	A6 Chapel to Heaton Moor	NW	8.7
	A6 Heaton Moor to Chapel	SE	8.7
2	A537 Knutsford to Macclesfield	E	16.4
	A537 Macclesfield to Knutsford	W	16.4
3	B5085 Knutsford to Alderley Edge	E	10.2
	B5085 Alderley Edge to Knutsford	W	10.2
4	B5087 Macclesfield to Alderley Edge	NW	6.6
	B5087 Alderley Edge to Macclesfield	SE	6.6
5	M56 Manchester Airport to West Didsbury	N	7.3
	M56 West Didsbury to Manchester Airport	S	6.8
6	B5166 Wilmslow to Northenden	N	10
	B5166 Northenden to Wilmslow	S	10
7	M56 J8 to J5	E	8.4
	M56 J5 to J8	W	8.4
8	A5102 Wilmslow to Bramhall	NE	7.6
	A5102 Bramhall to Wilmslow	SW	7.6
9	A34 Alderley Edge to East Didsbury	N	14.4
	A34 East Didsbury to Alderley Edge	S	14.3
10	A523 Prestbury to Hazel Grove	N	10.1
	A523 Hazel Grove to Prestbury	S	10
11	A555 MAELR Poynton to Manchester Airport	W	14.4
	A555 MAELR Manchester Airport to Poynton	E	14.4
12	A538 Prestbury to Hale	NW	22.1
	A538 Hale to Prestbury	SE	22.1
13	M60 J6 to J24	AC	17
	M60 J24 to J6	CW	17.2
14	Heald Green to Cheadle Heath	NE	5.2
	Cheadle Heath to Heald Green	SW	5.2
15	A5149/3 Cheadle Hulme to Hazel Grove	E	5.8
	A5143/9 Hazel Grove to Cheadle Hulme	W	5.8
16	Buxton Old Road / Higher Lane	SB	6
	Buxton Old Road / Higher Lane	NB	6
17	B5470 Chapel To Macclesfield	SB	16.5
	B5470 Macclesfield To Chapel	NB	16.5
18	B5090 / Bakestonedale Rd	WB	8.1
	B5090 / Bakestonedale Rd	EB	8.1
19	Bakestonedale Rd / Brookledge Lane / Mill Lane	WB	9.7
	Bakestonedale Rd / Brookledge Lane / Mill Lane	EB	9.7
20	B5358	NB	8.9
	B5358	SB	8.9
21	Roundy Lane / Middlewood Rd / Waterloo Rd	NB	7.3
	Roundy Lane / Middlewood Rd / Waterloo Rd	SB	7.3
22	B5465 / A626	NB	2.1
	B5465 / A626	SB	2.1
23	A626	NB	4.9
	A626	SB	4.9
24	A560	NB	3.9
	A560	SB	3.9
25	A6017	NB	3.9
	A6017	SB	3.9
26	A560 / A627	NB	6.6
	A560 / A627	SB	6.6
27	A626	NB	11.9
	A626	SB	11.9
28	A560	NB	4.9
	A560	SB	4.9
29	A627	NB	6.4
	A627	SB	6.4
30	A560	NB	7.1
	A560	SB	7.1
31	B6104	NB	5.8
	B6104	SB	5.8

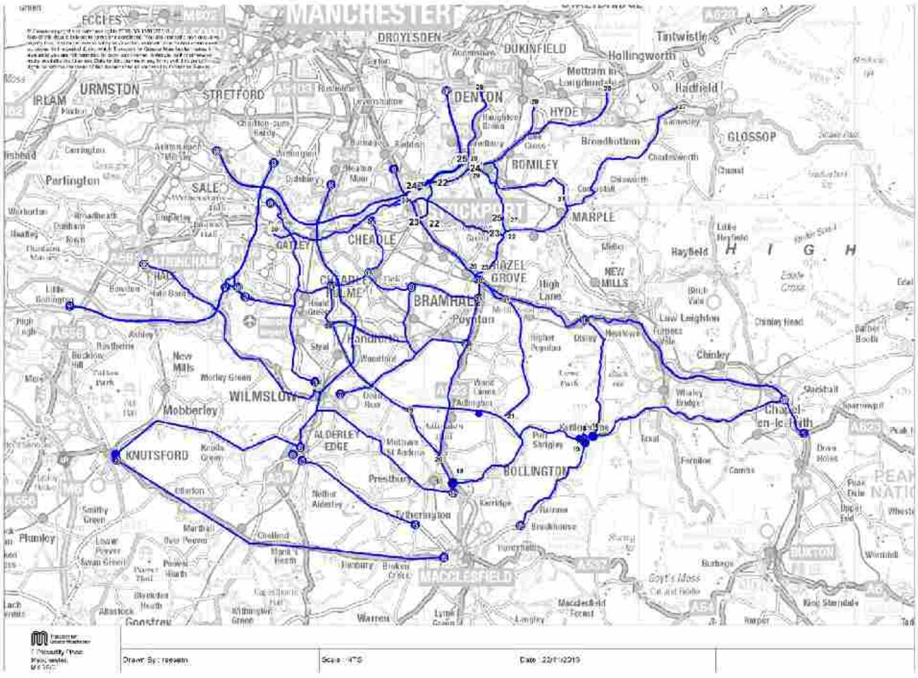


Figure 8.1 Journey Time Routes

AM Peak Hour Journey Time Validation Results

8.7 Table 8.2 compares modelled and observed journey times in the AM peak hour along the 42 journey time routes. In total, journey times on 54 out of 62 (or approximately 87%) of the routes meet DMRB journey time criteria that modelled times should be within 15% of observed times. The greatest differences between modelled and observed times are for routes on the M56 and M60, where the modelled times are too low on the M60 anticlockwise and too fast on the M60 clockwise and on the M56 Eastbound.

8.8 Considering all of the routes together, the total modelled time is approximately 8.0% lower than the total observed time, which is within the DMRB criteria, but suggests that the modelled speeds are slightly too low in general.

Table 8.2	Am Peak Journey Times						
Route Number	Route Description	Dir	Observed Time	Modelled Time	Modelled-Observed	% Error	Within DMRB
1A	A6 Chapel to Heaton Moor	NB	54.4	48.9	-5.5	10.0	Y
1B	A6 Heaton Moor To Chapel	SB	43.9	48.5	4.6	10.6	Y
2A	A537 Knutsford To Macclesfield	E	25.3	22.1	-3.2	12.5	Y
2B	A537 Macclesfield To Knutsford	W	23.6	20.7	-2.9	12.3	Y
3A	B5085 Knutsford To Alderley Edge	E	14.6	14.6	0.0	0.1	Y
3B	B5085 Alderley Edge To Knutsford	W	15.0	13.4	-1.6	10.6	Y
4A	B5087 Macclesfield To Alderley Edge	NW	7.8	6.9	-0.9	11.0	Y
4B	B5087 Alderley Edge To Macclesfield	SE	7.2	6.8	-0.4	6.0	Y
5A	M56 Manchester Airport To West Didsbury	N	13.1	6.6	-6.5	49.5	N
5B	M56 West Didsbury To Manchester Airport	S	5.9	6.4	0.6	9.5	Y
6A	B5166 Wilmslow to Northenden	N	17.4	17.1	-0.2	1.4	Y
6B	B5166 Northenden to Wilmslow	S	18.1	16.5	-1.6	9.0	Y
7A	M56 J8 to J5	E	8.9	6.2	-2.7	30.1	N
7B	M56 J5 to J8	W	5.2	5.8	0.6	11.7	Y
8A	A5102 Wilmslow to Bramhall	NE	12.2	12.3	0.2	1.5	Y
8B	A5102 Bramhall to Bramhall	SW	16.4	14.2	-2.2	13.3	Y
9A	A34 Alderley Edge to East Didsbury	N	27.0	28.2	1.2	4.6	Y
9B	A34 East Didsbury to Alderley Edge	S	26.0	24.6	-1.4	5.5	Y
10A	A523 Prestbury to Hazel Grove	N	17.1	18.1	1.0	6.0	Y
10B	A523 Hazel Grove to Prestbury	S	23.9	20.5	-3.4	14.1	Y
11A	A555 MAELR Poynton to Manchester Airport	W	25.5	24.7	-0.7	2.9	Y
11B	A555 Manchester Airport to Poynton	E	24.0	25.5	1.5	6.4	Y
12A	A538 Prestbury to Hazel Grove	NW	38.4	33.0	-5.4	14.0	Y
12B	A538 Hazel Grove to Prestbury	SE	40.9	36.2	-4.7	11.5	Y
13A	M60 J6 to J24	AC	12.5	15.7	3.3	26.1	N
13B	M60 J24 to J6	CW	22.8	14.4	-8.4	36.9	N
14A	Heald Green to Cheadle Heath	NE	13.0	14.1	1.1	8.8	Y
14B	Cheadle Heath to Heald Green	SW	14.9	14.2	-0.7	4.8	Y
15A	A5149/3 Cheadle Hulme to Hazel Grove	E	10.8	12.1	1.3	12.0	Y
15B	A5143/9 Hazel Grove to Cheadle Hulme	W	18.9	11.1	-7.8	41.3	N
16A	Buxton Old Rd / Higher Lane	SB	7.6	7.6	-0.1	0.8	Y
16B	Buxton Old Rd / Higher Lane	NB	7.9	7.5	-0.4	5.0	Y
17A	B5470 Chapel to Macclesfield	SB	22.2	20.7	-1.6	7.0	Y
17B	B5470 Macclesfield to Chapel	NB	22.0	20.4	-1.6	7.2	Y
18A	B5090 / Bakestonedale Rd	WB	12.3	11.8	-0.4	3.4	Y
18B	B5090 / Bakestonedale Rd	EB	12.2	11.7	-0.5	4.3	Y
19A	Bakestonedale Rd / Brookledge Lane / Mill Lane	WB	15.4	13.5	-1.9	12.1	Y
19B	Bakestonedale Rd / Brookledge Lane / Mill Lane	EB	12.4	13.1	0.6	5.0	Y
20A	B5358	NB	13.2	14.0	0.9	6.5	Y
20B	B5358	SB	15.1	16.2	1.1	7.3	Y

21A	Roundy Lane / Middlewood Rd / Waterloo Rd	NB	13.1	13.3	0.2	1.2	Y
21B	Roundy Lane / Middlewood Rd / Waterloo Rd	SB	12.5	12.2	-0.3	2.4	Y
22A	B5465 / A626	NB	5.5	5.9	0.4	7.7	Y
22B	B5465 / A626	SB	7.9	7.0	-0.9	10.9	Y
23A	A626	NB	20.1	18.9	-1.2	6.1	Y
23B	A626	SB	11.6	11.6	0.0	0.3	Y
24A	A560	NB	7.1	8.1	1.0	14.3	Y
24B	A560	SB	8.8	9.4	0.6	6.6	Y
25A	A6017	NB	7.8	7.0	-0.8	10.1	Y
25B	A6017	SB	12.9	6.3	-6.6	51.0	N
26A	A560 / A627	NB	14.8	14.3	-0.6	3.8	Y
26B	A560 / A627	SB	23.9	15.4	-8.5	35.5	N
27A	A626	NB	19.3	16.5	-2.8	14.6	Y
27B	A626	SB	24.0	17.7	-6.3	26.2	N
28A	A560	NB	7.0	8.1	1.0	14.9	Y
28B	A560	SB	6.6	6.6	0.0	0.0	Y
29A	A627	NB	13.6	12.5	-1.1	8.3	Y
29B	A627	SB	20.0	17.5	-2.5	12.3	Y
30A	A560	NB	23.0	20.1	-2.9	12.7	Y
30B	A560	SB	28.4	25.3	-3.1	10.9	Y
31A	B6104	NB	16.6	14.5	-2.1	12.4	Y
31B	B6104	SB	11.8	11.2	-0.7	5.5	Y
Total			1061.1	975.6	-85.5	-8.0%	
Number of routes satisfying DMRB Criteria = 54 out of 62 (87%)							

Inter-Peak Hour Journey Time Validation Results

8.9 Table 8.3 compares modelled and observed journey times in the inter-peak hour along the 42 journey time routes.

8.10 Overall, the comparisons are good, with 56 out of 62 (90%) of the routes meeting the DMRB criteria of +/-15%. Considering all of the routes together, the total modelled time is 2.8% lower than the observed time, which is within the DMRB criteria, but suggests that the modelled speeds are slightly faster in general.

8.11 The greatest difference in the observed journey time compared to the modelled journey time is on the route between Cheadle Hulme and Whaley Bridge which

Table 8,3	Inter Peak Journey Times						
Route Number	Route Description	Dir	Observed Time	Modelled Time	Modelled-Observed	% Error	Within DMRB
1A	A6 Chapel to Heaton Moor	NB	41.3	44.6	3.3	8.1	Y
1B	A6 Heaton Moor To Chapel	SB	39.5	42.5	2.9	7.4	Y
2A	A537 Knutsford To Macclesfield	E	19.5	20.0	0.5	2.8	Y
2B	A537 Macclesfield To Knutsford	W	18.9	20.0	1.1	6.0	Y
3A	B5085 Knutsford To Alderley Edge	E	13.4	12.5	-0.9	6.7	Y
3B	B5085 Alderley Edge To Knutsford	W	13.5	12.3	-1.2	9.0	Y
4A	B5087 Macclesfield To Alderley Edge	NW	7.5	6.5	-1.0	13.2	Y
4B	B5087 Alderley Edge To Macclesfield	SE	7.3	6.4	-0.9	12.4	Y
5A	M56 Manchester Airport To West Didsbury	N	5.6	5.8	0.3	4.5	Y
5B	M56 West Didsbury To Manchester Airport	S	5.3	5.3	0.0	0.3	Y
6A	B5166 Wilmslow to Northenden	N	15.5	15.2	-0.3	2.2	Y
6B	B5166 Northenden to Wilmslow	S	15.2	13.6	-1.6	10.7	Y
7A	M56 J8 to J5	E	5.2	4.9	-0.3	5.8	Y
7B	M56 J5 to J8	W	4.7	5.0	0.2	4.4	Y
8A	A5102 Wilmslow to Bramhall	NE	11.6	10.4	-1.2	10.3	Y
8B	A5102 Bramhall to Wilmslow	SW	12.1	10.1	-2.0	16.7	N
9A	A34 Alderley Edge to East Didsbury	N	16.9	18.0	1.1	6.7	Y
9B	A34 East Didsbury to Alderley Edge	S	17.4	15.7	-1.8	10.1	Y
10A	A523 Prestbury to Hazel Grove	N	15.1	14.5	-0.6	4.1	Y
10B	A523 Hazel Grove to Prestbury	S	14.3	13.9	-0.4	2.9	Y
11A	A555 MAELR Poynton to Manchester Airport	W	20.5	20.1	-0.5	2.3	Y
11B	A555 Manchester Airport to Poynton	E	21.4	21.4	0.0	0.2	Y
12A	A538 Prestbury to Hazel Grove	NW	31.9	28.9	-3.0	9.3	Y
12B	A538 Hazel Grove to Prestbury	SE	33.0	30.8	-2.1	6.5	Y
13A	M60 J6 to J24	AC	10.4	12.2	1.8	17.4	N
13B	M60 J24 to J6	CW	10.8	11.9	1.1	10.3	Y
14A	Heald Green to Cheadle Heath	NE	9.9	10.0	0.1	1.2	Y
14B	Cheadle Heath to Heald Green	SW	9.7	11.2	1.5	15.1	N
15A	A5149/3 Cheadle Hulme to Hazel Grove	E	10.2	9.2	-1.0	9.7	Y
15B	A5143/9 Hazel Grove to Cheadle Hulme	W	10.2	9.7	-0.5	5.4	Y
16A	Buxton Old Rd / Higher Lane	SB	7.7	7.6	-0.1	1.9	Y
16B	Buxton Old Rd / Higher Lane	NB	7.8	7.5	-0.3	3.5	Y
17A	B5470 Chapel to Macclesfield	SB	20.8	20.1	-0.7	3.6	Y
17B	B5470 Macclesfield to Chapel	NB	21.0	20.2	-0.8	3.9	Y
18A	B5090 / Bakestonedale Rd	WB	11.9	11.8	-0.1	1.1	Y
18B	B5090 / Bakestonedale Rd	EB	12.0	11.7	-0.4	3.0	Y
19A	Bakestonedale Rd / Brookledge Lane / Mill Lane	WB	12.5	13.2	0.7	5.3	Y

19B	Bakestonedale Rd / Brookledge Lane / Mill Lane	EB	12.4	13.0	0.6	4.6	Y
20A	B5358	NB	12.0	12.7	0.6	5.2	Y
20B	B5358	SB	12.3	13.4	1.2	9.6	Y
21A	Roundy Lane / Middlewood Rd / Waterloo Rd	NB	12.4	11.8	-0.7	5.3	Y
21B	Roundy Lane / Middlewood Rd / Waterloo Rd	SB	11.6	11.7	0.1	0.4	Y
22A	B5465 / A626	NB	4.6	4.9	0.3	6.9	Y
22B	B5465 / A626	SB	5.2	5.4	0.2	3.7	Y
23A	A626	NB	12.2	11.5	-0.6	5.2	Y
23B	A626	SB	11.6	10.5	-1.1	9.5	Y
24A	A560	NB	7.4	7.8	0.5	6.5	Y
24B	A560	SB	7.1	8.6	1.5	20.8	N
25A	A6017	NB	7.2	6.5	-0.7	9.8	Y
25B	A6017	SB	6.5	5.6	-0.9	14.2	Y
26A	A560 / A627	NB	12.9	13.0	0.0	0.4	Y
26B	A560 / A627	SB	14.3	12.6	-1.7	12.0	Y
27A	A626	NB	18.0	16.0	-2.0	11.0	Y
27B	A626	SB	18.0	15.9	-2.1	11.6	Y
28A	A560	NB	6.9	6.8	0.0	0.6	Y
28B	A560	SB	6.7	6.7	0.1	1.0	Y
29A	A627	NB	12.0	9.4	-2.6	21.8	N
29B	A627	SB	12.4	9.0	-3.4	27.4	N
30A	A560	NB	15.6	13.5	-2.1	13.5	Y
30B	A560	SB	17.6	15.1	-2.5	14.1	Y
31A	B6104	NB	10.3	9.7	-0.6	5.6	Y
31B	B6104	SB	10.1	9.7	-0.5	4.7	Y
Total			838.9	815.3	-23.6	-2.8	
Number of routes satisfying DMRB Criteria = 56 out of 62 (90%)							

PM Peak Hour Journey Time Validation Results

8.12 Table 8.4 compares modelled and observed journey times in the PM peak hour for the 42 journey time routes.

8.13 For most routes the comparisons are very good, with 53 out of 62 (85%) of the routes meeting the DMRB criteria of +/-15%. Considering all of the routes together, the total modelled time is 8.4% lower than the observed time, which is within the DMRB criteria, but suggests that the modelled speeds are slightly faster in general.

Table 8.4	PM Peak Journey Times							
Route Number	Route Description	Dir	Observed Time	Modelled Time	Modelled-Observed	% Error	Within DMRB
1A	A6 Chapel to Heaton Moor	NB	46.0	47.9	1.9	4.1	Y
1B	A6 Heaton Moor To Chapel	SB	49.0	48.0	-1.0	2.1	Y
2A	A537 Knutsford To Macclesfield	E	22.2	20.6	-1.6	7.2	Y
2B	A537 Macclesfield To Knutsford	W	21.3	20.8	-0.5	2.3	Y
3A	B5085 Knutsford To Alderley Edge	E	13.9	13.7	-0.2	1.6	Y
3B	B5085 Alderley Edge To Knutsford	W	15.9	14.5	-1.4	8.9	Y
4A	B5087 Macclesfield To Alderley Edge	NW	7.5	6.8	-0.6	8.3	Y
4B	B5087 Alderley Edge To Macclesfield	SE	7.2	6.8	-0.4	5.1	Y
5A	M56 Manchester Airport To West Didsbury	N	10.0	6.5	-3.5	34.8	N
5B	M56 West Didsbury To Manchester Airport	S	6.2	6.2	0.0	0.5	Y
6A	B5166 Wilmslow to Northenden	N	19.6	17.3	-2.3	11.9	Y
6B	B5166 Northenden to Wilmslow	S	18.4	16.2	-2.2	12.0	Y
7A	M56 J8 to J5	E	10.3	8.4	-1.9	18.6	N
7B	M56 J5 to J8	W	5.7	8.0	2.4	41.9	N
8A	A5102 Wilmslow to Bramhall	NE	15.1	13.8	-1.3	8.4	Y
8B	A5102 Bramhall to Bramhall	SW	13.9	12.5	-1.4	10.1	Y
9A	A34 Alderley Edge to East Didsbury	N	28.7	26.0	-2.7	9.4	Y
9B	A34 East Didsbury to Alderley Edge	S	22.9	21.8	-1.1	4.8	Y
10A	A523 Prestbury to Hazel Grove	N	18.9	17.0	-2.0	10.4	Y
10B	A523 Hazel Grove to Prestbury	S	15.3	14.5	-0.8	5.5	Y
11A	A555 MAELR Poynton to Manchester Airport	W	22.2	22.6	0.4	2.0	Y
11B	A555 Manchester Airport to Poynton	E	33.3	28.4	-4.9	14.7	Y
12A	A538 Prestbury to Hazel Grove	NW	34.9	34.3	-0.6	1.7	Y
12B	A538 Hazel Grove to Prestbury	SE	40.6	39.6	-1.0	2.4	Y
13A	M60 J6 to J24	AC	20.8	15.7	-5.2	24.8	N
13B	M60 J24 to J6	CW	15.3	13.8	-1.5	9.8	Y
14A	Heald Green to Cheadle Heath	NE	13.8	12.1	-1.7	12.5	Y
14B	Cheadle Heath to Heald Green	SW	14.8	12.9	-1.9	13.0	Y
15A	A5149/3 Cheadle Hulme to Hazel Grove	E	13.6	10.7	-2.9	21.5	N
15B	A5143/9 Hazel Grove to Cheadle Hulme	W	12.4	11.3	-1.1	9.0	Y
16A	Buxton Old Rd / Higher Lane	SB	7.7	7.6	0.0	0.4	Y
16B	Buxton Old Rd / Higher Lane	NB	8.4	7.5	-0.9	10.2	Y
17A	B5470 Chapel to Macclesfield	SB	21.6	20.4	-1.1	5.2	Y
17B	B5470 Macclesfield to Chapel	NB	21.5	20.0	-1.5	6.9	Y
18A	B5090 / Bakestonedale Rd	WB	11.9	11.8	-0.1	0.9	Y
18B	B5090 / Bakestonedale Rd	EB	12.1	11.8	-0.3	2.3	Y
19A	Bakestonedale Rd / Brookledge Lane / Mill Lane	WB	13.1	13.4	0.3	2.2	Y
19B	Bakestonedale Rd / Brookledge Lane / Mill Lane	EB	12.6	13.3	0.7	5.3	Y
20A	B5358	NB	12.6	14.3	1.7	13.8	Y
20B	B5358	SB	15.8	15.5	-0.3	1.8	Y

21A	Roundy Lane / Middlewood Rd / Waterloo Rd	NB	13.1	11.2	-1.9	14.3	Y
21B	Roundy Lane / Middlewood Rd / Waterloo Rd	SB	12.2	10.4	-1.8	14.7	Y
22A	B5465 / A626	NB	6.3	6.0	-0.3	5.4	Y
22B	B5465 / A626	SB	7.8	6.8	-1.0	12.7	Y
23A	A626	NB	14.4	12.8	-1.6	11.2	Y
23B	A626	SB	19.5	12.1	-7.5	38.2	N
24A	A560	NB	9.0	10.7	1.7	19.3	N
24B	A560	SB	8.1	8.1	0.0	0.5	Y
25A	A6017	NB	8.6	8.3	-0.3	3.4	Y
25B	A6017	SB	9.6	8.4	-1.2	12.6	Y
26A	A560 / A627	NB	18.1	15.9	-2.2	12.4	Y
26B	A560 / A627	SB	14.7	14.8	0.1	0.6	Y
27A	A626	NB	18.6	16.6	-2.0	10.7	Y
27B	A626	SB	18.3	17.5	-0.8	4.4	Y
28A	A560	NB	7.1	7.5	0.4	6.0	Y
28B	A560	SB	7.1	7.5	0.5	6.7	Y
29A	A627	NB	17.7	16.1	-1.6	9.0	Y
29B	A627	SB	14.7	13.3	-1.4	9.8	Y
30A	A560	NB	26.3	15.4	-10.8	41.2	N
30B	A560	SB	26.8	18.3	-8.4	31.5	N
31A	B6104	NB	10.1	11.0	0.9	9.1	Y
31B	B6104	SB	13.6	12.0	-1.6	11.7	Y
Total			1028.8	942.8	-85.9	-8.4	
Number of routes satisfying DMRB Criteria = 54 out of 62 (87%)							

Commentary on Journey Time Outliers

8.14 In all three time periods the major outliers are the motorway-based routes along the M56/A5103 from Junction 5 to West Didsbury and the M60 from Junction 6 to Junction 24. These journey time routes display significant degrees of variability in times. For example:

8.15 The variability in times reflects:

- The wider range of possible speeds on the motorway network (given the speed limit of 70mph);
- the closely spaced junctions along these sections of motorways and the resulting weaving, merging and shock wave effects; and
- the variations in flow on the motorway network that can result from 'strategic' diversion of traffic.

8.16 The frequency of junctions and associated weaving, merging, lane-drops/gains etc impact on driver behaviour and on lane chose e.g. lanes 1 and 2 may move much slower than lanes 3 and 4 causing drivers to switch lanes.

8.17 Flows (and therefore times/speeds) can vary significantly as a result of incidents elsewhere on the SRN which can cause traffic to divert. For example, an incident on the M62 west of Manchester can result in traffic diverting to the M56. Many of these incidents can be some distance from the section of motorway being observed and may not be identified when 'filtering' data for use in analysis.

8.18 Note that SATURN as a modelling package cannot model lane use, lane switching or driver behaviour to the same extent as microsimulation or mesoscopic models. Working with the Highways Agency and Leeds ITS, HFAS has undertaken extensive testing to improve the representation of motorways within the GMSM and SATURN models in general. Further changes are being made to SATURN software (for example, the introduction of link specific parameters which will reflect the willingness of vehicles to move out of the nearside lane to permit merging vehicles to join) which may improve the representation of urban motorways in the future.

Conclusions of Journey Time Validation

8.19 The results presented above indicate that the journey time validation fully meets DMRB requirements in all three time period.

8.20 The percentages of routes within 15% of the observed time ranges are 87%, 90% and 87% in the AM peak hour, inter-peak hour and PM peak hour respectively.

8.21 Graphs of observed versus modelled journey times are included in Appendix 3.

9. Conclusions

9.1 The A6 to M60 SATURN model has been built to inform the development of the business case for the proposed A6 to M60 Relief Road. The models have been developed from the GM-SATURN model.

9.2 The A6 to M60 modelling network is in full SATURN simulation detail throughout the A6 to M60 Area of Influence (Stockport, South Manchester and the northern part of Cheshire East) and the remainder of Greater Manchester, and SATURN buffer network outside of these areas.

9.3 The model was well converged in all time periods, with Delta values well below 1% and the percentage of links with flows changing by less than 2% over approximately 99% in all periods.

9.4 The SATURN model has been built to evaluate the A6 to M60 Relief Road. The model has therefore been validated by comparing modelled link flows and journey times with observed data across the SEMMMS Area of Influence, for the 2015 base year.

9.5 In the AM peak, inter-peak and PM peak hours the percentages of all motorway and local road sites used in matrix estimation which met webtag validation criteria were 89%, 91% and 88% respectively.

9.6 Eighteen cordons and screenlines were formed for the link flow validation within the AOI.

9.7 Considering the 18 ME cordon and screenlines together, the percentage with screenline GEH values less than 4 is 78% in the AM peak, 78% in the inter-peak and 72% in the PM peak. Of these several routes marginally exceed 4 with values less than 4.5 of 86% in the AM peak, 89% in the inter-peak and 86% in the PM peak.

9.8 Modelled and observed journey times were compared on 31 (two-way) routes covering key radials and orbitals crossing or parallel to the proposed scheme.

9.9 The Webtag guideline for journey time validation is that modelled times should be within 15% (or 1 minute if this is higher) of the observed time on more than 85% of route. The percentages of routes within 15% of the observed time ranges were 87%, 90% and 85% in the AM peak hour, inter-peak hour and PM peak hour respectively. All time periods therefore comfortably meet Webtag criteria.

9.10 The model is well converged in all three modelled time periods and the modelled traffic volumes are therefore very stable.

9.11 The results presented above indicate that the model meets Webtag requirements in almost all regards. Where it falls short of these requirements it does so only marginally.

9.12 Overall we consider that the model provides a sound basis for forecasting the effects of the proposed A6 to M60 Model.

10. References

1. Traffic Appraisal of Road Schemes – Traffic Appraisal Advice, Design Manual for Roads and Bridges, Volume 12, Highways Agency, May 1996

2. Manchester Airport Master Plan to 2030, Manchester Airport, 2007

3. Manchester Airport Ground Transport Plan, Manchester Airport, 2007

4. The Need for Land – Manchester Airport Company's Response to Manchester City Council's LDF Option Development, Manchester Airport

5. A6 to Manchester Airport Relief Road Area of Influence, Greater Manchester Transportation Unit, A6 to M60 Briefing Note 24

6. A6 to M60 A6 to Manchester Airport Relief Road Technical Node 13, Highway Demand Matrices, MVA, July 2010

Appendix 1 Example Calculation of Generalised Cost

A6M60 uses a set of user class specific generalised costs. These are calculated using an excel workbook prepared initially by MVA Consultancy The basic approach has been applied in a number of studies from the Greater Manchester TIF bid onwards, with regular reviews and updates to reflect the impact of changes to WebTAG parameters. The approach is summarised below

Basic Parameters

The basic parameter inputs to the calculation process consist of:

- Perceived Values of Time per person expressed as pence per hour at average 2002 prices and values, sourced from Tables 1 and 2 of WebTag Unit 3.5.6
- Vehicle Occupancies per trip by vehicle type and work/non-work, sourced from WebTag Unit 3.5.6, Table 4
- Vehicle Operating Costs (fuel) sourced from WebTag Unit 3.5.6 Table 10 (parameter values), Table 11 (Fuel cost factors) and Table 12 (fleet composition)
- Vehicle Operating Costs (non-fuel) sourced from WebTag Unit 3.5.6 Table 15
- Goods vehicle splits from GMTU monitoring (class by proportion of vehicles and proportion of veh/km) and GMATS RSI data (work, non-work).

All WebTag inputs are drawn from the April 2011 edition of Unit 3.5.6.

Growth Rates

Information on growth in parameter values is based on WebTag Unit 3.5.6, April 2011. Tables used are:

- Value of Time per person 2003-2052, Table 3
- Car passenger occupancy by period, 2000-2036, Table 6
- Fleet composition 2002-2031, Table 12
- Fuel Efficiency improvements 2002-2035, Table 13
- Fuel price – increase in resource cost/hr, Table 14; and
- Fuel Price – fuel costs, duties and VAT, Table 11.

Process – Worked Example - 2009 Car Work-Time AM Peak Hour

Value of Time (PPM)

Value of Time for car work-time driver 2002 = 2186 pence per hour

Growth in VOT for car work-time from 2002 to 2009 = 1.05
VOT for car work-time driver, 2009 = 2186*1.05 = 2296 pence per hour per person
Value of Time for car work-time passenger 2002 = 1566 pence per hour
Growth in VOT for car work-time from 2002 to 2009 = 1.05

VOT for car work-time passenger, 2009 = 1566*1.05 = 1645 pence per hour per person
Occupants per car work-time, 2000 = 1.20
Growth in Passengers from 2000 to 2009 (AM Peak) = 0.9576
Occupants per car work-time, 2009 = (1.20 – 1)*0.9576=0.19

Value of time, pence per hour at 2009 = 2296 + (1645*0.19) = 2611 pence
Value of time, pence per minute at 2009 = 2611/60 = 43.52 pence

Value of Distance (PPK)

Fuel Consumption (Petrol)

From WebTag, Consumption Formula is $L = (a + bV + cV^2 + dV^3) / V$

For Petrol:

A = 1.04285

B= 0.04484

C=-0.00005

D=0.0000021781

V= 37.8 kph (AM Peak Network speed)

Substituting in above formula

$L =(1.054285+0.04484*37.8+-0.00005*37.8^2+0.0000021781*37.8^3)/37.8$

L= 0.07368

Growth adjustment for Petrol based on WebTag Unit 3.5.6, Table 13

= 0.07368*0.94 = 0.0695

For Diesel

A = 0.48099
B= 0.06450
C=-0.00058
D=0.0000045416
V= 37.8 kph

Substituting in above formula

L =(0.48099+0.06450*37.8+-0.00058*37.8^2+0.0000045416*37.8^3)/37.8
L= 0.06188

Growth adjustment for Diesel based on WebTag Unit 3.5.6, Table 13
= 0.06188*0.92 = 0.570

Fuel Price Per Litre
Price = Resource Cost + Duty + VAT

Petrol
Resource Cost = Fuel Cost Factor*(2009 Resource Cost Growth Factor/2005 Resource Cost Growth Factor) = 25 * (1.617/1.497) = 27.00

Fuel Duty = Duty*(2009 Duty Growth Factor/2005 Duty Growth Factor) =43.7 * (1.002/0.954) = 45.51

VAT = 2009 VAT Rate * Fuel Cost Factor = 0 * 1 = 0

Petrol price = (27 + 45.51)*0 = 72.51p/ltr
Diesel
Resource Cost = Fuel Cost Factor*(2009 Resource Cost Growth Factor/2005 Resource Cost Growth Factor) = 28 * (1.636/1.522) = 30.10

Fuel Duty = Duty*(2009 Duty Growth Factor/2005 Duty Growth Factor) = 43.7 * (1.002/0.954) = 45.51
VAT = 2009 VAT Rate * Fuel Cost Factor = 0* 1 = 0

Diesel price = (30.1 + 45.51)*0= 75.61p/ltr
Cost Per Km

Proportion of fleet using petrol & diesel

2009 Petrol = 0.621
2009 Diesel = 0.379

Petrol = 0.0695*72.51*0.621 = 3.129
Diesel = 0.0570*75.61*0.379 = 1.633
Cost per KM = 4.76

Vehicle Operating Costs – Non-Fuel
Based on formula C=a1 + b1/v

For car work-time:
A1=4.069
B1= 111.391

VOC (Non-Fuel) = 4.069 + 111.391/37.8 = 7.016

Final Values:

PPM= 43.52
PPK = (4.76+7.016) =11.78

Appendix 2 Prior and Estimated Matrix Comparisons by Sector

AM – Peak – ALL PCU's														
Sectors	SATME2	1	2	3	4	5	6	7	8	9	10	11	12	Orig Totals
1	Prior	1425.3	904.0	354.5	1000.0	1476.4	261.7	139.7	152.9	69.2	24.9	140.1	598.8	6547.4
	After	1285.1	1069.3	234.3	1393.7	1126.8	321.9	158.9	188.5	76.0	23.6	184.9	731.2	6794.3
	Perc Diff	-9.8%	18.3%	-33.9%	39.4%	-23.7%	23.0%	13.8%	23.3%	9.9%	-5.0%	32.0%	22.1%	3.8%
2	Prior	1025.0	4020.7	2296.3	661.2	2664.8	449.7	744.5	184.7	164.5	44.3	324.8	891.7	13472.4
	After	938.5	5356.1	2555.1	689.9	2287.8	546.3	935.4	165.3	154.3	69.4	384.4	933.6	15016.0
	Perc Diff	-8.4%	33.2%	11.3%	4.3%	-14.1%	21.5%	25.6%	-10.5%	-6.2%	56.7%	18.3%	4.7%	11.5%
3	Prior	598.4	3193.4	12938.7	851.3	6070.6	335.0	944.0	354.3	229.4	155.5	3331.2	1609.7	30611.5
	After	433.3	2380.7	14329.3	717.0	4916.0	469.5	1080.7	218.3	103.0	108.9	2553.3	1232.8	28542.8
	Perc Diff	-27.6%	-25.4%	10.7%	-15.8%	-19.0%	40.1%	14.5%	-38.4%	-55.1%	-30.0%	-23.4%	-23.4%	-6.8%
4	Prior	1553.2	898.8	845.0	14580.7	8811.6	1231.6	232.7	1480.5	485.3	170.1	438.7	2346.3	33074.5
	After	2125.6	791.3	850.8	15897.1	10602.9	1406.1	189.9	759.8	323.4	107.2	590.4	1666.7	35311.0
	Perc Diff	36.8%	-12.0%	0.7%	9.0%	20.3%	14.2%	-18.4%	-48.7%	-33.4%	-37.0%	34.6%	-29.0%	6.8%
5	Prior	1644.6	2441.1	4616.8	4879.6	63658.3	1095.6	709.9	3370.5	3691.7	1208.4	6807.4	6005.5	100129.4
	After	1633.9	2294.5	3718.7	5650.6	70489.5	1142.0	447.0	3164.1	2837.3	913.6	5317.2	4958.3	102566.6
	Perc Diff	-0.7%	-6.0%	-19.5%	15.8%	10.7%	4.2%	-37.0%	-6.1%	-23.1%	-24.4%	-21.9%	-17.4%	2.4%
6	Prior	235.8	239.6	106.0	709.2	547.9	6382.2	525.5	373.1	74.9	25.5	82.1	3715.4	13017.2
	After	363.3	270.8	228.4	816.6	601.5	6382.2	538.5	351.1	72.0	19.0	209.3	3696.1	13548.9
	Perc Diff	54.1%	13.0%	115.4%	15.1%	9.8%	0.0%	2.5%	-5.9%	-3.8%	-25.3%	155.0%	-0.5%	4.1%
7	Prior	154.6	656.6	763.0	151.1	520.6	603.9	6217.7	123.2	51.9	13.6	124.8	1777.7	11158.7
	After	96.9	756.5	1138.5	159.8	343.1	699.8	6608.6	72.4	20.2	6.5	70.9	1713.0	11686.1
	Perc Diff	-37.3%	15.2%	49.2%	5.8%	-34.1%	15.9%	6.3%	-41.2%	-61.1%	-52.4%	-43.2%	-3.6%	4.7%
8	Prior	242.7	223.6	328.4	1856.5	6049.2	852.5	192.0	39461.6	6297.4	231.0	401.2	13748.0	69884.1
	After	287.3	125.1	190.5	1047.3	5250.3	828.1	133.5	36313.7	5497.2	129.5	211.2	12422.9	62436.6
	Perc Diff	18.4%	-44.1%	-42.0%	-43.6%	-13.2%	-2.9%	-30.5%	-8.0%	-12.7%	-43.9%	-47.4%	-9.6%	-10.7%
9	Prior	181.2	150.3	266.2	509.0	6012.9	238.2	72.0	4304.0	38797.0	2064.9	1233.0	5589.3	59418.0
	After	141.3	76.3	186.0	146.6	4677.3	38.8	18.1	4014.4	37682.4	1843.1	1064.6	4988.3	54877.1
	Perc Diff	-22.0%	-49.2%	-30.1%	-71.2%	-22.2%	-83.7%	-74.9%	-6.7%	-2.9%	-10.7%	-13.7%	-10.8%	-7.6%
10	Prior	54.3	55.1	128.7	128.2	2001.3	88.2	31.7	194.1	2368.2	13931.7	3825.3	2258.8	25065.5
	After	27.9	40.4	106.5	38.6	1262.0	3.5	4.7	134.8	1995.7	13749.7	3279.2	2510.0	23153.0
	Perc Diff	-48.7%	-26.6%	-17.2%	-69.8%	-36.9%	-96.0%	-85.2%	-30.6%	-15.7%	-1.3%	-14.3%	11.1%	-7.6%
11	Prior	312.7	375.4	2942.1	407.5	9714.2	212.6	156.5	350.3	1296.0	3307.1	30668.6	2572.1	52315.0
	After	245.6	144.7	2322.3	327.1	10616.9	277.6	59.8	412.9	1020.2	3300.0	30286.8	2129.7	51143.5
	Perc Diff	-21.5%	-61.5%	-21.1%	-19.7%	9.3%	30.6%	-61.8%	17.9%	-21.3%	-0.2%	-1.2%	-17.2%	-2.2%
12	Prior	1376.8	888.8	1559.8	2085.2	8607.1	6413.8	2362.6	11495.2	4961.4	1818.9	2880.8	720480.1	764930.5
	After	1548.0	806.7	1603.2	1597.0	6414.1	5711.7	2307.0	11657.8	5367.8	2173.6	2408.5	719171.8	760767.2
	Perc Diff	12.4%	-9.2%	2.8%	-23.4%	-25.5%	-10.9%	-2.4%	1.4%	8.2%	19.5%	-16.4%	-0.2%	-0.5%
Dest Totals	Prior	8804.5	14047.4	27145.6	27819.7	116134.9	18164.9	12328.8	61844.3	58486.9	22995.8	50258.1	761593.3	1179624.1
	After	9126.7	14112.4	27463.5	28481.4	118588.2	17827.5	12482.0	57452.9	55149.5	22444.2	46560.6	756154.2	1165843.0
	Perc Diff	3.7%	0.5%	1.2%	2.4%	2.1%	-1.9%	1.2%	-7.1%	-5.7%	-2.4%	-7.4%	-0.7%	-1.2%

Inter – Peak – ALL PCU's

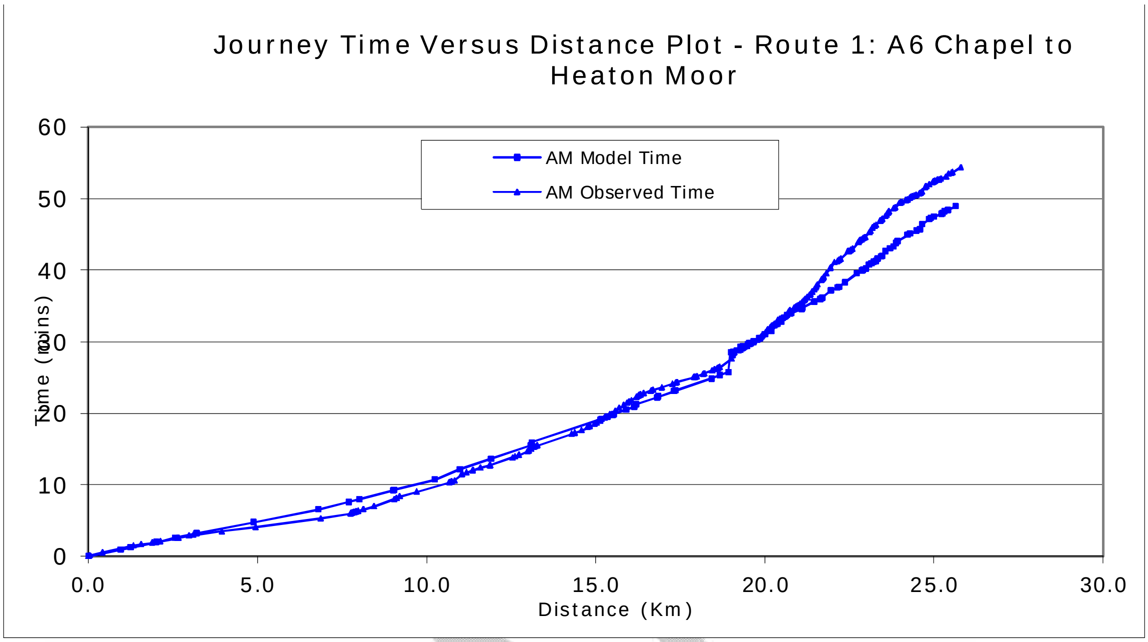
Sectors	SATME2	1	2	3	4	5	6	7	8	9	10	11	12	Orig Totals
1	Prior	1453.5	801.5	394.6	896.3	1165.8	181.2	99.2	119.7	81.4	30.4	143.9	490.3	5857.9
	After	1293.5	862.9	343.4	1247.7	1296.8	207.2	83.5	127.9	97.6	37.3	193.2	557.3	6348.1
	Perc Diff	-11.0%	7.7%	-13.0%	39.2%	11.2%	14.3%	-15.9%	6.8%	19.9%	22.5%	34.3%	13.7%	8.4%
2	Prior	850.9	3382.8	2352.2	453.3	1633.1	287.8	522.9	104.1	74.5	37.6	208.3	483.3	10390.7
	After	795.4	4306.5	2212.0	549.1	1460.0	296.0	488.7	89.2	75.7	65.4	152.5	505.6	10995.9
	Perc Diff	-6.5%	27.3%	-6.0%	21.1%	-10.6%	2.9%	-6.6%	-14.3%	1.6%	73.6%	-26.8%	4.6%	5.8%
3	Prior	404.7	2180.4	14100.1	318.3	4265.5	160.3	786.2	132.2	138.5	75.7	2777.5	968.0	26307.2
	After	336.1	2250.2	14535.0	371.3	3762.2	234.6	779.2	144.8	122.3	74.0	2273.4	1000.0	25883.3
	Perc Diff	-17.0%	3.2%	3.1%	16.7%	-11.8%	46.4%	-0.9%	9.5%	-11.7%	-2.3%	-18.1%	3.3%	-1.6%
4	Prior	1074.4	438.6	340.0	11999.6	4553.9	785.2	102.6	1136.5	280.4	80.3	218.6	1364.5	22374.7
	After	1337.1	534.6	380.2	12969.5	5212.8	862.5	98.5	630.1	233.7	81.2	305.2	1203.9	23849.2
	Perc Diff	24.5%	21.9%	11.8%	8.1%	14.5%	9.8%	-4.0%	-44.6%	-16.7%	1.1%	39.6%	-11.8%	6.6%
5	Prior	1224.2	1528.3	4245.0	4286.7	54313.0	726.2	434.9	3252.5	3577.2	1042.9	6516.8	5104.8	86252.7
	After	1174.0	1454.2	4133.8	4083.5	56655.1	845.3	188.0	2908.5	2916.8	791.1	5560.4	4970.6	85681.4
	Perc Diff	-4.1%	-4.8%	-2.6%	-4.7%	4.3%	16.4%	-56.8%	-10.6%	-18.5%	-24.2%	-14.7%	-2.6%	-0.7%
6	Prior	144.2	216.7	144.0	697.8	528.8	4676.1	341.9	416.5	119.9	71.2	156.0	2896.0	10408.9
	After	136.3	236.2	175.1	748.3	665.2	4676.0	336.4	378.1	85.7	46.7	278.7	2897.3	10660.0
	Perc Diff	-5.5%	9.0%	21.6%	7.2%	25.8%	0.0%	-1.6%	-9.2%	-28.5%	-34.4%	78.7%	0.0%	2.4%
7	Prior	105.1	516.4	708.5	108.7	274.5	386.8	4991.8	53.4	27.8	14.0	108.0	1183.6	8478.6
	After	95.3	436.9	799.1	80.4	137.1	378.0	5323.5	33.6	8.7	5.7	47.7	1200.1	8546.0
	Perc Diff	-9.3%	-15.4%	12.8%	-26.0%	-50.1%	-2.3%	6.6%	-37.0%	-68.6%	-59.4%	-55.9%	1.4%	0.8%
8	Prior	114.8	75.1	114.8	1115.1	2696.3	384.7	34.4	35385.5	3918.3	157.4	236.2	8380.5	52613.2
	After	116.4	55.0	98.3	534.2	3074.4	349.7	30.8	31670.8	3673.4	103.9	190.4	7803.1	47700.3
	Perc Diff	1.3%	-26.8%	-14.4%	-52.1%	14.0%	-9.1%	-10.4%	-10.5%	-6.2%	-34.0%	-19.4%	-6.9%	-9.3%
9	Prior	86.5	54.8	130.6	269.3	3282.8	116.9	28.2	4103.9	32775.8	2039.4	814.0	3438.4	47140.6
	After	130.5	67.6	221.2	209.2	2998.1	31.3	17.4	3851.3	31204.8	1601.0	682.3	3674.8	44689.5
	Perc Diff	50.9%	23.3%	69.3%	-22.3%	-8.7%	-73.2%	-38.1%	-6.2%	-4.8%	-21.5%	-16.2%	6.9%	-5.2%
10	Prior	36.7	28.4	77.8	77.0	1000.2	67.2	14.2	165.9	2056.8	13682.2	2739.5	1580.0	21525.9
	After	26.7	26.0	89.4	49.8	702.9	9.4	4.6	151.0	1598.7	12876.5	2470.7	1842.4	19848.1
	Perc Diff	-27.3%	-8.6%	15.0%	-35.3%	-29.7%	-86.0%	-67.8%	-9.0%	-22.3%	-5.9%	-9.8%	16.6%	-7.8%
11	Prior	142.0	178.7	2673.3	203.6	6391.4	175.8	103.7	277.6	866.7	2685.0	28879.0	1916.2	44492.9
	After	168.9	173.2	2633.3	252.4	5842.6	269.4	71.1	308.2	918.0	2557.6	27874.6	2127.8	43196.9
	Perc Diff	19.0%	-3.1%	-1.5%	24.0%	-8.6%	53.2%	-31.5%	11.0%	5.9%	-4.7%	-3.5%	11.0%	-2.9%
12	Prior	793.3	502.9	1263.0	1492.5	5151.6	3498.2	1171.8	9346.3	3868.7	1757.8	2316.1	553768.0	584930.1
	After	861.2	476.4	1346.3	1160.4	4648.9	3150.6	1205.3	8470.8	3569.2	1897.7	1826.9	554096.3	582710.1
	Perc Diff	8.6%	-5.3%	6.6%	-22.3%	-9.8%	-9.9%	2.9%	-9.4%	-7.7%	8.0%	-21.1%	0.1%	-0.4%
Dest Totals	Prior	6430.3	9904.7	26544.0	21918.1	85256.9	11446.2	8631.8	54494.2	47785.8	21673.8	45113.9	581573.7	920773.4
	After	6471.3	10879.8	26967.1	22255.7	86456.2	11309.9	8626.9	48764.2	44504.6	20138.0	41856.0	581879.1	910108.8
	Perc Diff	0.6%	9.8%	1.6%	1.5%	1.4%	-1.2%	-0.1%	-10.5%	-6.9%	-7.1%	-7.2%	0.1%	-1.2%

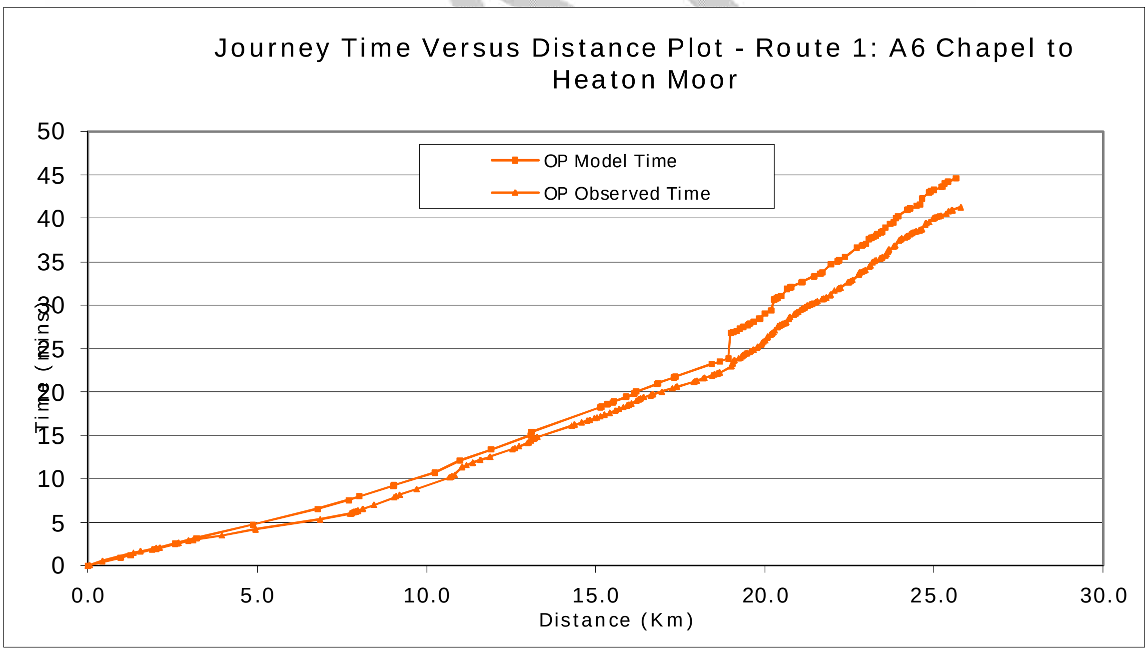
PM– Peak – ALL PCU's

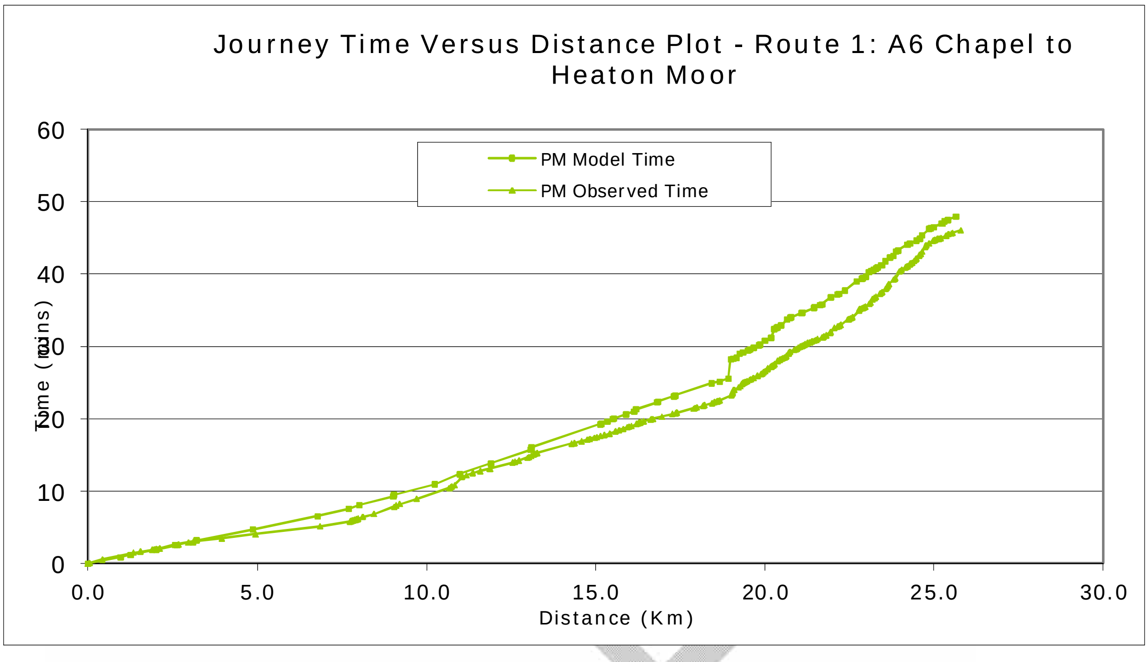
Sectors	SATME2	1	2	3	4	5	6	7	8	9	10	11	12	Orig Totals

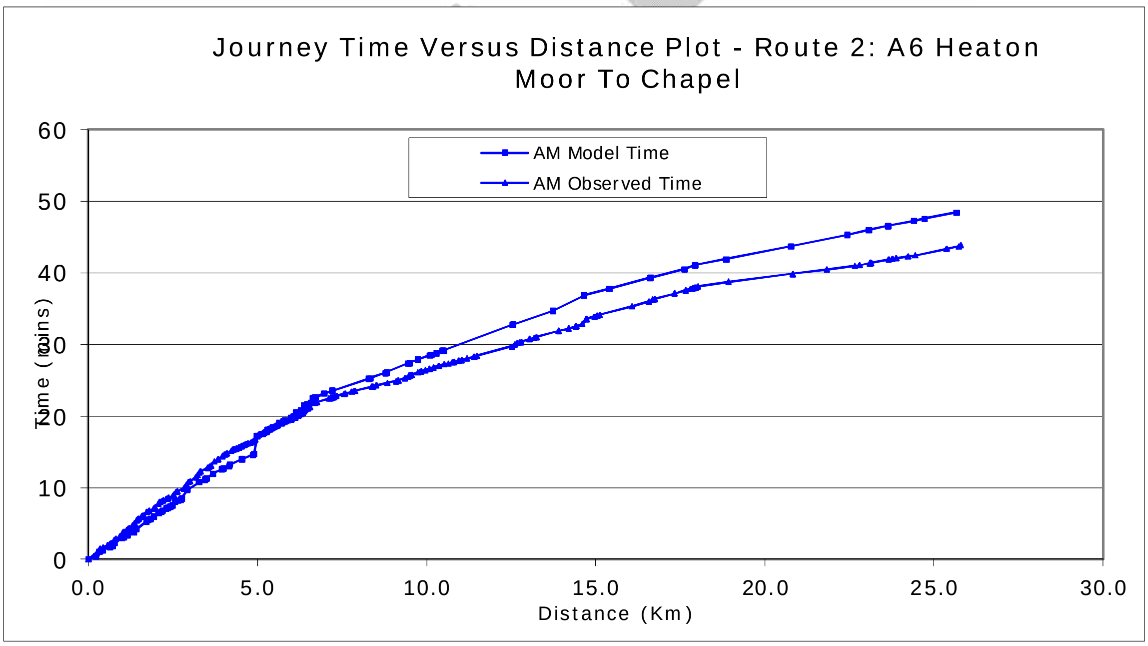
1	Prior	1190.2	872.4	639.3	1188.2	2014.5	288.6	228.1	344.5	267.0	107.4	359.1	2279.0	9778.2
	After	1194.0	1237.3	514.9	1624.1	1501.6	471.4	203.7	250.0	79.6	28.7	273.7	1600.6	8979.8
	Perc Diff	0.3%	41.8%	-19.4%	36.7%	-25.5%	63.3%	-10.7%	-27.4%	-70.2%	-73.2%	-23.8%	-29.8%	-8.2%
2	Prior	847.8	3238.1	2778.3	701.0	2399.3	324.4	739.1	155.7	138.9	72.2	395.2	792.2	12582.1
	After	792.1	4041.9	2587.8	816.5	1883.0	354.3	790.2	88.3	97.2	49.4	375.3	653.1	12529.0
	Perc Diff	-6.6%	24.8%	-6.9%	16.5%	-21.5%	9.2%	6.9%	-43.3%	-30.0%	-31.6%	-5.0%	-17.6%	-0.4%
3	Prior	448.2	2133.7	12726.8	466.6	4701.1	197.9	887.8	157.1	211.0	117.2	3265.9	1199.3	26512.7
	After	343.0	2355.2	13879.3	580.6	4791.0	356.2	1194.0	99.4	215.8	91.4	2660.5	1154.1	27720.5
	Perc Diff	-23.5%	10.4%	9.1%	24.4%	1.9%	79.9%	34.5%	-36.8%	2.3%	-22.1%	-18.5%	-3.8%	4.6%
4	Prior	1068.8	610.9	560.0	11884.2	5492.1	949.1	166.0	1624.4	466.5	123.1	362.3	2106.9	25414.3
	After	1698.0	926.7	699.2	13039.5	7003.3	1146.5	241.4	1021.4	331.3	69.2	437.0	1617.2	28230.7
	Perc Diff	58.9%	51.7%	24.8%	9.7%	27.5%	20.8%	45.4%	-37.1%	-29.0%	-43.8%	20.6%	-23.2%	11.1%
5	Prior	1484.9	2235.6	5435.9	6709.2	59017.5	958.7	749.6	5183.7	5763.0	1886.3	9002.5	7455.5	105882.5
	After	1477.6	2341.7	5531.5	6169.4	63193.6	1731.5	312.0	5479.2	4915.1	1614.8	8444.5	7511.2	108722.1
	Perc Diff	-0.5%	4.7%	1.8%	-8.0%	7.1%	80.6%	-58.4%	5.7%	-14.7%	-14.4%	-6.2%	0.7%	2.7%
6	Prior	221.7	374.5	358.9	1270.3	1145.4	5901.0	648.1	850.0	234.6	93.5	343.1	6689.4	18130.7
	After	315.3	414.7	379.1	1252.5	983.4	5901.0	686.0	769.8	120.2	36.0	297.1	6348.9	17504.0
	Perc Diff	42.2%	10.7%	5.6%	-1.4%	-14.1%	0.0%	5.8%	-9.4%	-48.8%	-61.5%	-13.4%	-5.1%	-3.5%
7	Prior	158.4	757.8	1065.7	247.5	723.3	531.6	6465.7	86.5	81.3	30.2	184.6	2212.6	12545.3
	After	64.6	720.7	1023.5	176.8	361.2	495.5	6753.0	49.8	25.7	6.1	41.5	2100.3	11818.7
	Perc Diff	-59.2%	-4.9%	-4.0%	-28.6%	-50.1%	-6.8%	4.4%	-42.5%	-68.4%	-79.7%	-77.5%	-5.1%	-5.8%
8	Prior	122.3	107.7	173.0	1524.3	3280.4	482.9	52.9	36231.6	4669.4	180.1	324.8	10463.6	57613.2
	After	149.8	113.8	135.9	965.6	3187.9	426.7	50.2	34792.7	4328.3	108.7	212.1	10266.1	54737.7
	Perc Diff	22.4%	5.6%	-21.5%	-36.7%	-2.8%	-11.6%	-5.3%	-4.0%	-7.3%	-39.6%	-34.7%	-1.9%	-5.0%
9	Prior	94.6	91.2	198.6	442.6	4225.2	107.3	33.3	5294.4	33701.9	2340.6	1168.9	4439.0	52137.5
	After	112.4	95.2	216.7	195.5	3544.9	27.2	11.6	5377.7	34315.9	2194.5	907.3	5080.6	52079.6
	Perc Diff	18.9%	4.4%	9.1%	-55.8%	-16.1%	-74.7%	-65.2%	1.6%	1.8%	-6.2%	-22.4%	14.5%	-0.1%
10	Prior	35.5	32.1	105.6	111.8	1342.2	43.7	15.3	219.0	2168.2	12797.9	2964.4	1802.5	21638.4
	After	69.2	52.1	178.1	78.8	1084.0	9.9	5.1	216.9	1800.1	12033.4	2905.2	2376.9	20809.8
	Perc Diff	94.8%	62.4%	68.6%	-29.5%	-19.2%	-77.3%	-66.6%	-1.0%	-17.0%	-6.0%	-2.0%	31.9%	-3.8%
11	Prior	194.2	240.6	2915.9	326.0	7100.6	137.0	136.3	345.6	1239.4	3207.3	27529.4	2222.6	45594.9
	After	270.0	222.4	2874.8	498.3	7040.0	355.4	71.6	477.3	1304.5	2968.7	27838.3	2830.1	46751.3
	Perc Diff	39.0%	-7.6%	-1.4%	52.9%	-0.9%	159.4%	-47.5%	38.1%	5.2%	-7.4%	1.1%	27.3%	2.5%
12	Prior	972.4	857.4	1884.6	2712.1	8675.6	5031.9	1995.4	13141.9	5713.3	2347.3	3293.2	711997.6	758622.7
	After	1099.1	805.8	1564.1	2097.9	5036.3	4634.9	1876.5	12992.4	4901.3	2141.3	2185.7	706690.6	746026.0
	Perc Diff	13.0%	-6.0%	-17.0%	-22.6%	-41.9%	-7.9%	-6.0%	-1.1%	-14.2%	-8.8%	-33.6%	-0.7%	-1.7%
Dest Totals	Prior	6839.0	11552.0	28842.7	27583.9	100117.4	14954.1	12117.6	63634.4	54654.6	23303.1	49193.4	753660.2	1146452.5
	After	7585.0	13327.5	29584.9	27495.6	99610.1	15910.4	12195.2	61615.0	52435.2	21342.1	46578.2	748229.8	1135909.1
	Perc Diff	10.9%	15.4%	2.6%	-0.3%	-0.5%	6.4%	0.6%	-3.2%	-4.1%	-8.4%	-5.3%	-0.7%	-0.9%

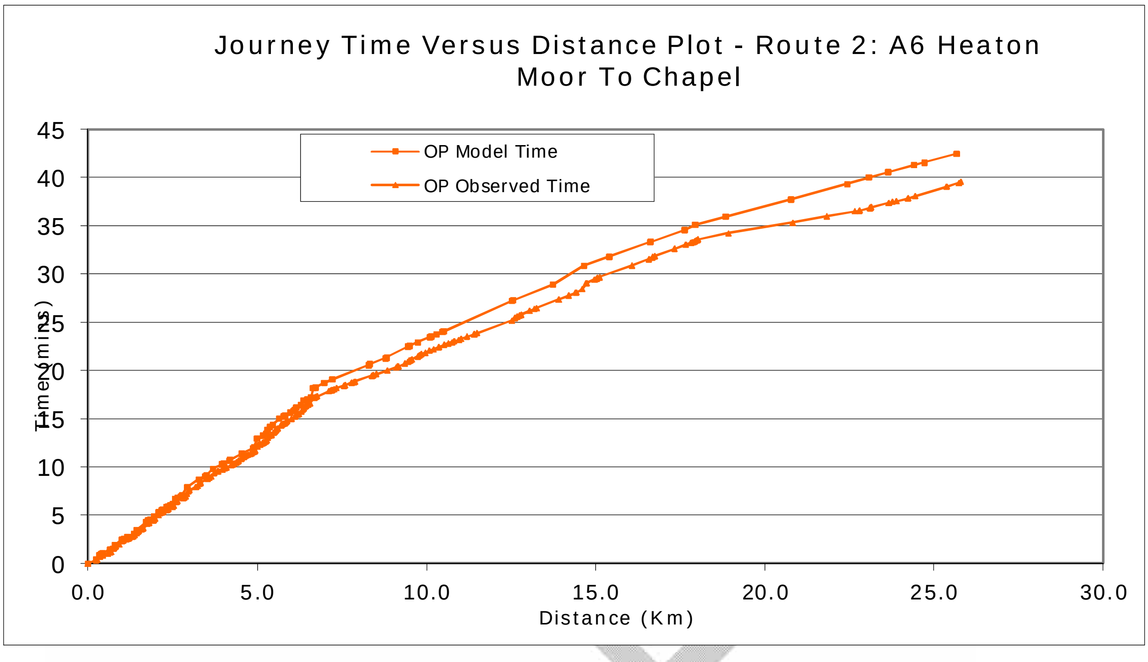
Appendix 3 – Journey time Graphs

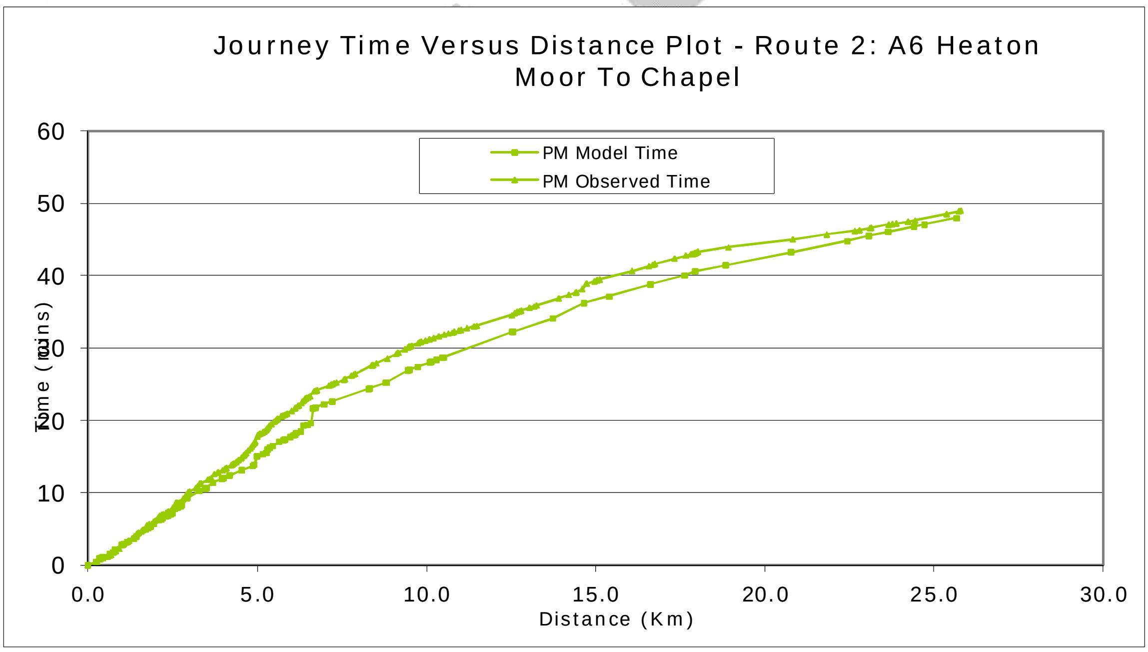


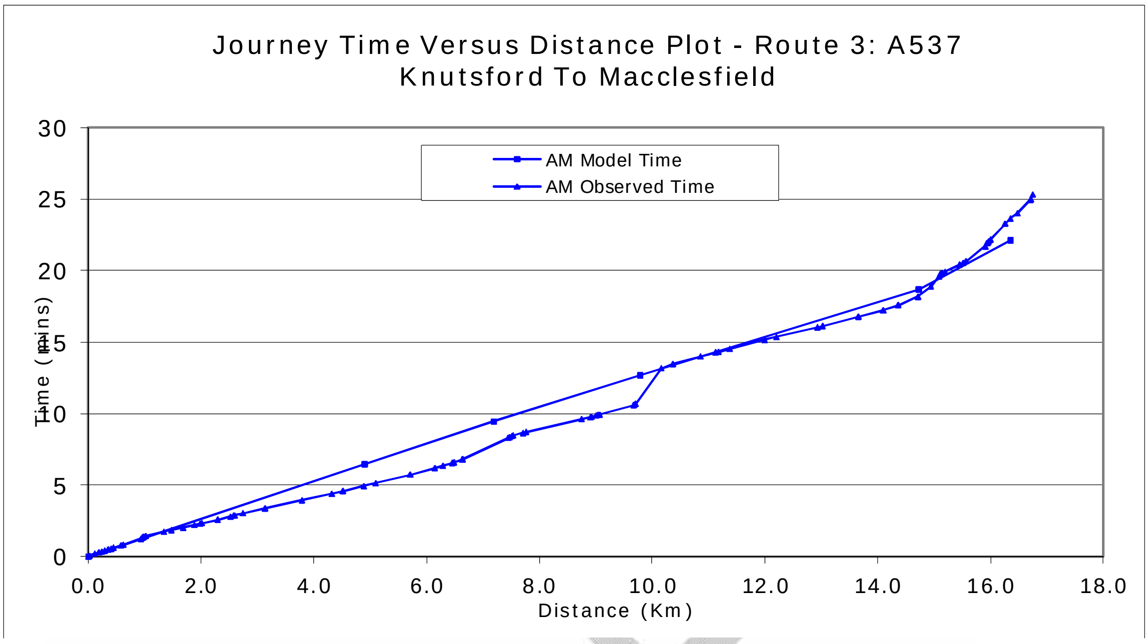


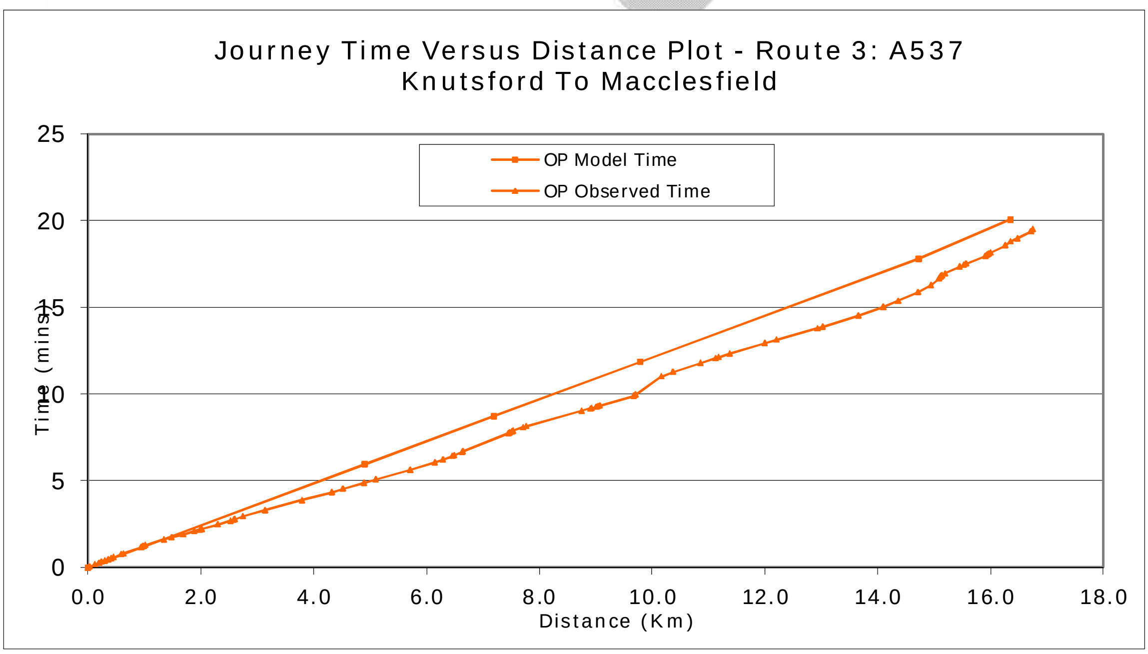

Journey Time Versus Distance Plot - Route 1: A6 Chapel to Heaton Moor
PM Model Time
PM Observed Time
Time (mins)
60
50
40
30
20
10
0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Distance (Km)

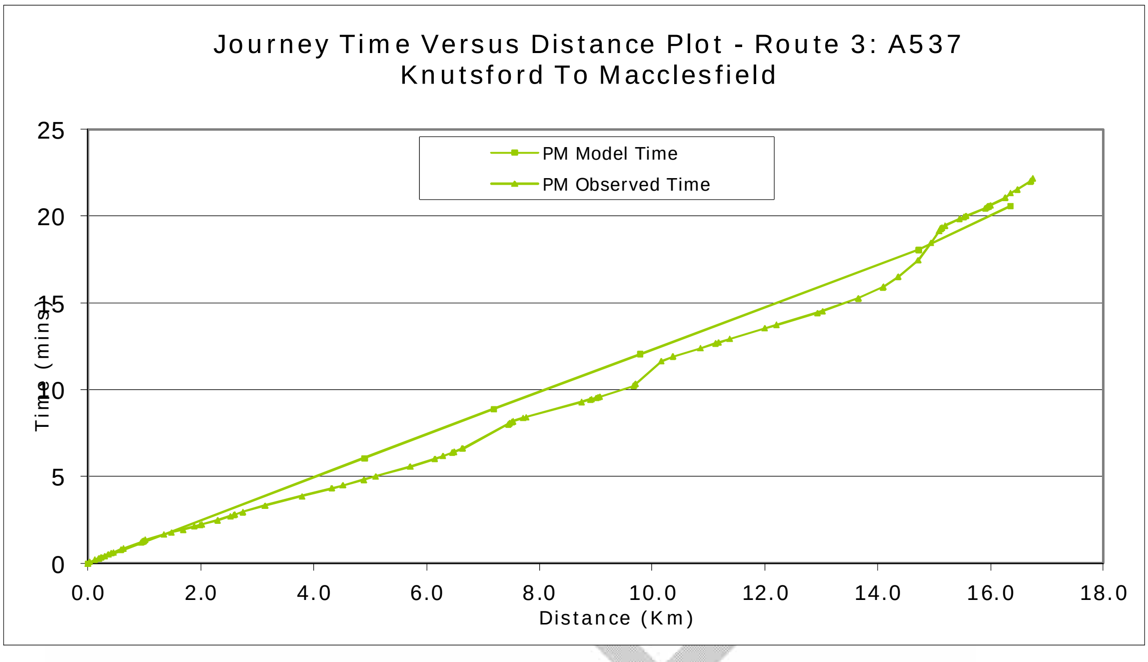

Journey Time Versus Distance Plot - Route 2: A6 Heaton Moor To Chapel
AM Model Time
AM Observed Time
Time (mins)
60
50
40
30
20
10
0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Distance (Km)

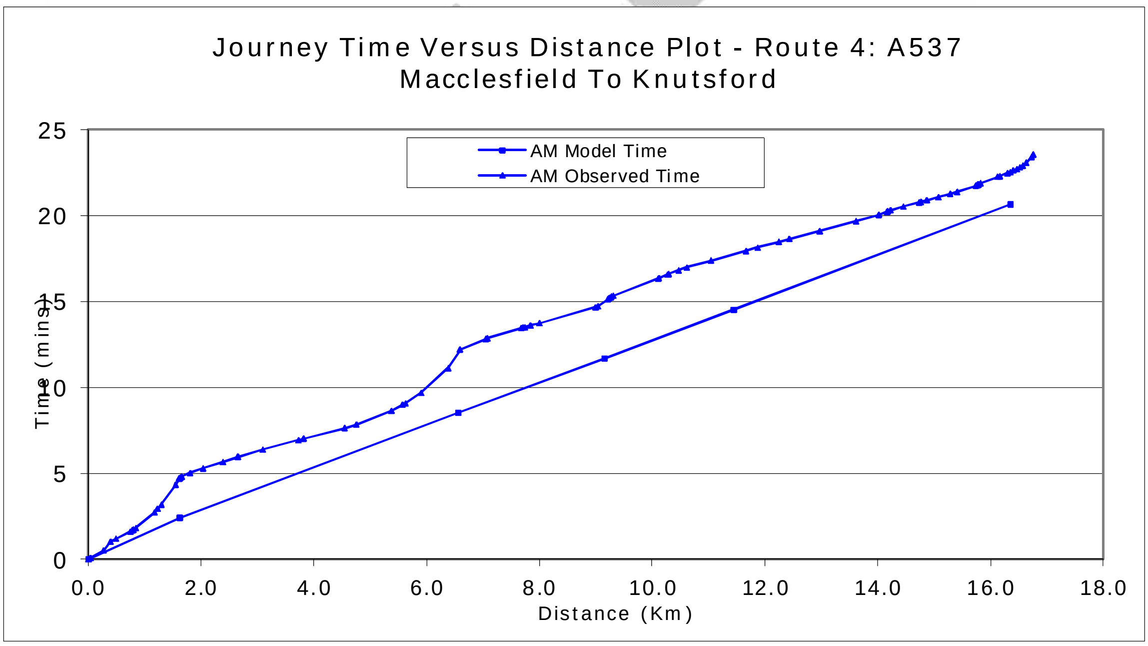

Journey Time Versus Distance Plot - Route 2: A6 Heaton Moor To Chapel
OP Model Time
OP Observed Time
Time (mins)
45
40
35
30
25
20
15
10
5
0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Distance (Km)

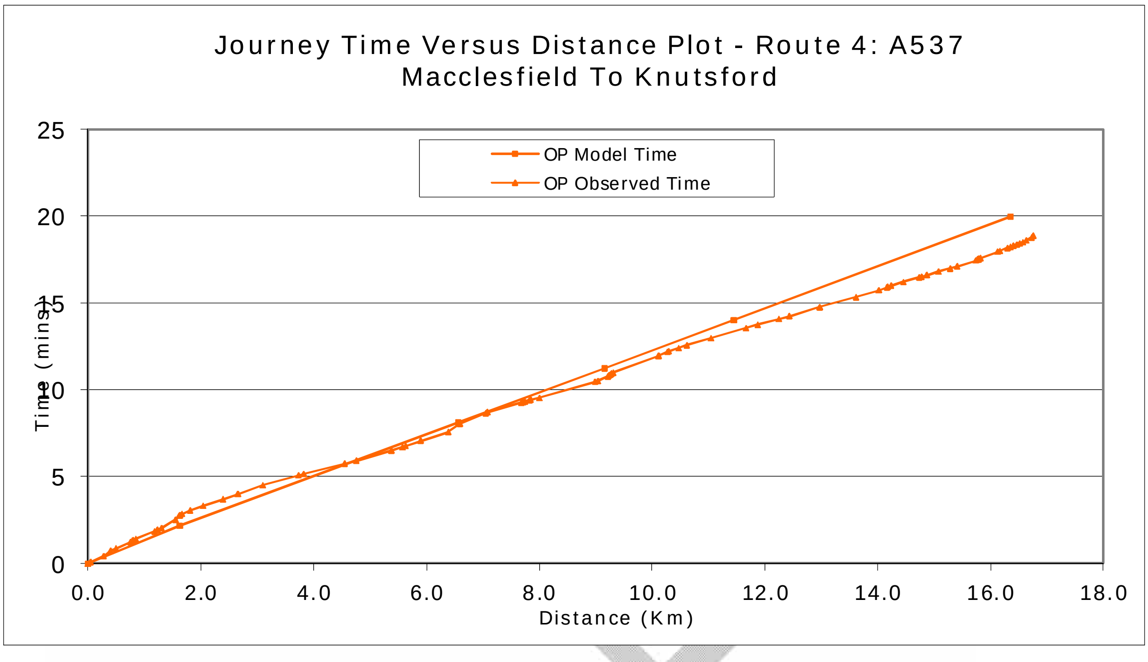

Journey Time Versus Distance Plot - Route 2: A6 Heaton Moor To Chapel
PM Model Time
PM Observed Time
Time (mins)
60
50
40
30
20
10
0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Distance (Km)

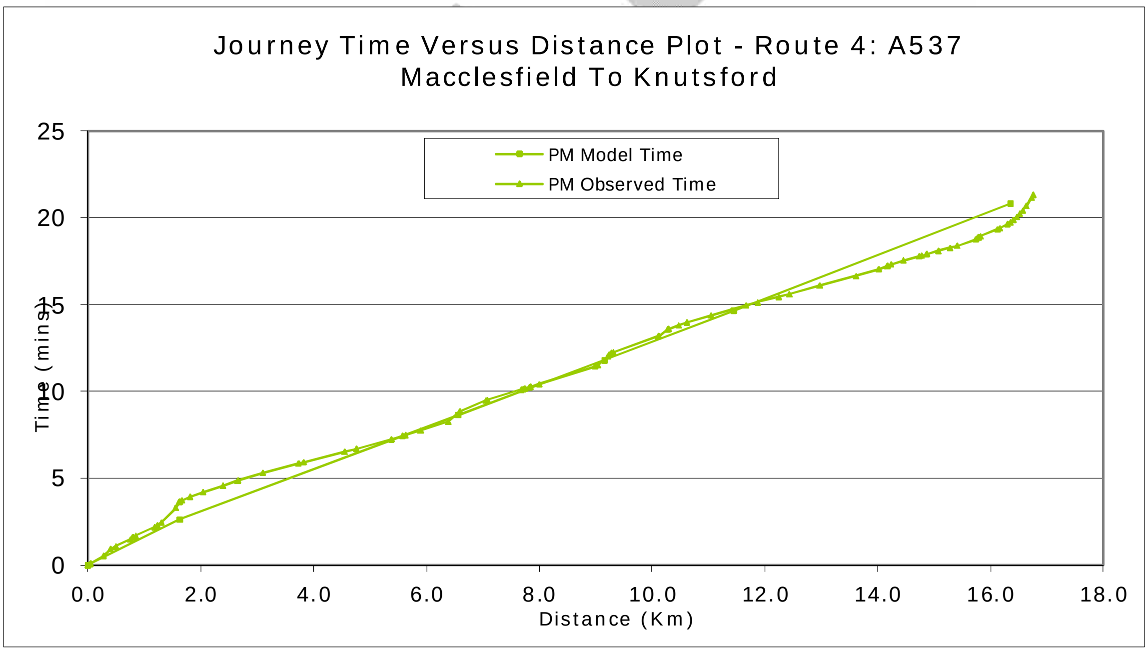

Journey Time Versus Distance Plot - Route 3: A537 Knutsford To Macclesfield
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
30
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

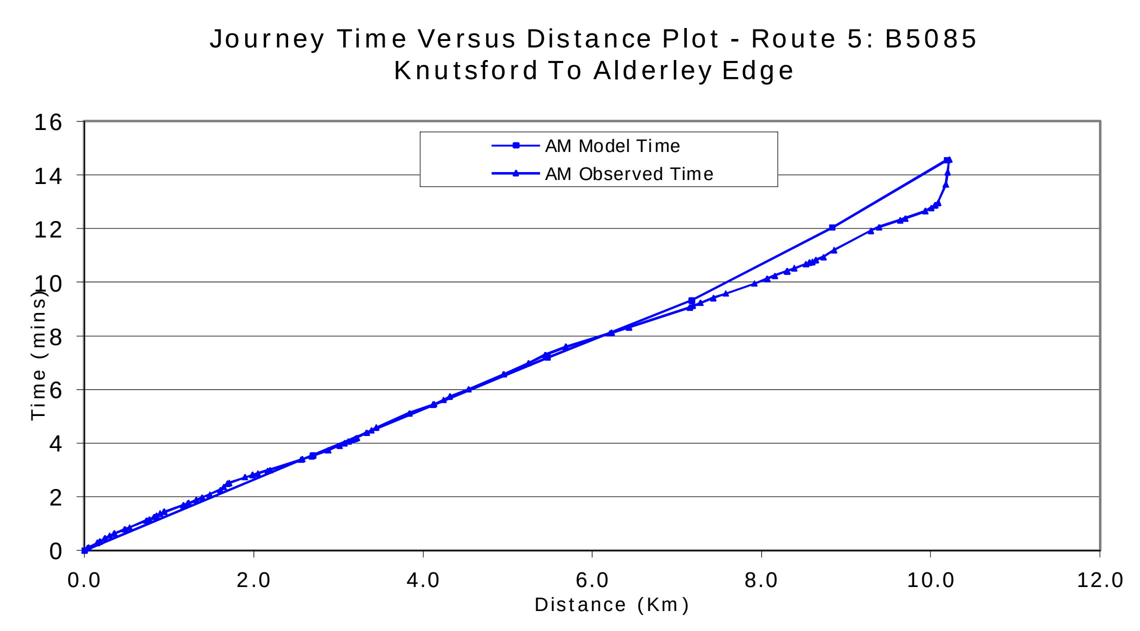

Journey Time Versus Distance Plot - Route 3: A537 Knutsford To Macclesfield
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

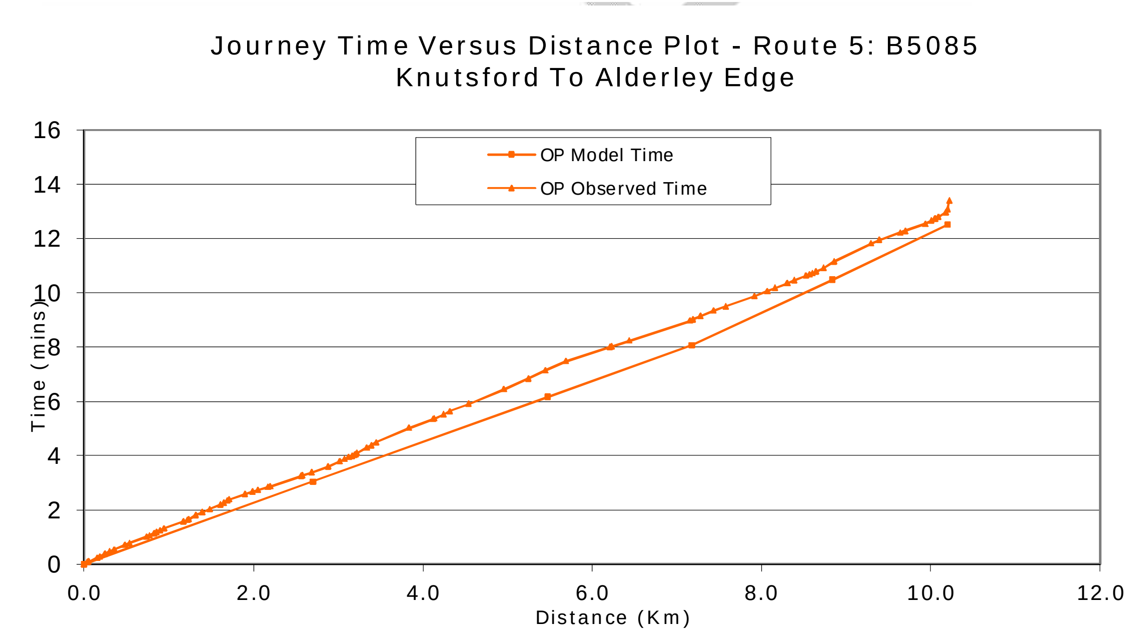

Journey Time Versus Distance Plot - Route 3: A537 Knutsford To Macclesfield
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

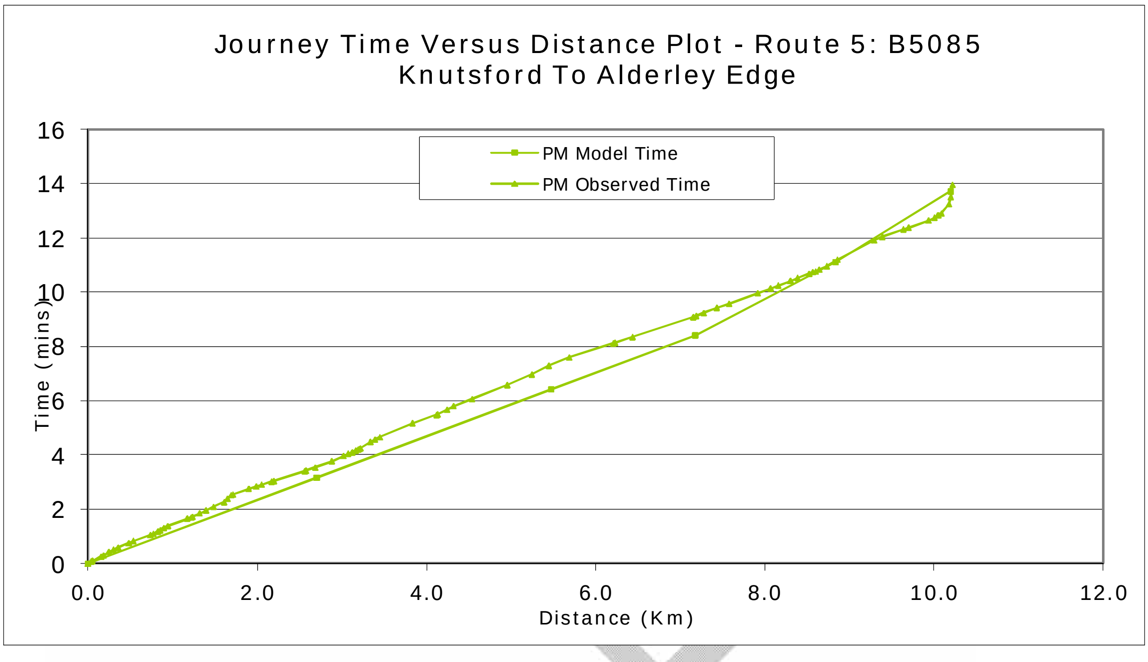

Journey Time Versus Distance Plot - Route 4: A537 Macclesfield To Knutsford
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

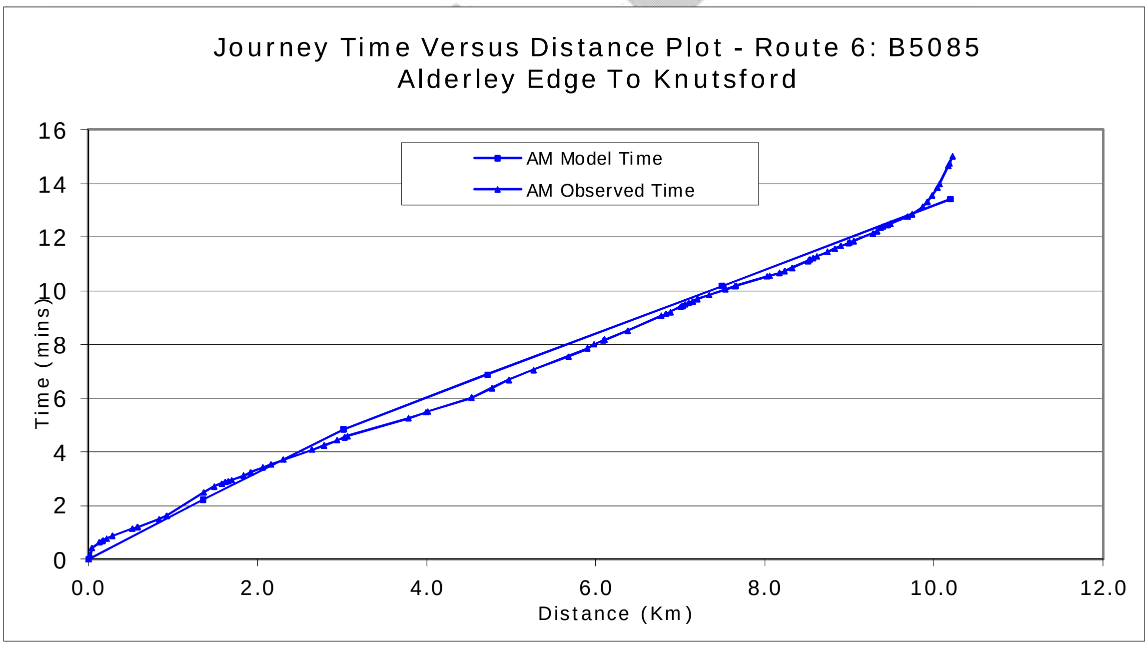

Journey Time Versus Distance Plot - Route 4: A537 Macclesfield To Knutsford
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

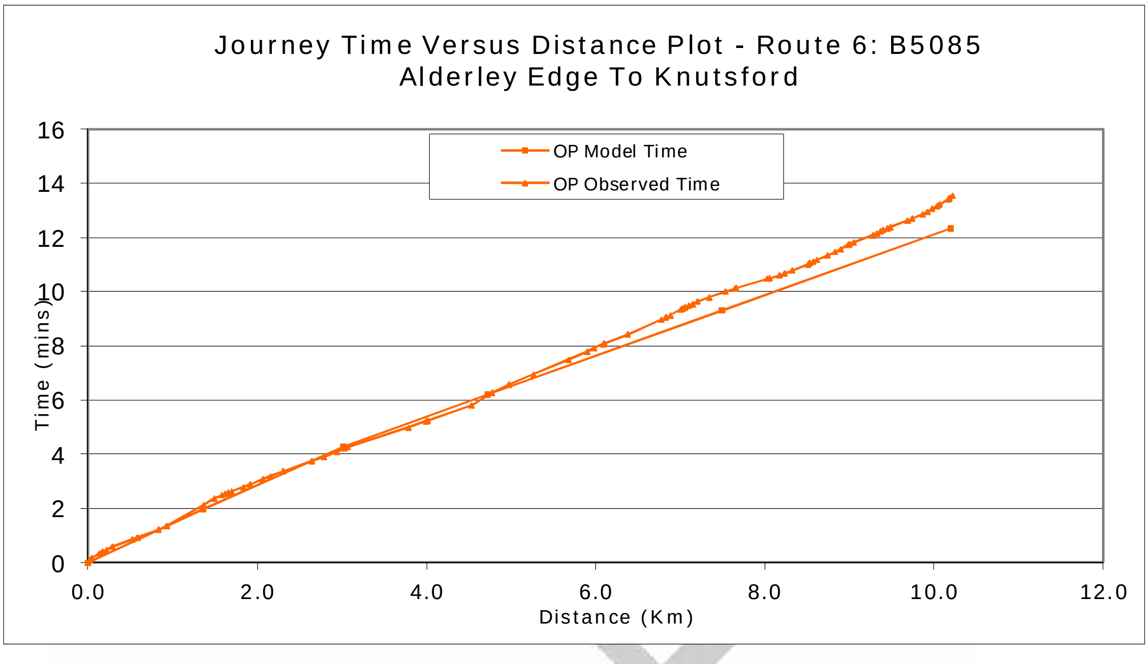

Journey Time Versus Distance Plot - Route 4: A537 Macclesfield To Knutsford
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0


Journey Time Versus Distance Plot - Route 5: B5085 Knutsford To Alderley Edge
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0
12.0

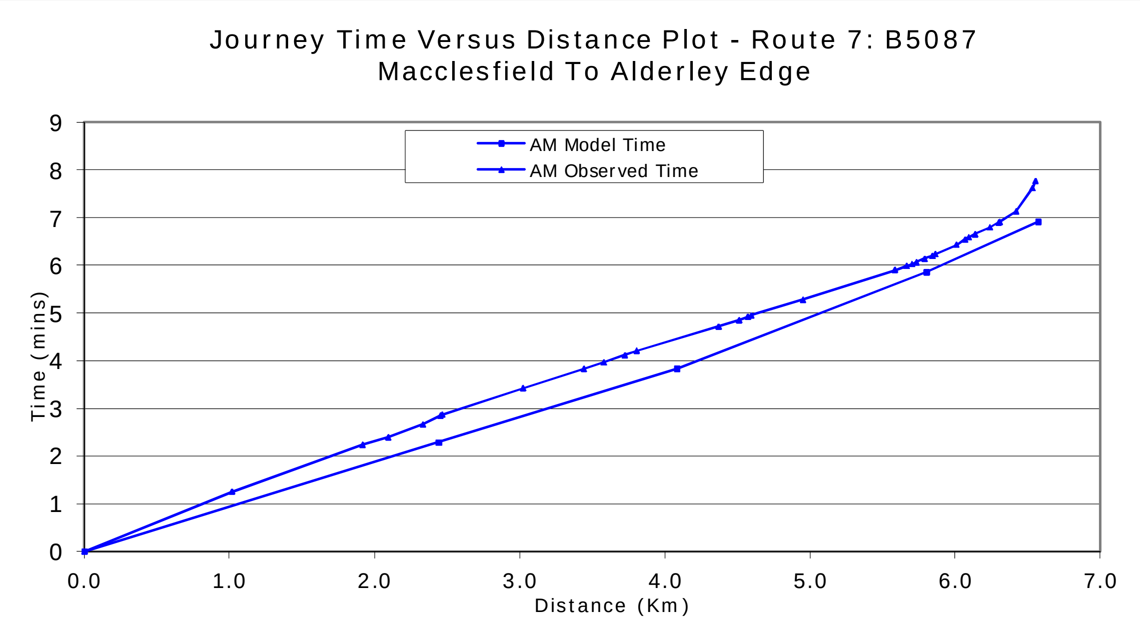

Journey Time Versus Distance Plot - Route 5: B5085 Knutsford To Alderley Edge
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0
12.0

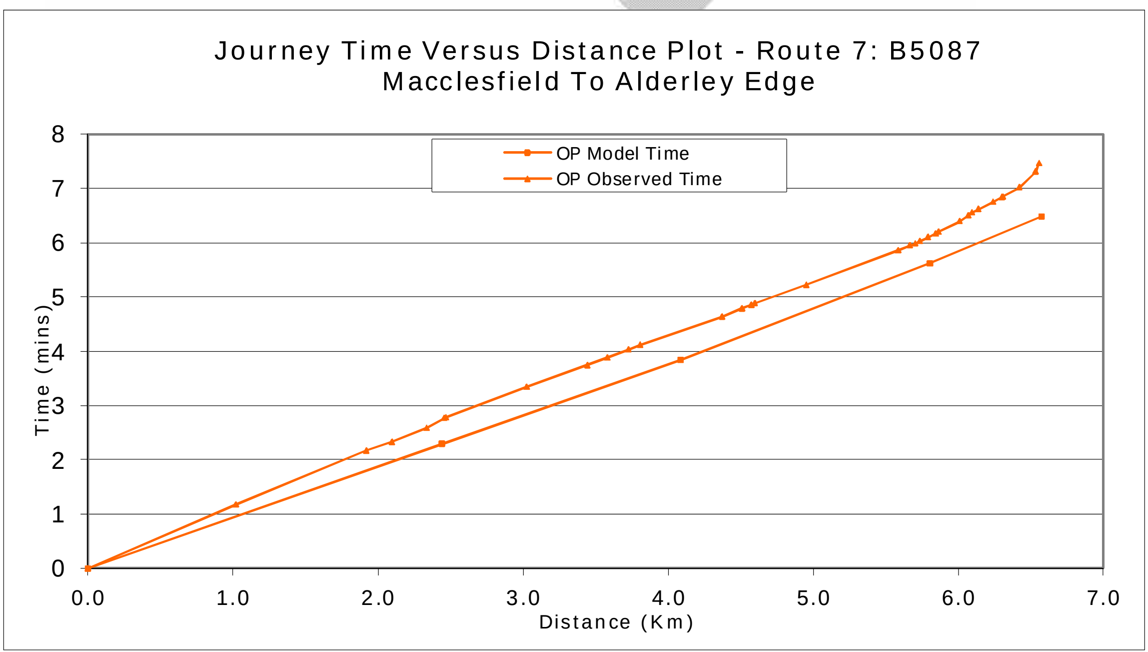

Journey Time Versus Distance Plot - Route 5: B5085 Knutsford To Alderley Edge
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0
12.0

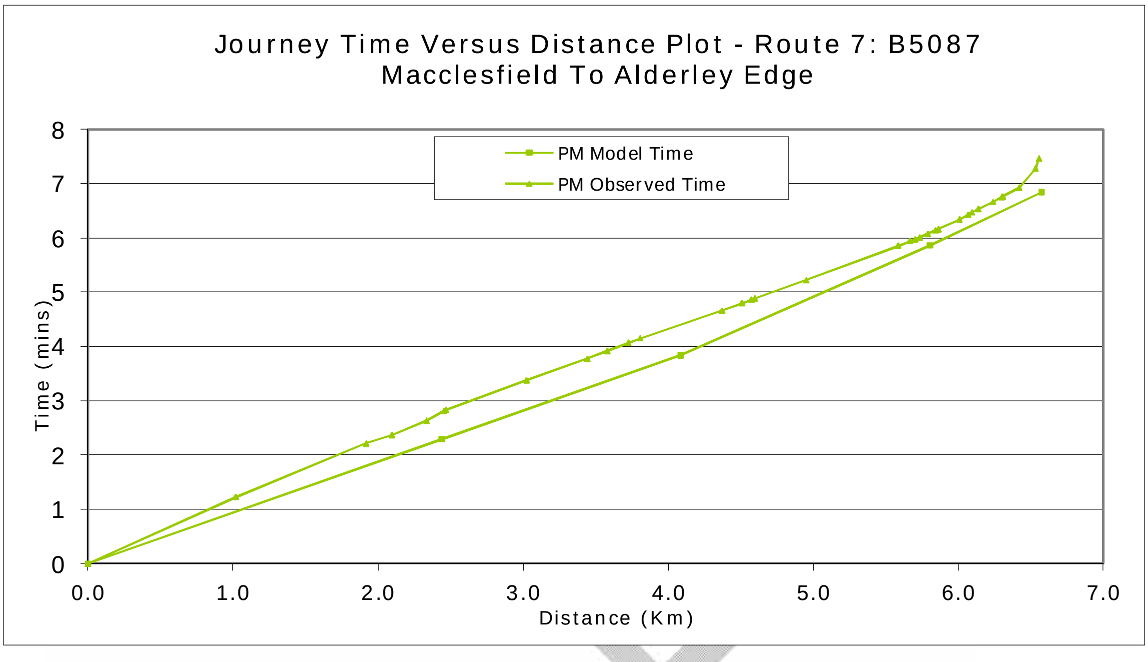

Journey Time Versus Distance Plot - Route 6: B5085 Alderley Edge To Knutsford
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0
12.0

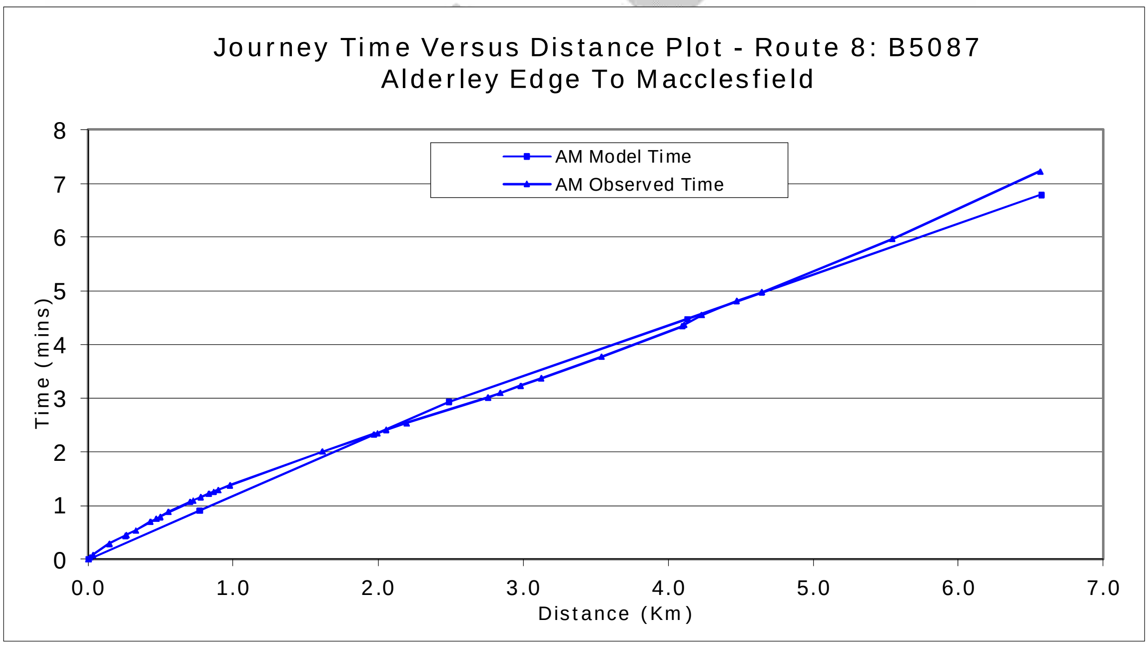

Journey Time Versus Distance Plot - Route 6: B5085 Alderley Edge To Knutsford
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0
12.0

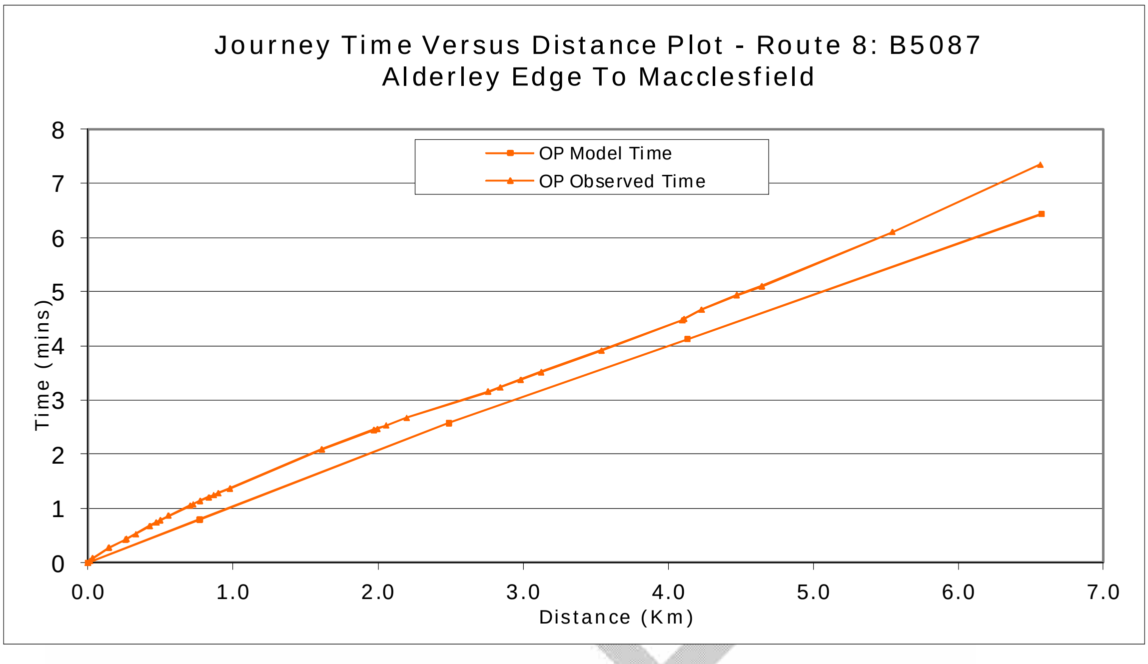

Journey Time Versus Distance Plot - Route 6: B5085 Alderley Edge To Knutsford
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
0.0
2.0
4.0
6.0
8.0
10.0
12.0

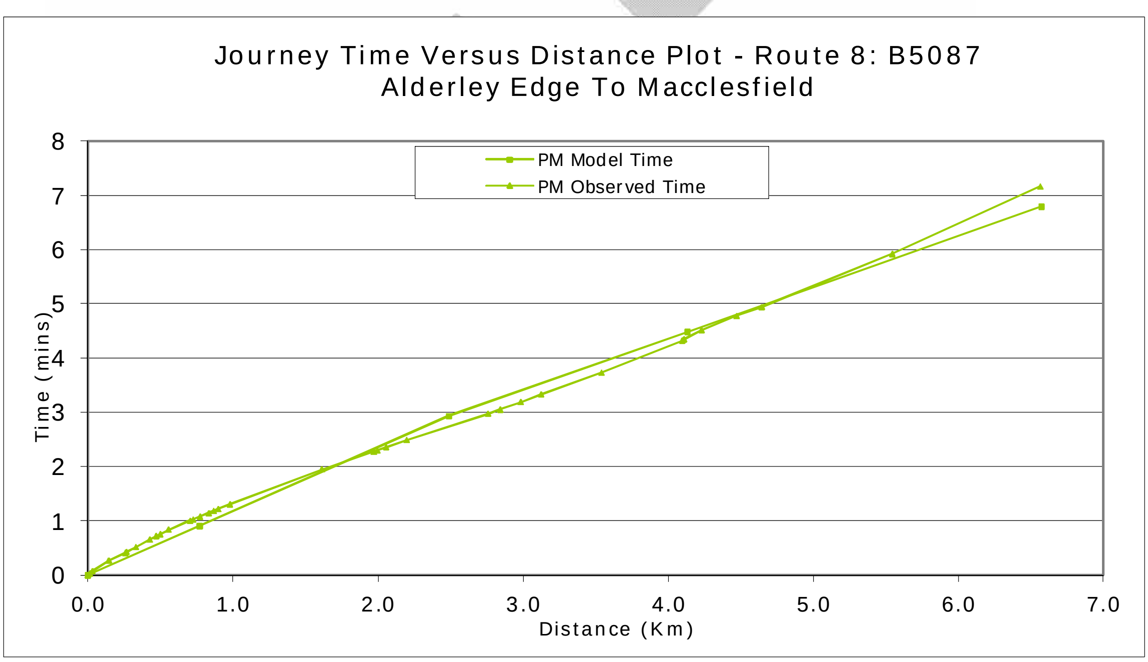

Journey Time Versus Distance Plot - Route 7: B5087 Macclesfield To Alderley Edge
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

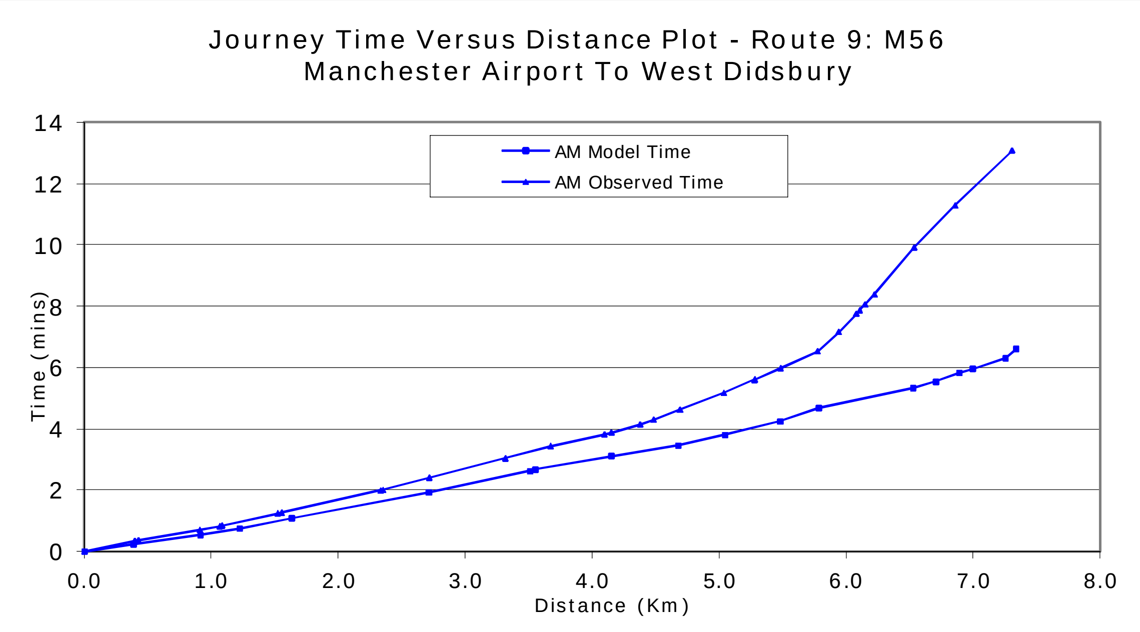

Journey Time Versus Distance Plot - Route 7: B5087 Macclesfield To Alderley Edge
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

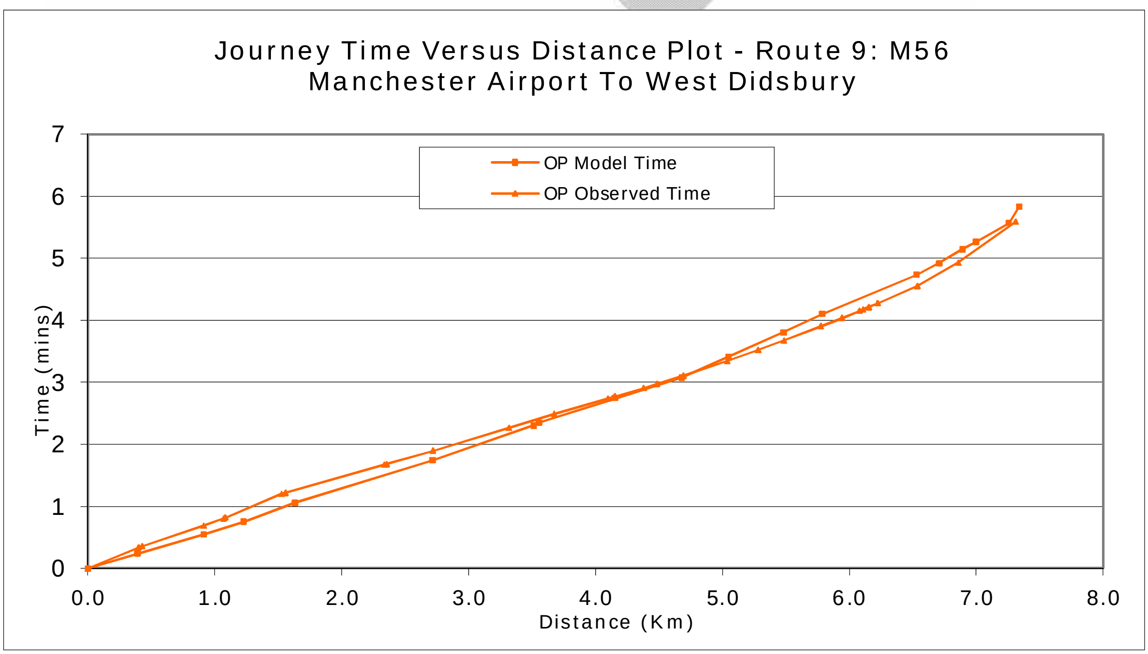

Journey Time Versus Distance Plot - Route 7: B5087 Macclesfield To Alderley Edge
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)

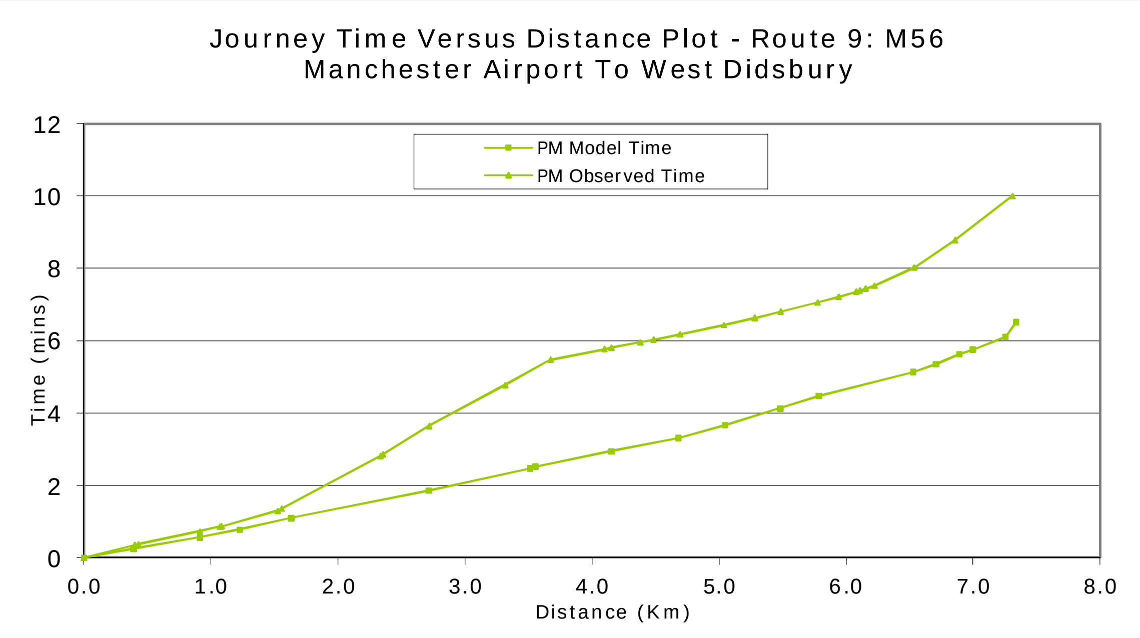

Journey Time Versus Distance Plot - Route 8: B5087 Alderley Edge To Macclesfield
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)

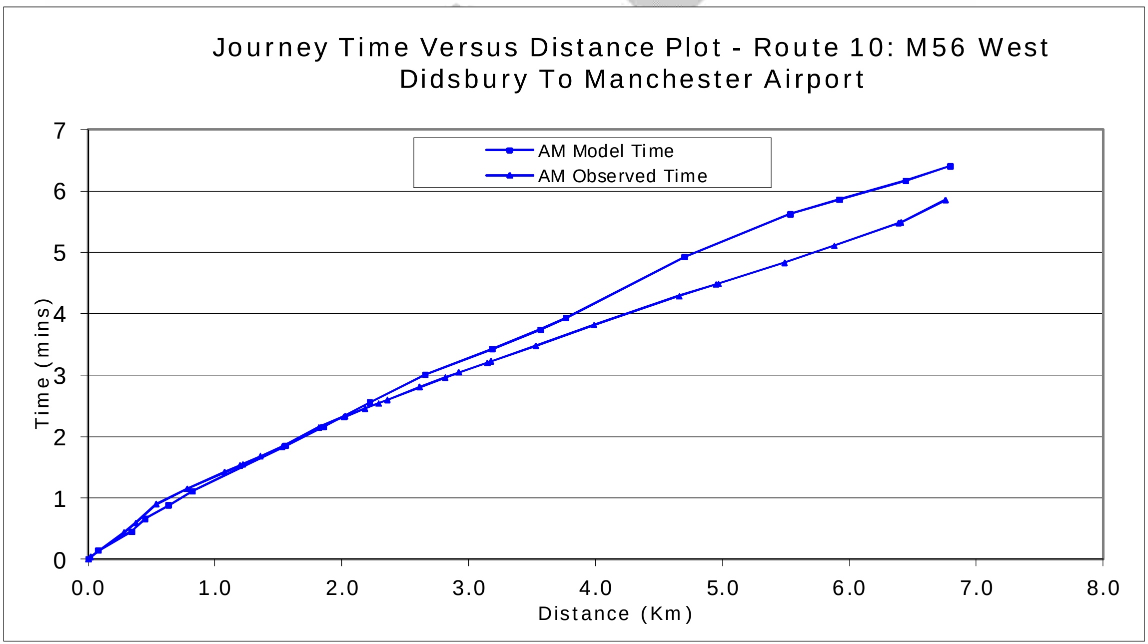

Journey Time Versus Distance Plot - Route 8: B5087
Alderley Edge To Macclesfield
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

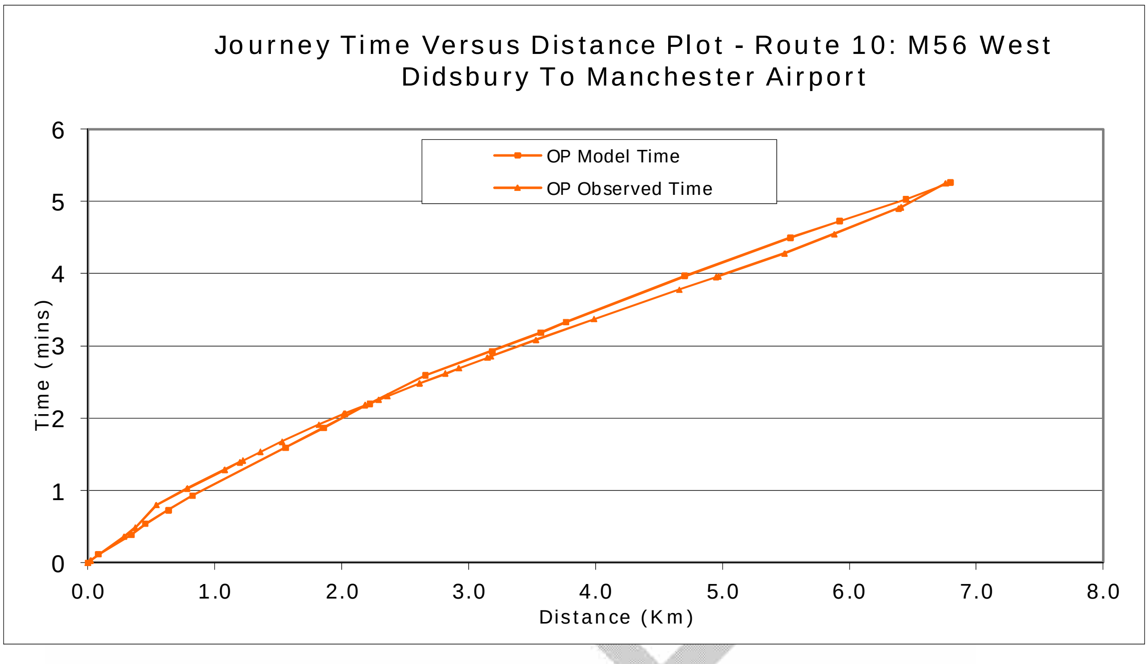

Journey Time Versus Distance Plot - Route 8: B5087
Alderley Edge To Macclesfield
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

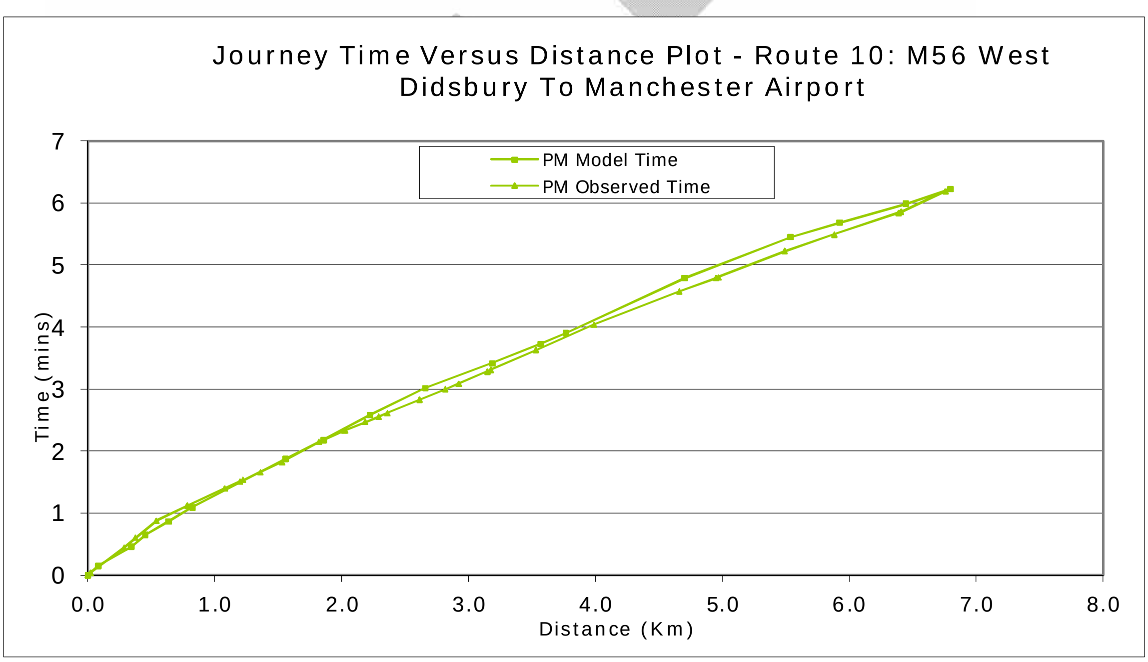

Journey Time Versus Distance Plot - Route 9: M56
Manchester Airport To West Didsbury
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

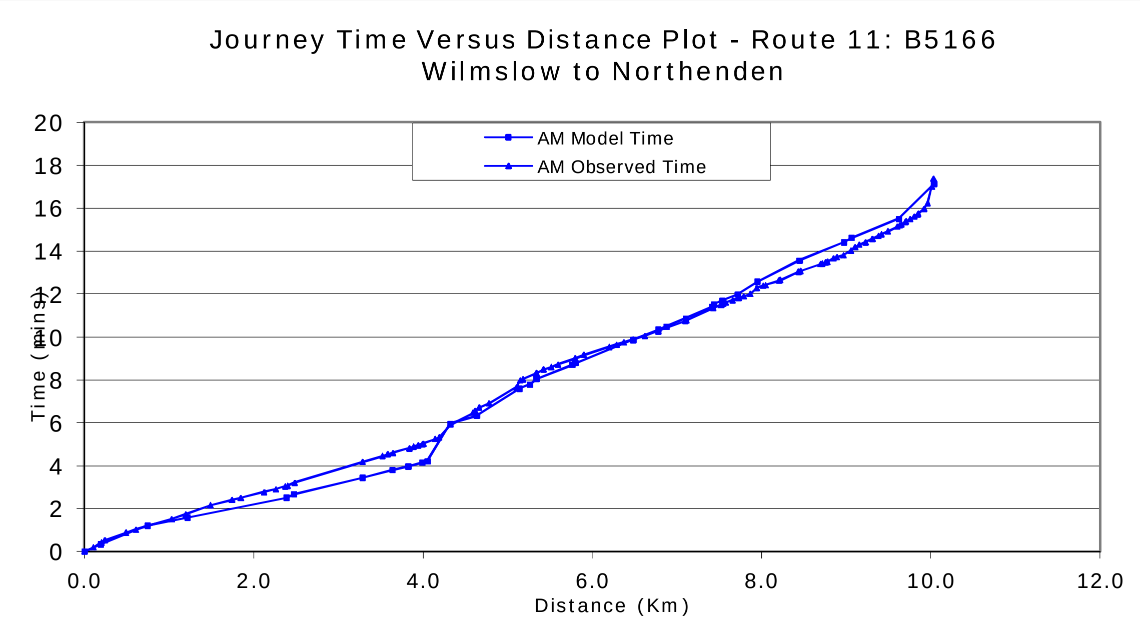

Journey Time Versus Distance Plot - Route 9: M56
Manchester Airport To West Didsbury
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

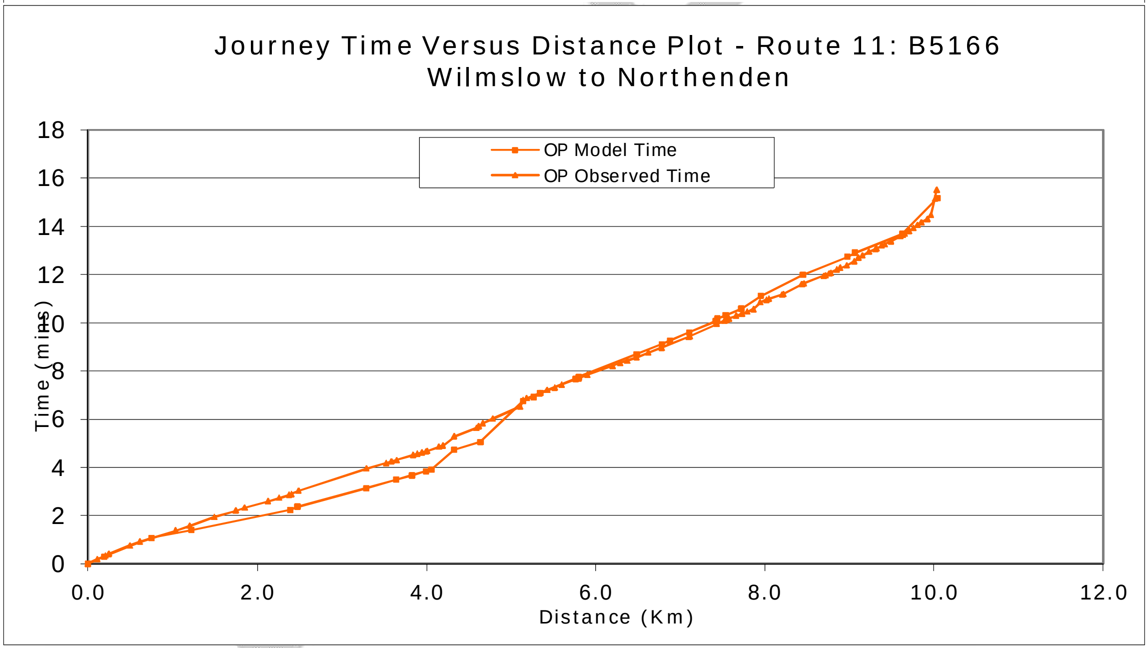

Journey Time Versus Distance Plot - Route 9: M56 Manchester Airport To West Didsbury
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

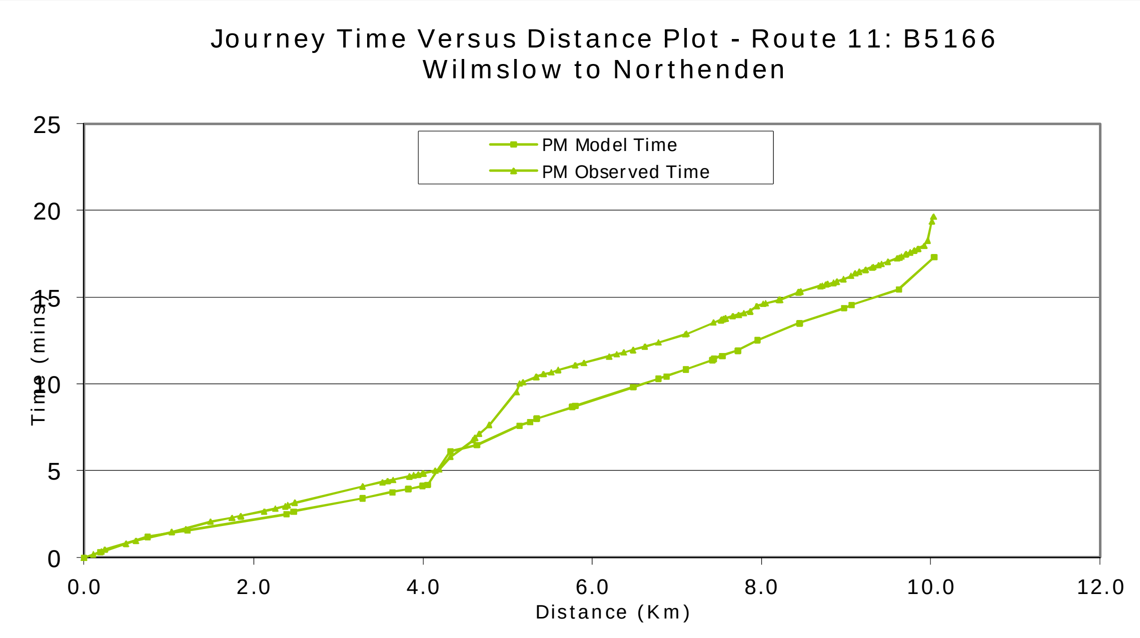

Journey Time Versus Distance Plot - Route 10: M56 West Didsbury To Manchester Airport
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

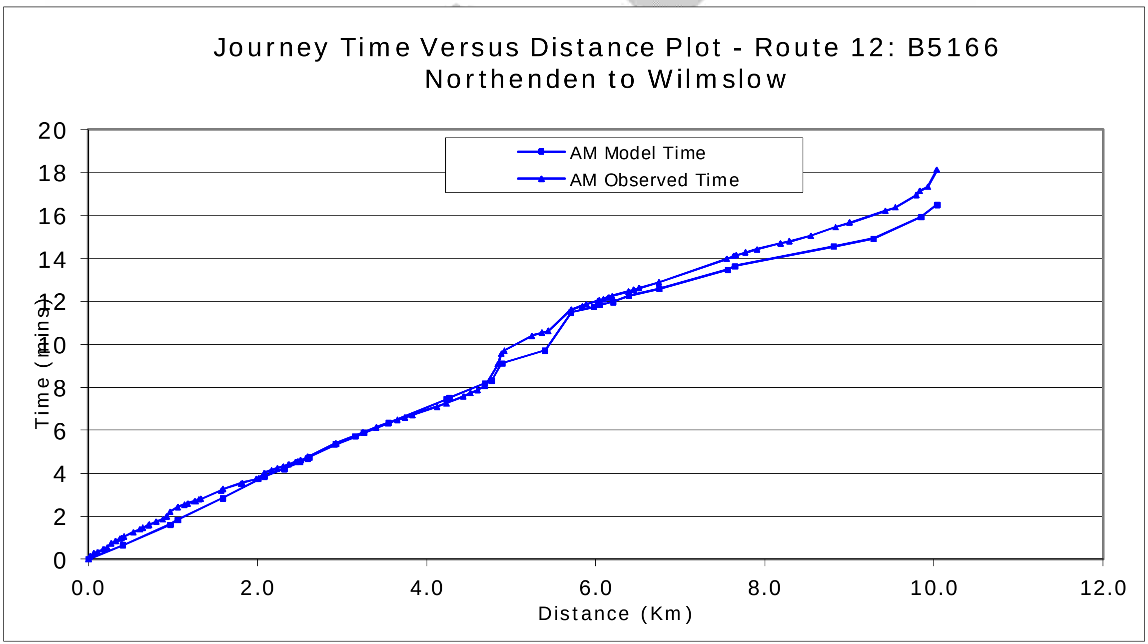

Journey Time Versus Distance Plot - Route 10: M56 West Didsbury To Manchester Airport
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

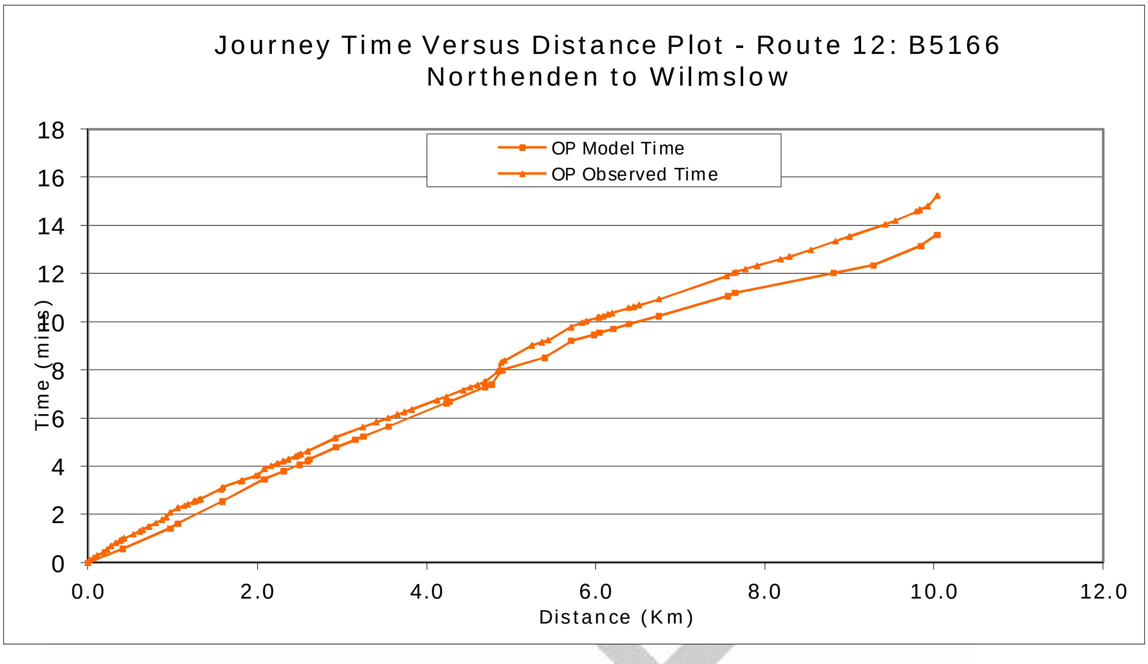

Journey Time Versus Distance Plot - Route 10: M56 West Didsbury To Manchester Airport
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

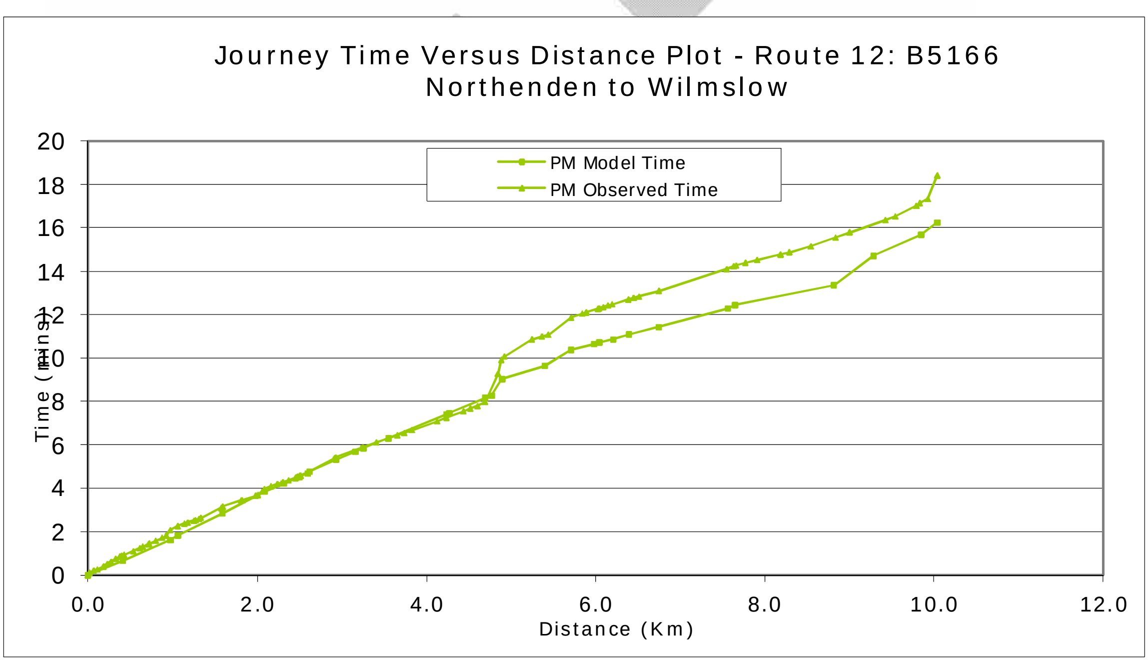

Journey Time Versus Distance Plot - Route 11: B5166 Wilmslow to Northenden
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
2.0
4.0
6.0
8.0
10.0
12.0

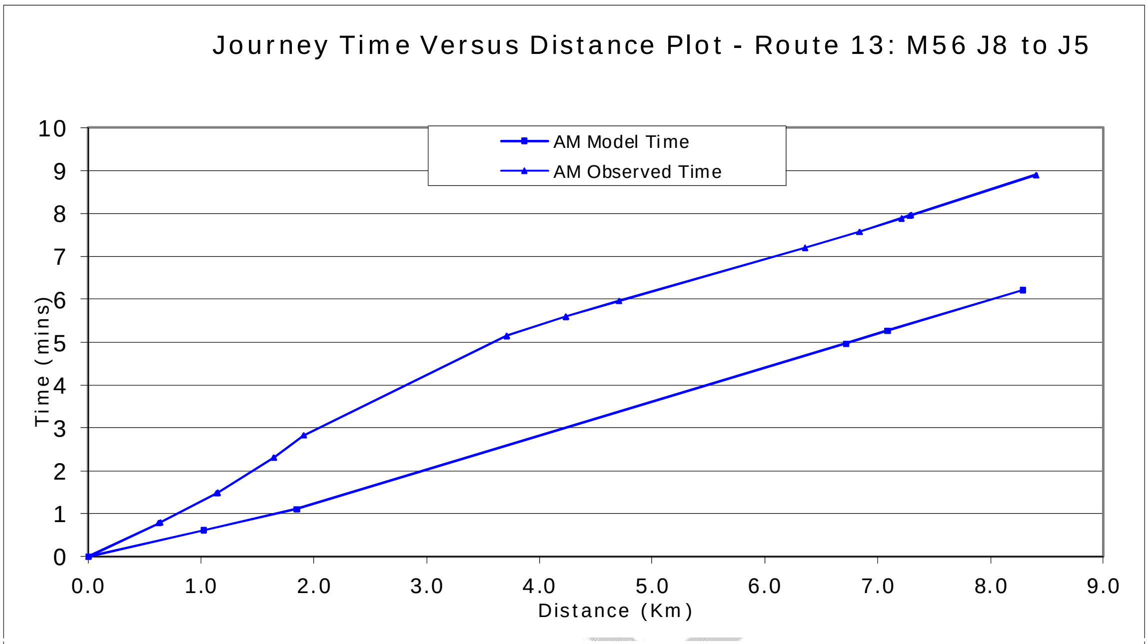

Journey Time Versus Distance Plot - Route 11: B5166 Wilmslow to Northenden
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
0.0
2.0
4.0
6.0
8.0
10.0
12.0

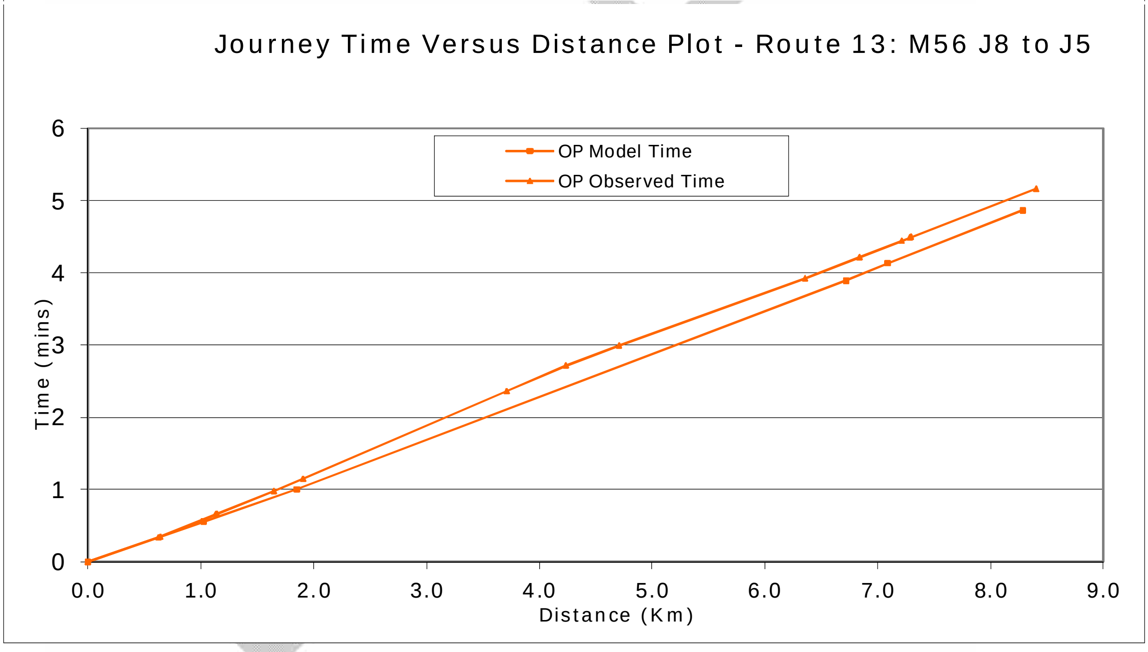

Journey Time Versus Distance Plot - Route 11: B5166 Wilmslow to Northenden
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0

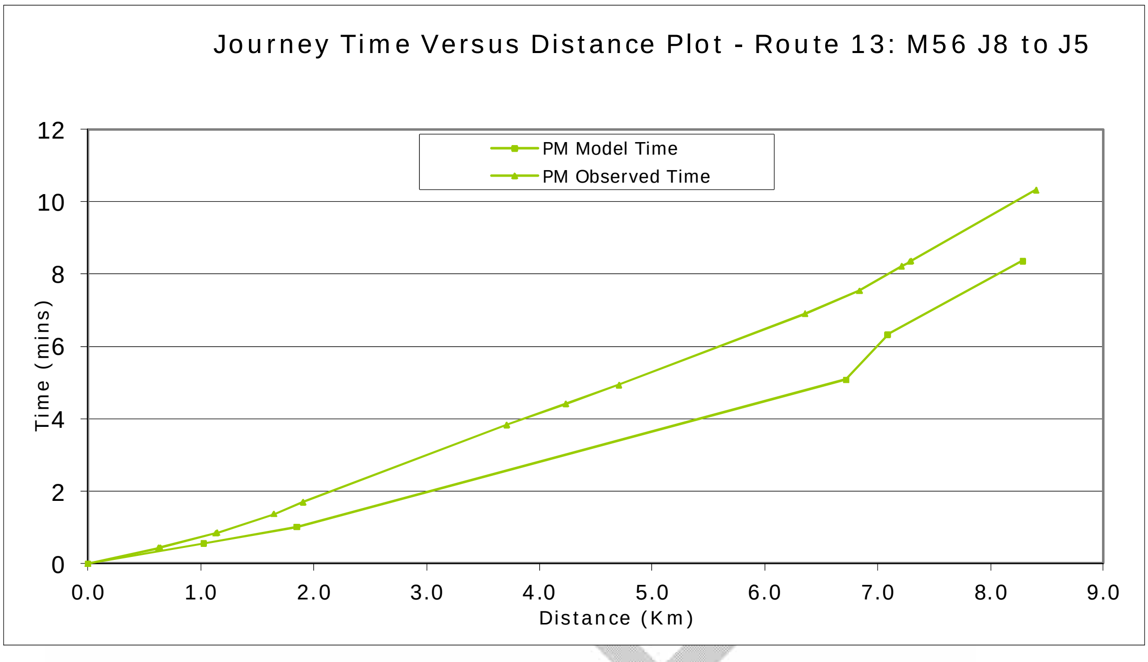

Journey Time Versus Distance Plot - Route 12: B5166 Northenden to Wilmslow
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
20
18
16
14
12
10
8
6
4
2
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0

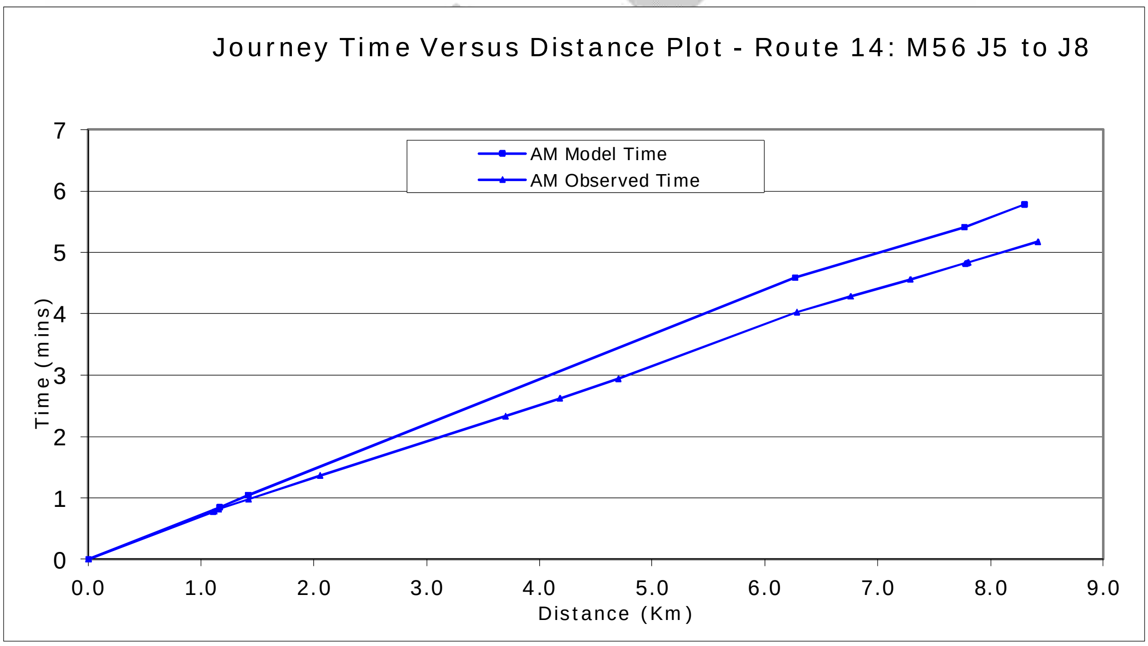

Journey Time Versus Distance Plot - Route 12: B5166 Northenden to Wilmslow
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
0.0
2.0
4.0
6.0
8.0
10.0
12.0

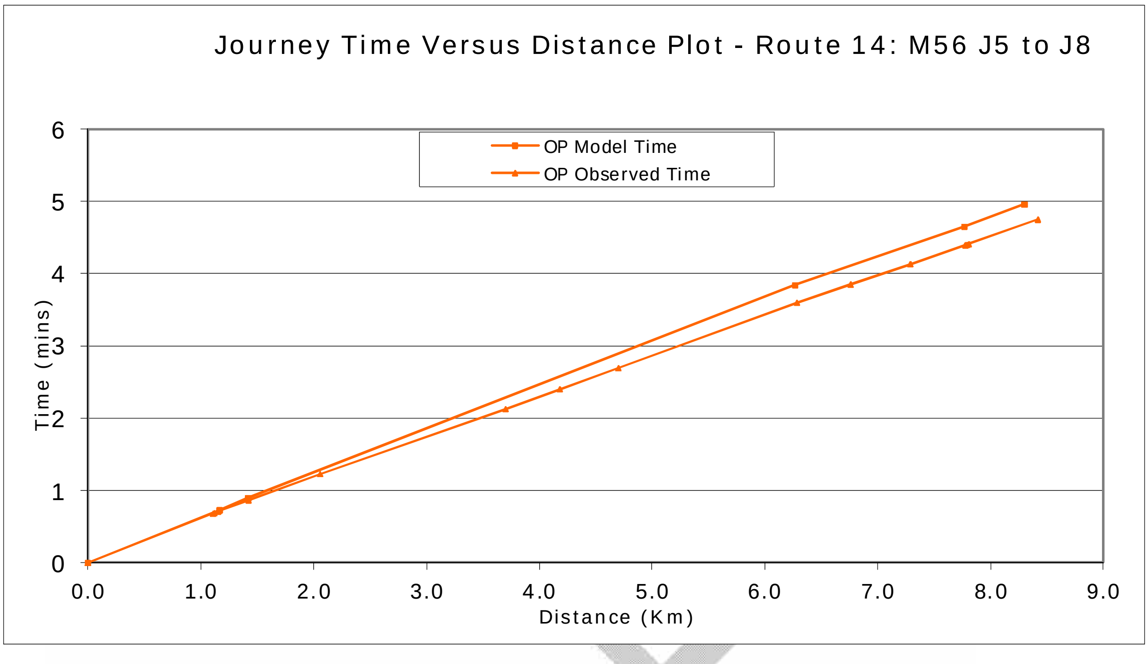

Journey Time Versus Distance Plot - Route 12: B5166 Northenden to Wilmslow
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
2.0
4.0
6.0
8.0
10.0
12.0

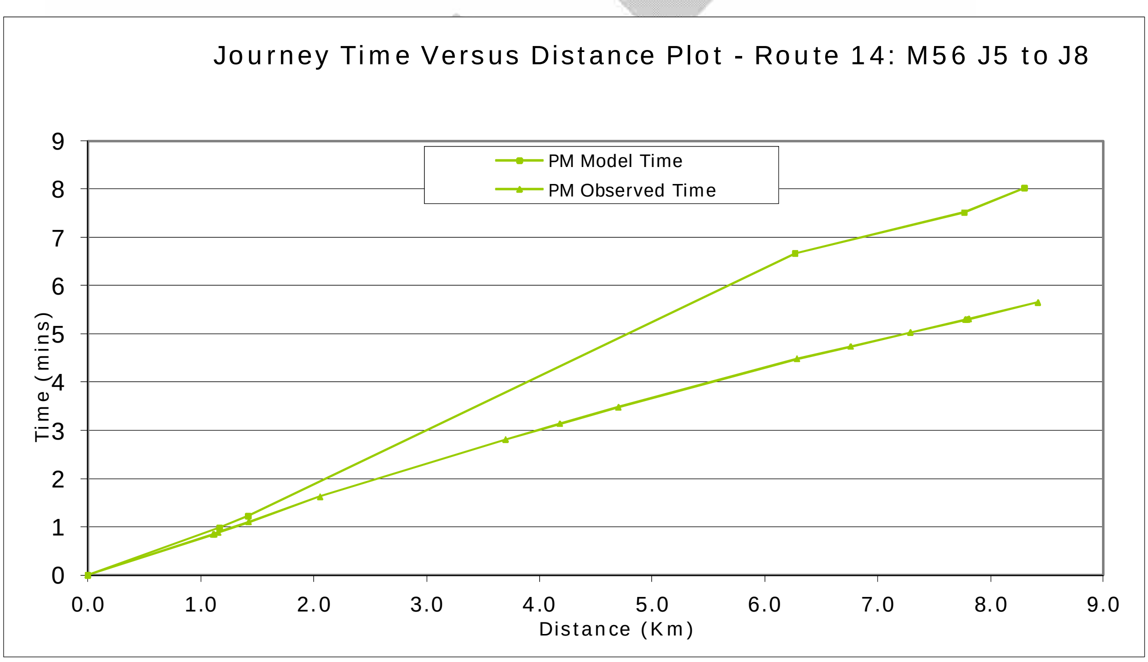

Journey Time Versus Distance Plot - Route 13: M56 J8 to J5
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
10
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

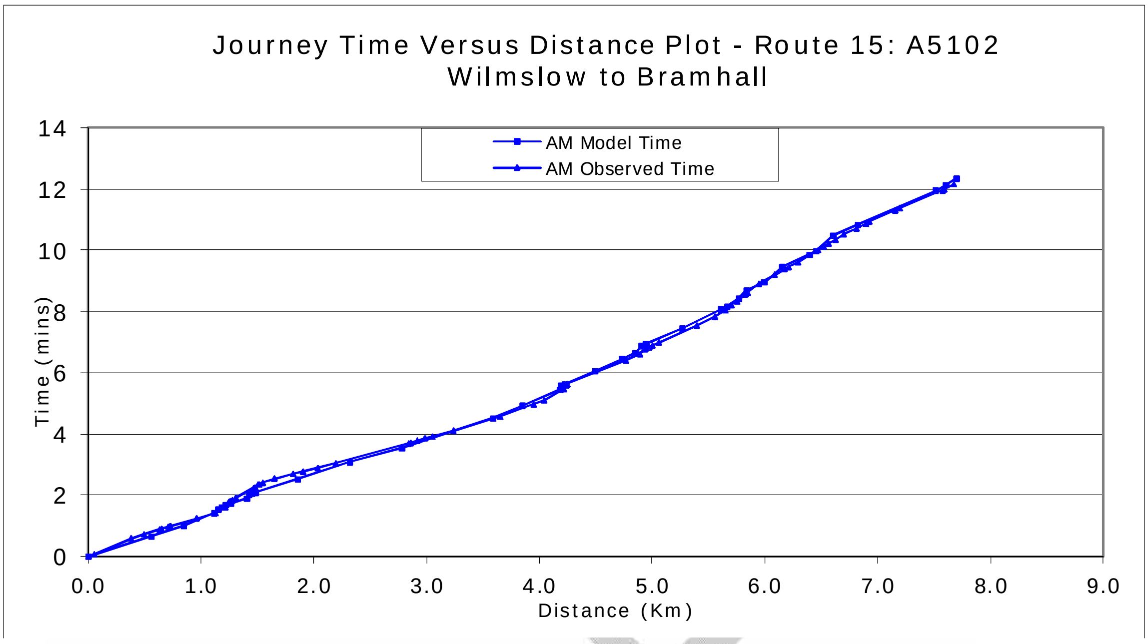

Journey Time Versus Distance Plot - Route 13: M56 J8 to J5
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

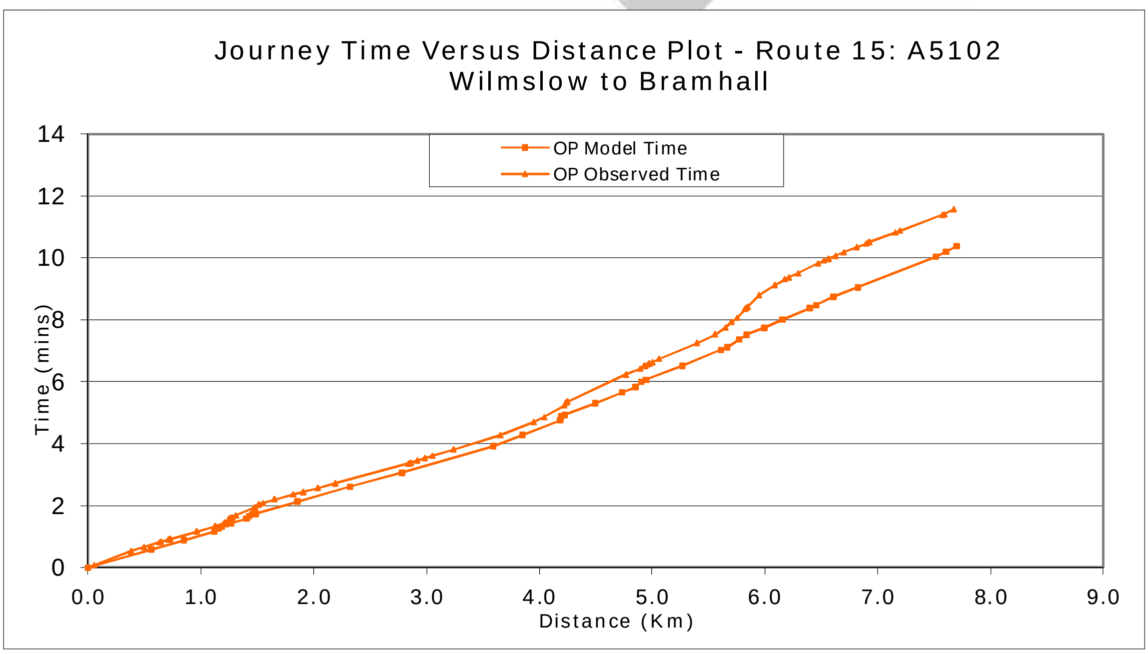

Journey Time Versus Distance Plot - Route 13: M56 J8 to J5
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

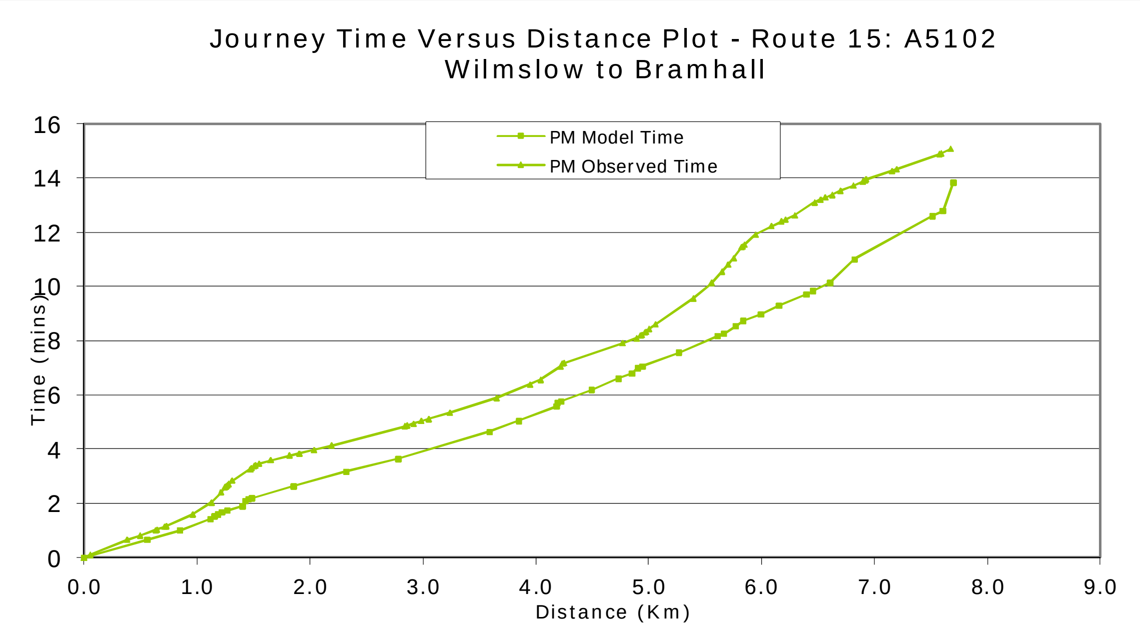

Journey Time Versus Distance Plot - Route 14: M56 J5 to J8
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

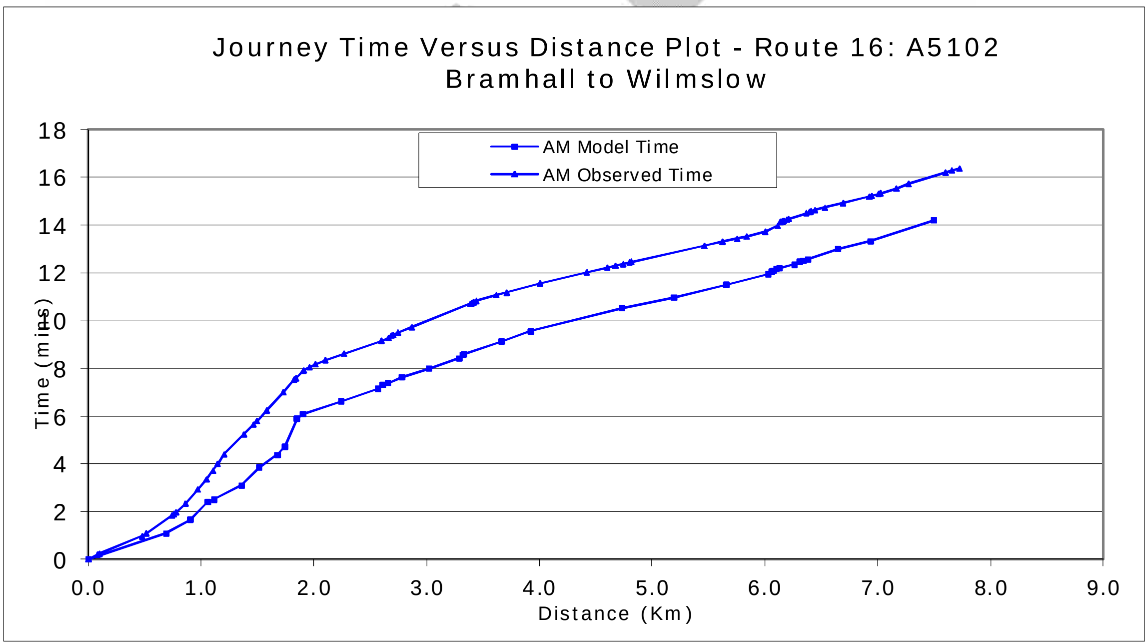

Journey Time Versus Distance Plot - Route 14: M56 J5 to J8
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

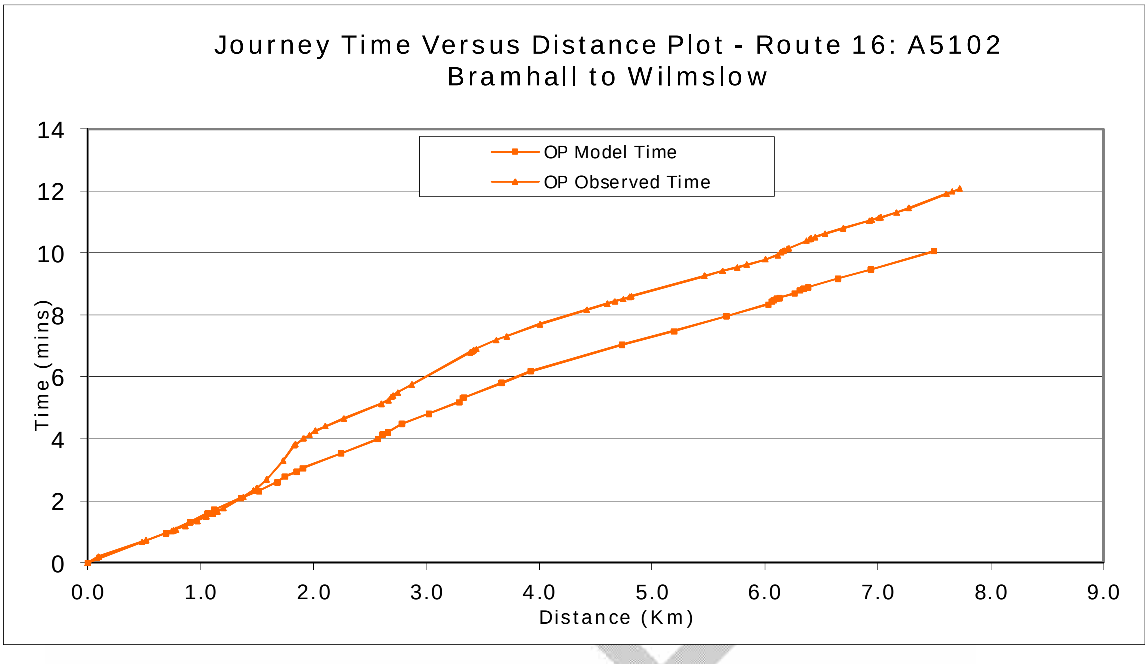

Journey Time Versus Distance Plot - Route 14: M56 J5 to J8
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

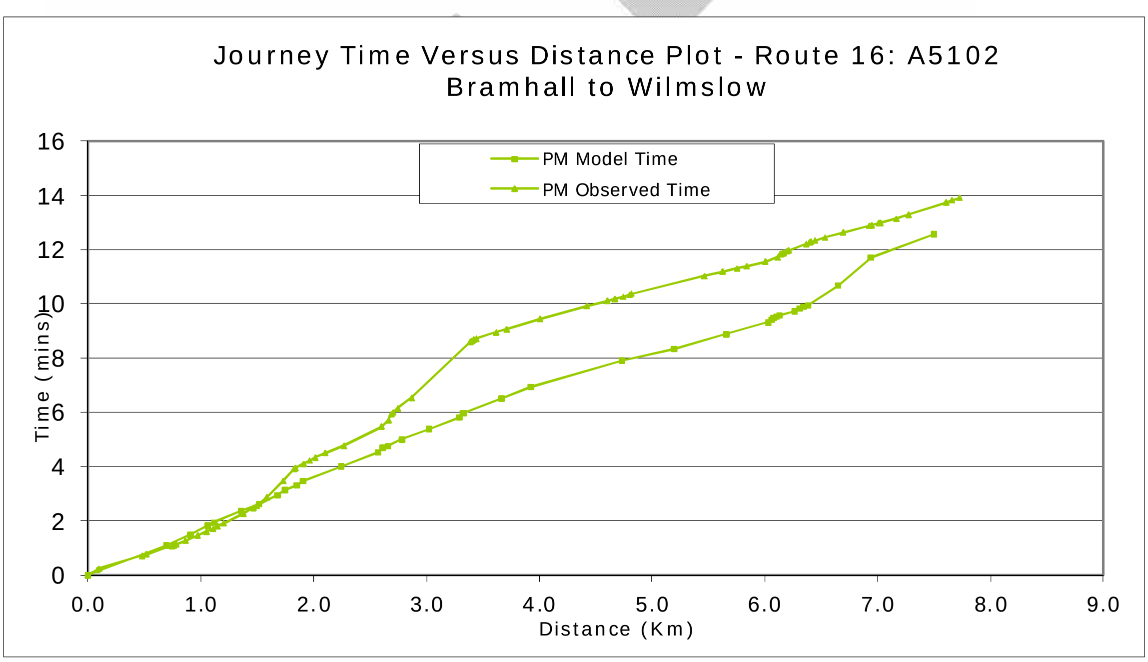

Journey Time Versus Distance Plot - Route 15: A5102 Wilmslow to Bramhall
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

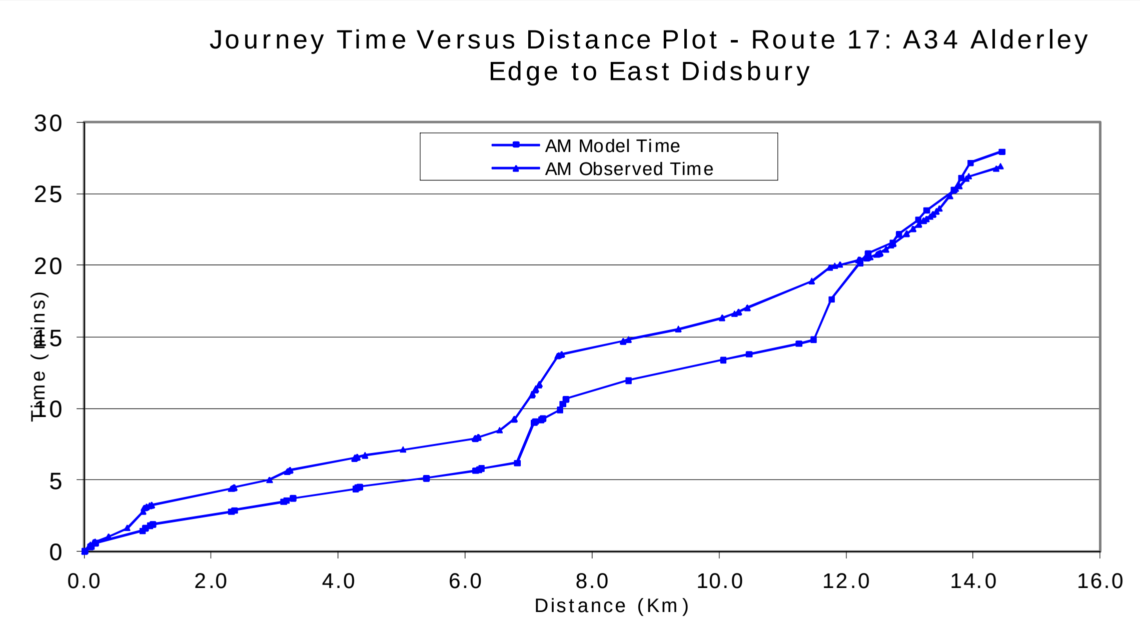

Journey Time Versus Distance Plot - Route 15: A5102 Wilmslow to Bramhall
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

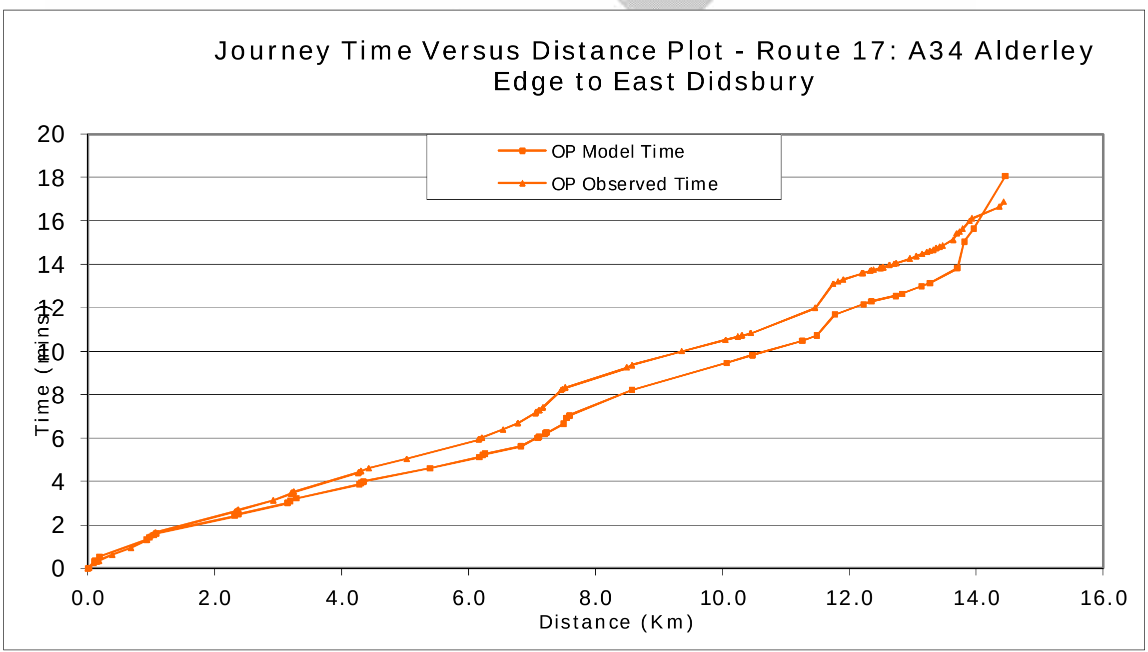

Journey Time Versus Distance Plot - Route 15: A5102 Wilmslow to Bramhall
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

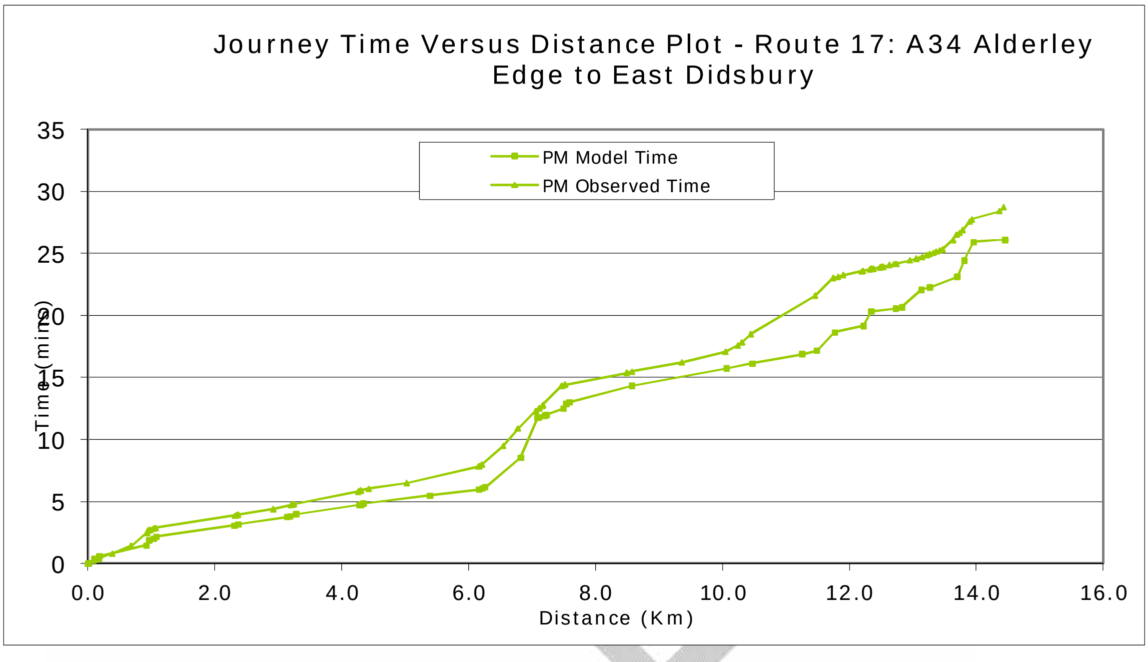

Journey Time Versus Distance Plot - Route 16: A5102 Bramhall to Wilmslow
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

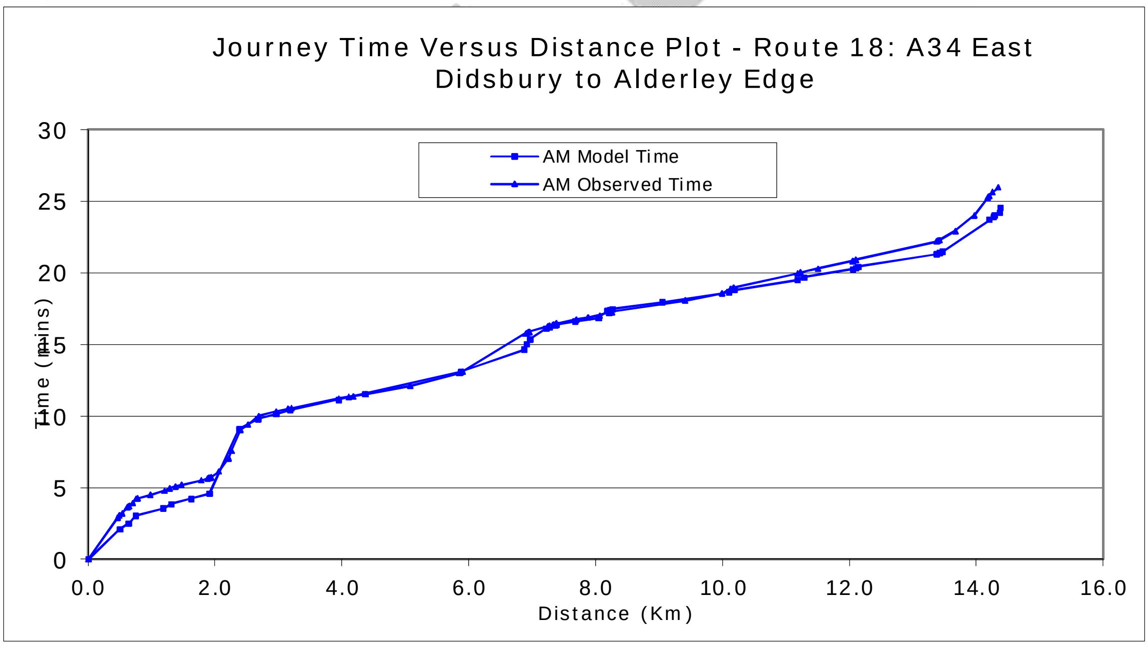

Journey Time Versus Distance Plot - Route 16: A5102 Bramhall to Wilmslow
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

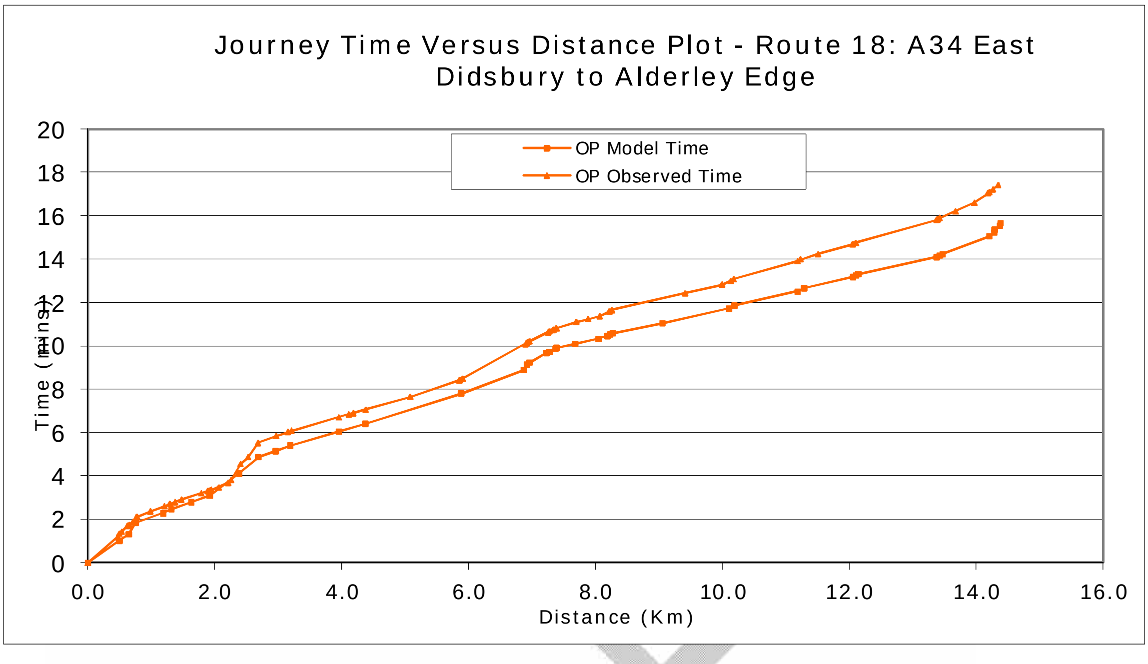

Journey Time Versus Distance Plot - Route 16: A5102 Bramhall to Wilmslow
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

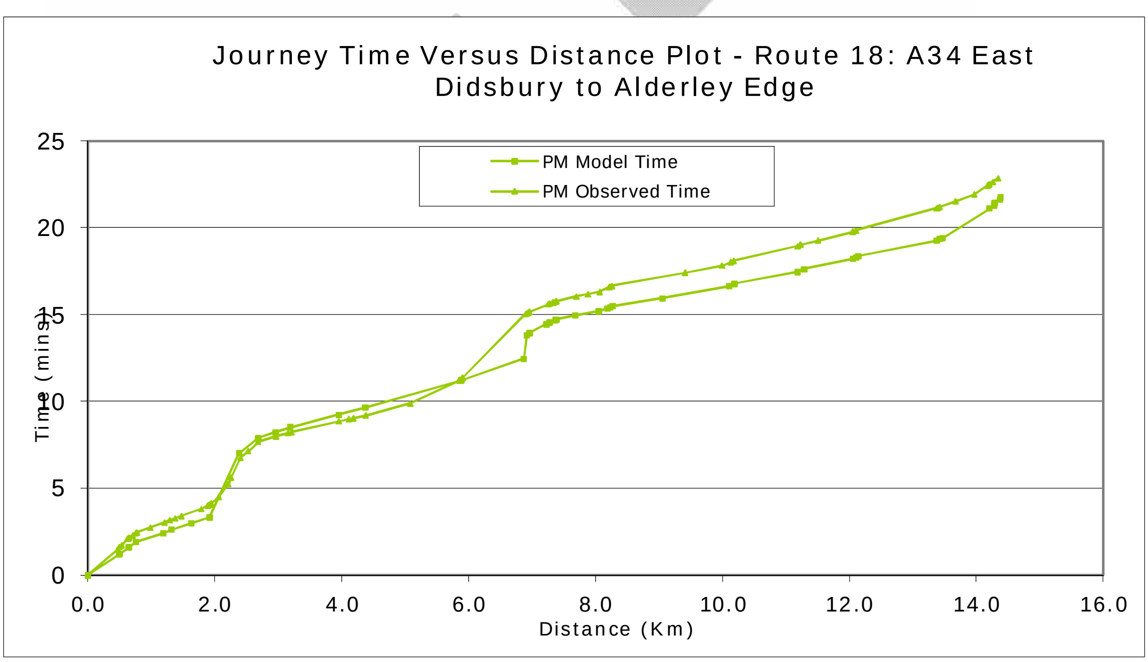

Journey Time Versus Distance Plot - Route 17: A34 Alderley Edge to East Didsbury
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
30
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

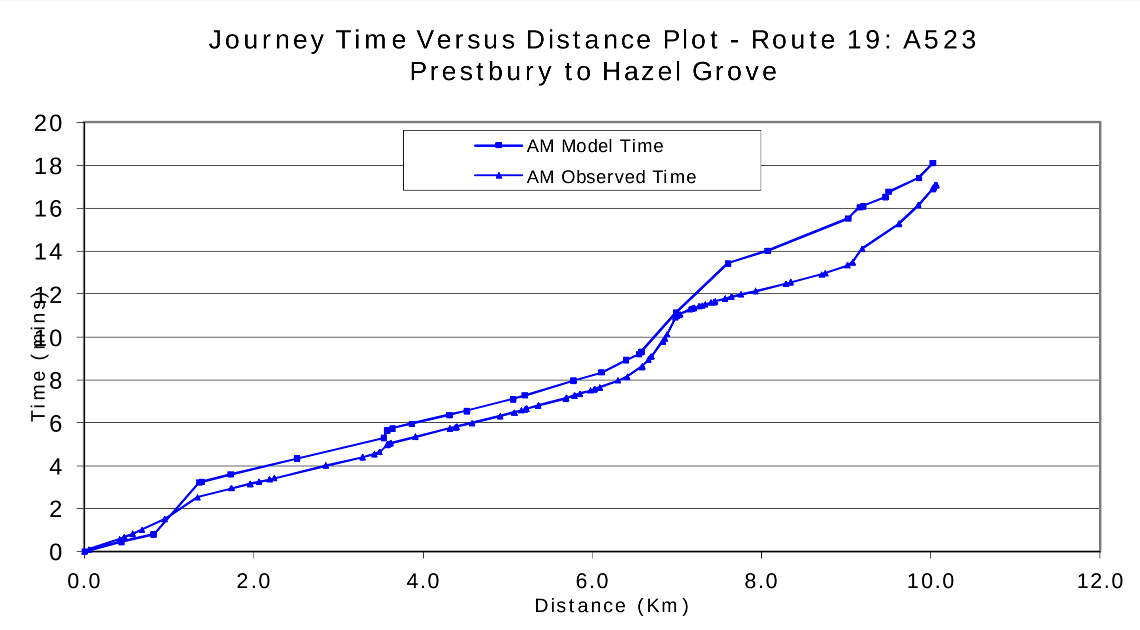

Journey Time Versus Distance Plot - Route 17: A34 Alderley Edge to East Didsbury
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

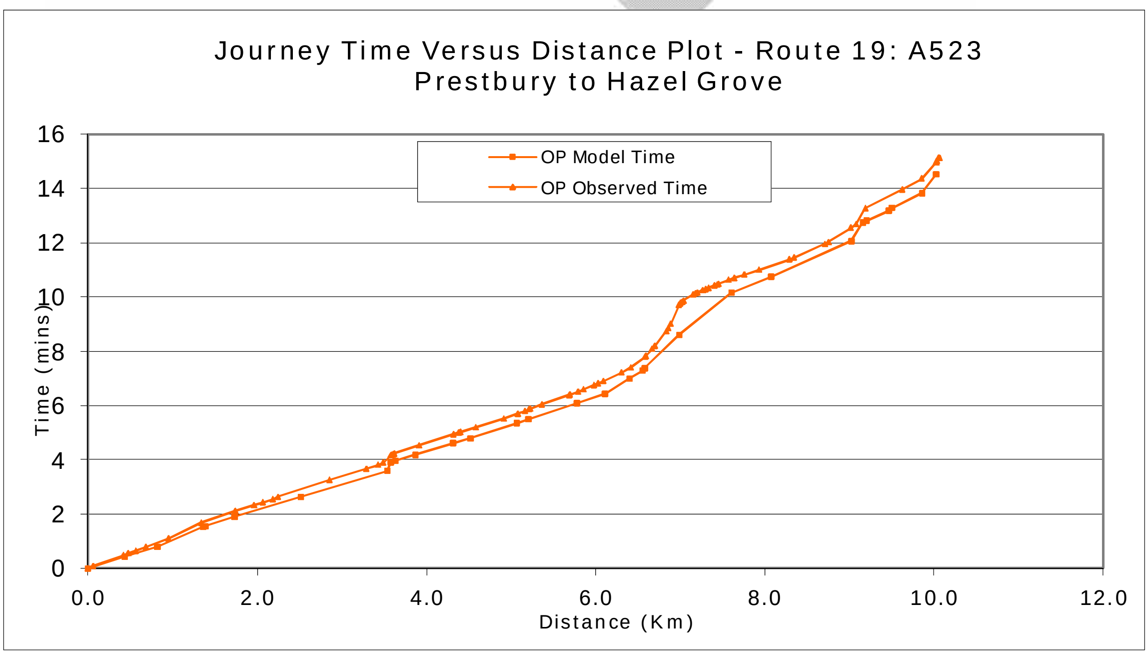

Journey Time Versus Distance Plot - Route 17: A34 Alderley Edge to East Didsbury
PM Model Time
PM Observed Time
Time (mins)
35
30
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Distance (Km)

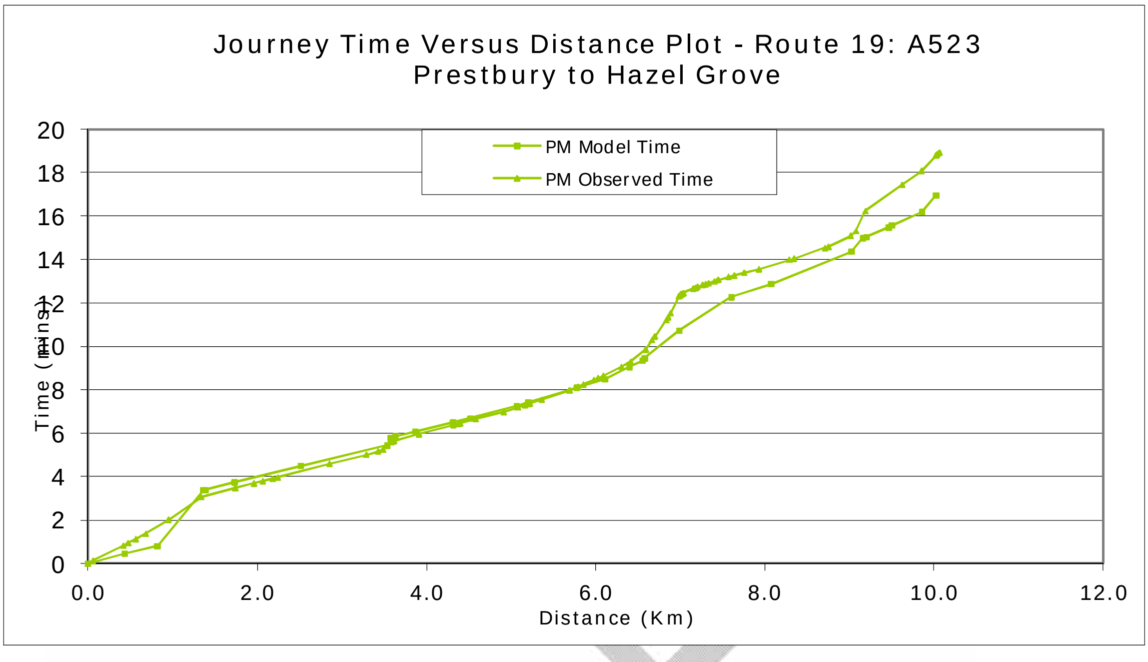

Journey Time Versus Distance Plot - Route 18: A34 East Didsbury to Alderley Edge
AM Model Time
AM Observed Time
Time (mins)
30
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
Distance (Km)

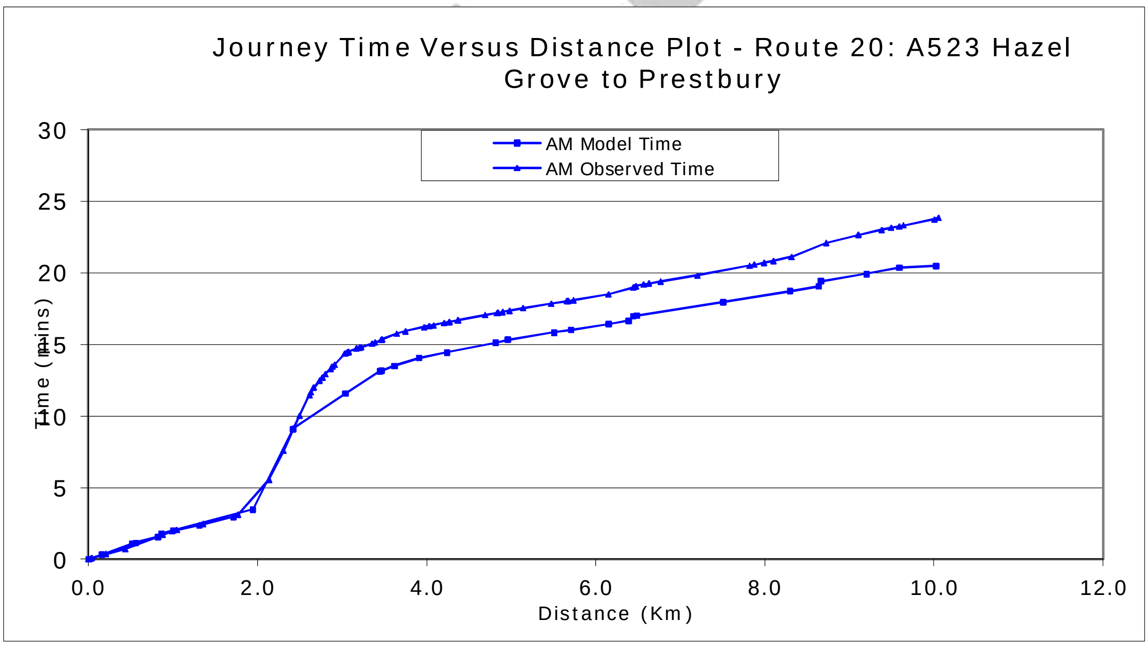

Journey Time Versus Distance Plot - Route 18: A34 East Didsbury to Alderley Edge
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

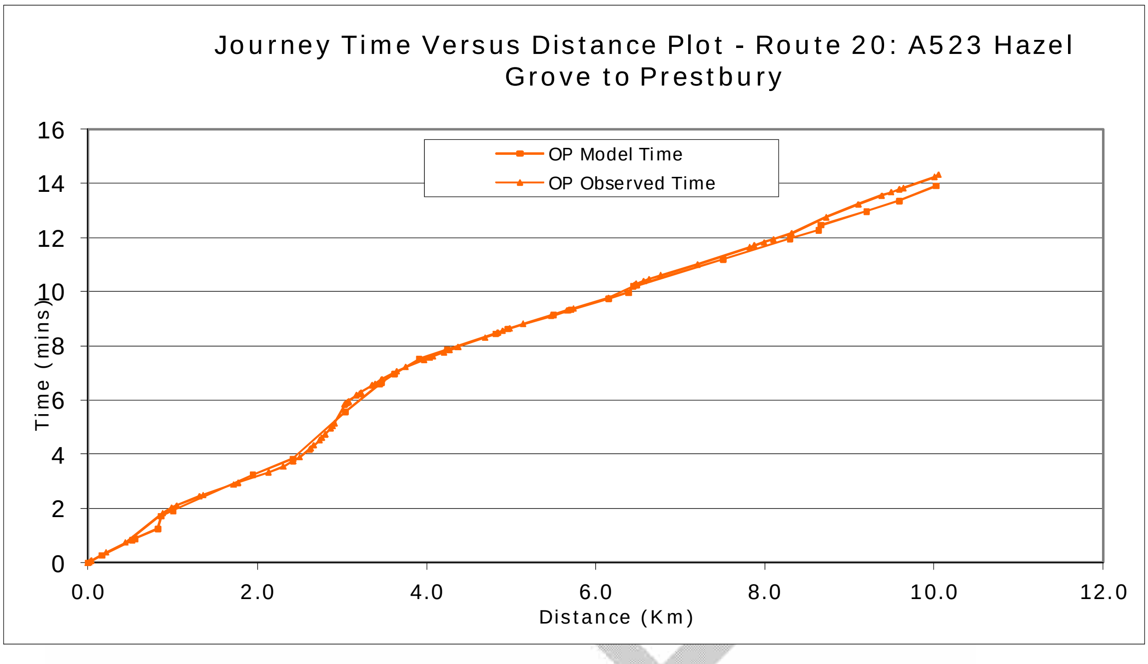

Journey Time Versus Distance Plot - Route 18: A34 East Didsbury to Alderley Edge
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

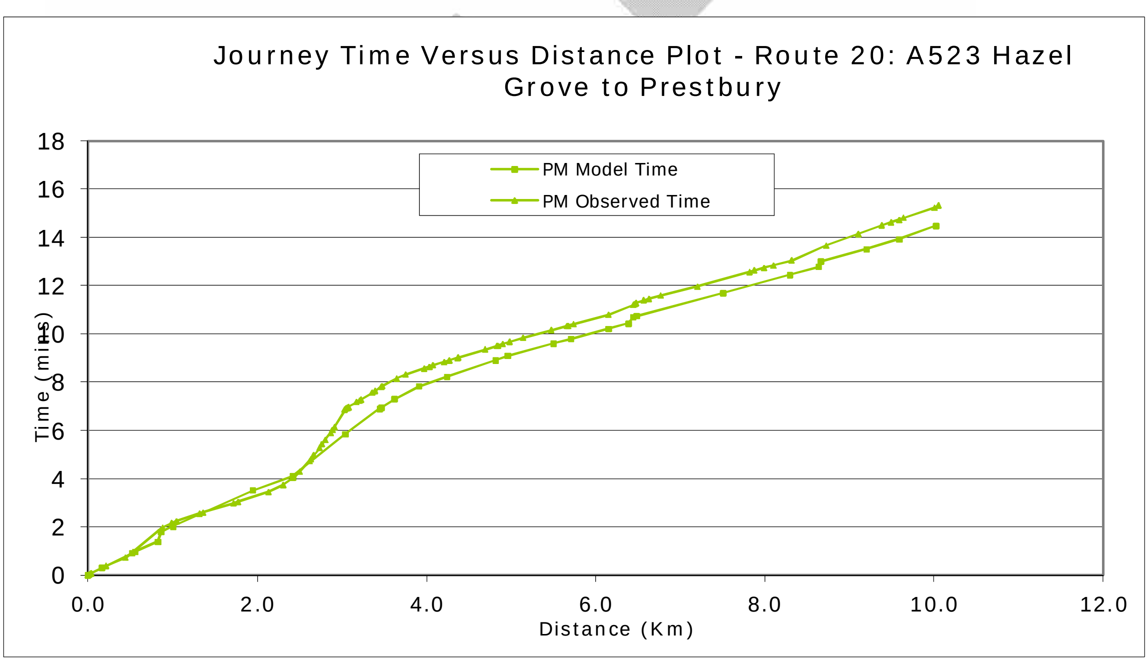

Journey Time Versus Distance Plot - Route 19: A523 Prestbury to Hazel Grove
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
2.0
4.0
6.0
8.0
10.0
12.0

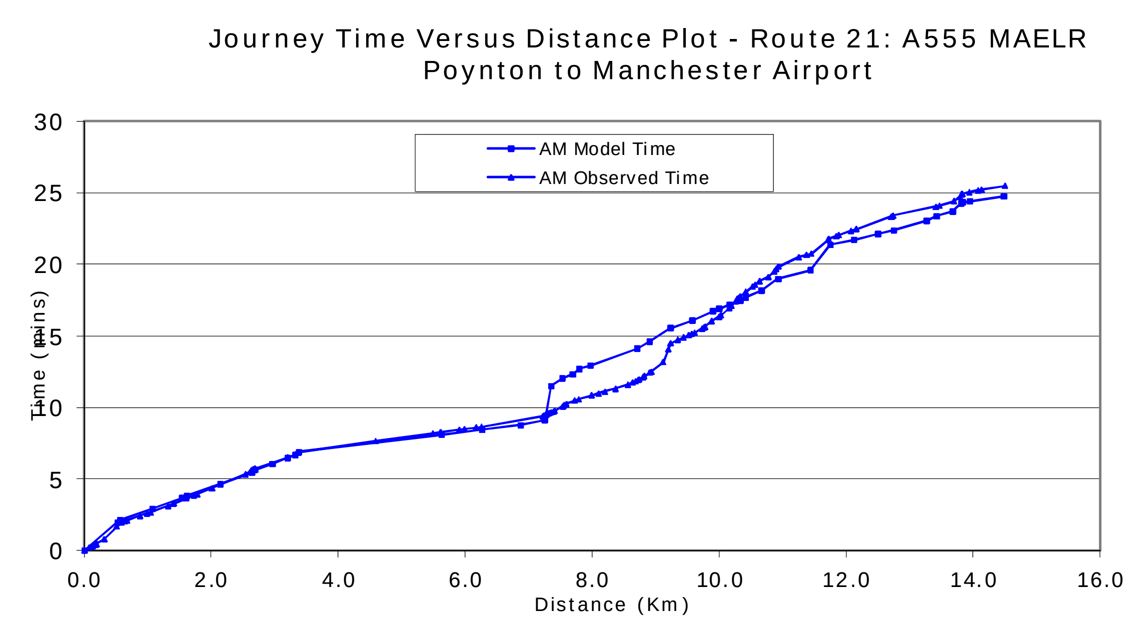

Journey Time Versus Distance Plot - Route 19: A523 Prestbury to Hazel Grove
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0
12.0

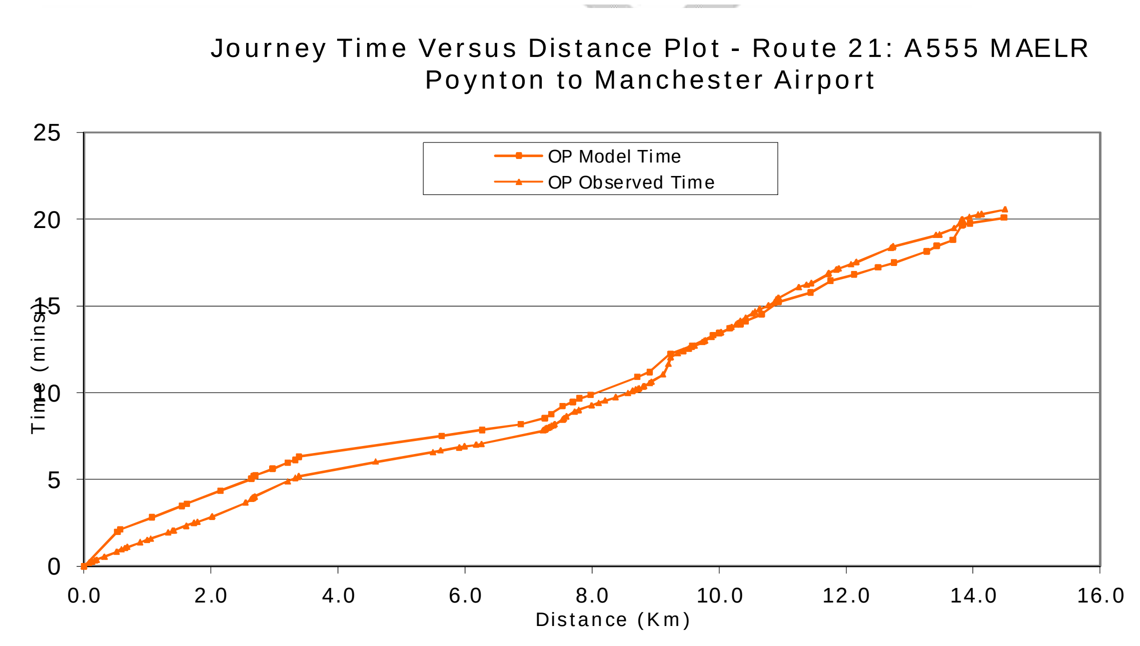

Journey Time Versus Distance Plot - Route 19: A523 Prestbury to Hazel Grove
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
2.0
4.0
6.0
8.0
10.0
12.0

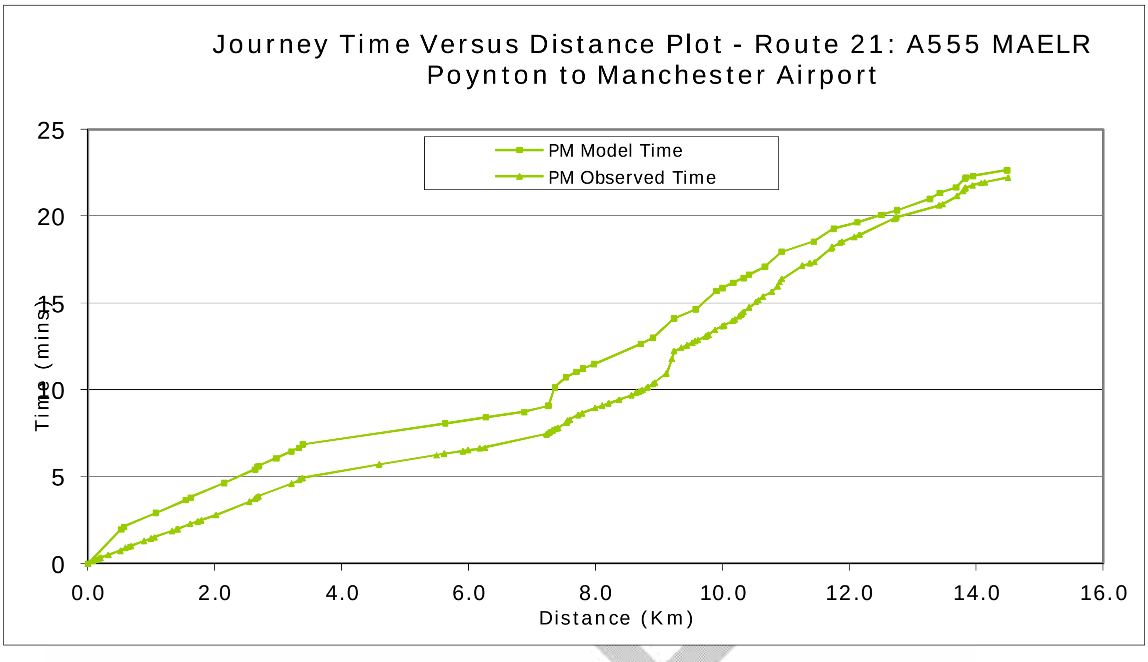

Journey Time Versus Distance Plot - Route 20: A523 Hazel Grove to Prestbury
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
30
0.0
2.0
4.0
6.0
8.0
10.0
12.0

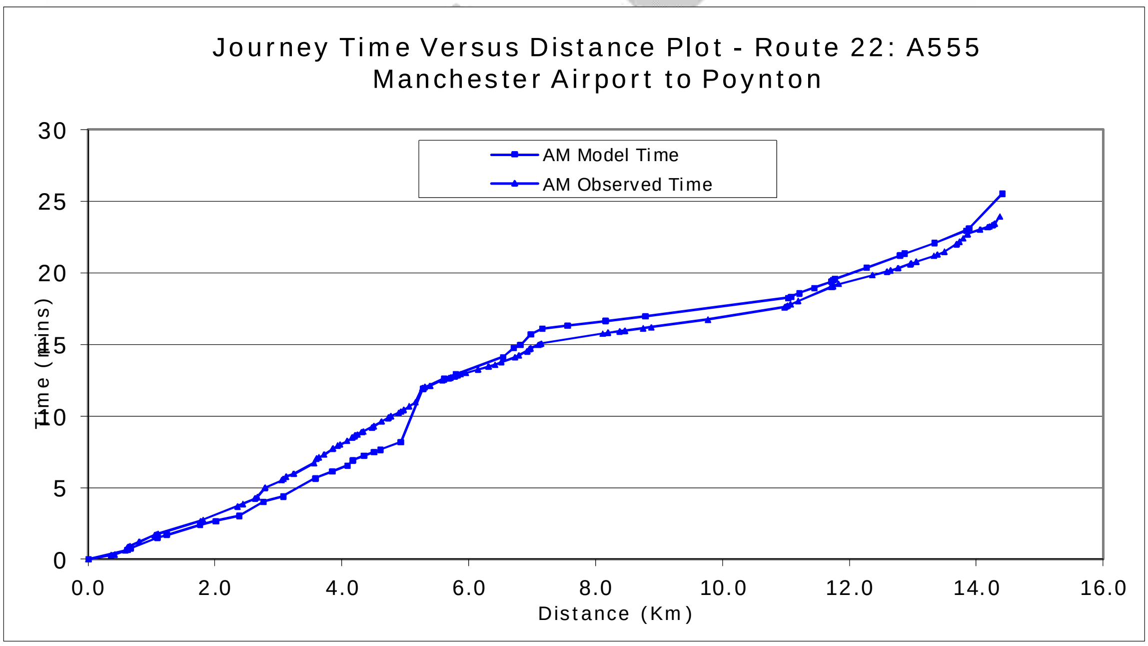

Journey Time Versus Distance Plot - Route 20: A523 Hazel Grove to Prestbury
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0
12.0

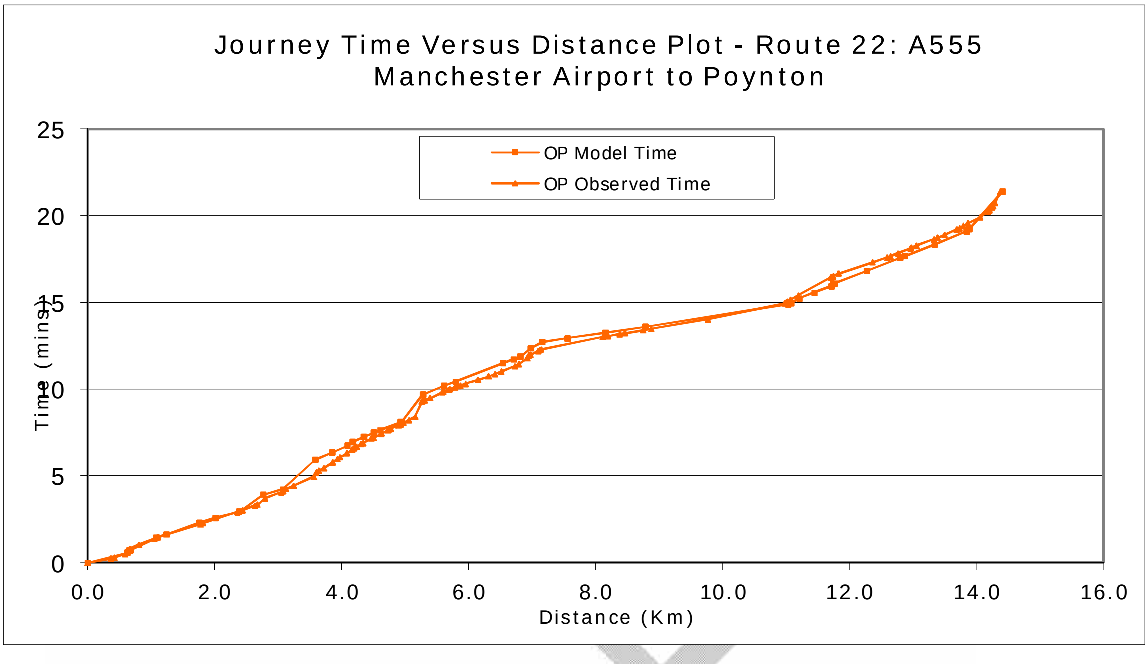

Journey Time Versus Distance Plot - Route 20: A523 Hazel Grove to Prestbury
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
0.0
2.0
4.0
6.0
8.0
10.0
12.0

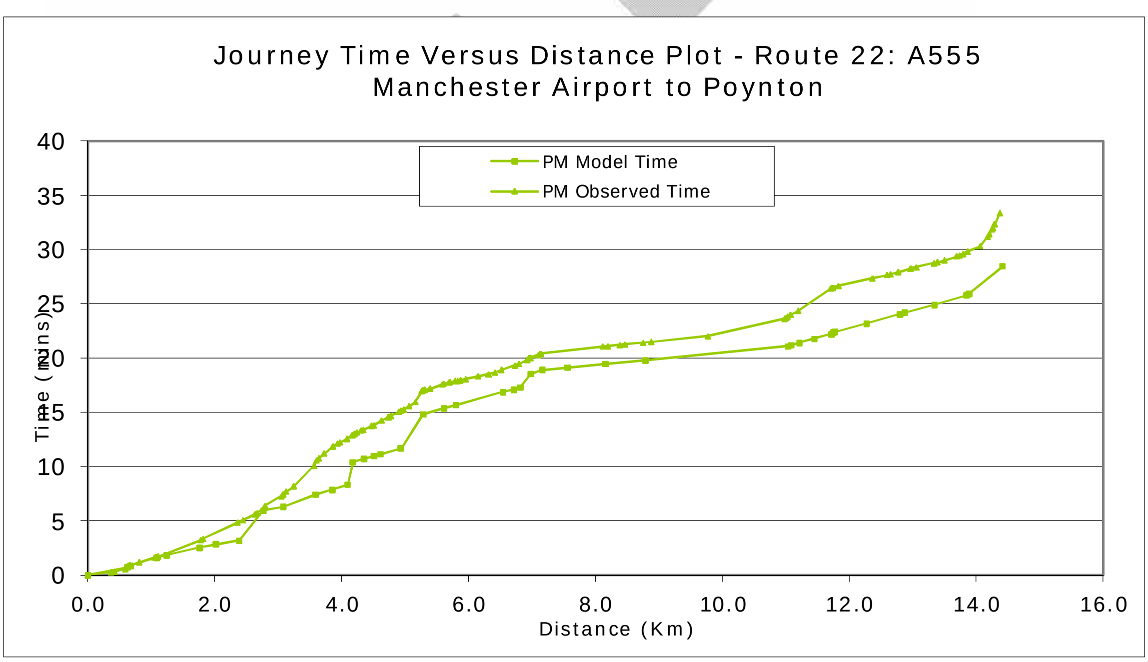

Journey Time Versus Distance Plot - Route 21: A555 MAELR
Poynton to Manchester Airport
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
30
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

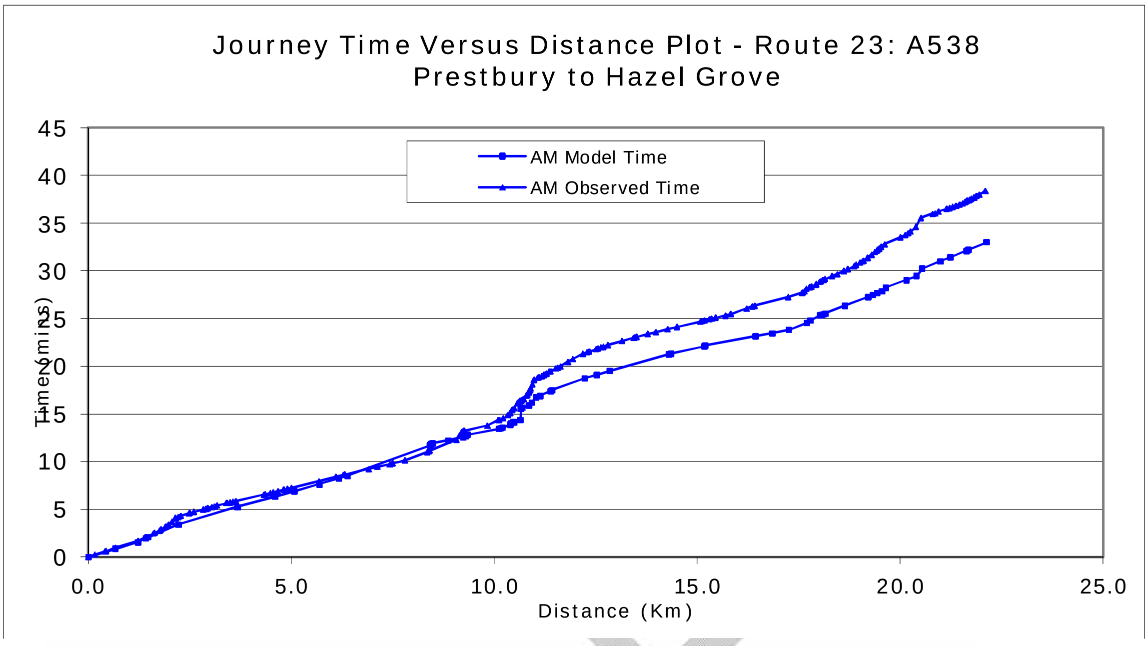

Journey Time Versus Distance Plot - Route 21: A555 MAELR
Poynton to Manchester Airport
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

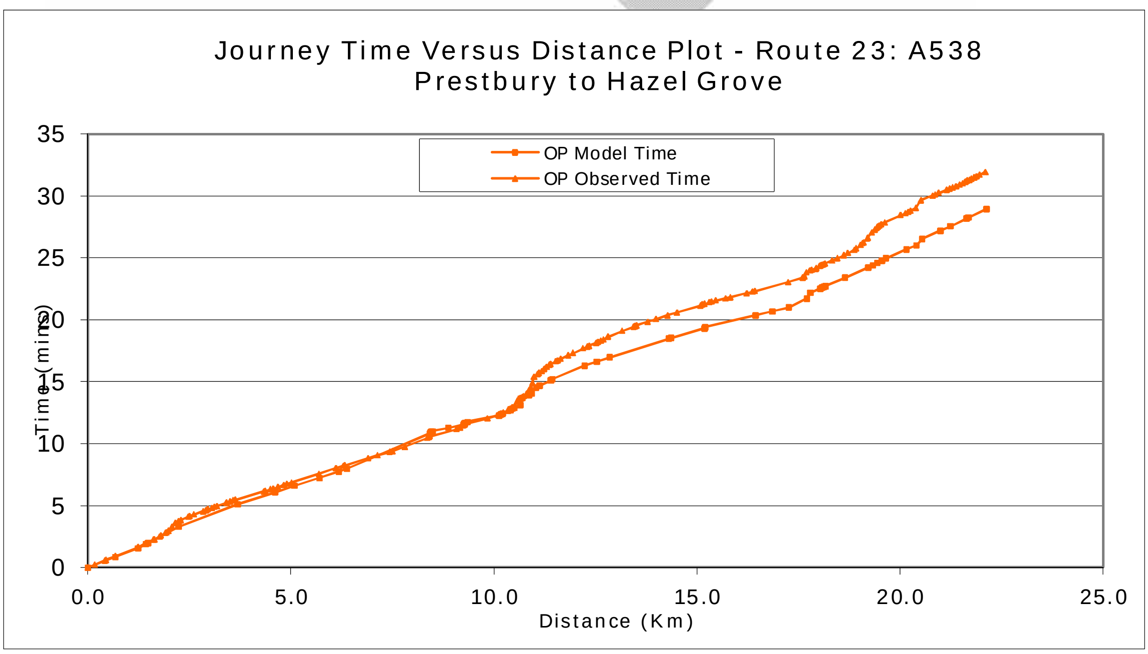

Journey Time Versus Distance Plot - Route 21: A555 MAELR Poynton to Manchester Airport
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

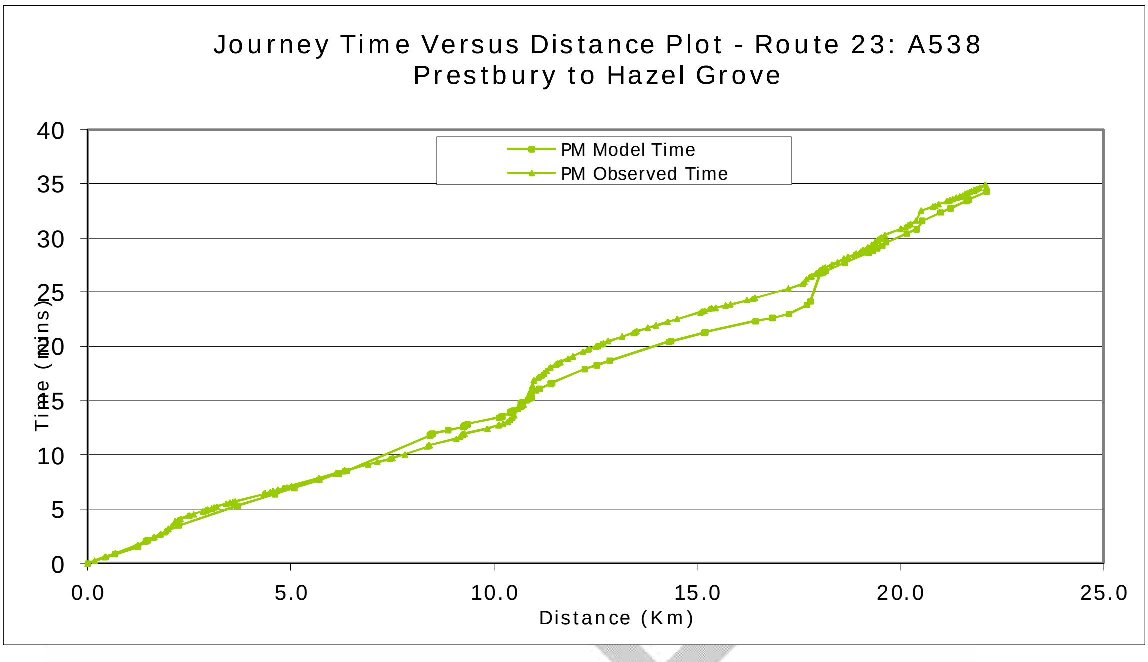

Journey Time Versus Distance Plot - Route 22: A555 Manchester Airport to Poynton
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
30
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

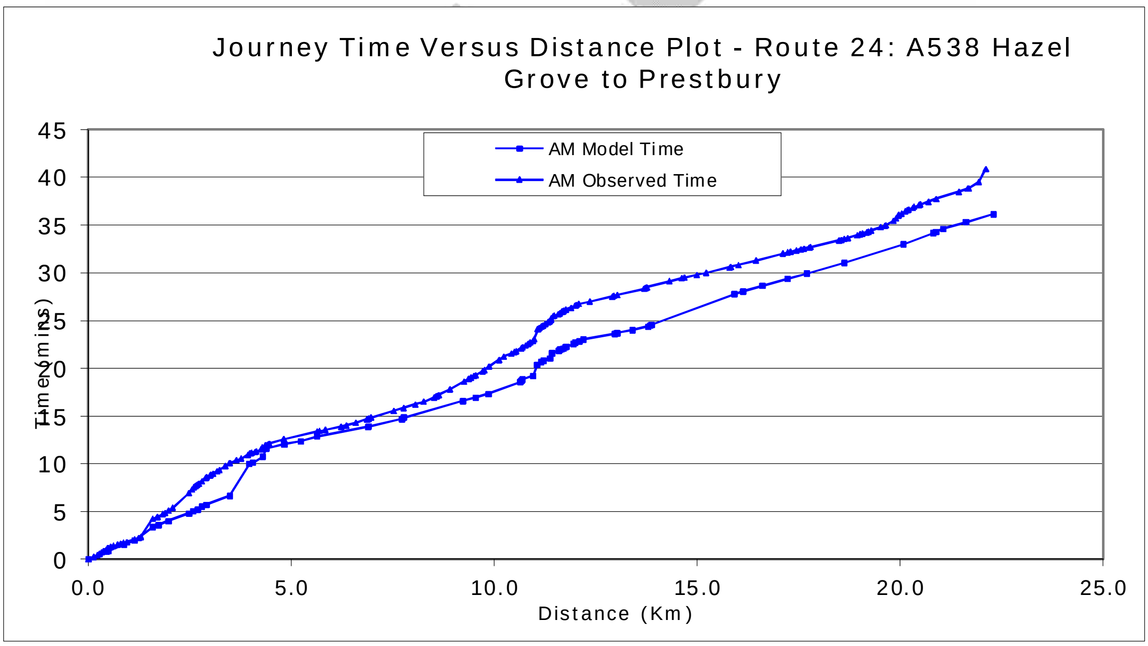

Journey Time Versus Distance Plot - Route 22: A555 Manchester Airport to Poynton
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

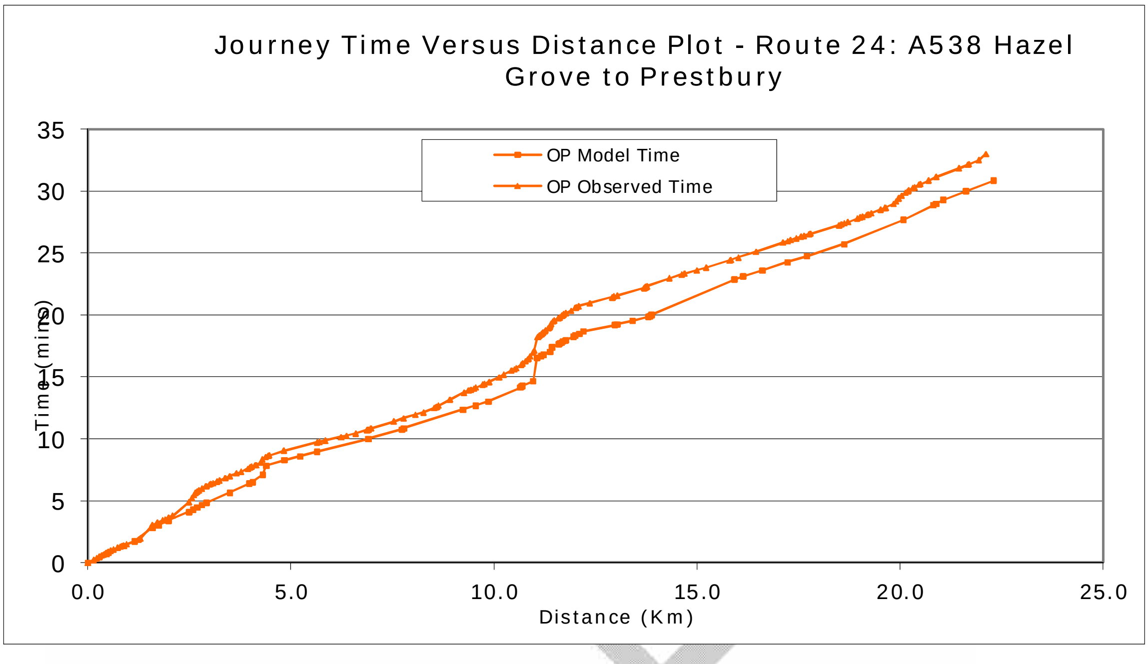

Journey Time Versus Distance Plot - Route 22: A555 Manchester Airport to Poynton
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
40
35
30
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0

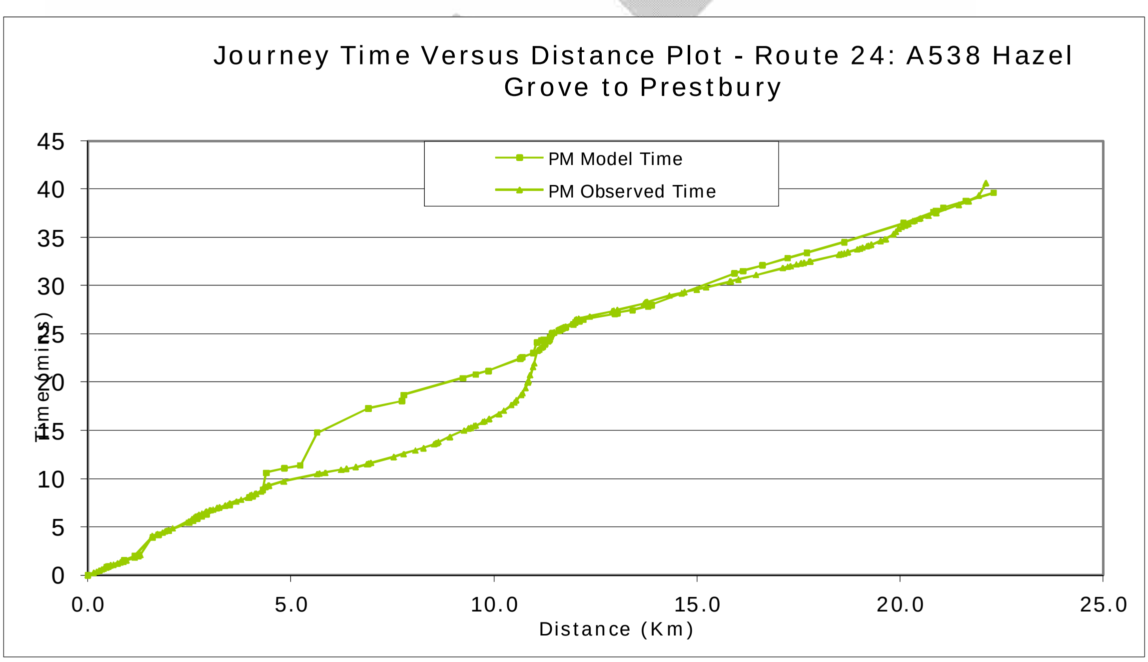

Journey Time Versus Distance Plot - Route 23: A538 Prestbury to Hazel Grove
AM Model Time
AM Observed Time
Time (mins)
45
40
35
30
25
20
15
10
5
0
0.0
5.0
10.0
15.0
20.0
25.0
Distance (Km)

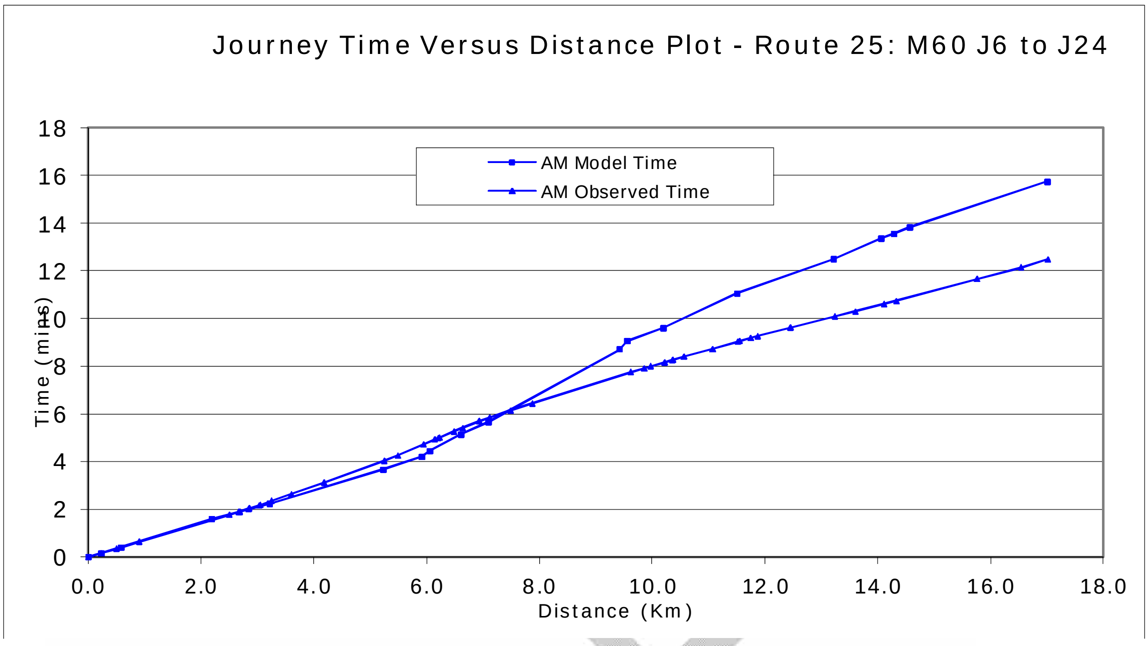

Journey Time Versus Distance Plot - Route 23: A538 Prestbury to Hazel Grove
OP Model Time
OP Observed Time
Time (mins)
35
30
25
20
15
10
5
0
0.0
5.0
10.0
15.0
20.0
25.0
Distance (Km)

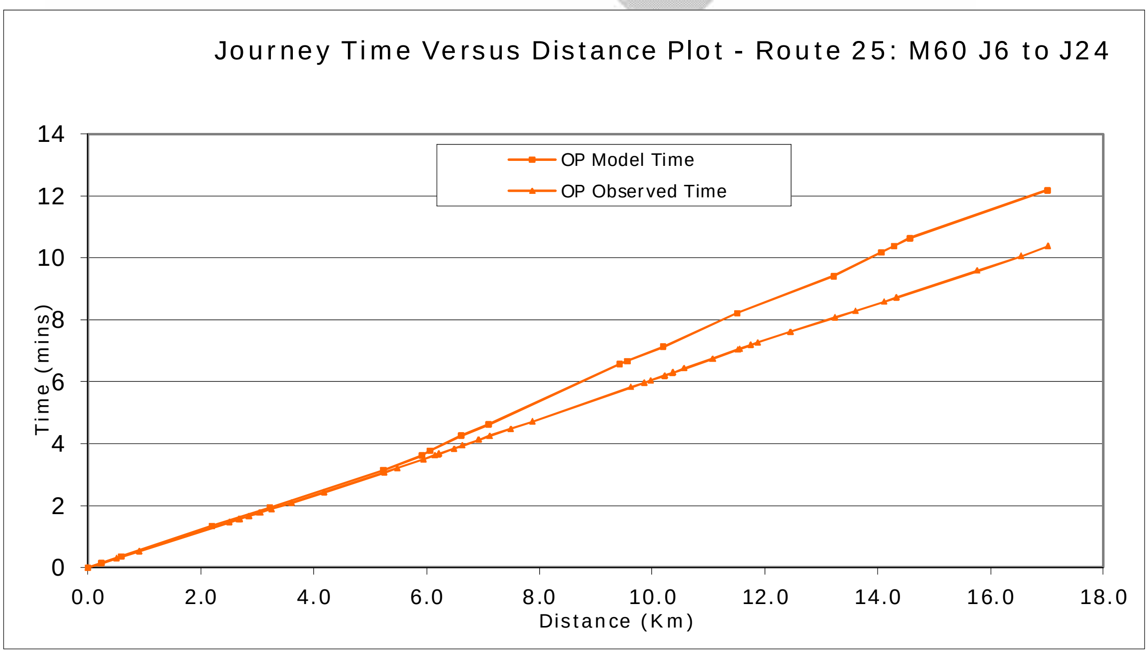

Journey Time Versus Distance Plot - Route 23: A538 Prestbury to Hazel Grove
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
30
35
40
0.0
5.0
10.0
15.0
20.0
25.0

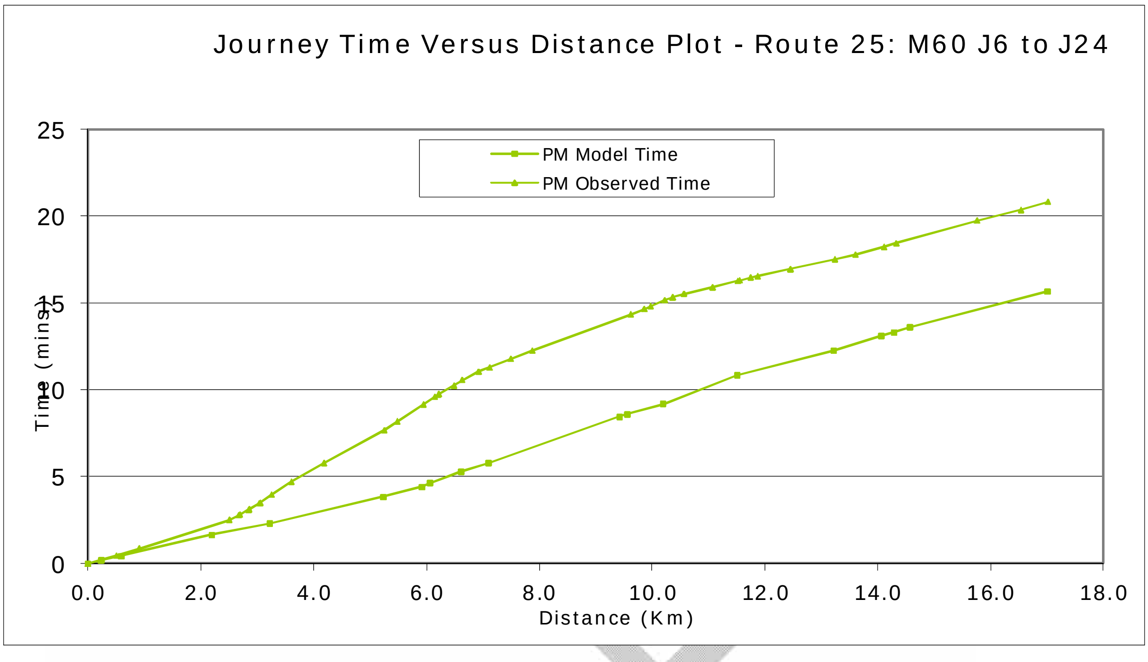

Journey Time Versus Distance Plot - Route 24: A538 Hazel Grove to Prestbury
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
30
35
40
45
0.0
5.0
10.0
15.0
20.0
25.0

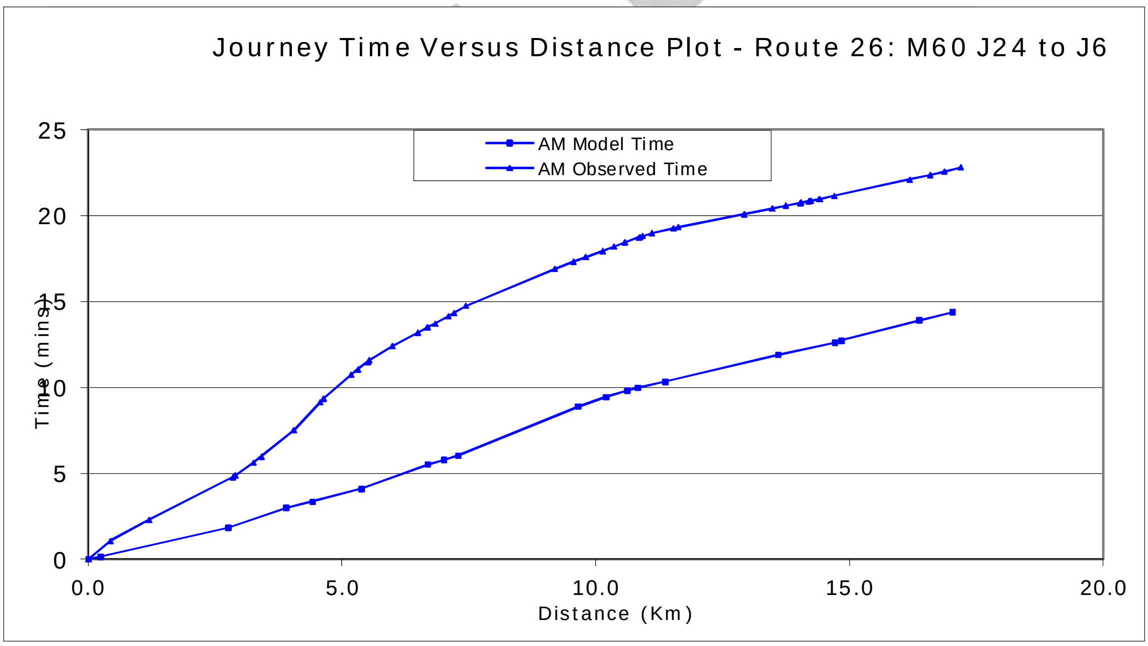

Journey Time Versus Distance Plot - Route 24: A538 Hazel Grove to Prestbury
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
30
35
0.0
5.0
10.0
15.0
20.0
25.0

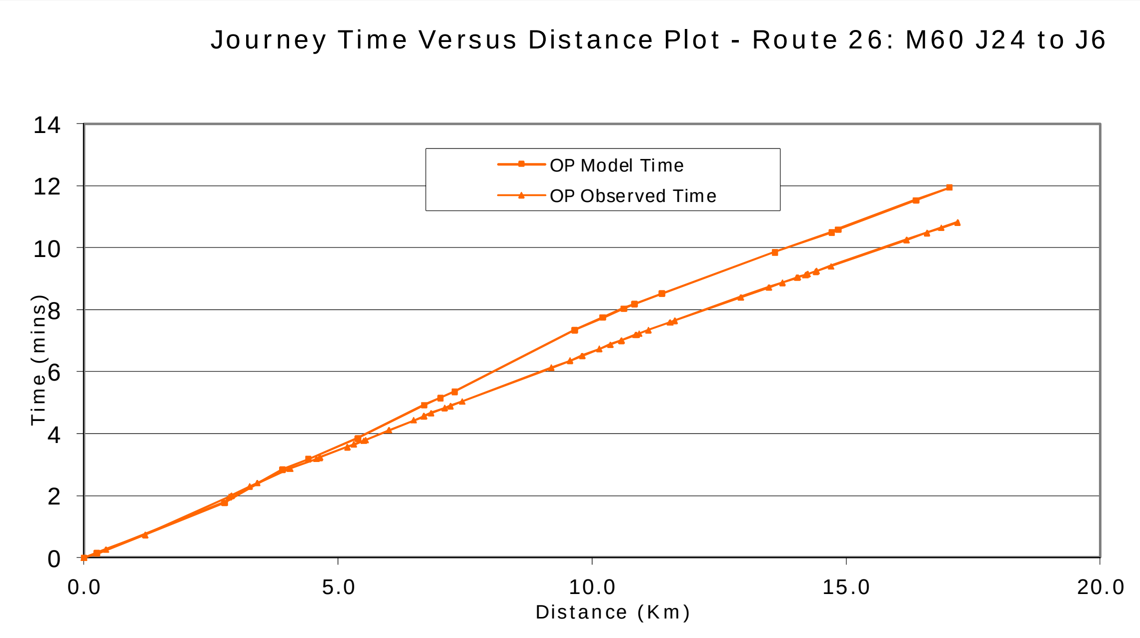

Journey Time Versus Distance Plot - Route 24: A538 Hazel Grove to Prestbury
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
30
35
40
45
0.0
5.0
10.0
15.0
20.0
25.0

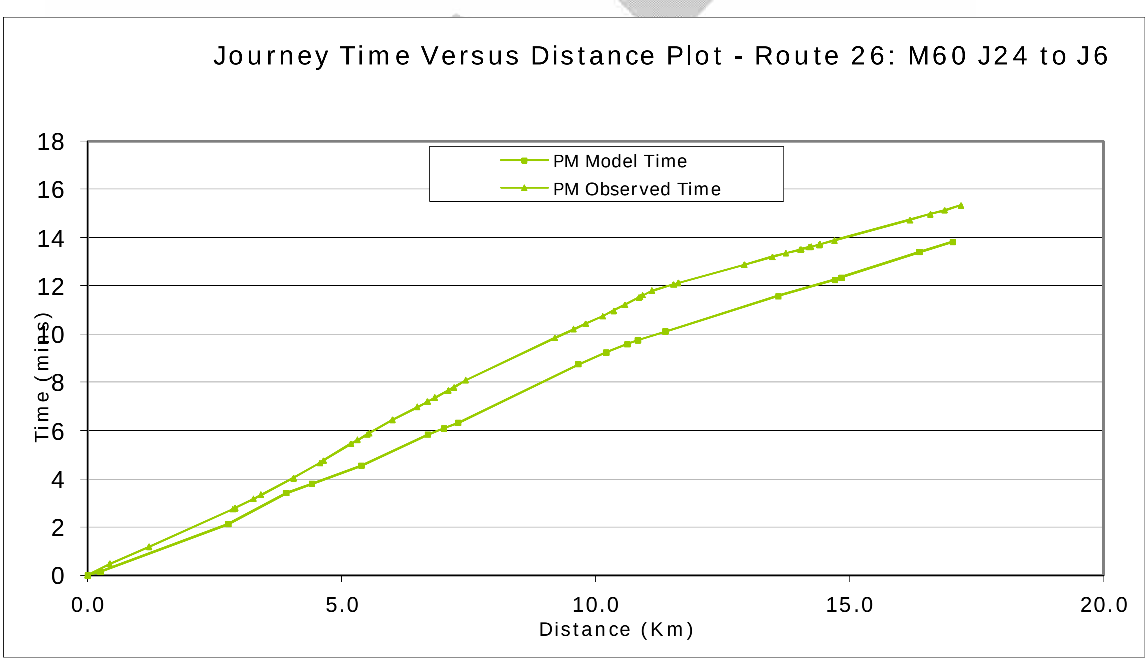

Journey Time Versus Distance Plot - Route 25: M60 J6 to J24
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

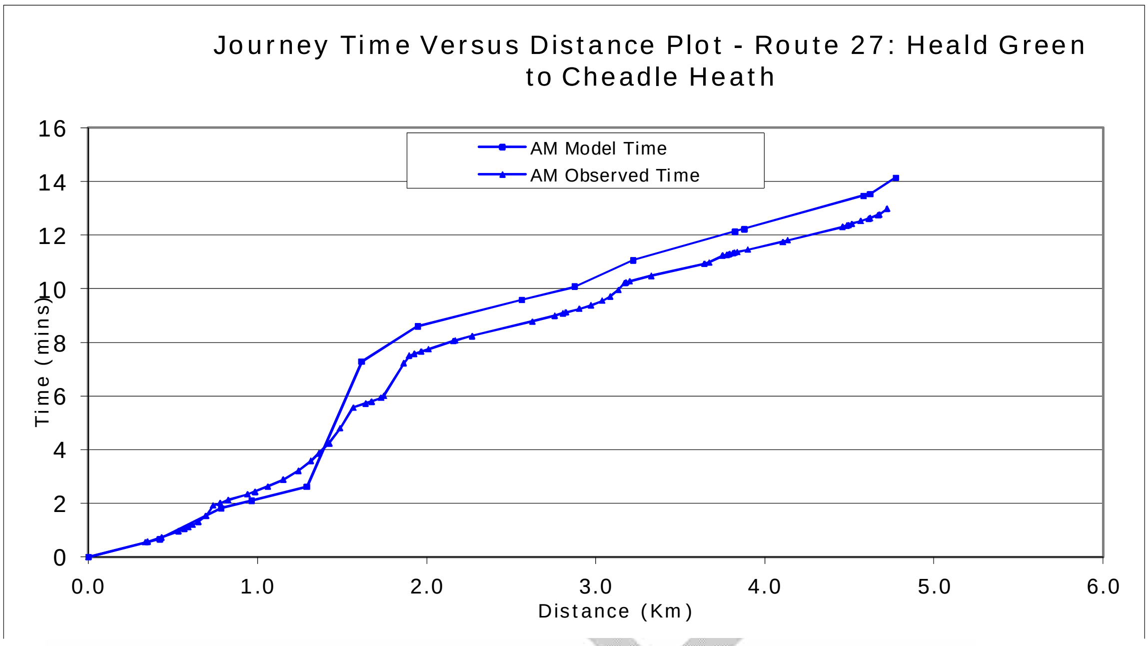

Journey Time Versus Distance Plot - Route 25: M60 J6 to J24
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

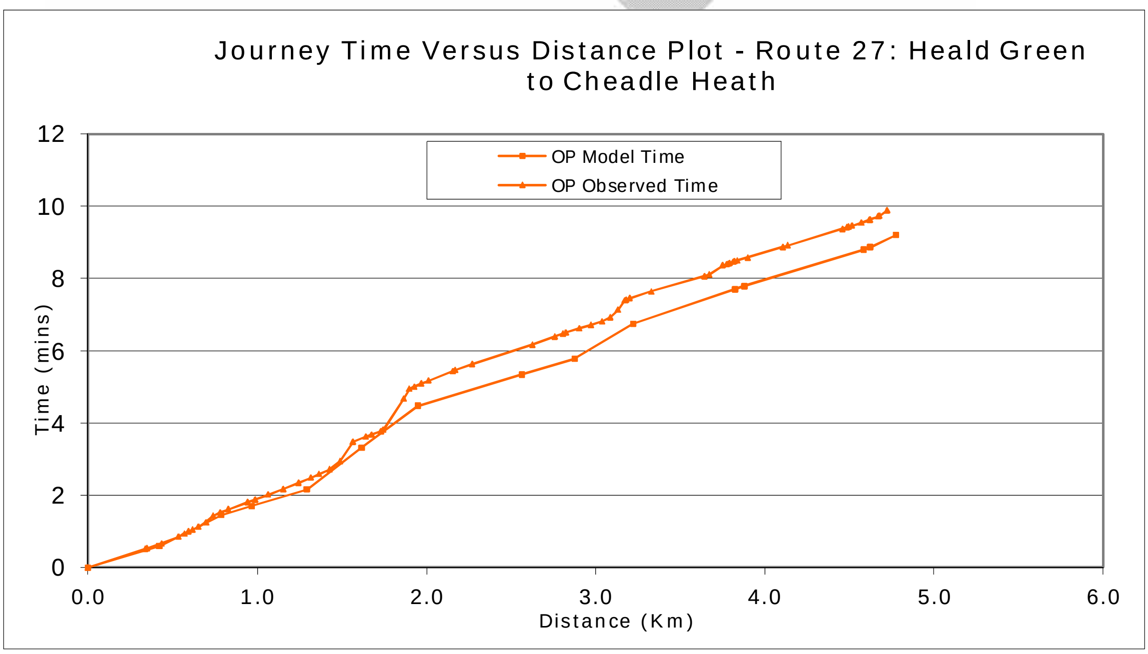

Journey Time Versus Distance Plot - Route 25: M60 J6 to J24
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

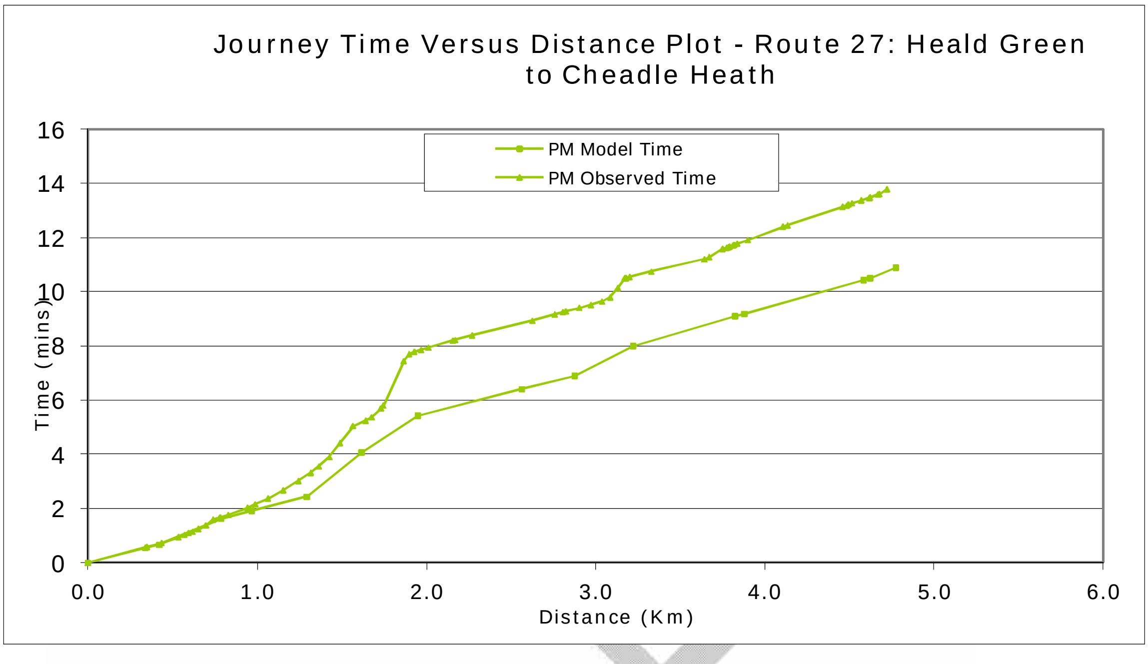

Journey Time Versus Distance Plot - Route 26: M60 J24 to J6
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
5.0
10.0
15.0
20.0

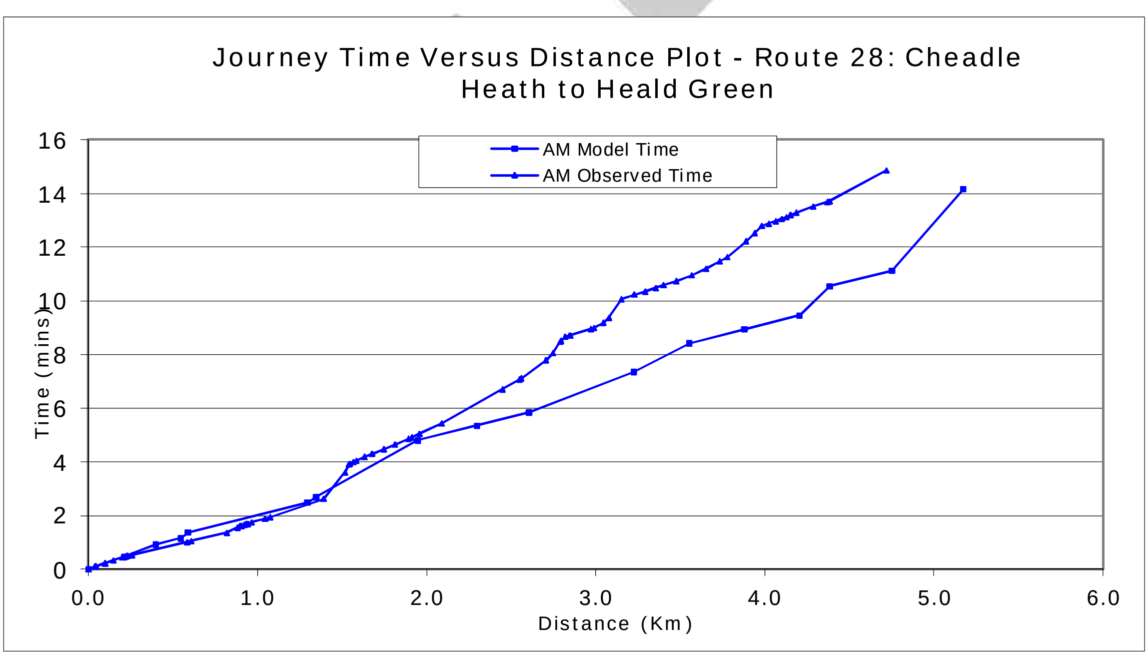

Journey Time Versus Distance Plot - Route 26: M60 J24 to J6
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
14
12
10
8
6
4
2
0
0.0
5.0
10.0
15.0
20.0

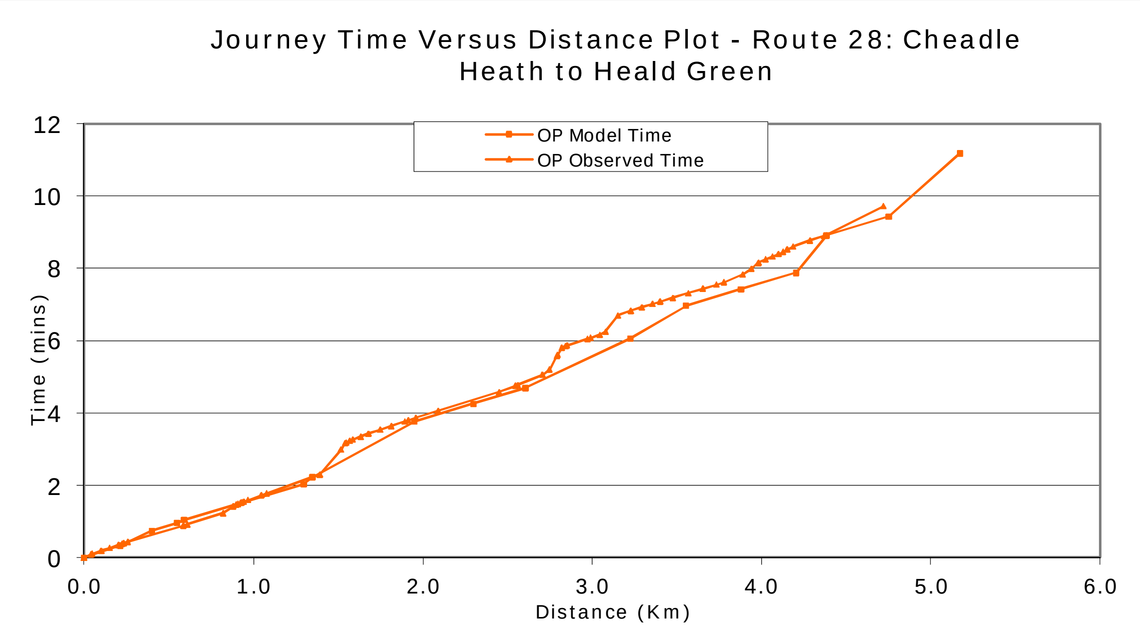

Journey Time Versus Distance Plot - Route 26: M60 J24 to J6
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
18
16
14
12
10
8
6
4
2
0
0.0
5.0
10.0
15.0
20.0

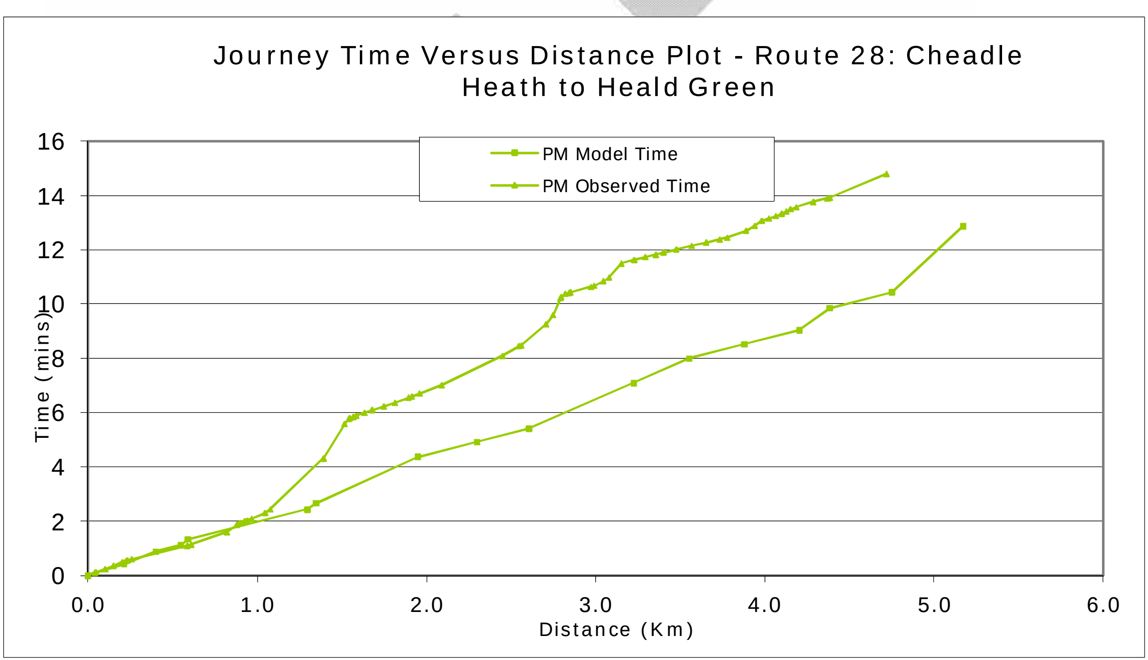

Journey Time Versus Distance Plot - Route 27: Heald Green to Cheadle Heath
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
16
14
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0

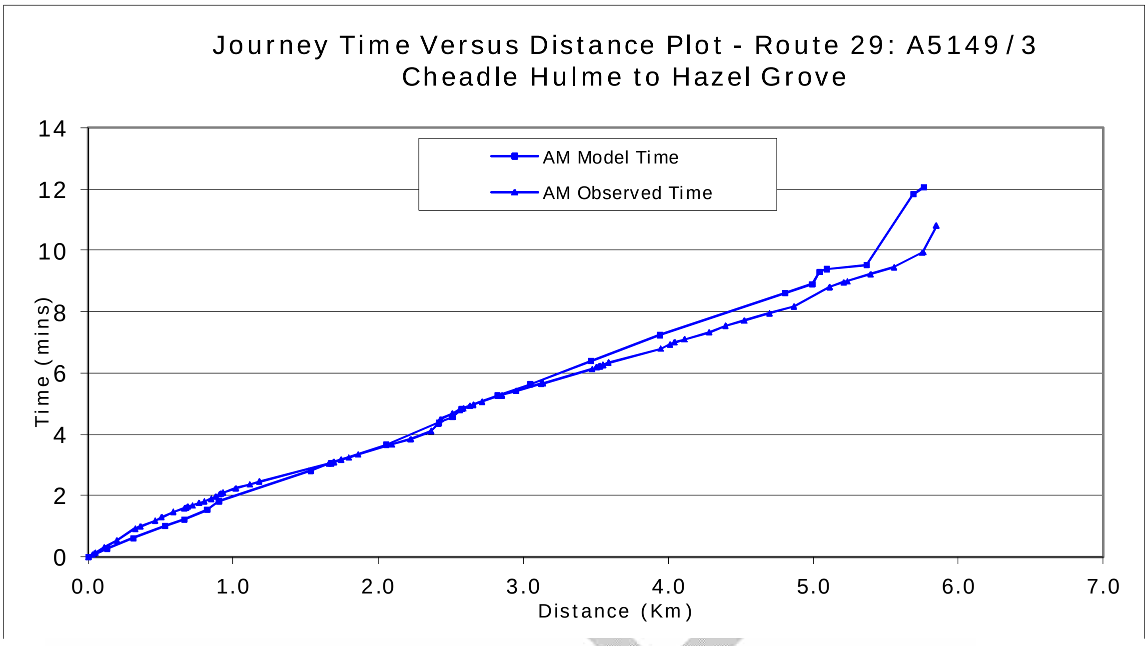

Journey Time Versus Distance Plot - Route 27: Heald Green to Cheadle Heath
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0

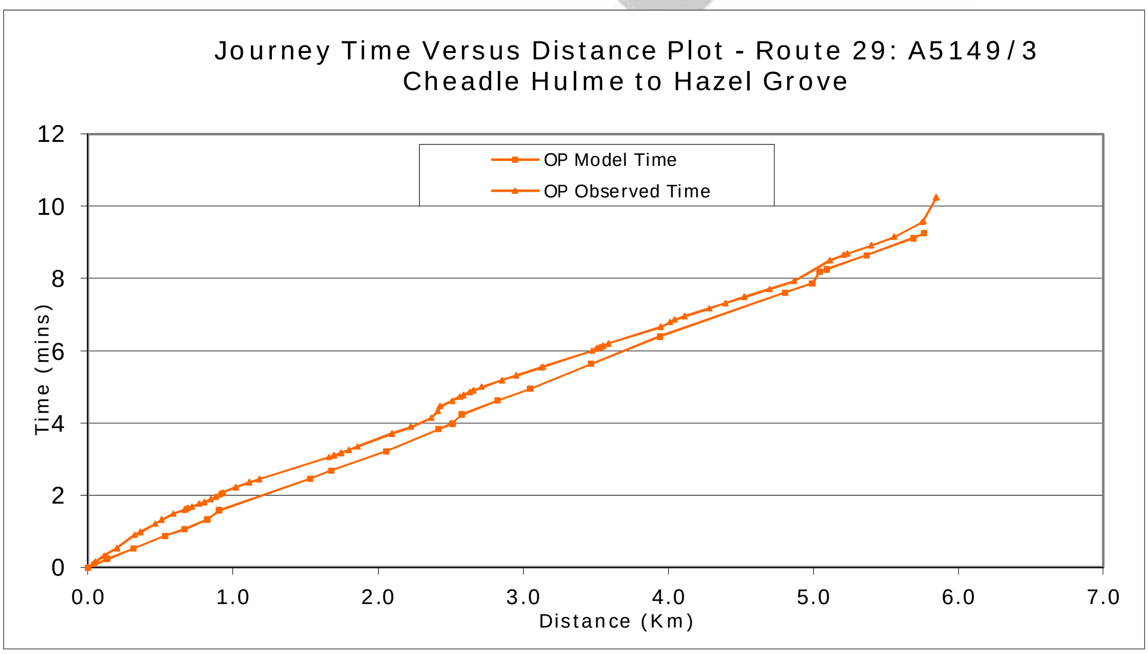

Journey Time Versus Distance Plot - Route 27: Heald Green to Cheadle Heath
PM Model Time
PM Observed Time
Time (mins)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Distance (Km)

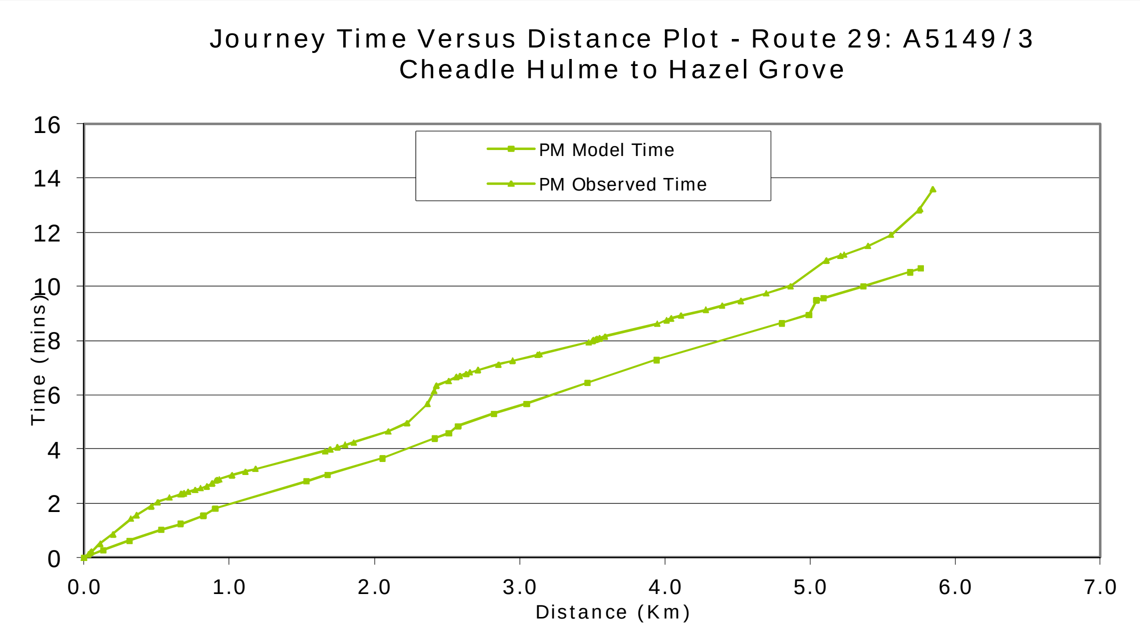

Journey Time Versus Distance Plot - Route 28: Cheadle Heath to Heald Green
AM Model Time
AM Observed Time
Time (mins)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Distance (Km)

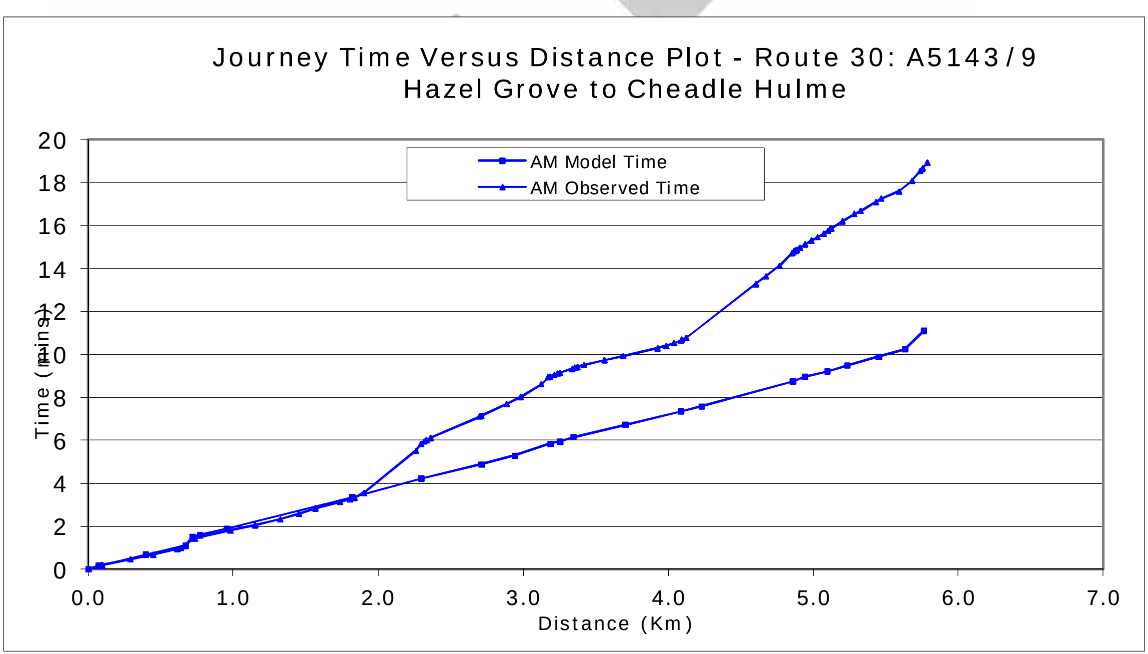

Journey Time Versus Distance Plot - Route 28: Cheadle Heath to Heald Green
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0

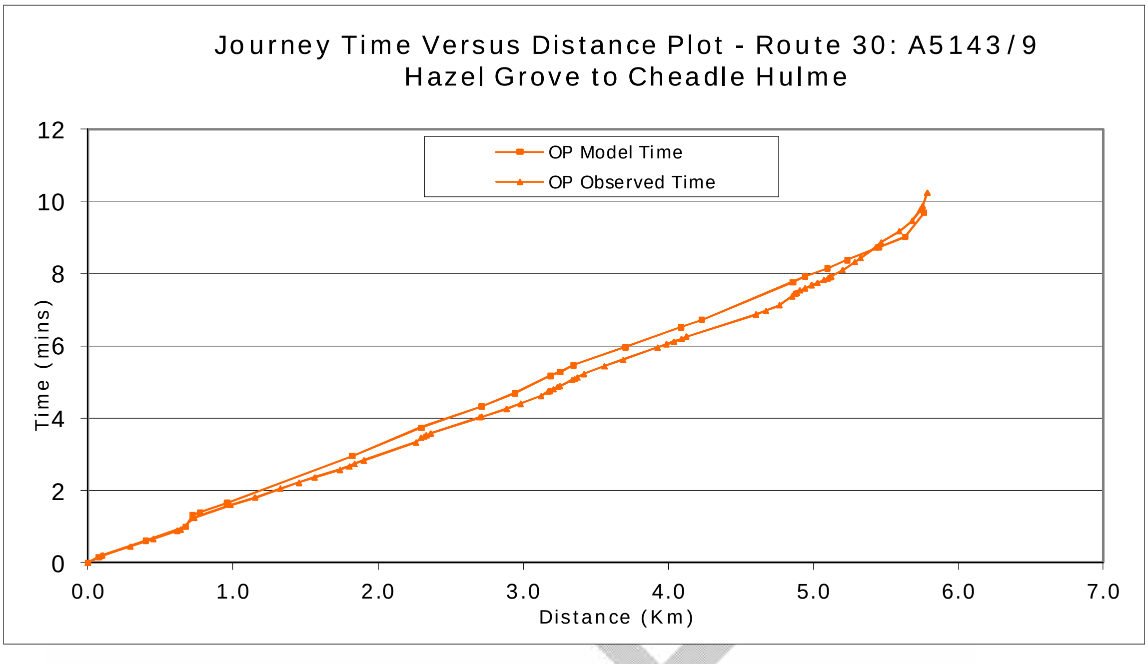

Journey Time Versus Distance Plot - Route 28: Cheadle Heath to Heald Green
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0

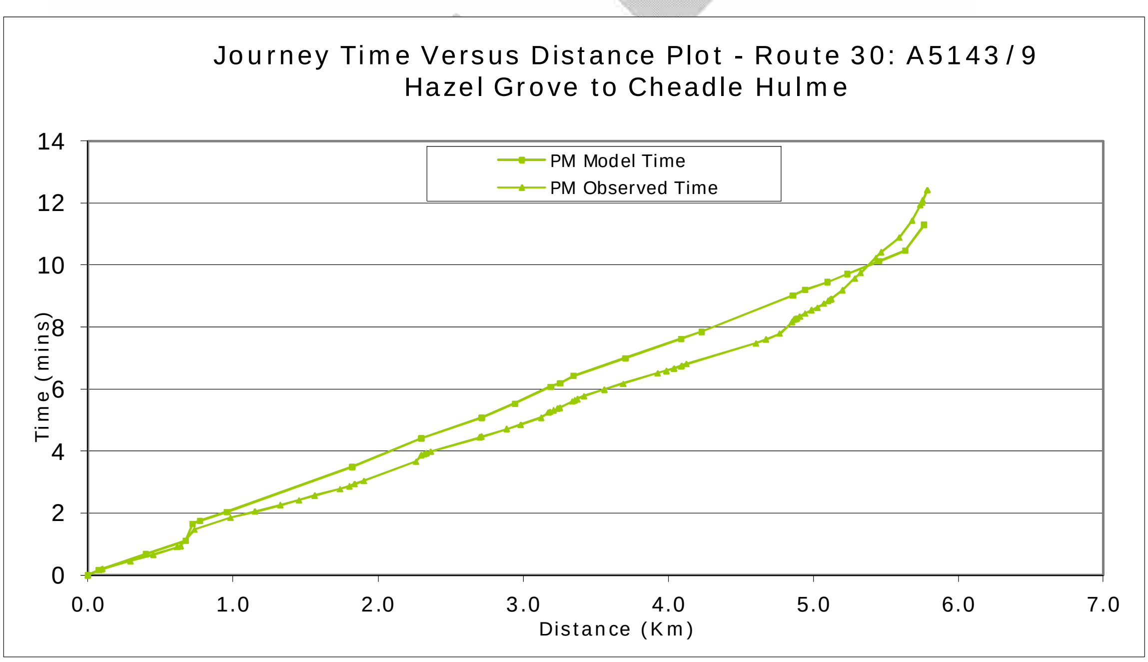

Journey Time Versus Distance Plot - Route 29: A5149/3
Cheadle Hulme to Hazel Grove
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

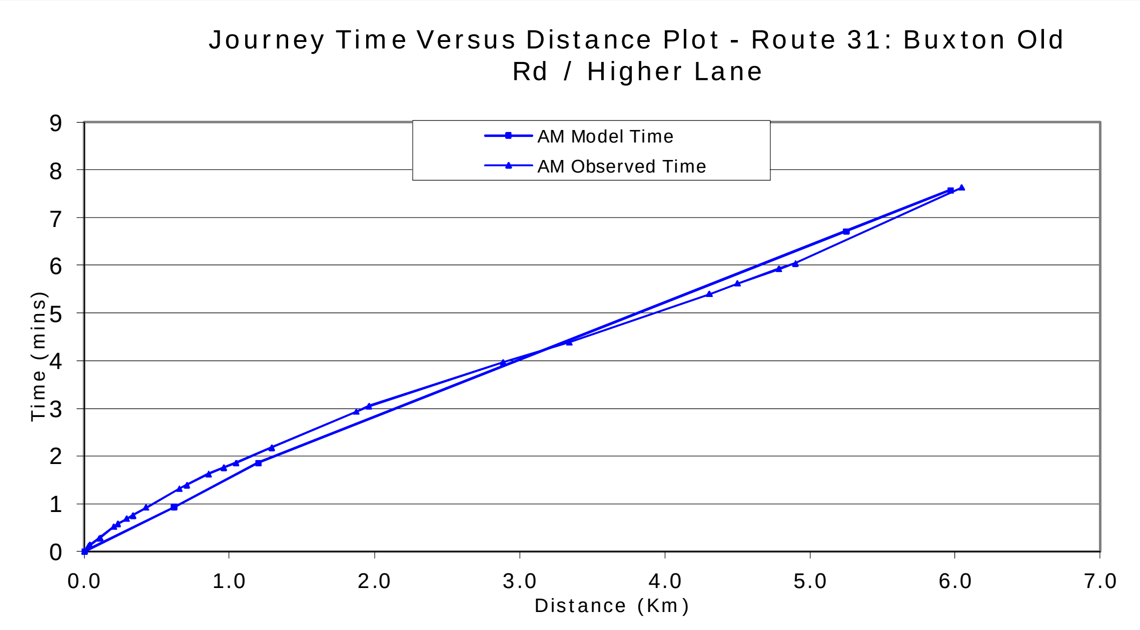

Journey Time Versus Distance Plot - Route 29: A5149/3
Cheadle Hulme to Hazel Grove
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

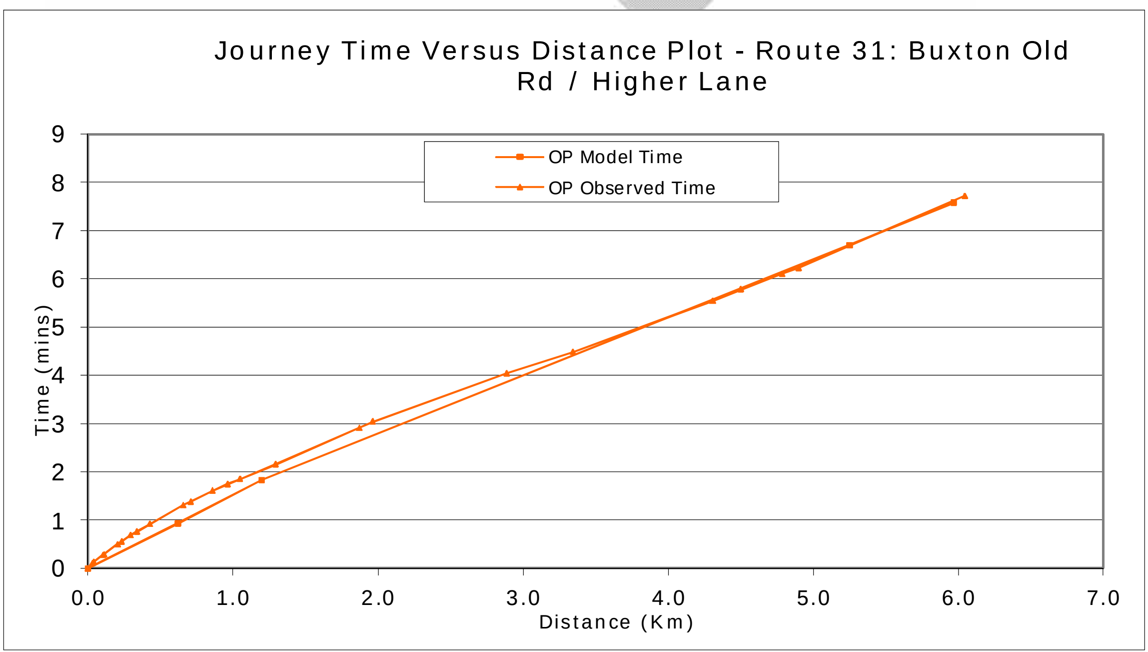

Journey Time Versus Distance Plot - Route 29: A5149/3
Cheadle Hulme to Hazel Grove
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

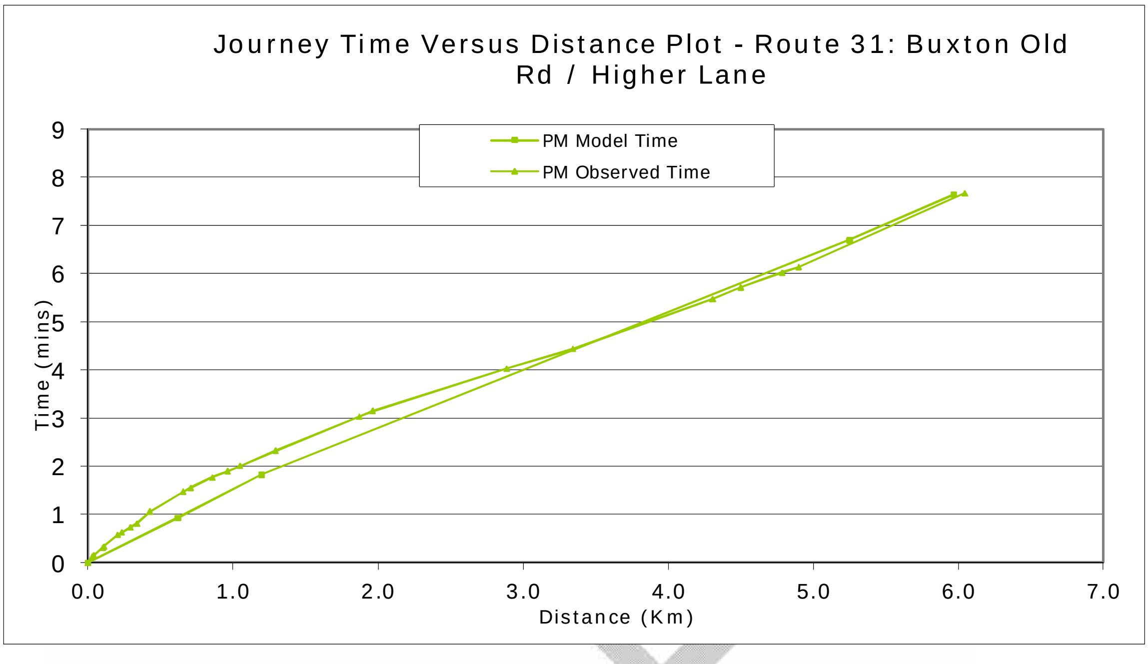

Journey Time Versus Distance Plot - Route 30: A5143/9
Hazel Grove to Cheadle Hulme
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

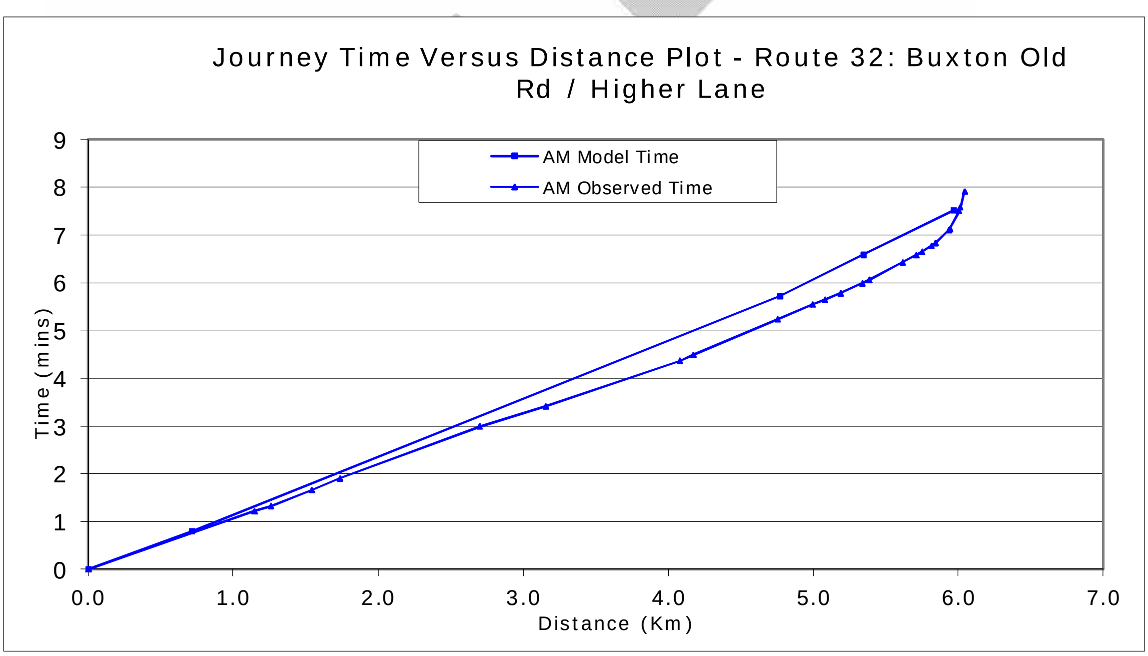

Journey Time Versus Distance Plot - Route 30: A5143/9
Hazel Grove to Cheadle Hulme
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

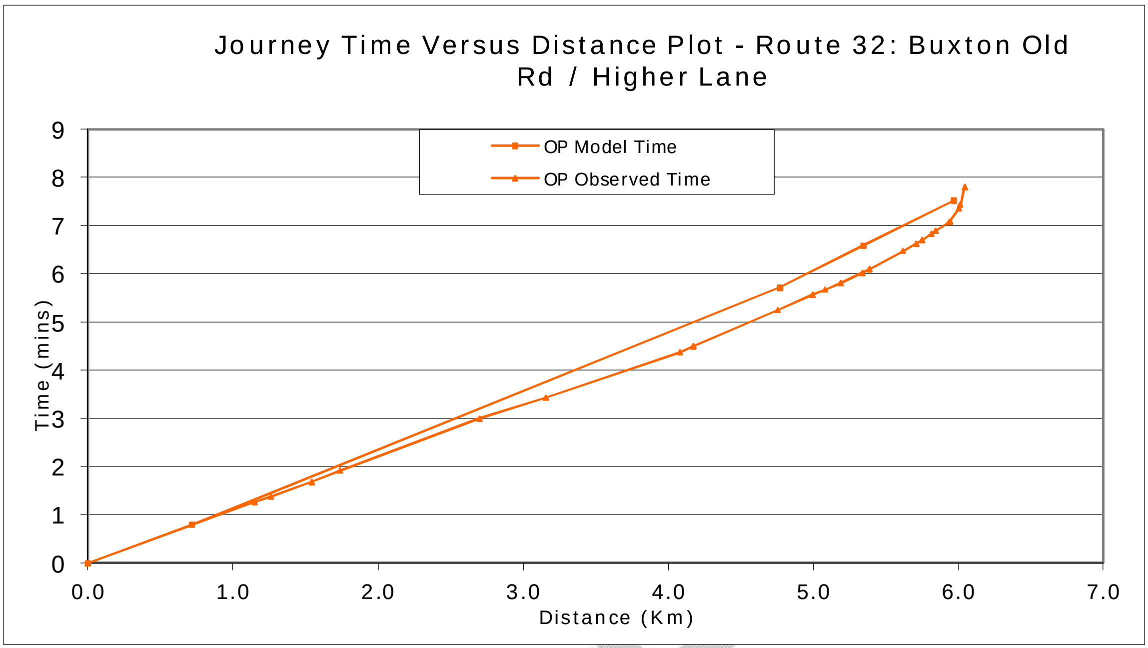

Journey Time Versus Distance Plot - Route 30: A5143/9
Hazel Grove to Cheadle Hulme
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

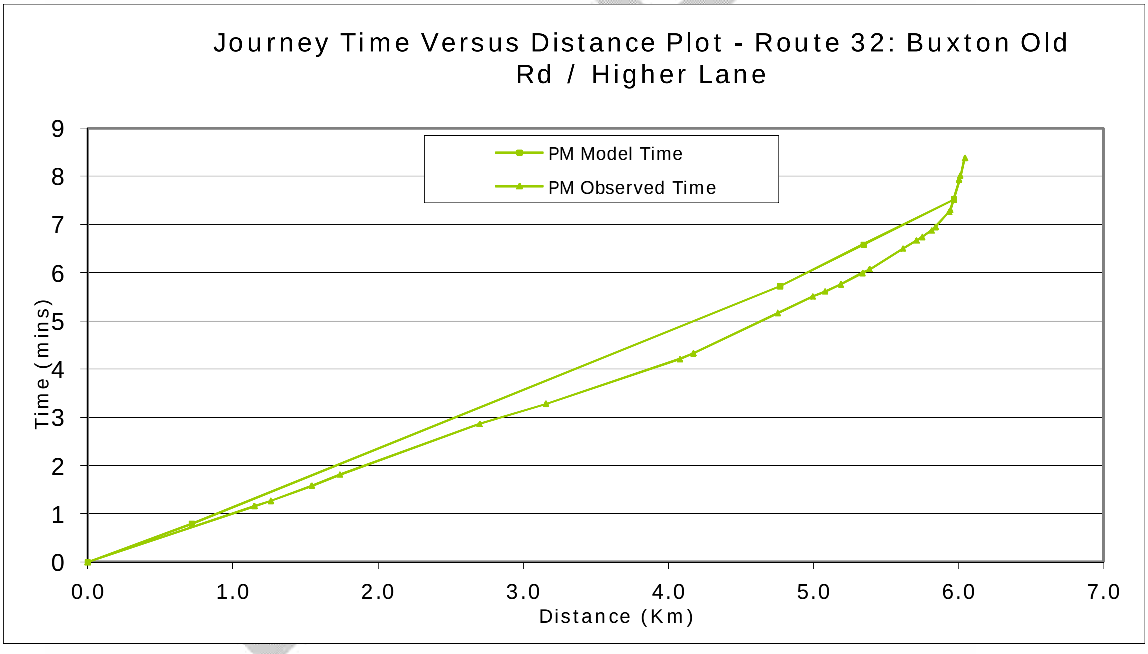

Journey Time Versus Distance Plot - Route 31: Buxton Old Rd / Higher Lane
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

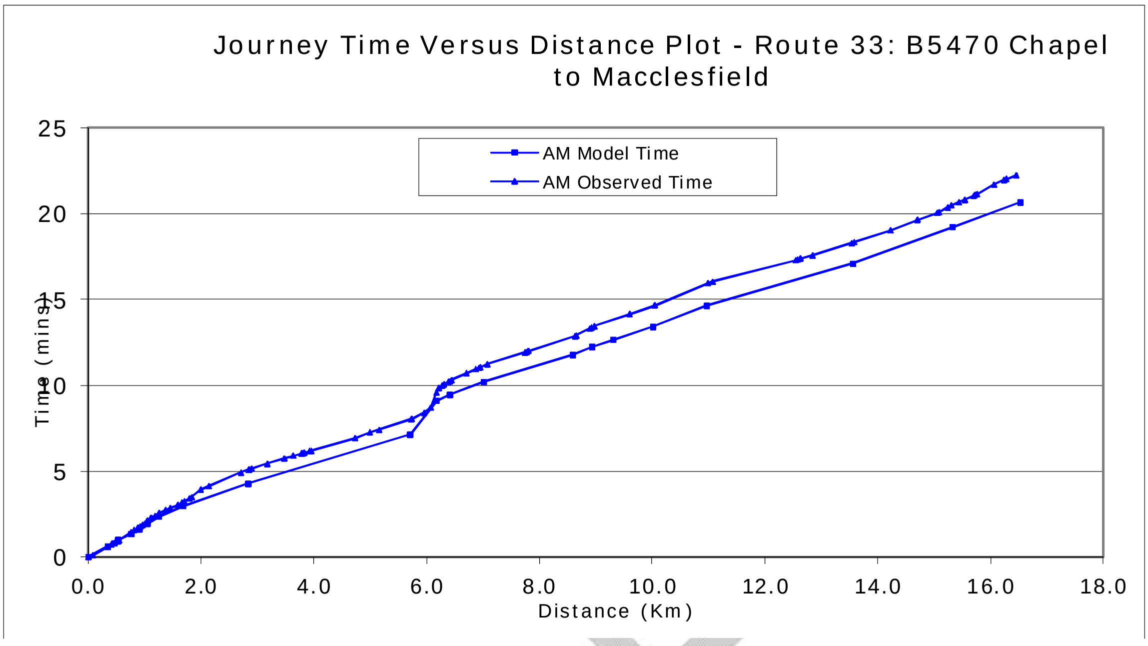

Journey Time Versus Distance Plot - Route 31: Buxton Old Rd / Higher Lane
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

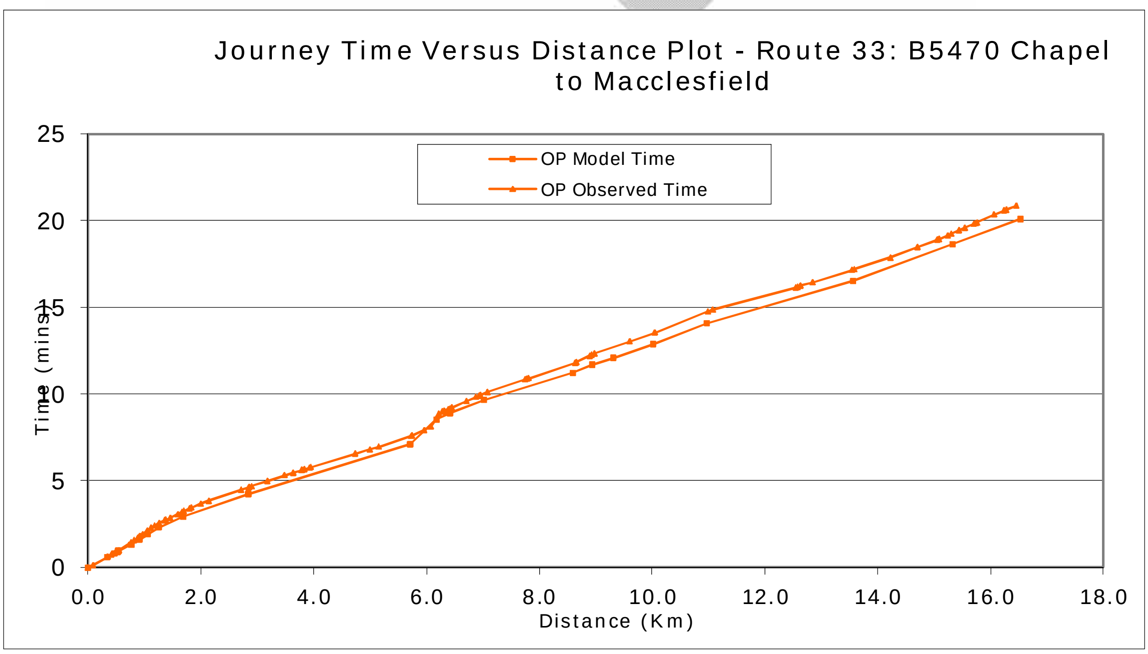

Journey Time Versus Distance Plot - Route 31: Buxton Old Rd / Higher Lane
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)

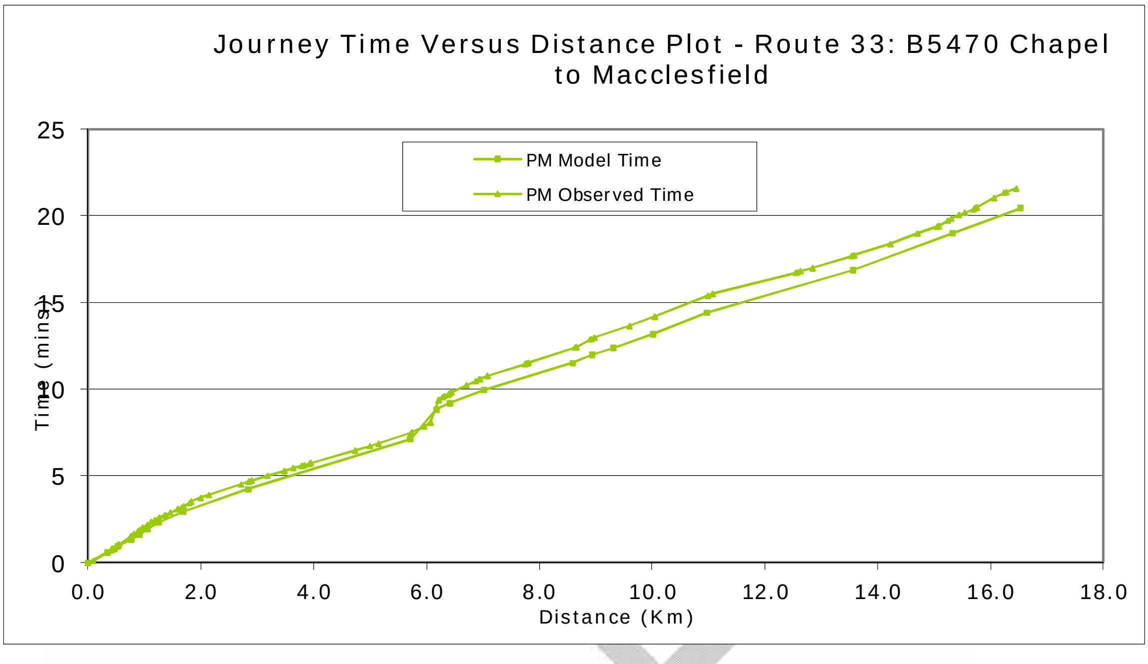

Journey Time Versus Distance Plot - Route 32: Buxton Old Rd / Higher Lane
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)

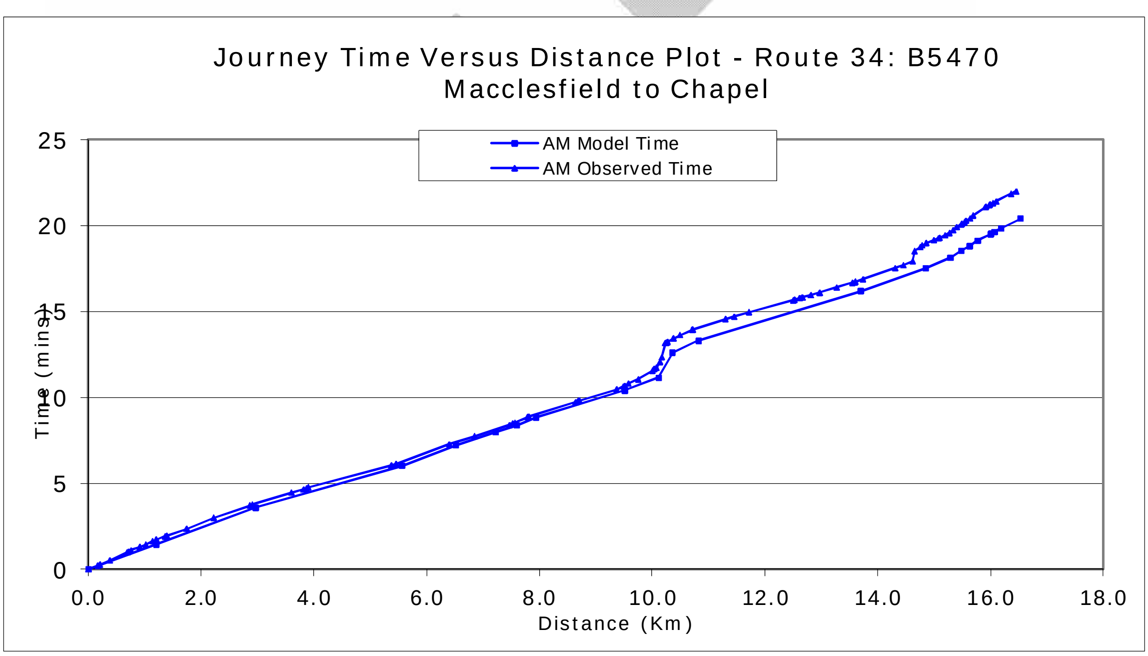

Journey Time Versus Distance Plot - Route 32: Buxton Old Rd / Higher Lane
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

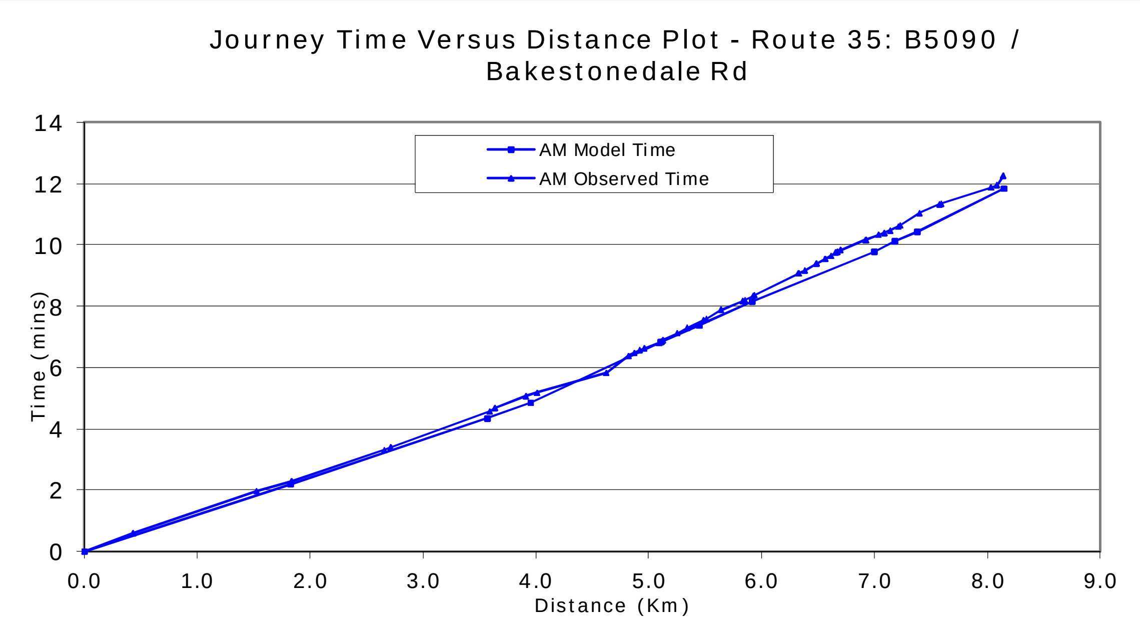

Journey Time Versus Distance Plot - Route 32: Buxton Old Rd / Higher Lane
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

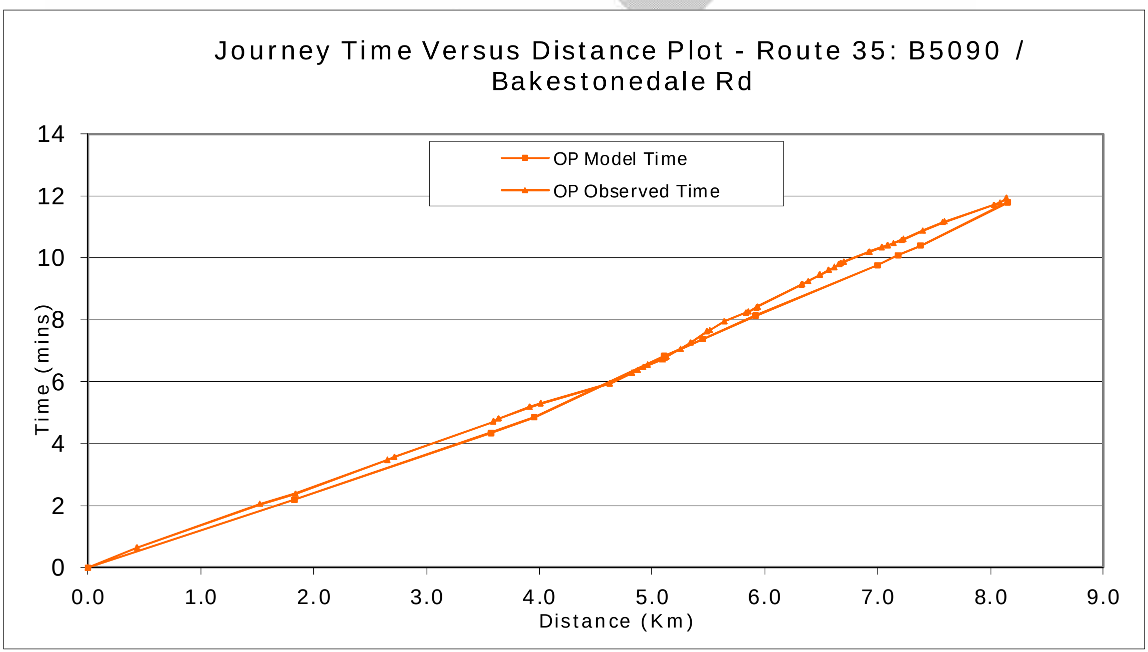

Journey Time Versus Distance Plot - Route 33: B5470 Chapel to Macclesfield
AM Model Time
AM Observed Time
Time (mins)
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
Distance (Km)

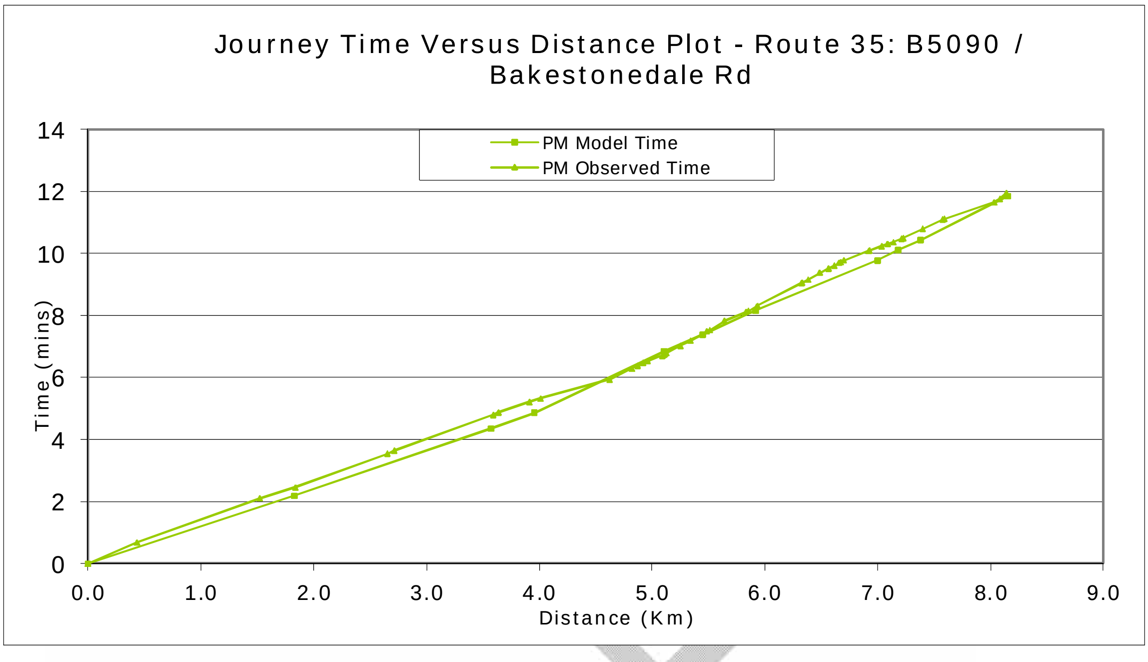

Journey Time Versus Distance Plot - Route 33: B5470 Chapel to Macclesfield
OP Model Time
OP Observed Time
Time (mins)
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
Distance (Km)

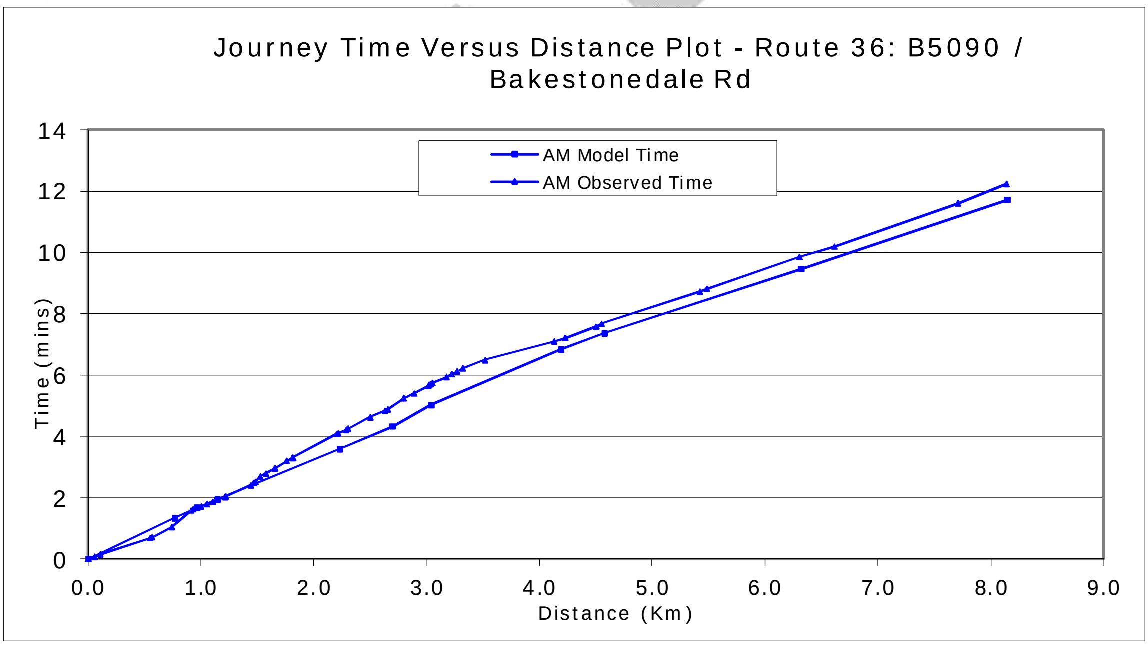

Journey Time Versus Distance Plot - Route 33: B5470 Chapel to Macclesfield
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

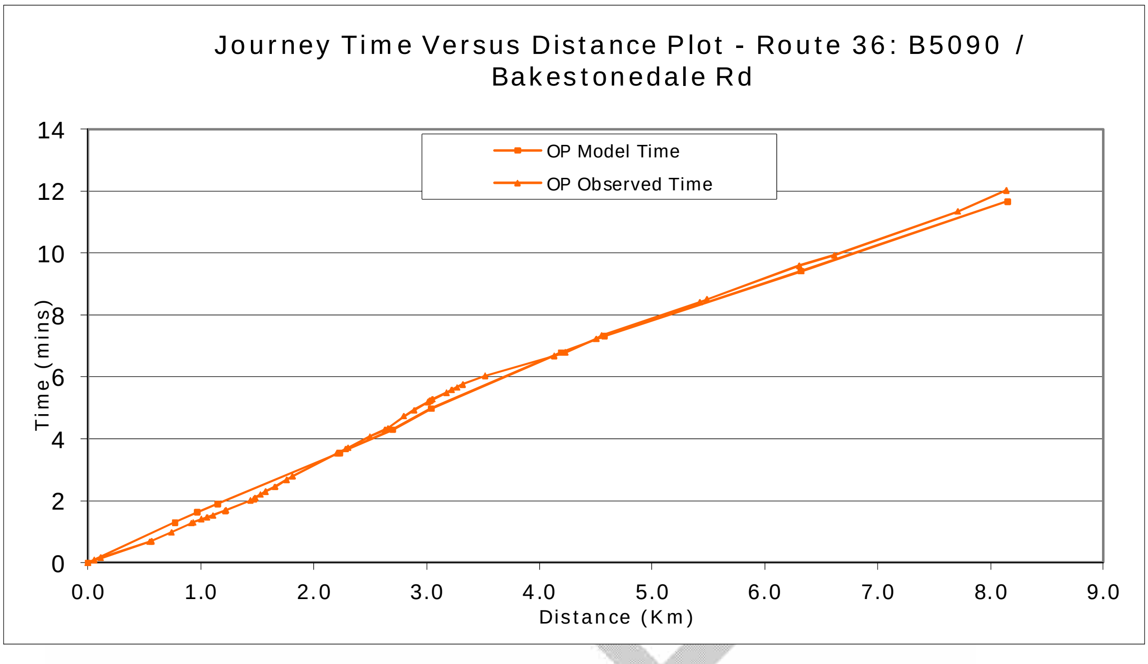

Journey Time Versus Distance Plot - Route 34: B5470 Macclesfield to Chapel
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0

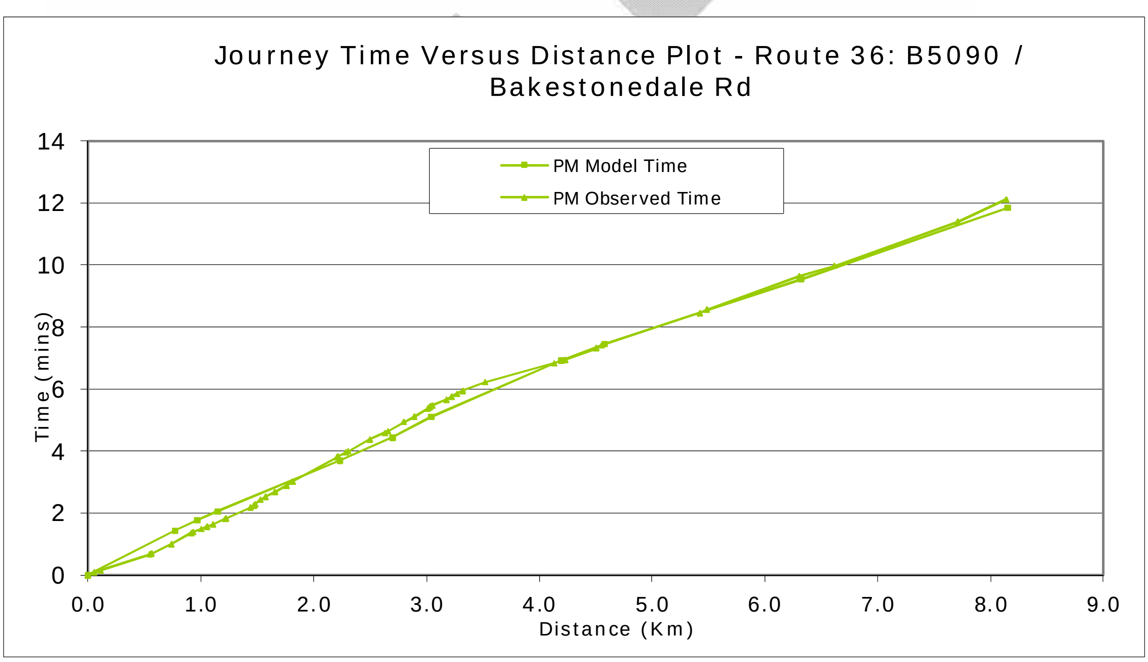

Journey Time Versus Distance Plot - Route 35: B5090 / Bakestonedale Rd
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

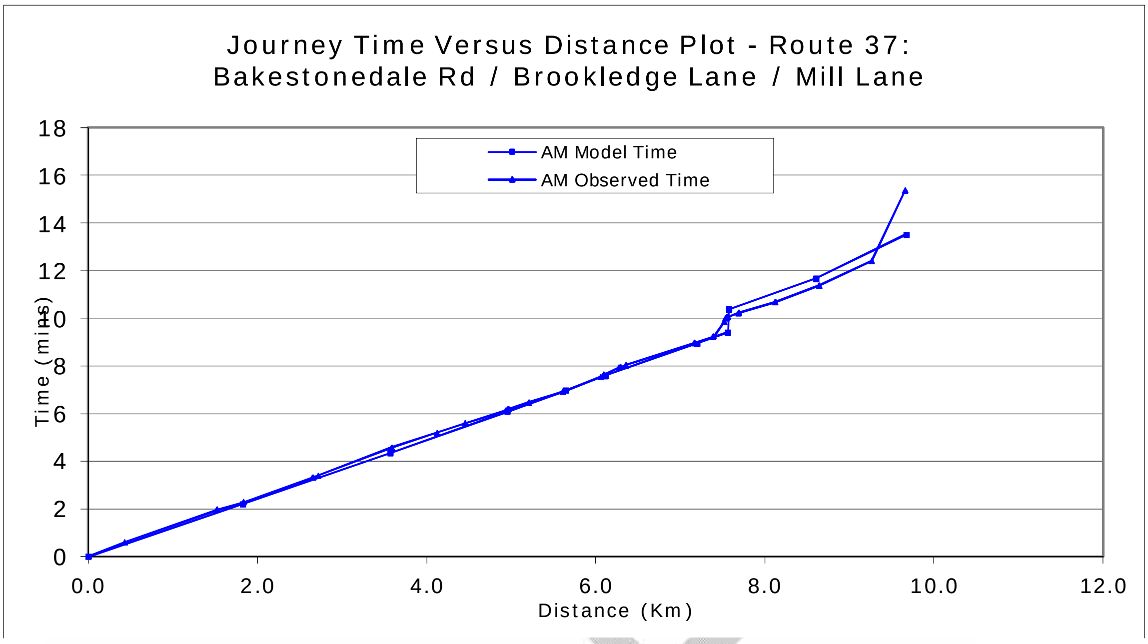

Journey Time Versus Distance Plot - Route 35: B5090 / Bakestonedale Rd
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

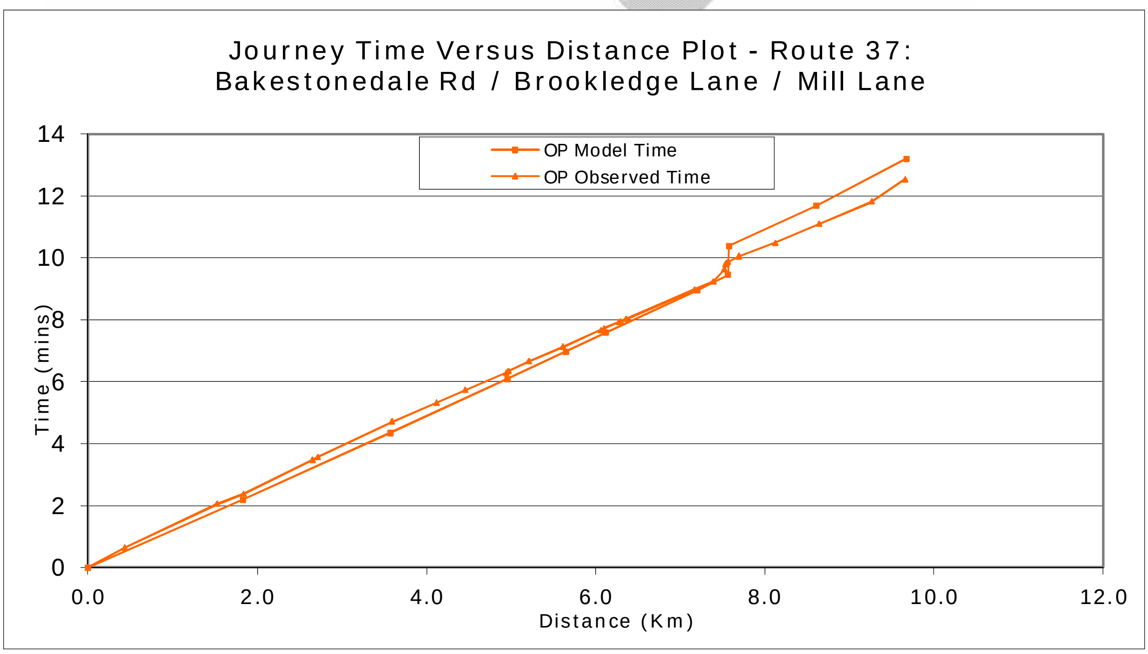

Journey Time Versus Distance Plot - Route 35: B5090 / Bakestonedale Rd
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

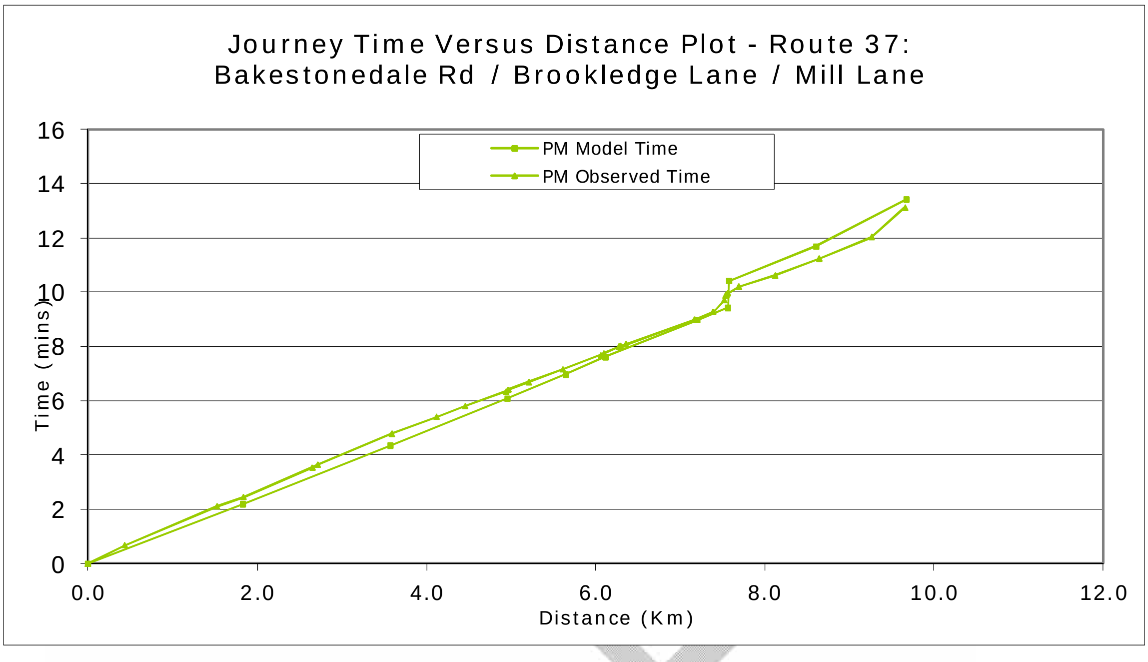

Journey Time Versus Distance Plot - Route 36: B5090 / Bakestonedale Rd
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

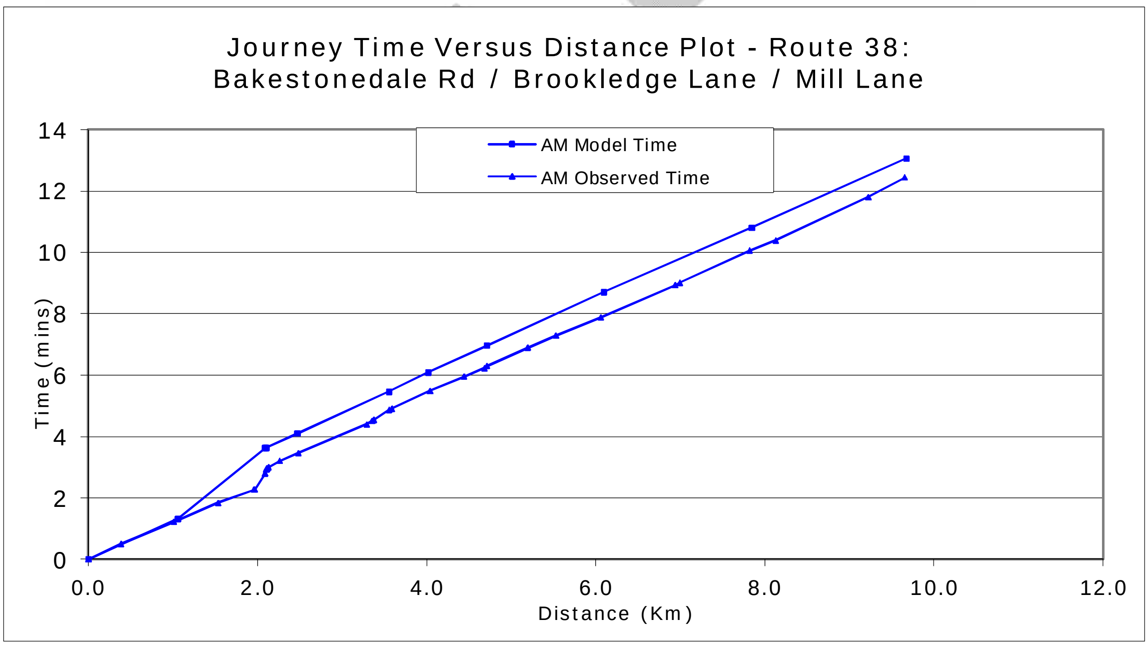

Journey Time Versus Distance Plot - Route 36: B5090 / Bakestonedale Rd
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

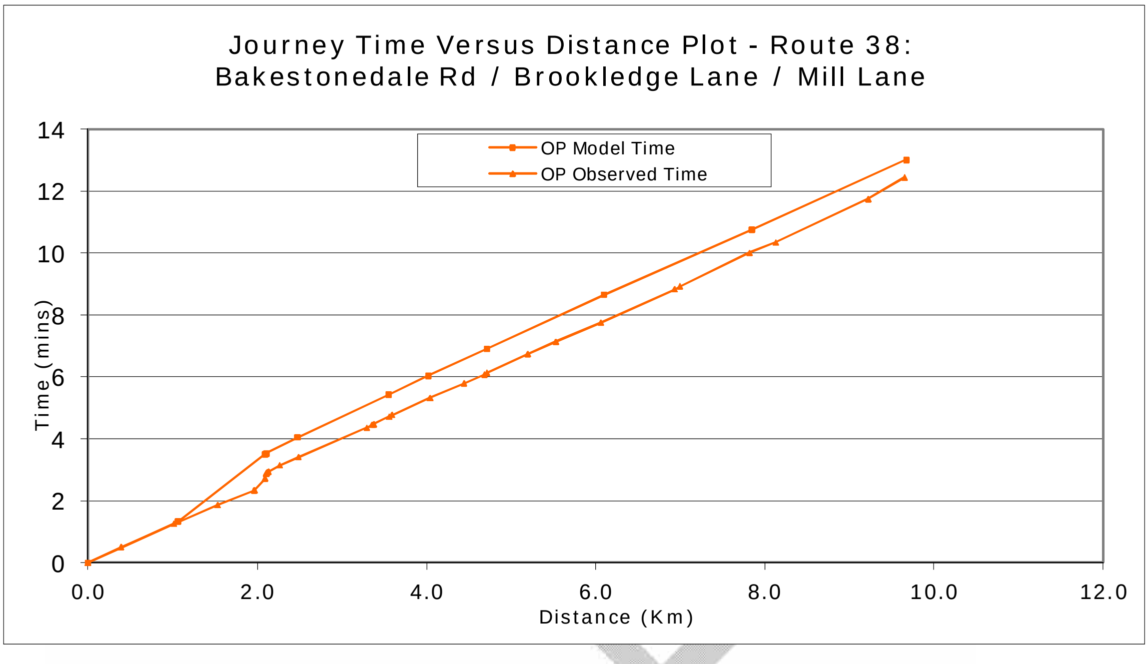

Journey Time Versus Distance Plot - Route 36: B5090 / Bakestonedale Rd
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0

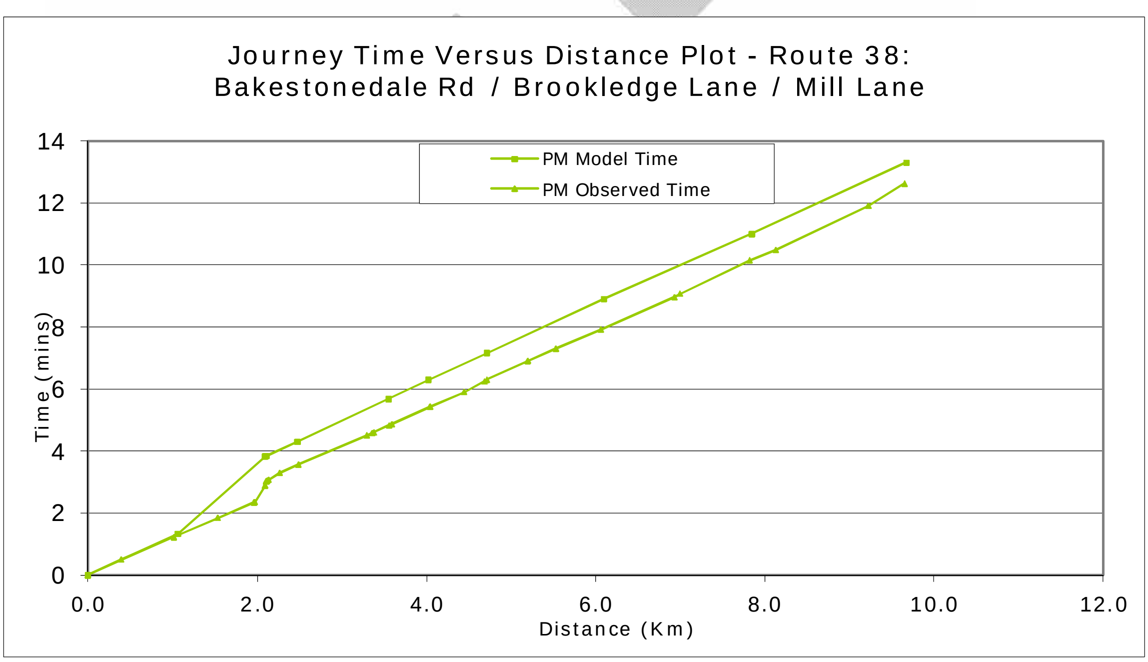

Journey Time Versus Distance Plot - Route 37:
Bakestonedale Rd / Brookledge Lane / Mill Lane
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
0.0
2.0
4.0
6.0
8.0
10.0
12.0

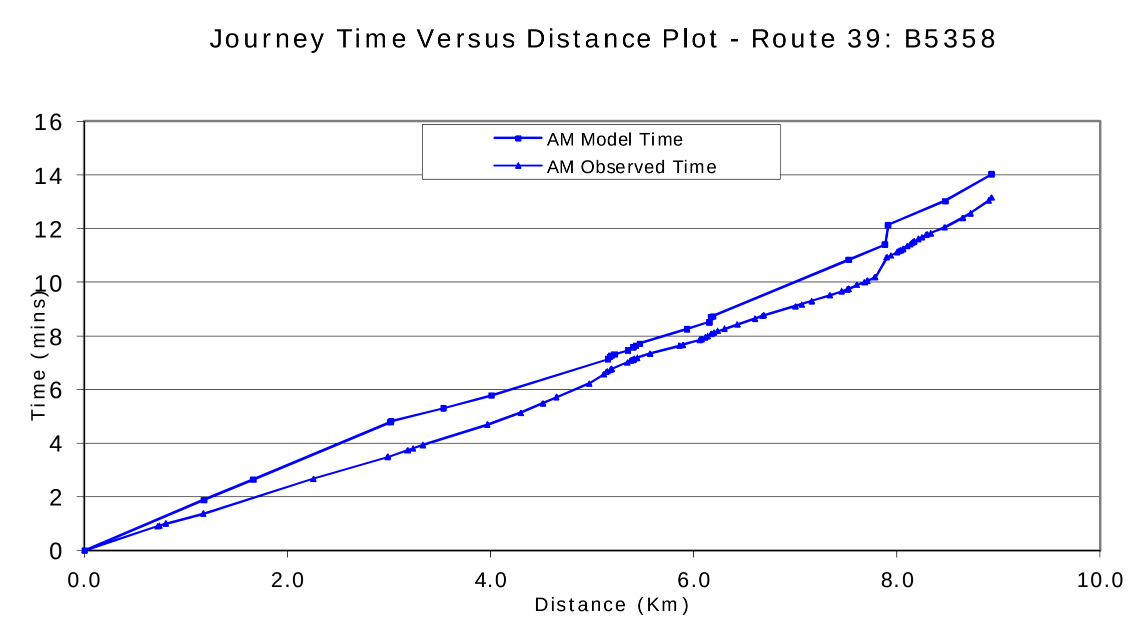

Journey Time Versus Distance Plot - Route 37:
Bakestonedale Rd / Brookledge Lane / Mill Lane
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
2.0
4.0
6.0
8.0
10.0
12.0

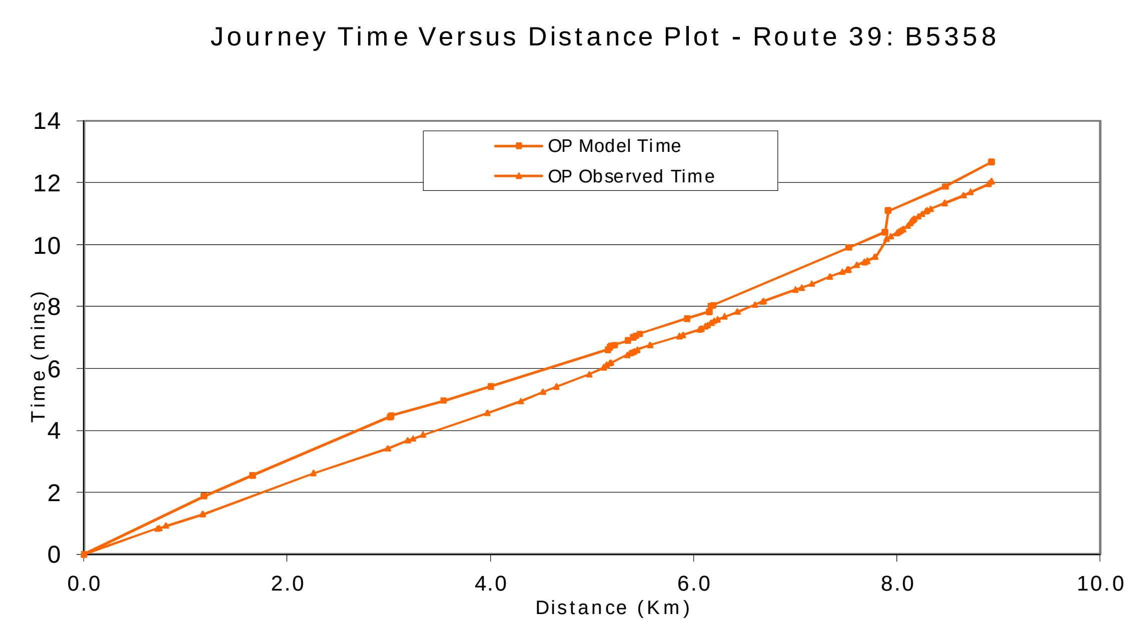

Journey Time Versus Distance Plot - Route 37: Bakestonedale Rd / Brookledge Lane / Mill Lane
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0
12.0

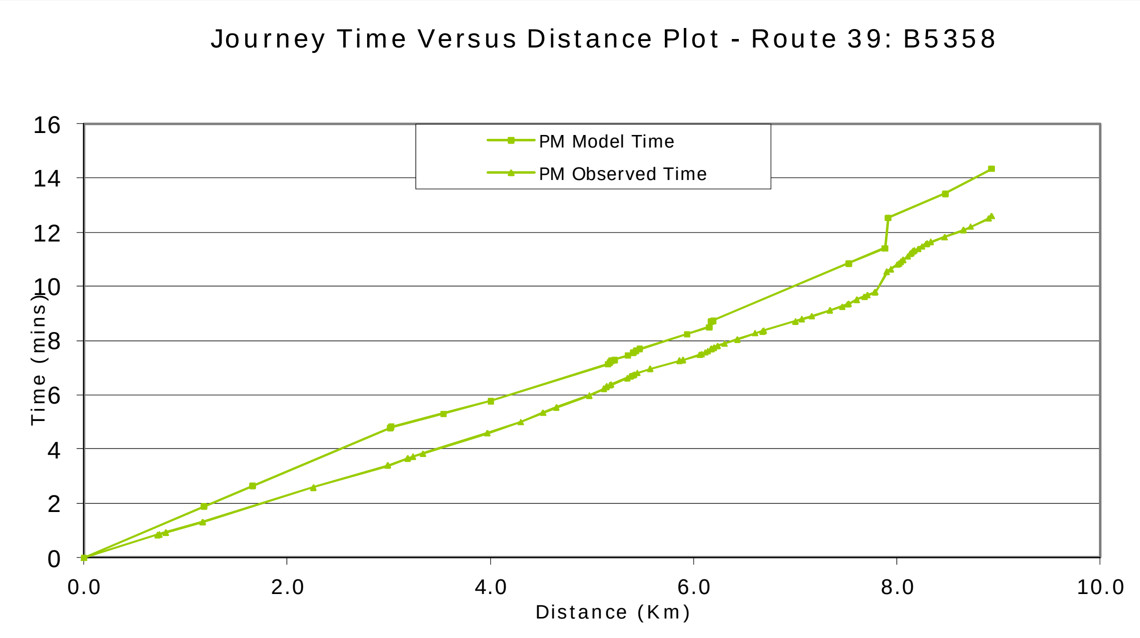

Journey Time Versus Distance Plot - Route 38: Bakestonedale Rd / Brookledge Lane / Mill Lane
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
2.0
4.0
6.0
8.0
10.0
12.0

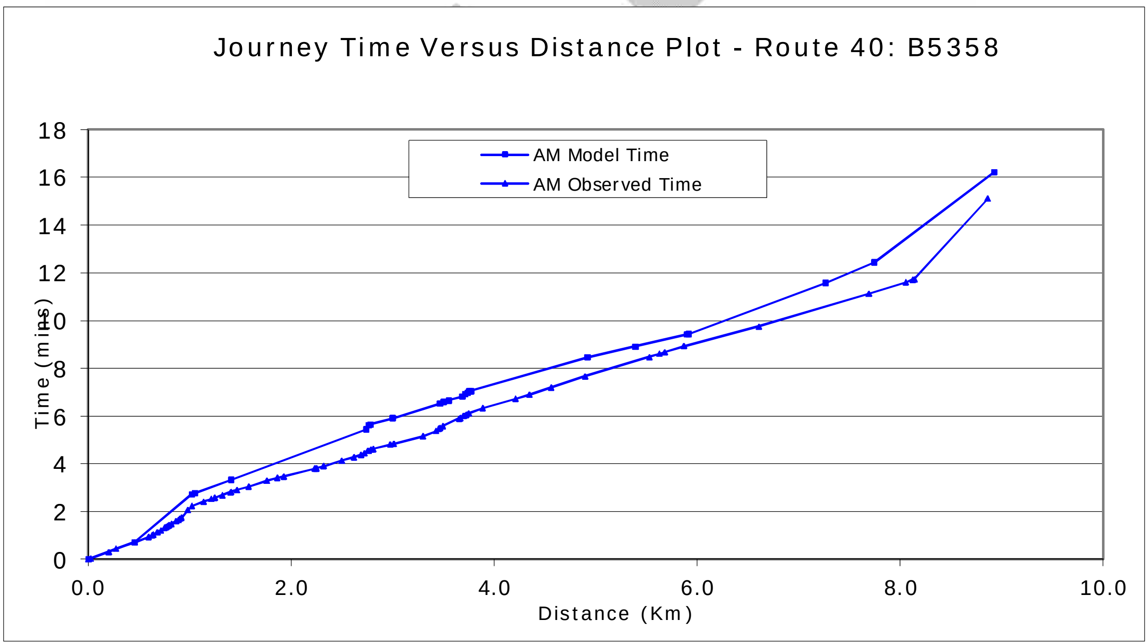

Journey Time Versus Distance Plot - Route 38:
Bakestonedale Rd / Brookledge Lane / Mill Lane
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
2.0
4.0
6.0
8.0
10.0
12.0

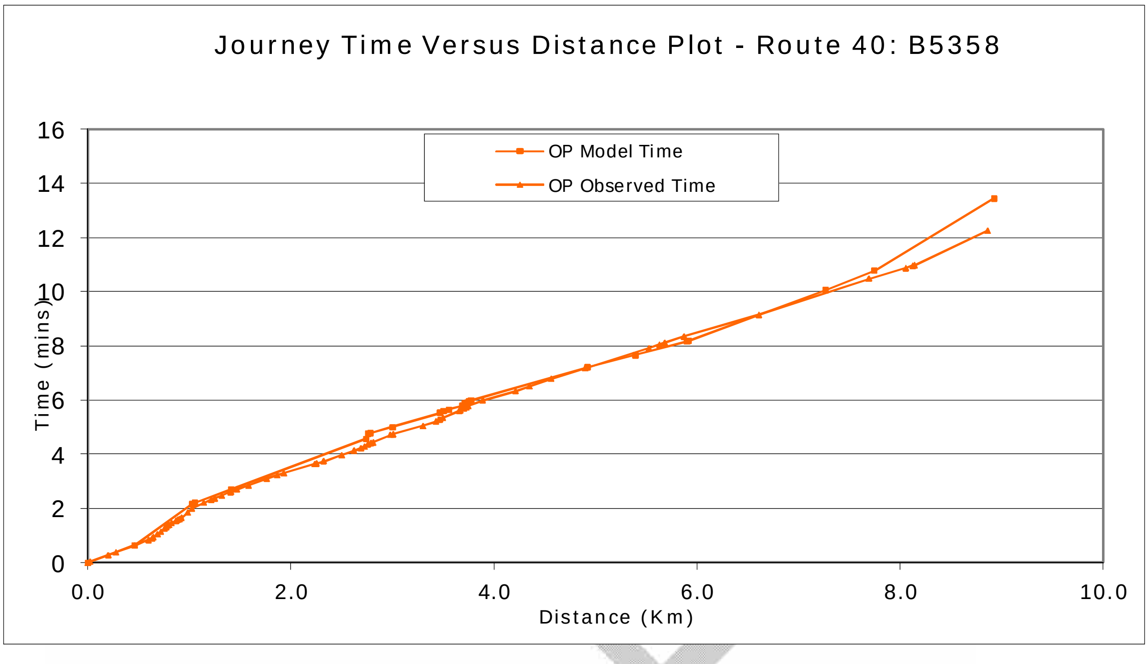

Journey Time Versus Distance Plot - Route 38:
Bakestonedale Rd / Brookledge Lane / Mill Lane
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
2.0
4.0
6.0
8.0
10.0
12.0

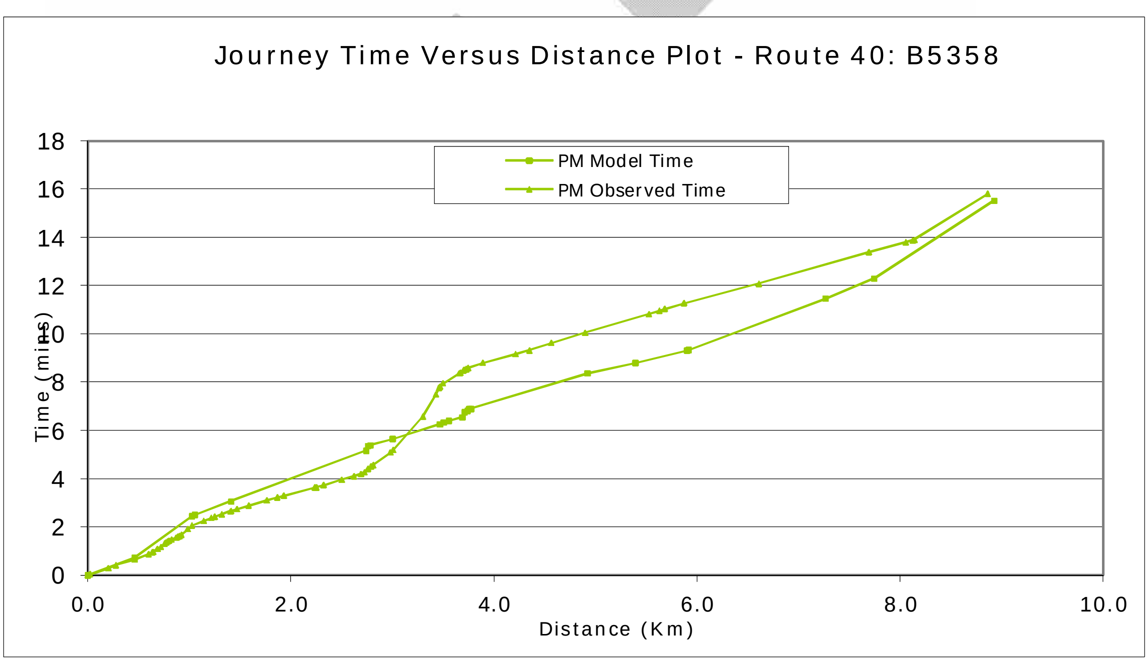

Journey Time Versus Distance Plot - Route 39: B5358
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0


Journey Time Versus Distance Plot - Route 39: B5358
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
2.0
4.0
6.0
8.0
10.0

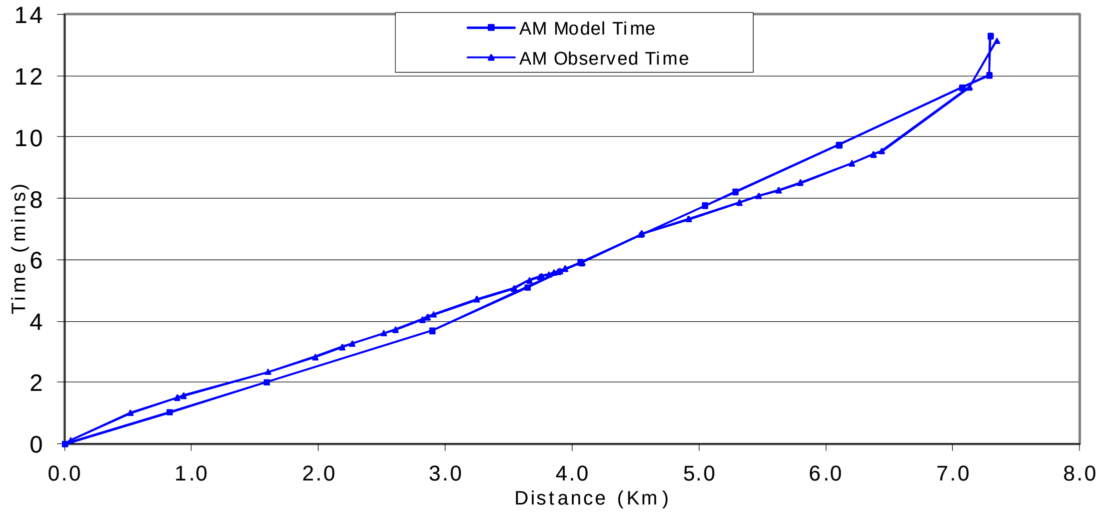

Journey Time Versus Distance Plot - Route 39: B5358
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
2.0
4.0
6.0
8.0
10.0


Journey Time Versus Distance Plot - Route 40: B5358
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
0.0
2.0
4.0
6.0
8.0
10.0

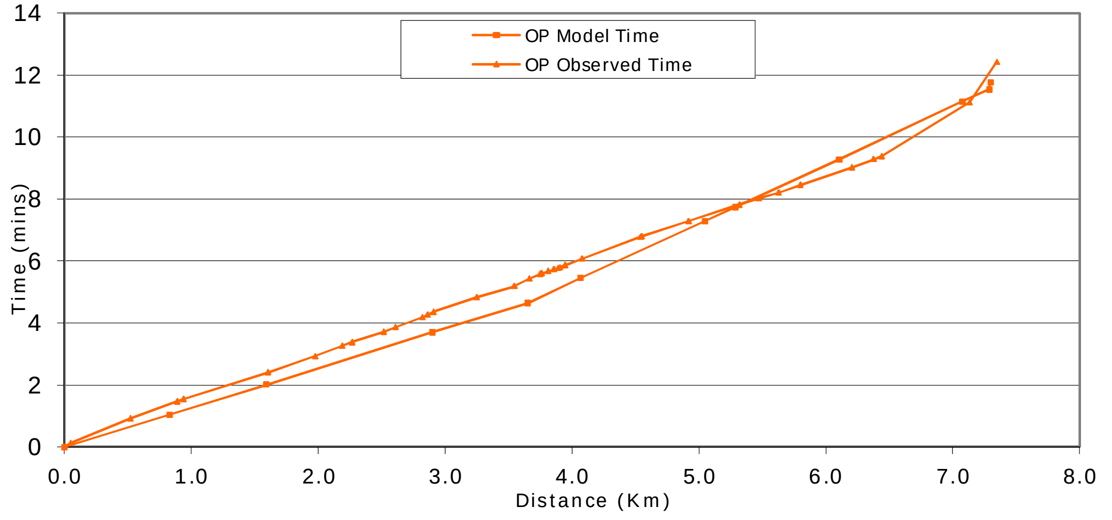

Journey Time Versus Distance Plot - Route 40: B5358
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
16
14
12
10
8
6
4
2
0
0.0
2.0
4.0
6.0
8.0
10.0

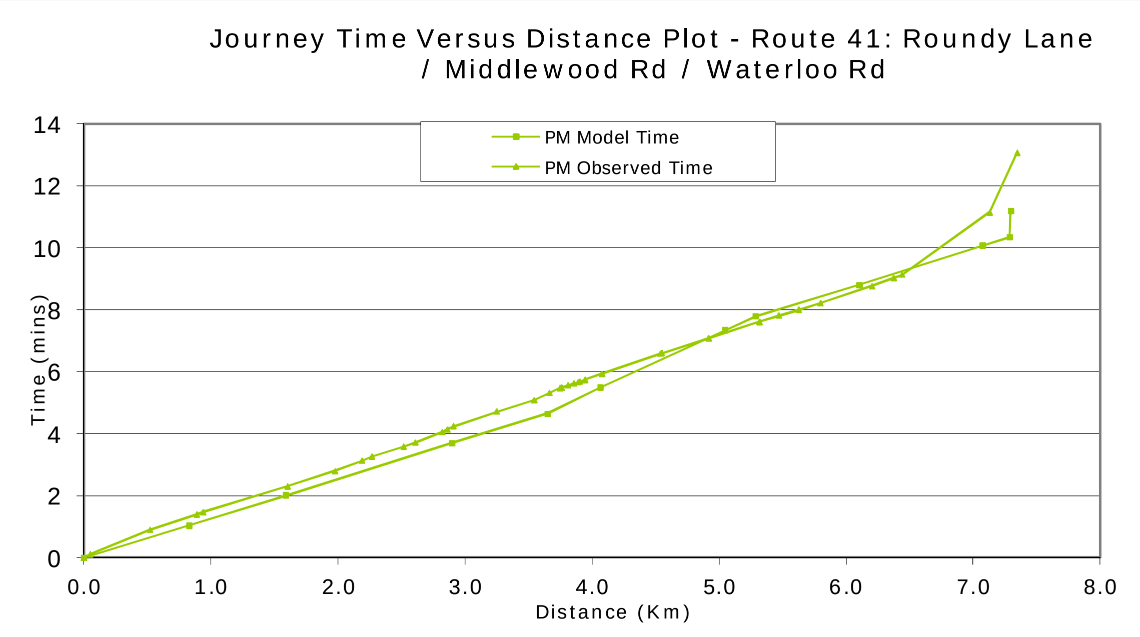

Journey Time Versus Distance Plot - Route 40: B5358
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
18
16
14
12
10
8
6
4
2
0
0.0
2.0
4.0
6.0
8.0
10.0

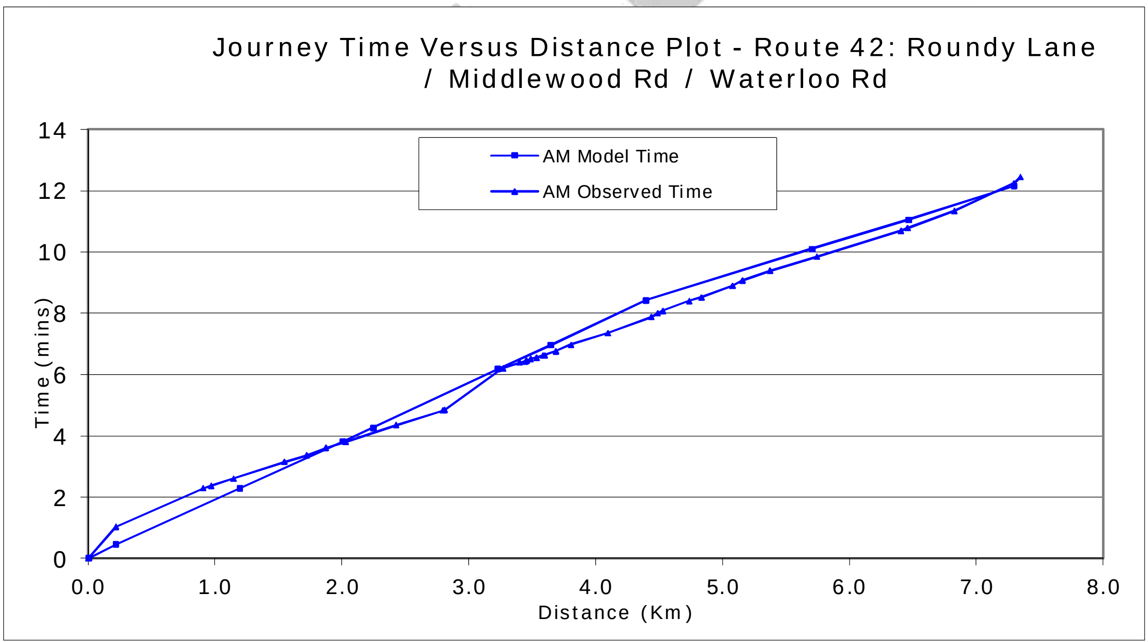
Journey Time Versus Distance Plot - Route 41: Roundy Lane / Middlewood Rd / Waterloo Rd

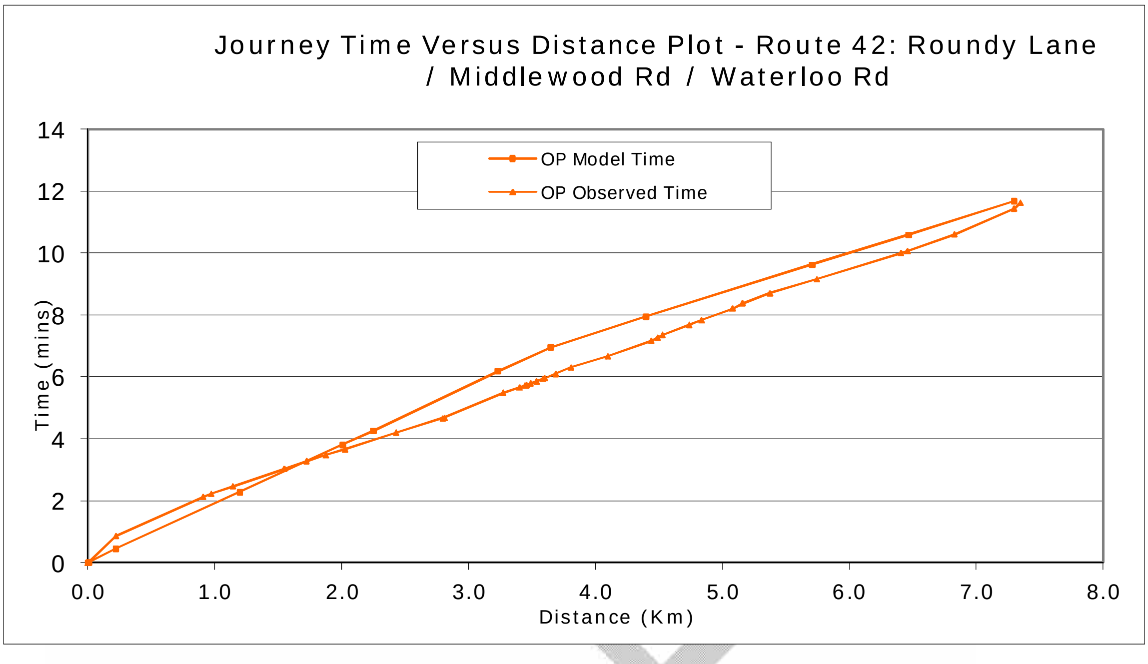


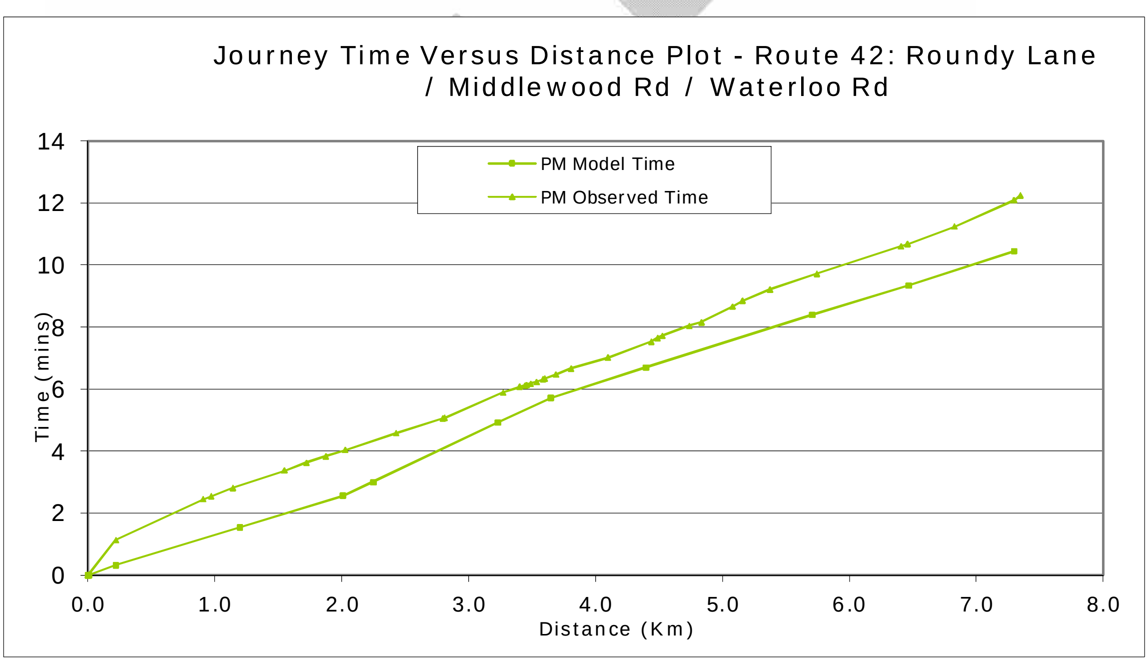
Journey Time Versus Distance Plot - Route 41: Roundy Lane / Middlewood Rd / Waterloo Rd

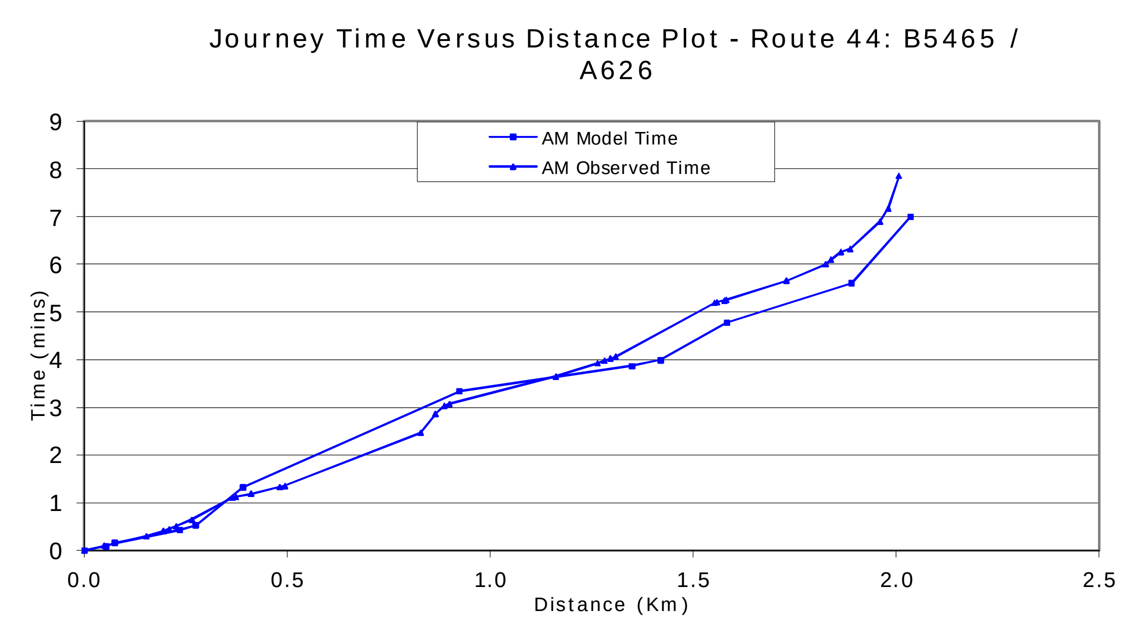


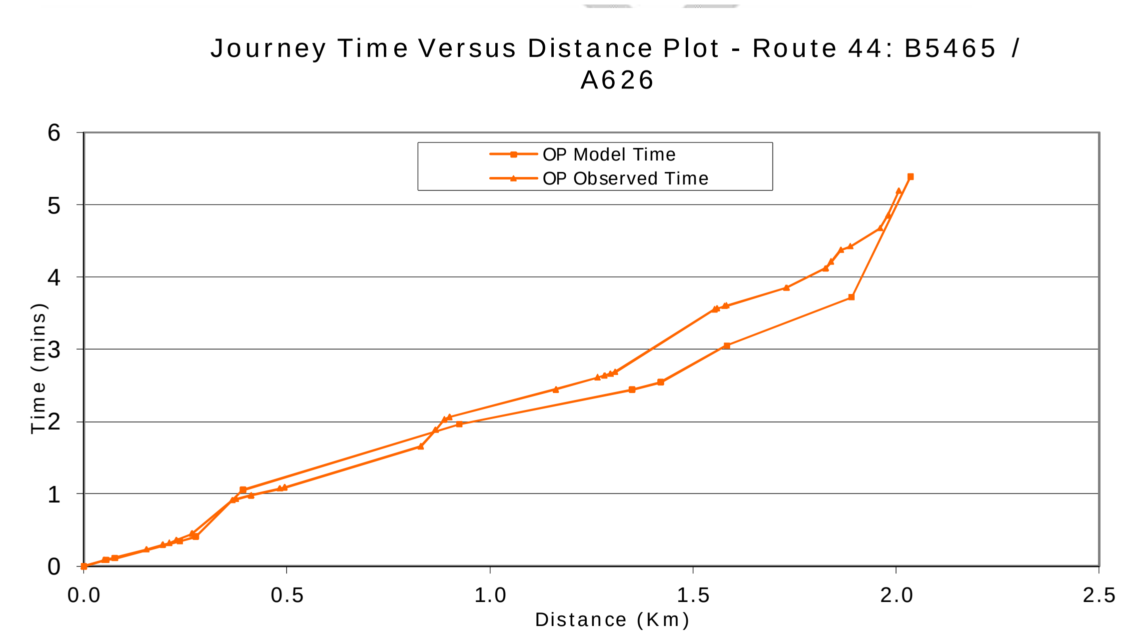

Journey Time Versus Distance Plot - Route 41: Roundy Lane / Middlewood Rd / Waterloo Rd
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

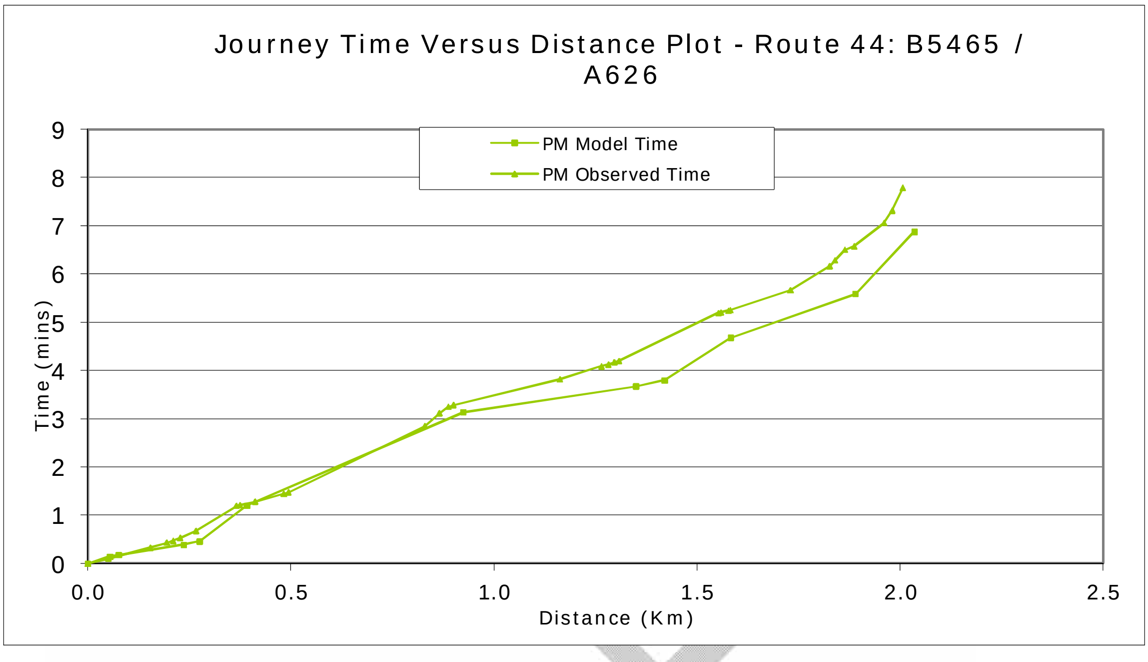

Journey Time Versus Distance Plot - Route 42: Roundy Lane / Middlewood Rd / Waterloo Rd
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

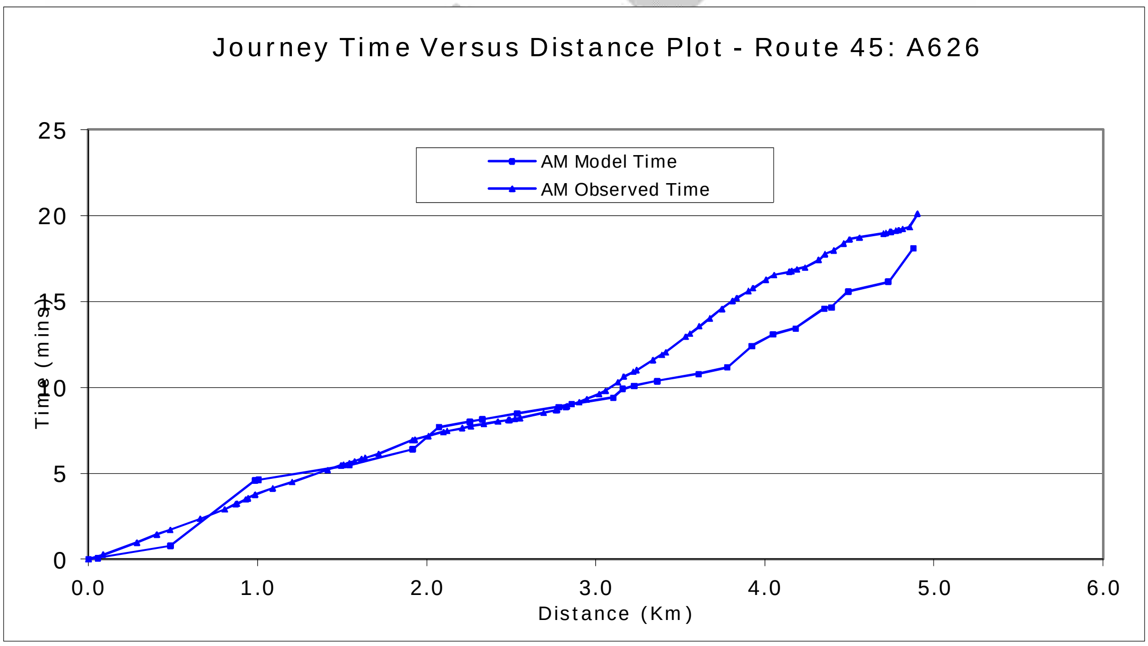

Journey Time Versus Distance Plot - Route 42: Roundy Lane / Middlewood Rd / Waterloo Rd
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
14
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

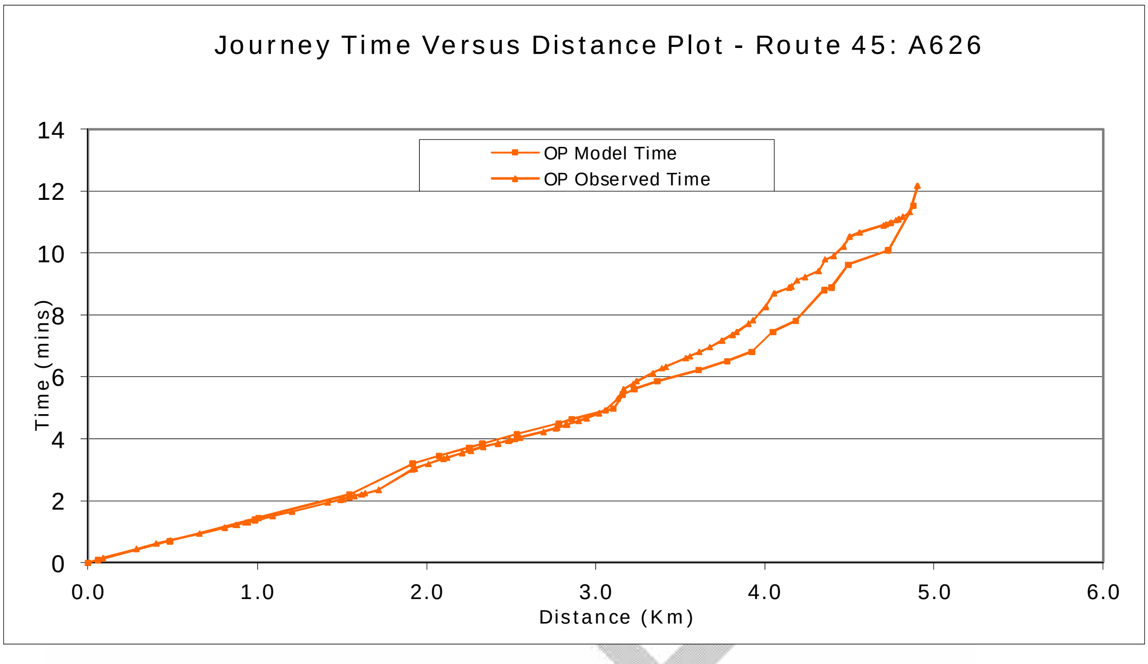

Journey Time Versus Distance Plot - Route 42: Roundy Lane / Middlewood Rd / Waterloo Rd
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
14
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

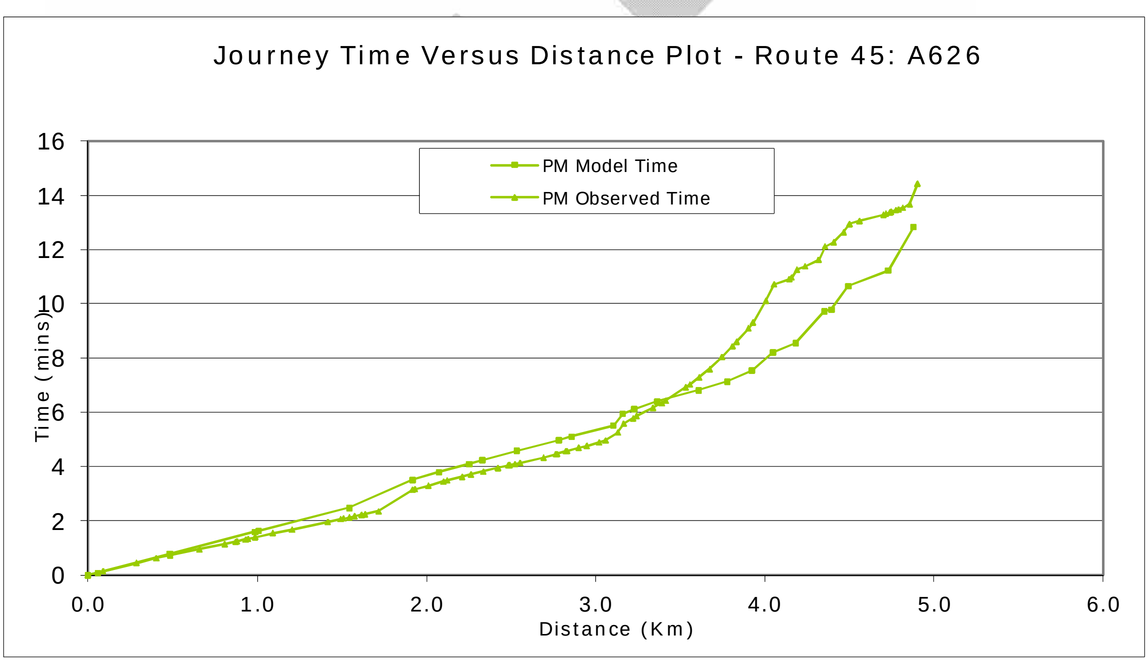

Journey Time Versus Distance Plot - Route 44: B5465 / A626
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
0.5
1.0
1.5
2.0
2.5

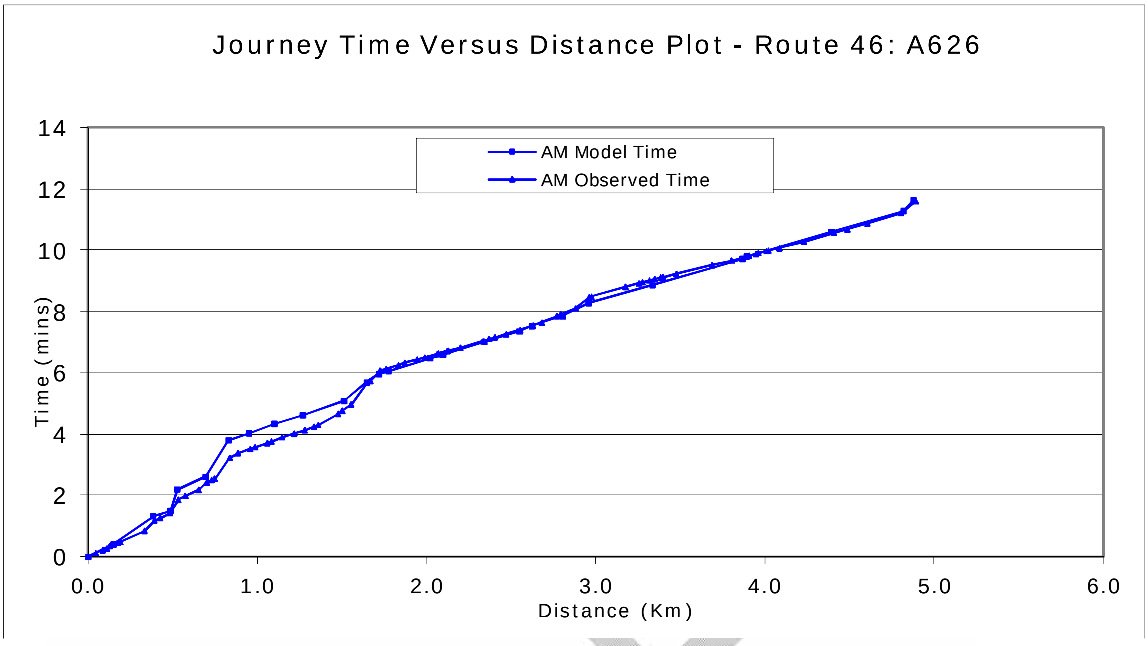

Journey Time Versus Distance Plot - Route 44: B5465 / A626
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
0.0
0.5
1.0
1.5
2.0
2.5

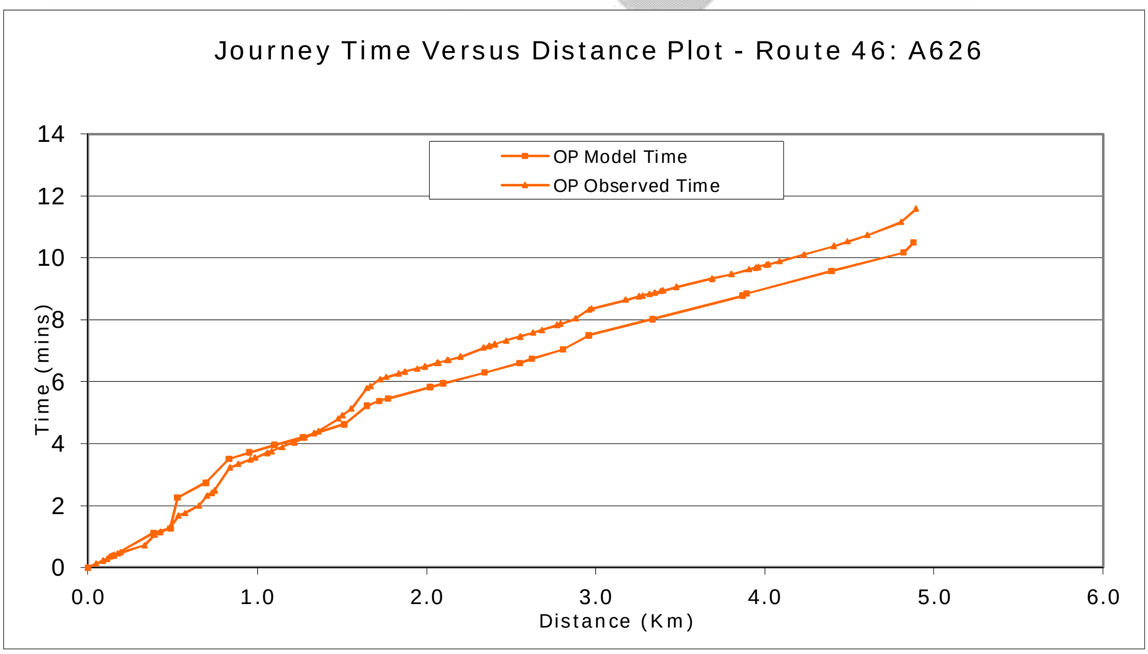

Journey Time Versus Distance Plot - Route 44: B5465 / A626
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
0.5
1.0
1.5
2.0
2.5

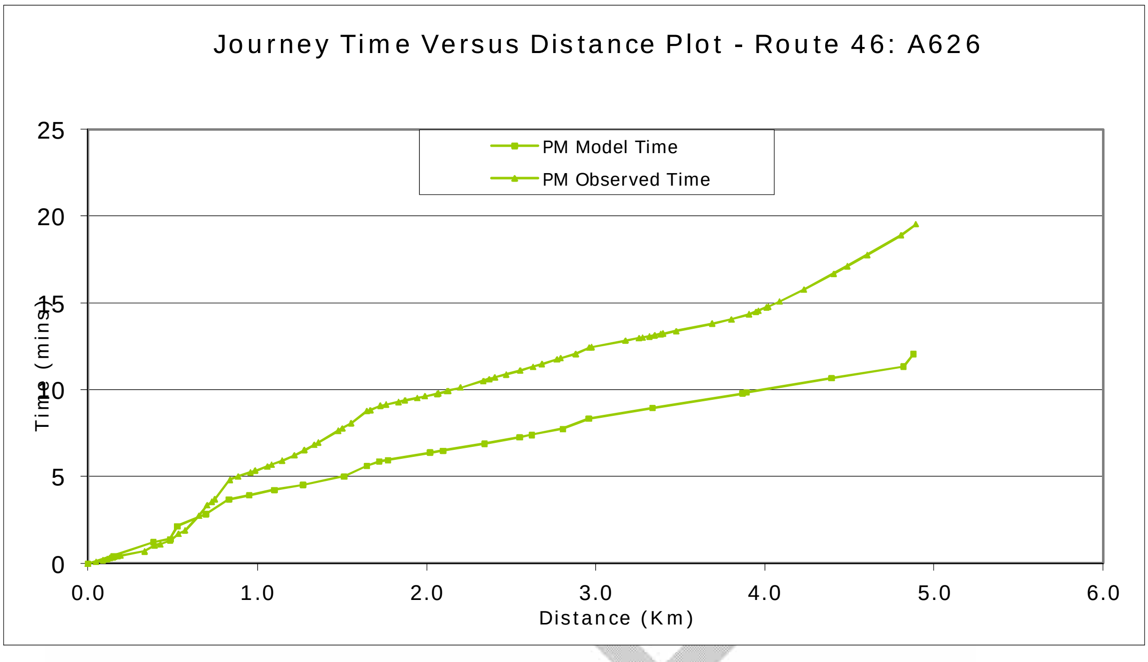

Journey Time Versus Distance Plot - Route 45: A626
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
1.0
2.0
3.0
4.0
5.0
6.0

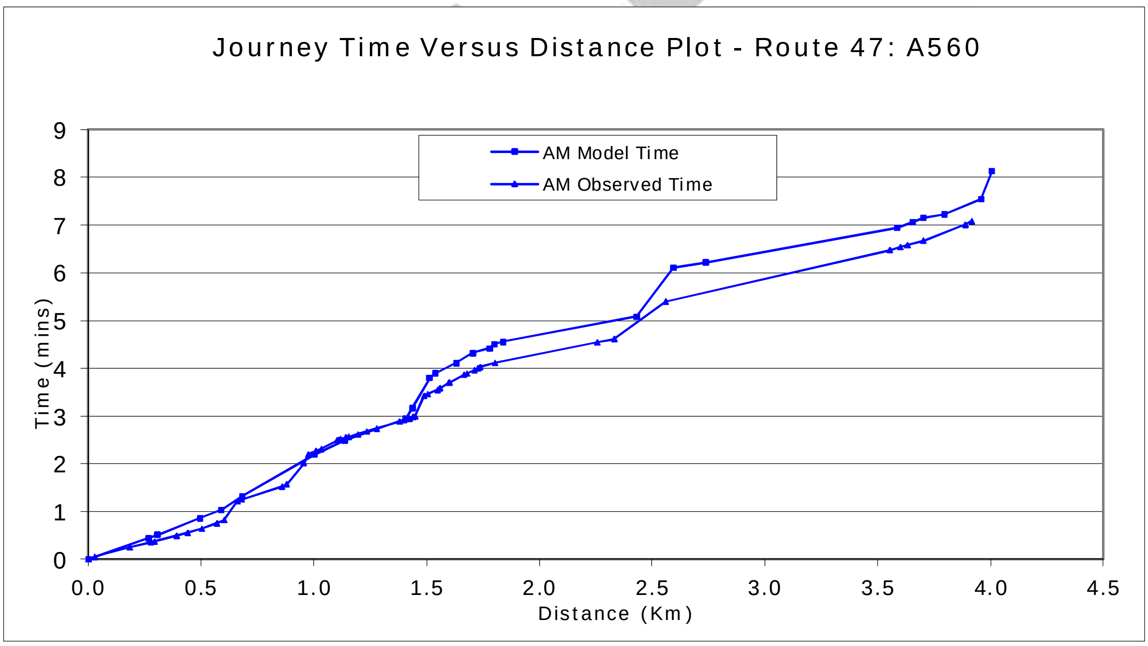

Journey Time Versus Distance Plot - Route 45: A626
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0

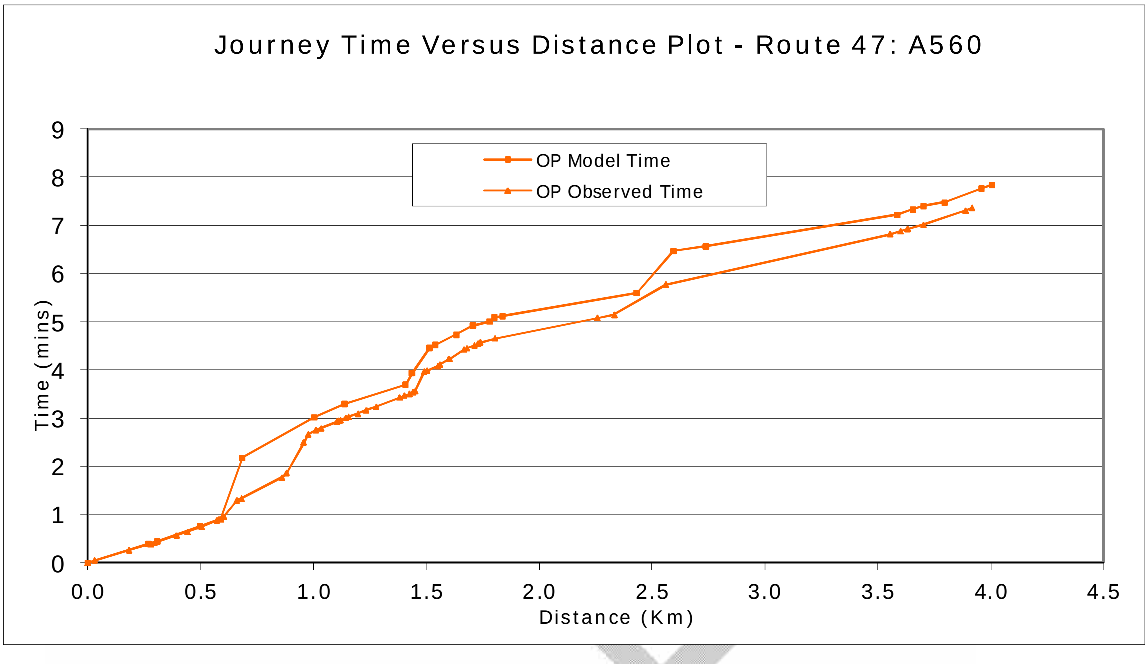

Journey Time Versus Distance Plot - Route 45: A626
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0

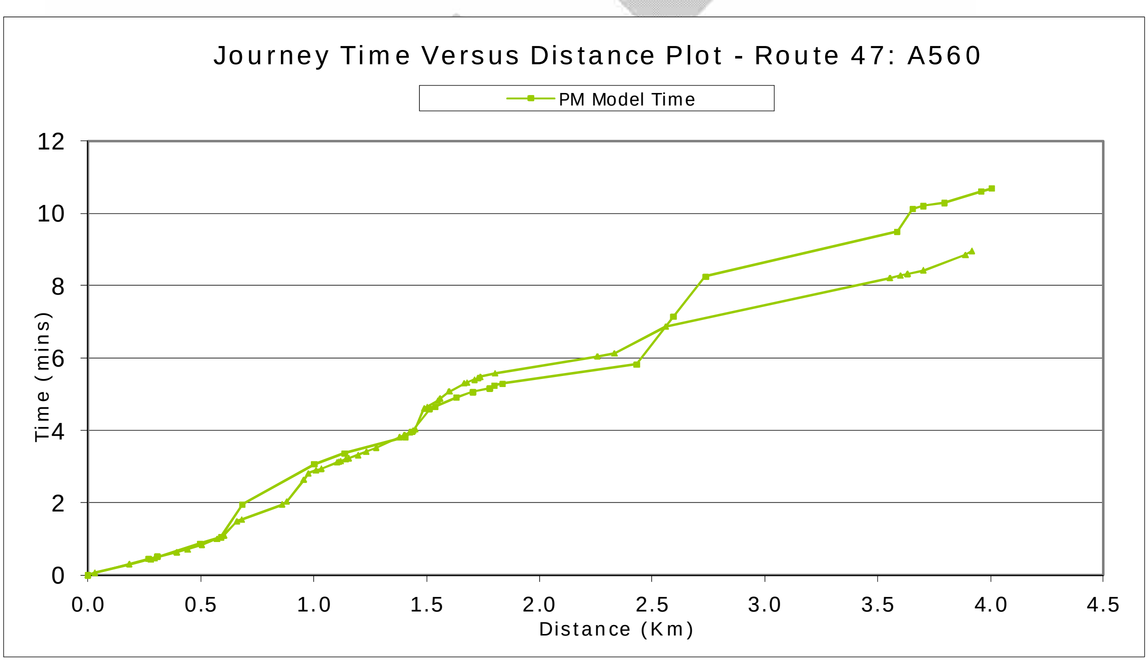

Journey Time Versus Distance Plot - Route 46: A626
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0

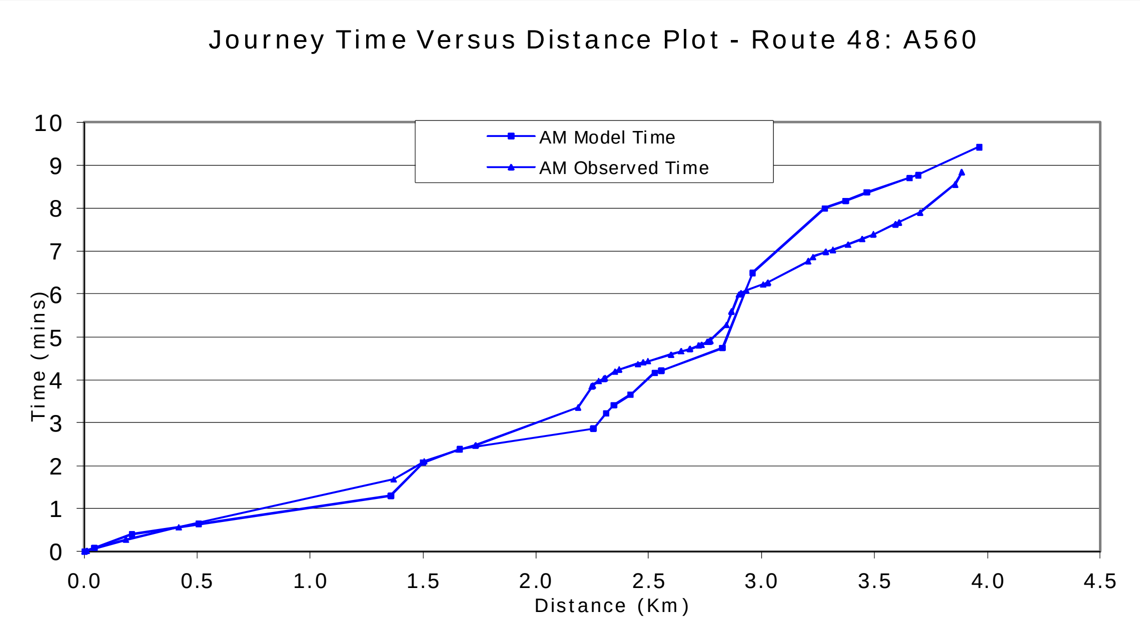

Journey Time Versus Distance Plot - Route 46: A626
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0

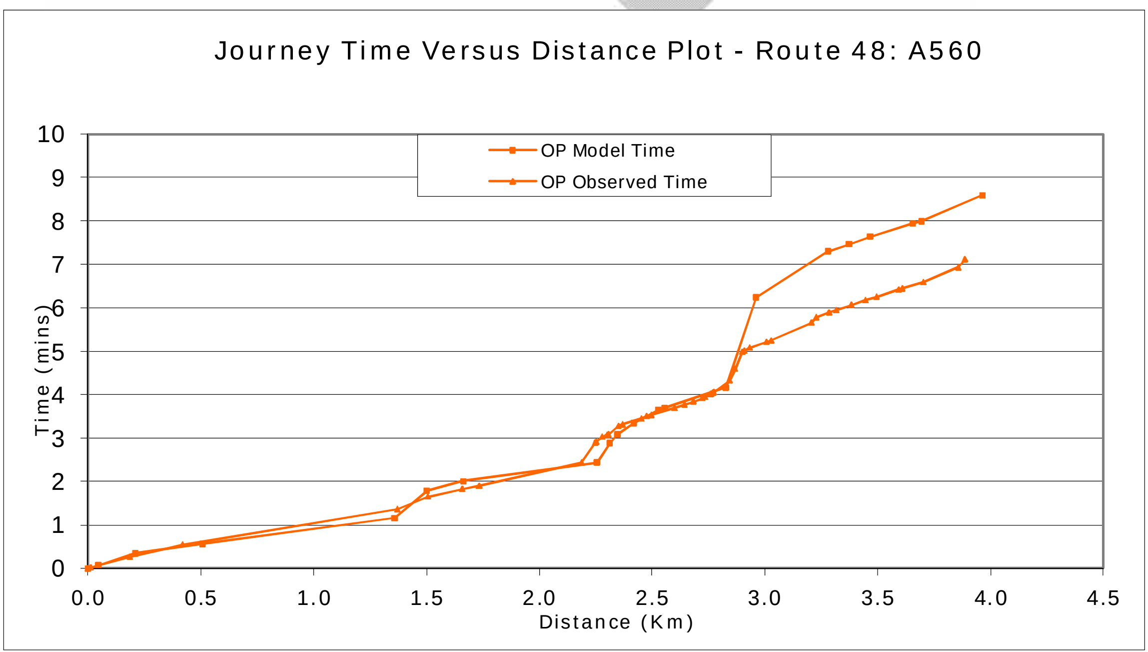

Journey Time Versus Distance Plot - Route 46: A626
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
25
20
15
10
5
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0

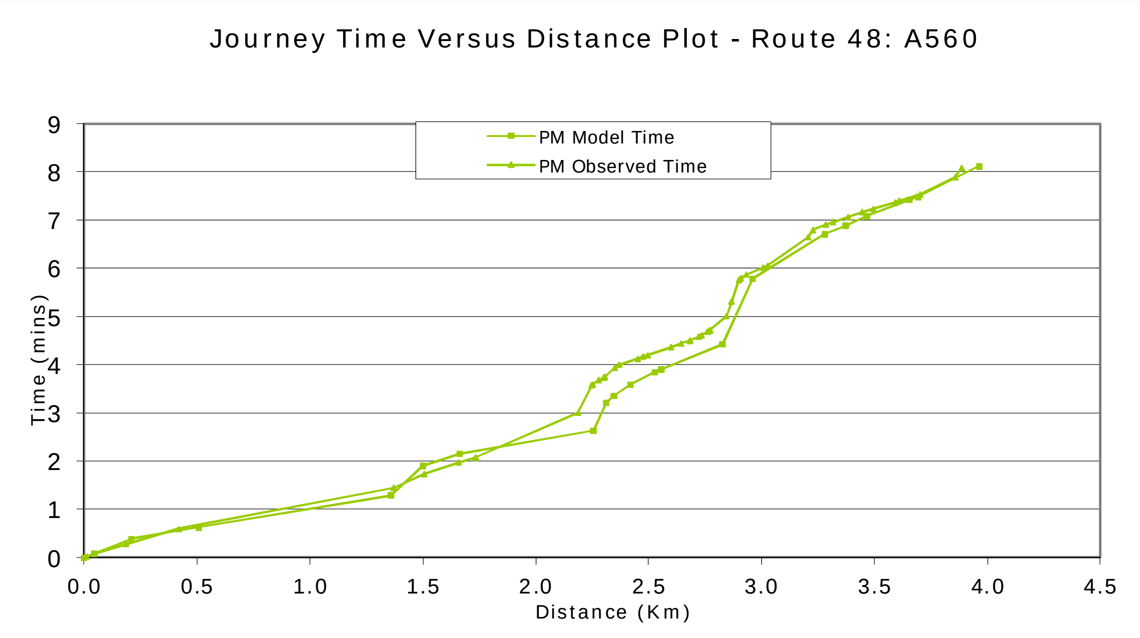

Journey Time Versus Distance Plot - Route 47: A560
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
9
8
7
6
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

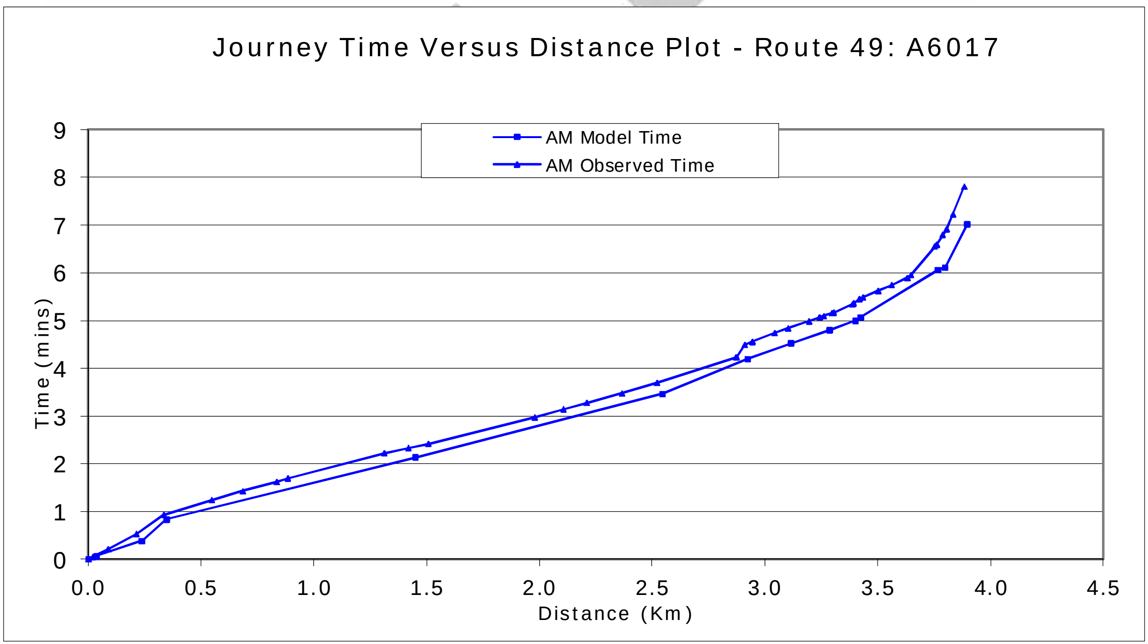

Journey Time Versus Distance Plot - Route 47: A560
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

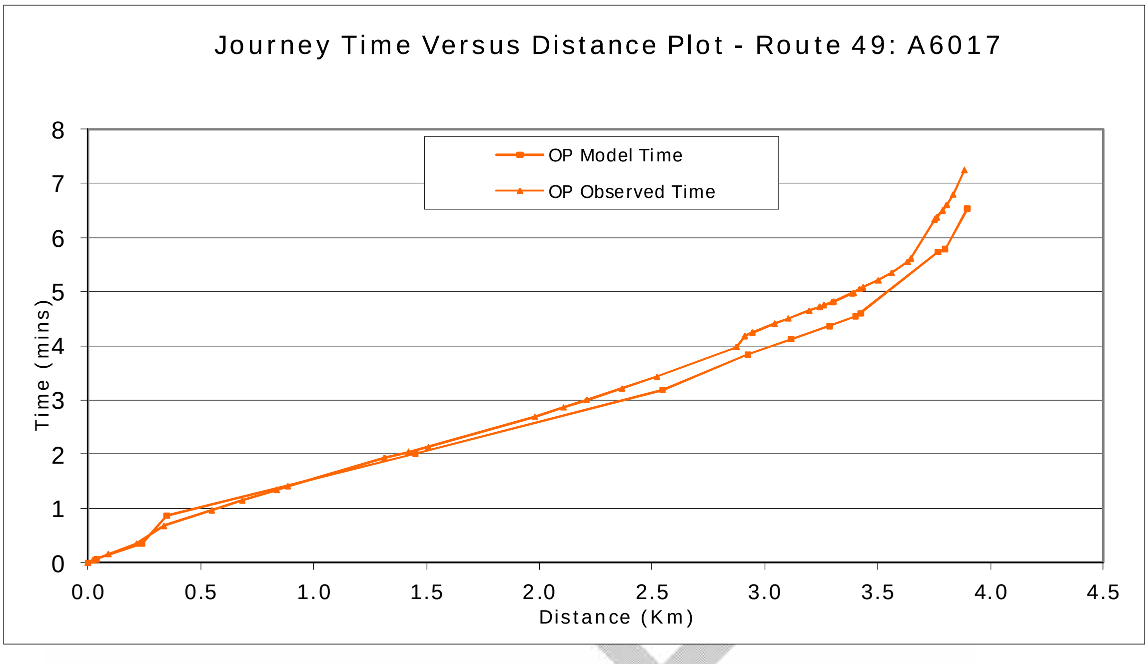

Journey Time Versus Distance Plot - Route 47: A560
PM Model Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

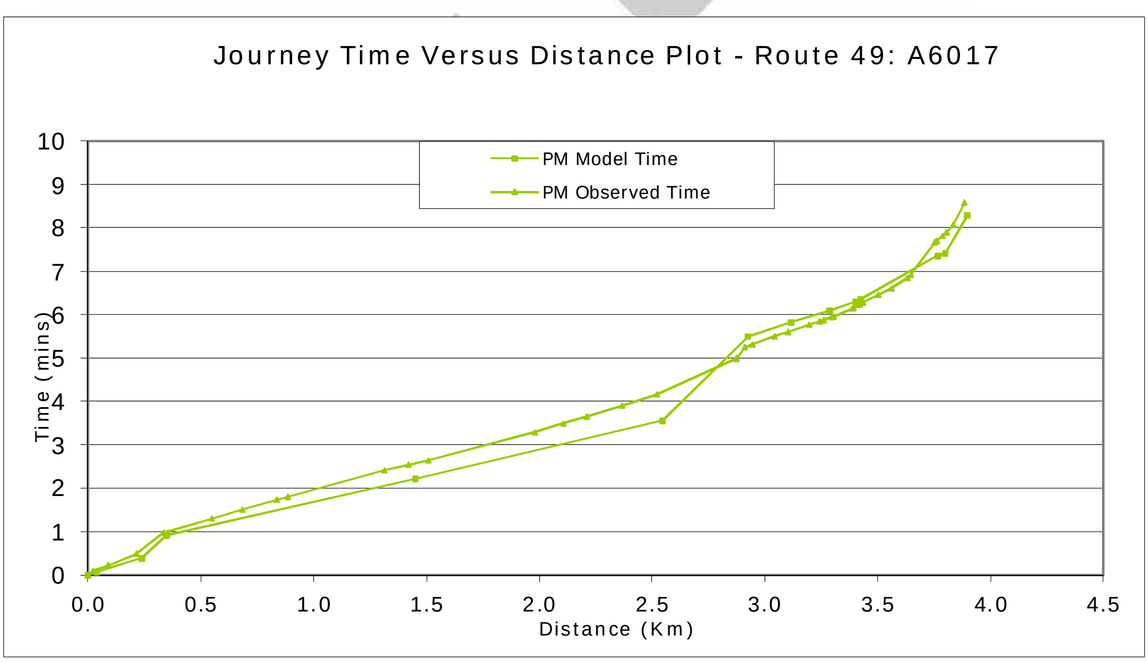

Journey Time Versus Distance Plot - Route 48: A560
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
10
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

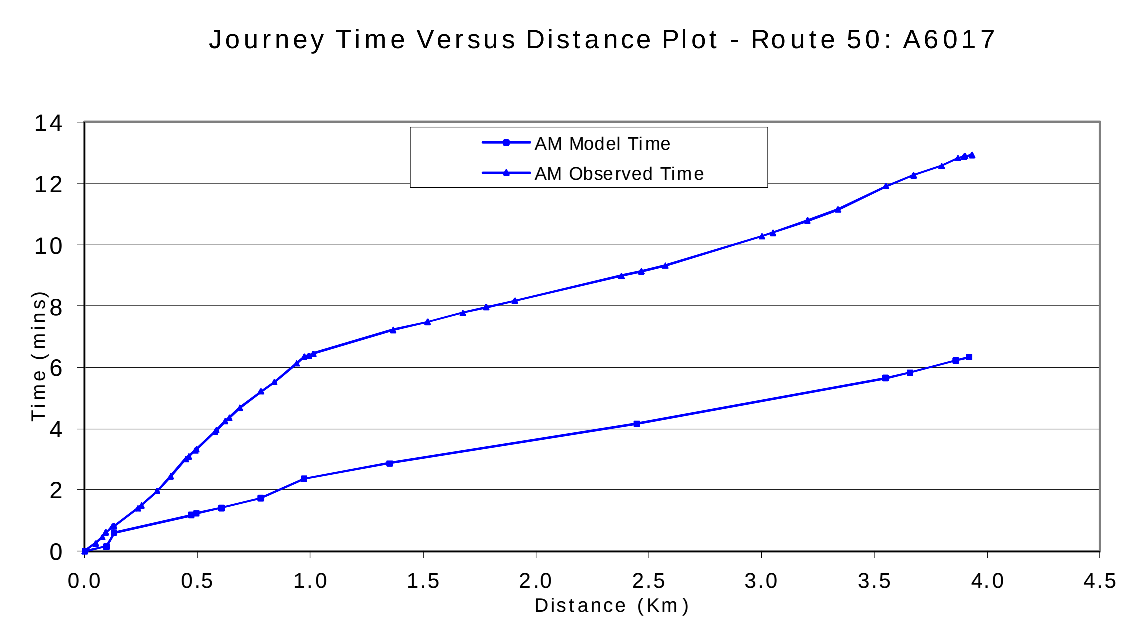

Journey Time Versus Distance Plot - Route 48: A560
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
10
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

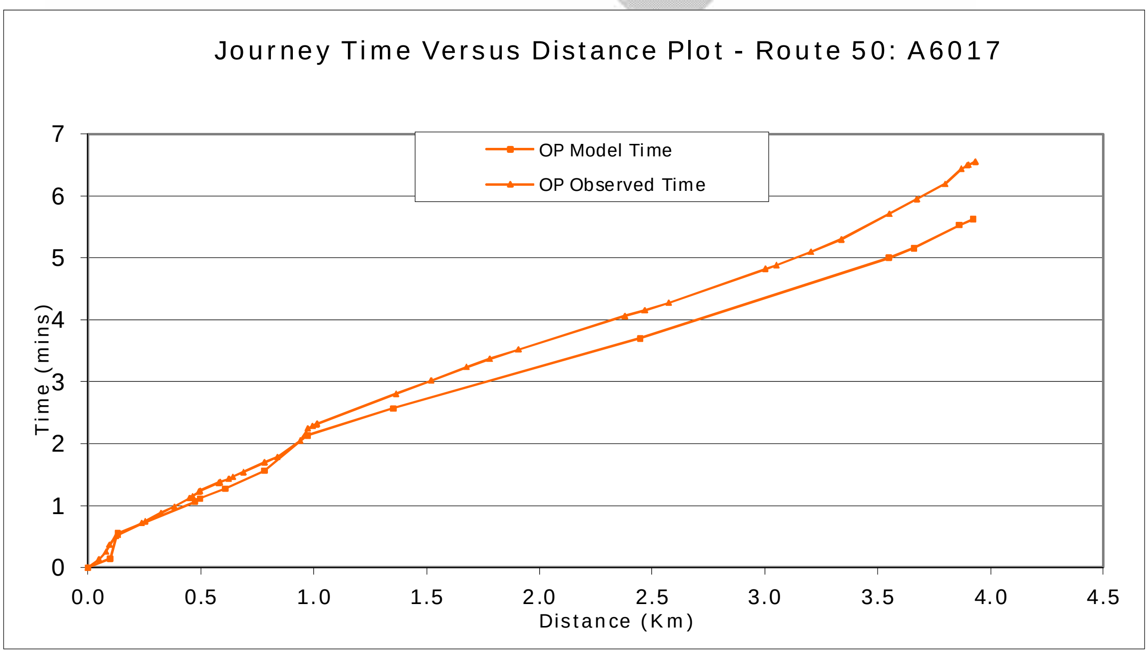

Journey Time Versus Distance Plot - Route 48: A560
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

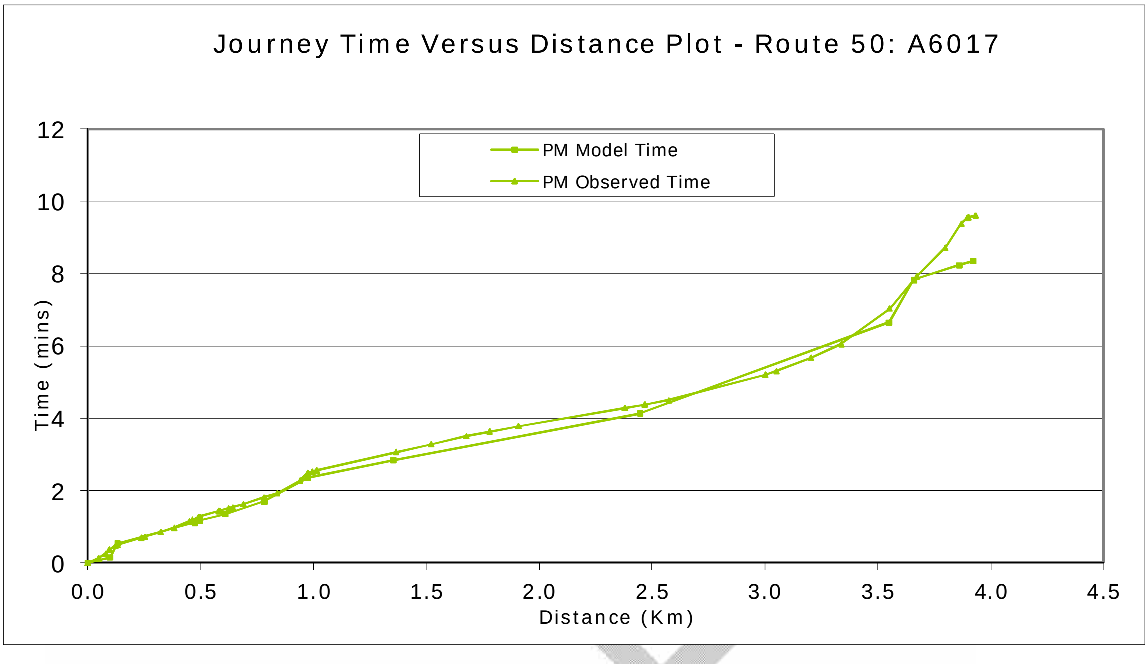

Journey Time Versus Distance Plot - Route 49: A6017
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

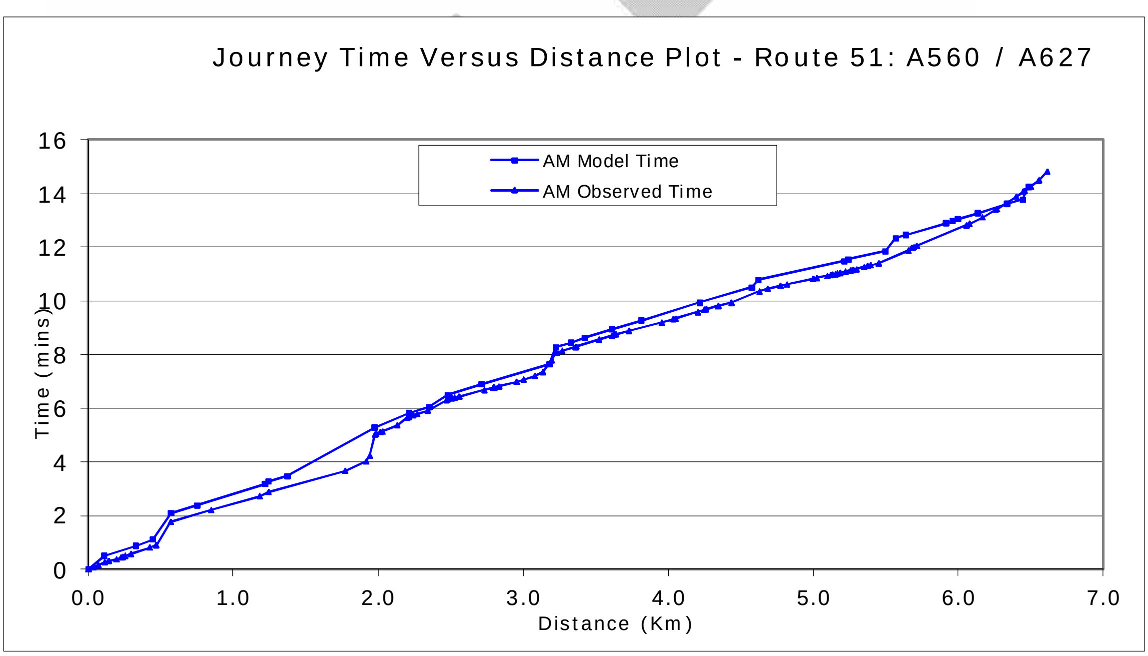

Journey Time Versus Distance Plot - Route 49: A6017
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
8
7
6
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

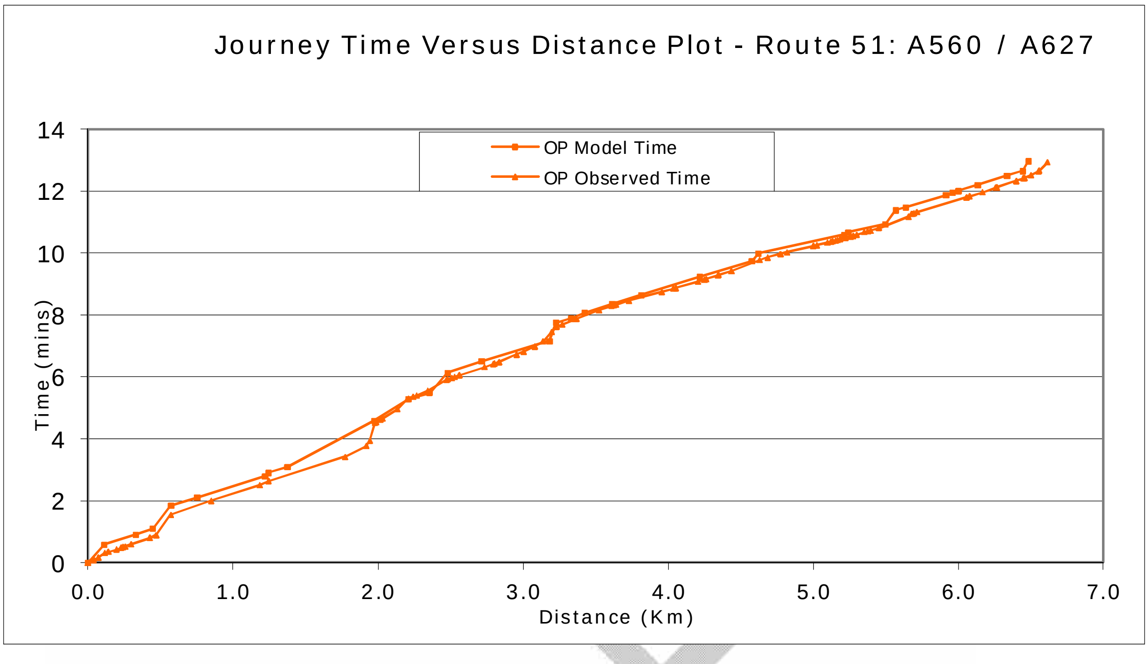

Journey Time Versus Distance Plot - Route 49: A6017
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
10
9
8
7
6
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

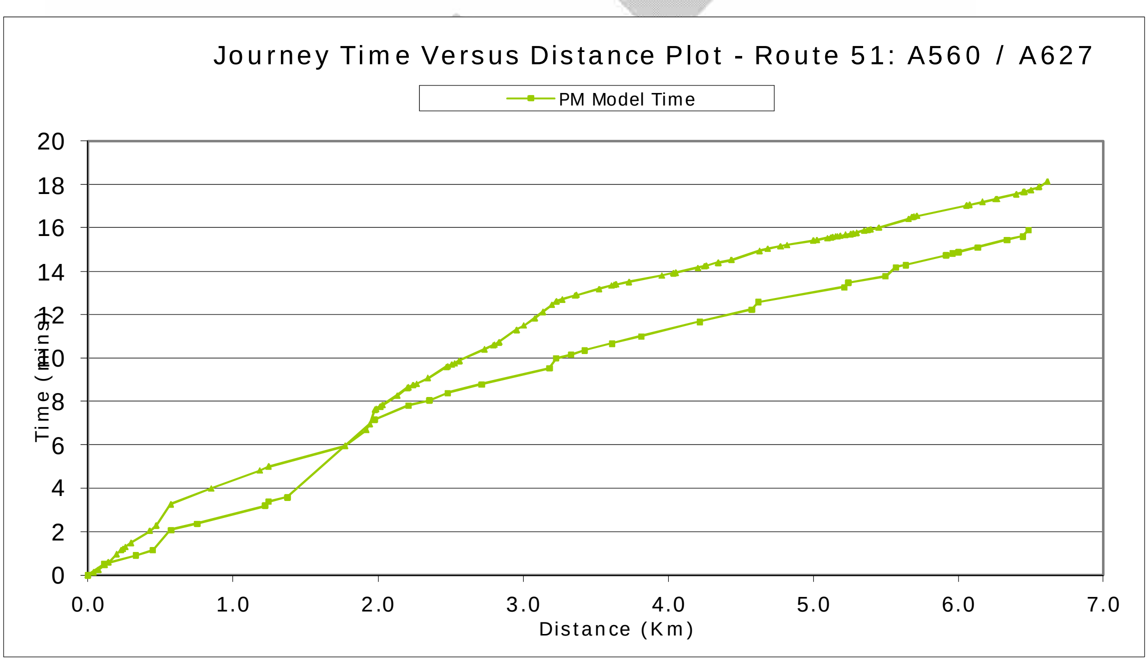

Journey Time Versus Distance Plot - Route 50: A6017
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

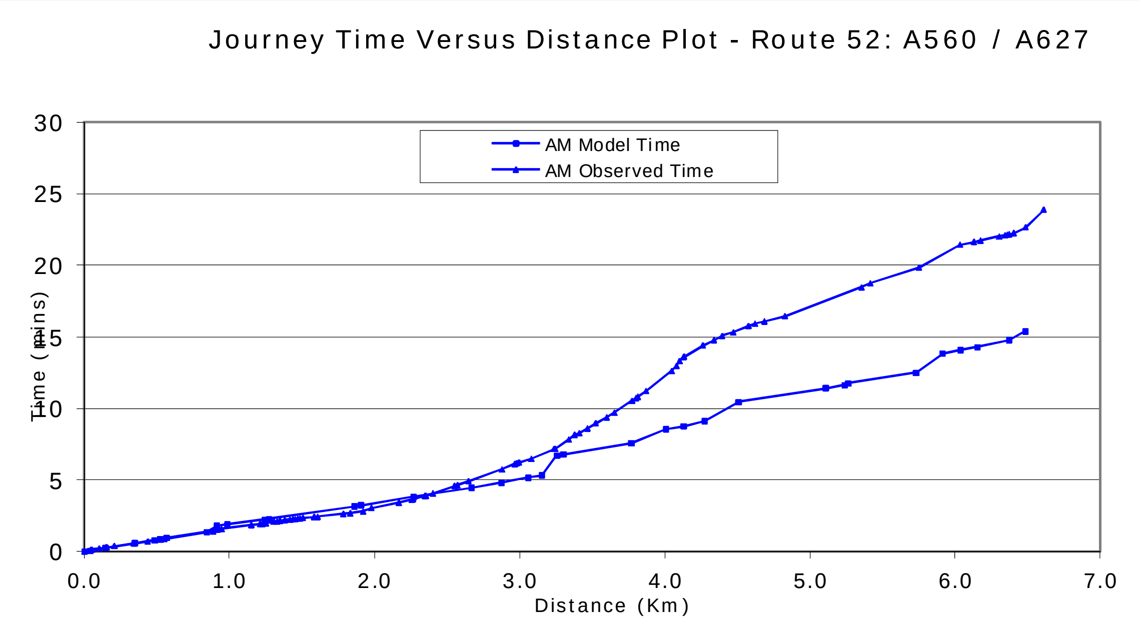

Journey Time Versus Distance Plot - Route 50: A6017
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

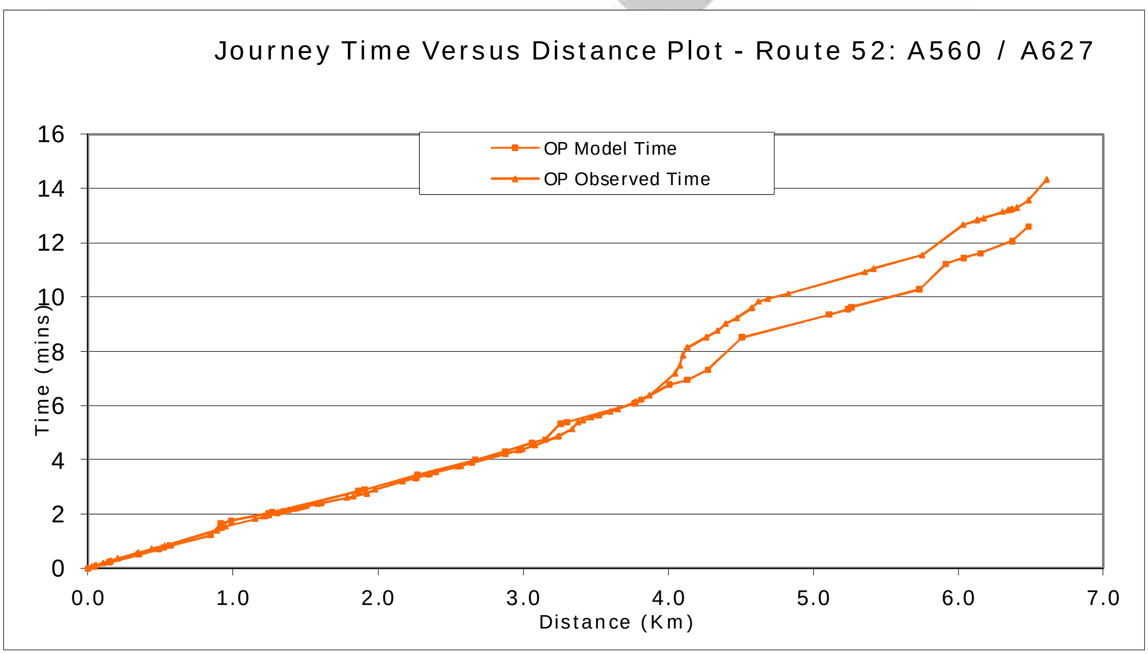

Journey Time Versus Distance Plot - Route 50: A6017
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5

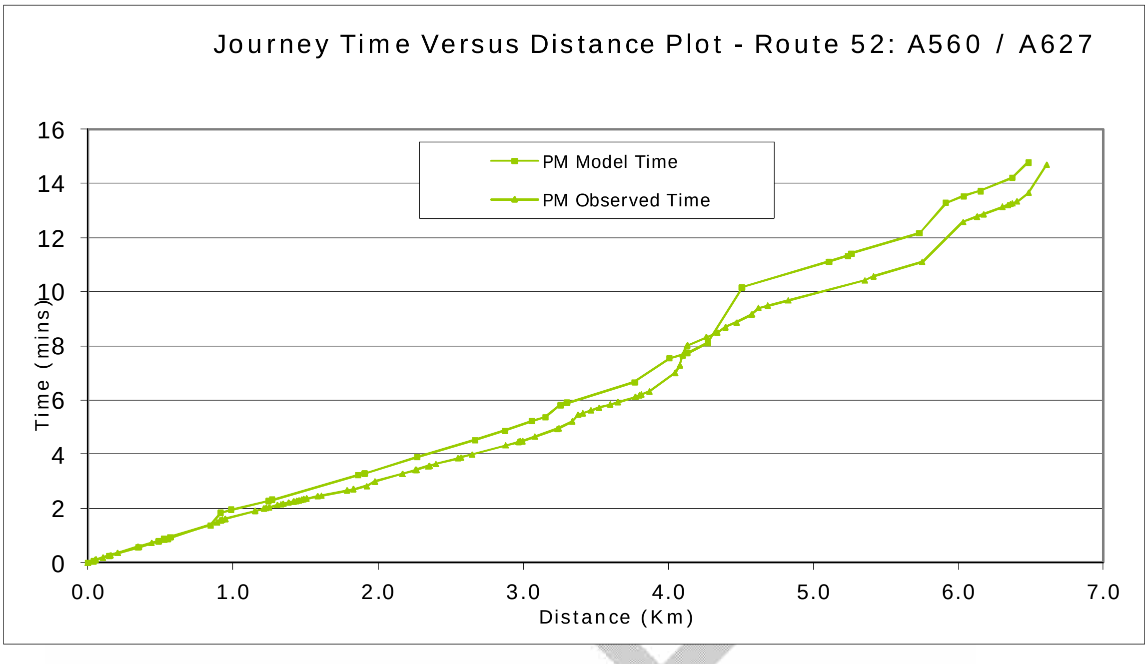

Journey Time Versus Distance Plot - Route 51: A560 / A627
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

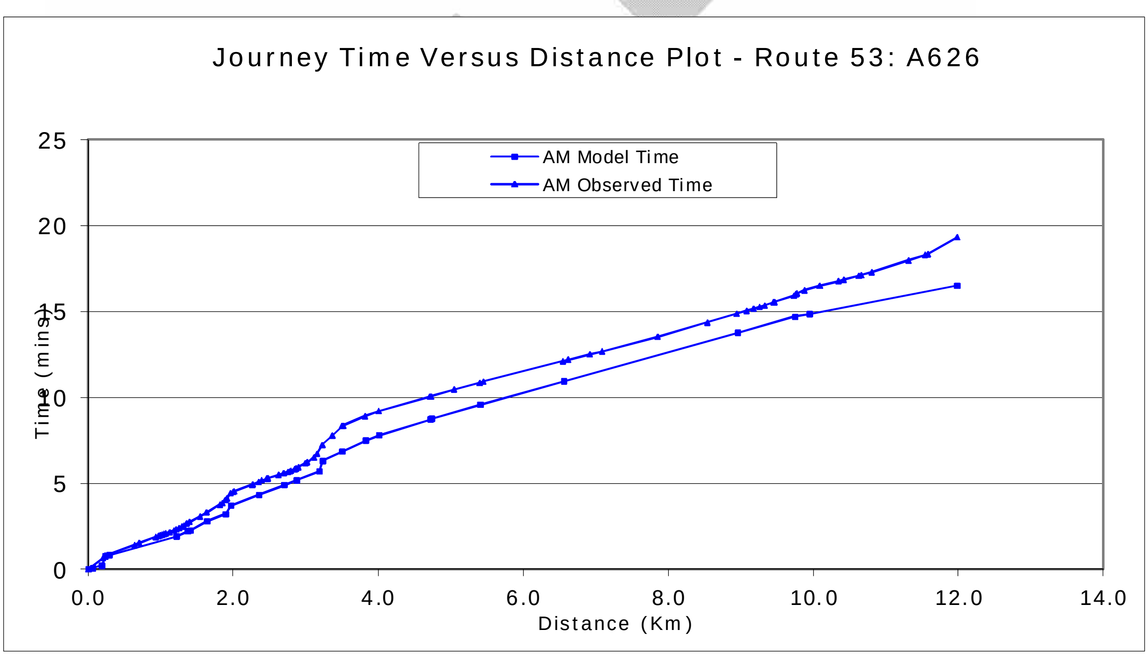

Journey Time Versus Distance Plot - Route 51: A560 / A627
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
14
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

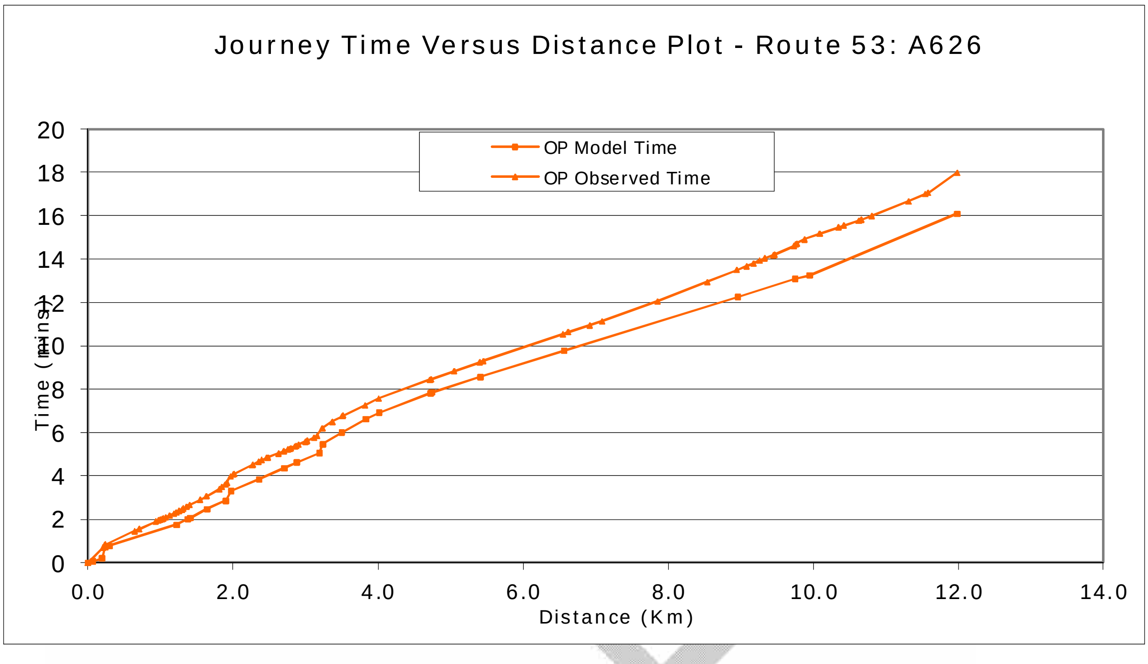

Journey Time Versus Distance Plot - Route 51: A560 / A627
PM Model Time
Time (mins)
Distance (Km)
20
18
16
14
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

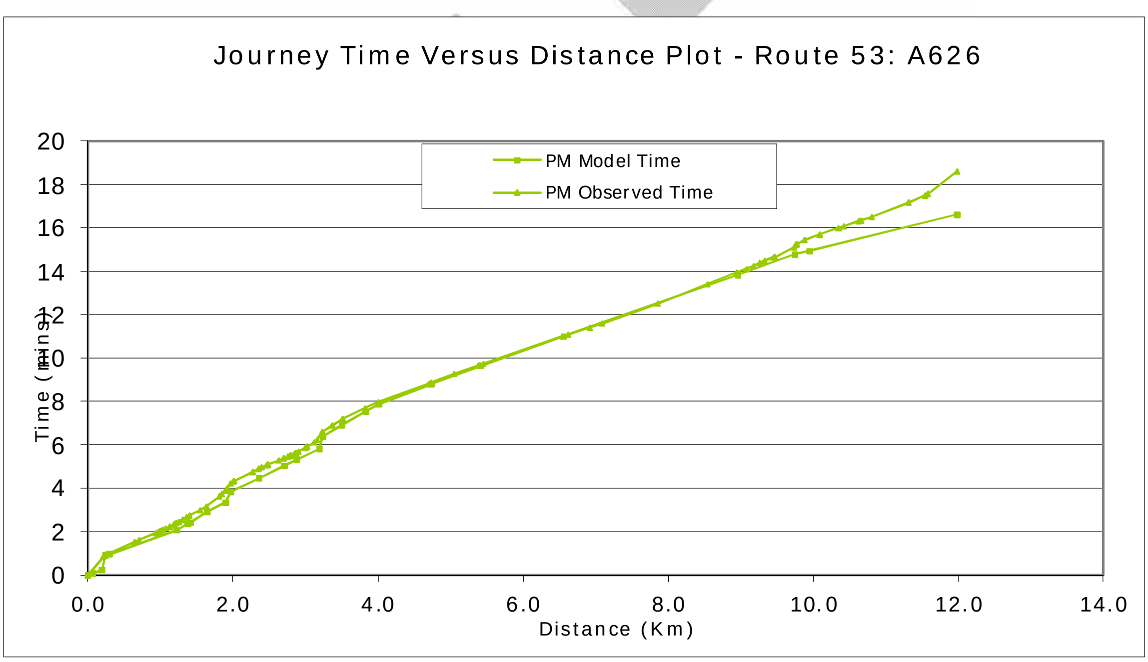

Journey Time Versus Distance Plot - Route 52: A560 / A627
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
30
25
20
15
10
5
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

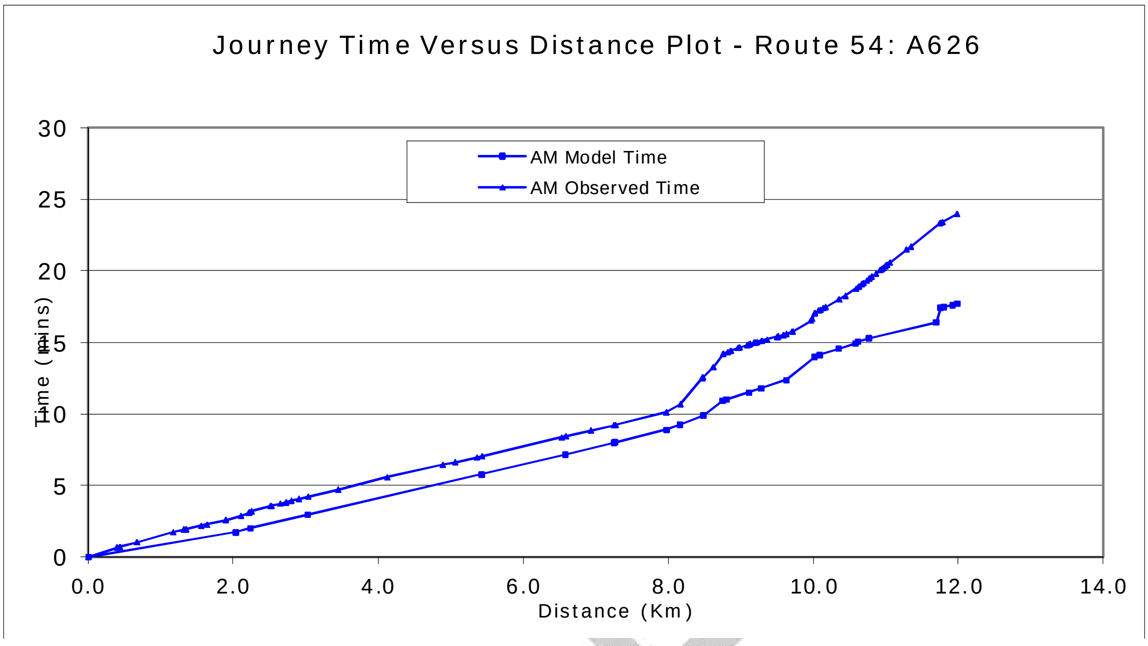

Journey Time Versus Distance Plot - Route 52: A560 / A627
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
16
14
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

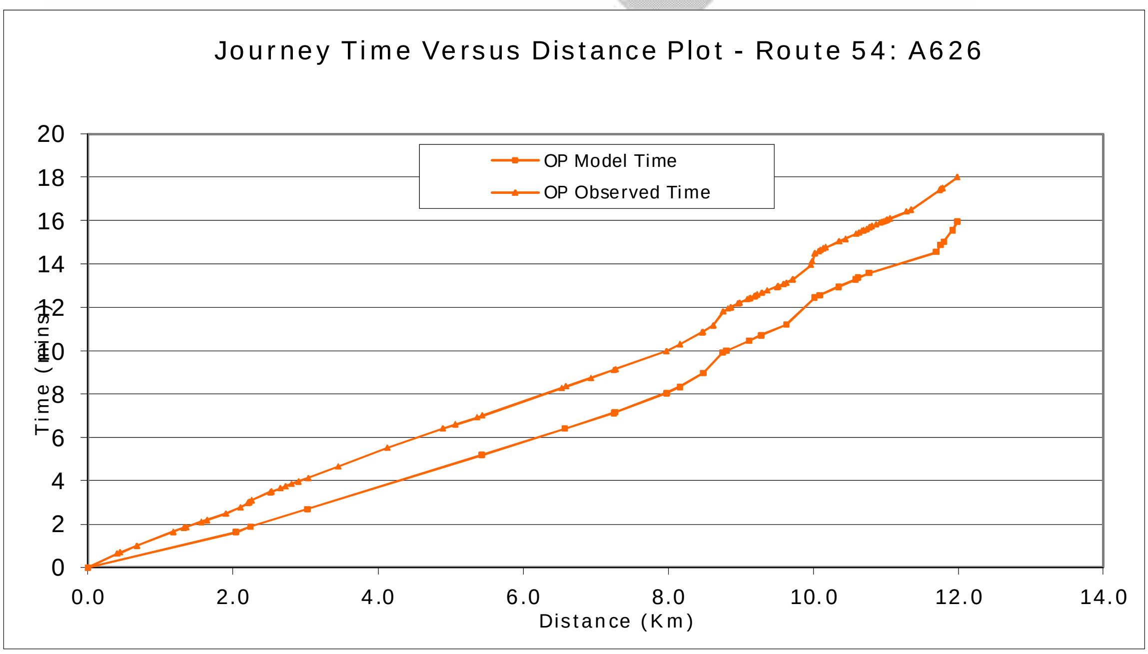

Journey Time Versus Distance Plot - Route 52: A560 / A627
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
16
14
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

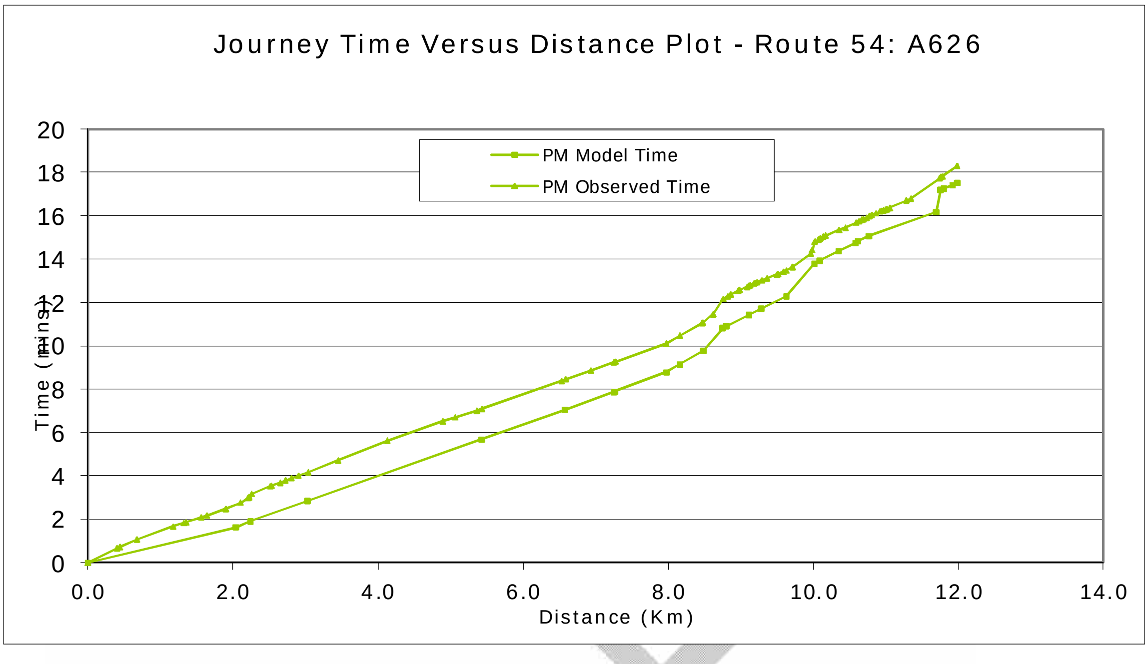

Journey Time Versus Distance Plot - Route 53: A626
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

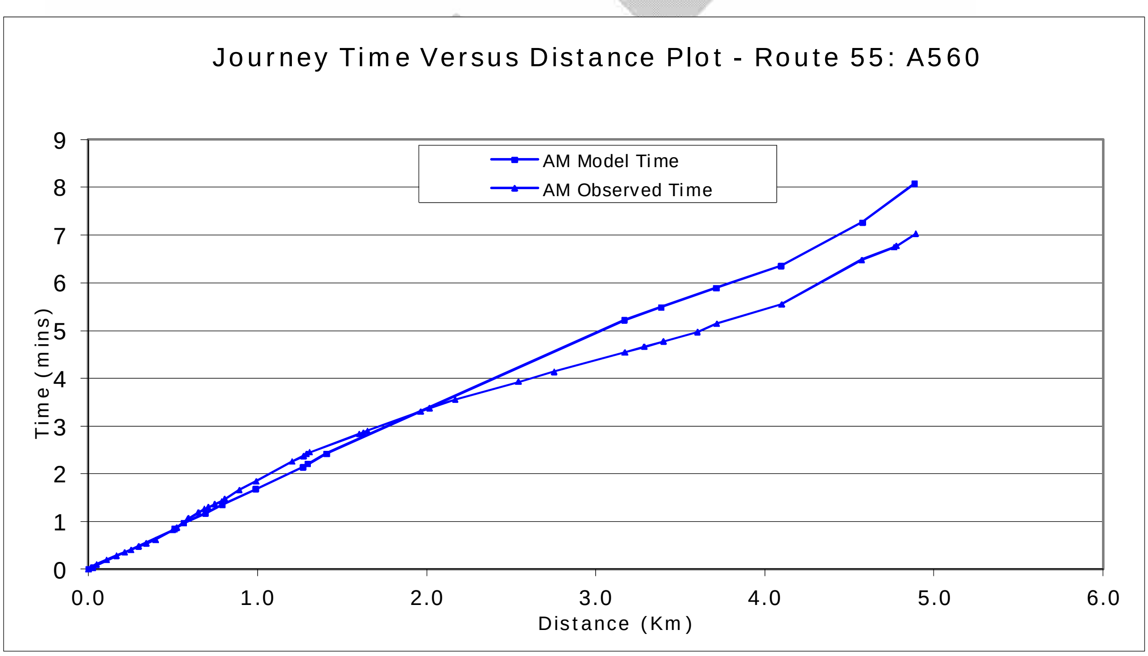

Journey Time Versus Distance Plot - Route 53: A626
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
20
18
16
14
12
10
8
6
4
2
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

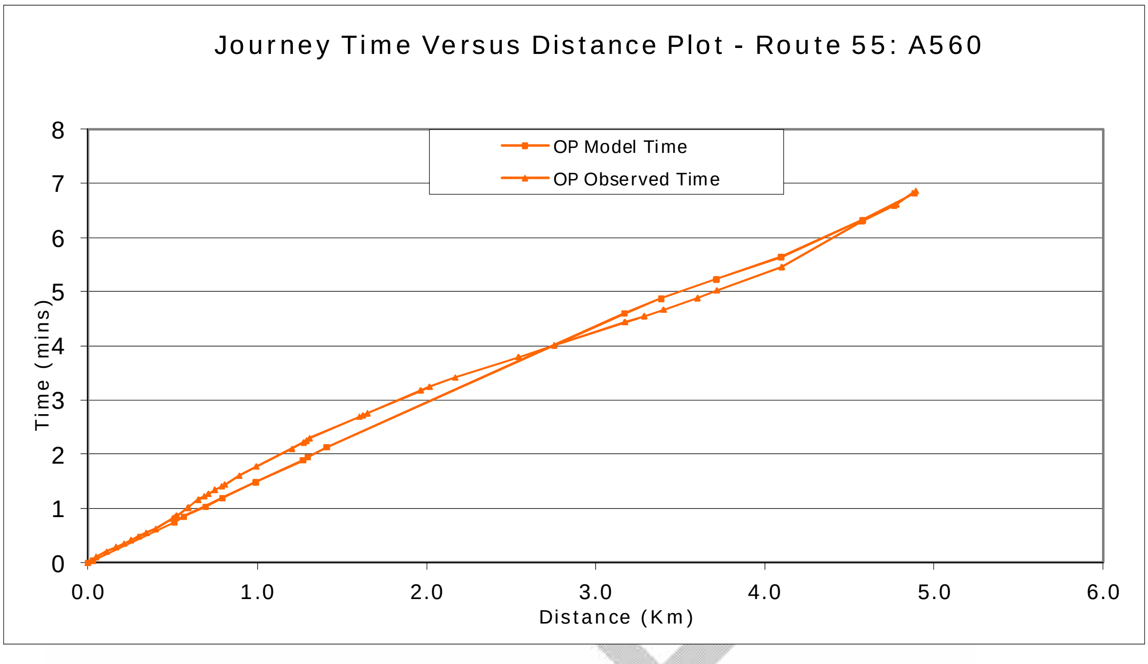

Journey Time Versus Distance Plot - Route 53: A626
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
20
18
16
14
12
10
8
6
4
2
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

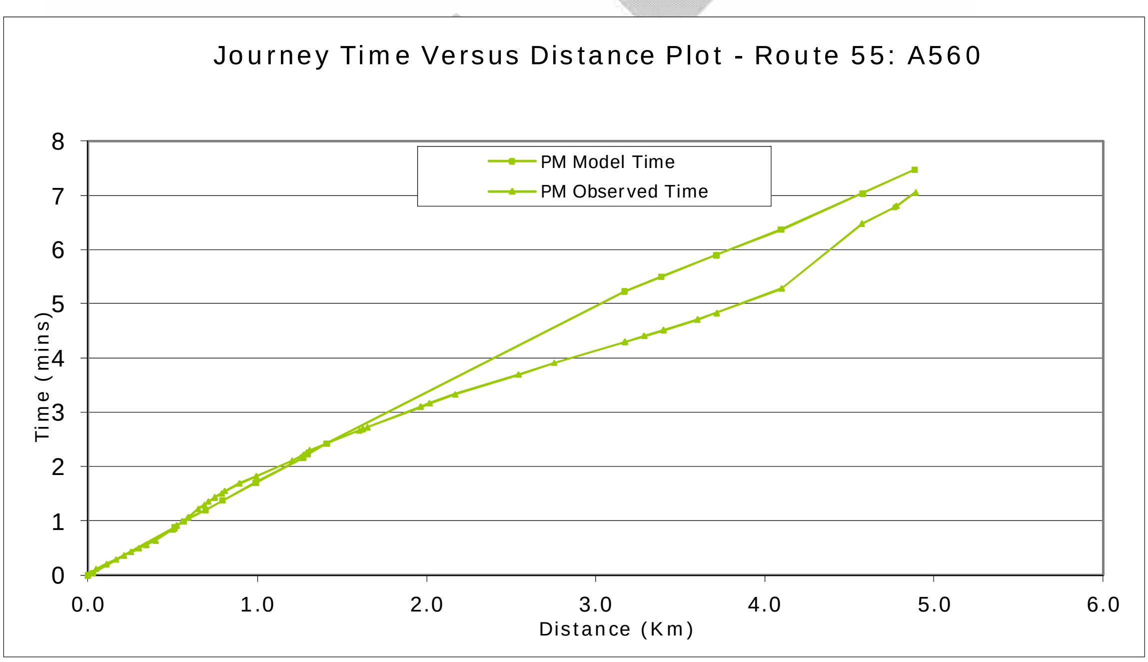

Journey Time Versus Distance Plot - Route 54: A626
AM Model Time
AM Observed Time
Time (mins)
30
25
20
15
10
5
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Distance (Km)

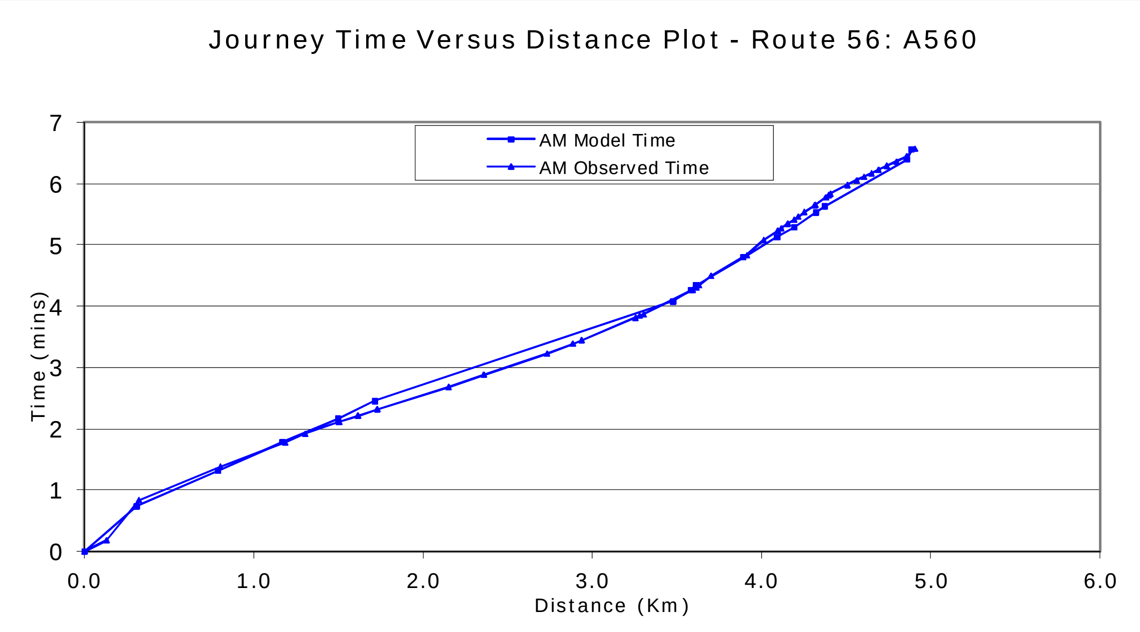

Journey Time Versus Distance Plot - Route 54: A626
OP Model Time
OP Observed Time
Time (mins)
20
18
16
14
12
10
8
6
4
2
0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
Distance (Km)

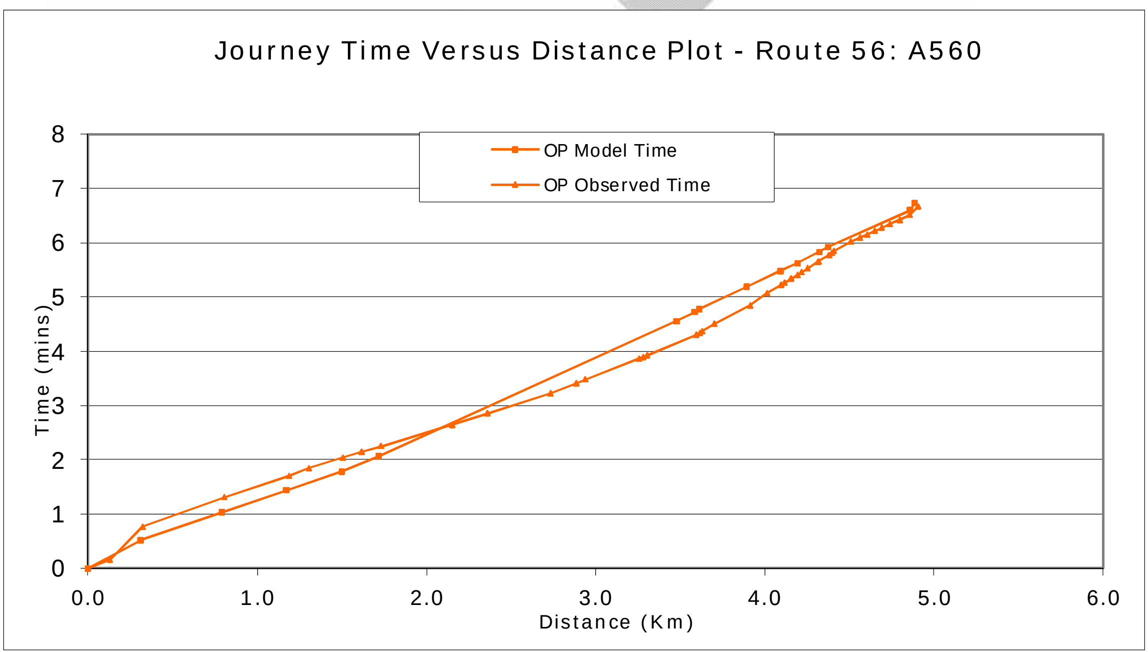

Journey Time Versus Distance Plot - Route 54: A626
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

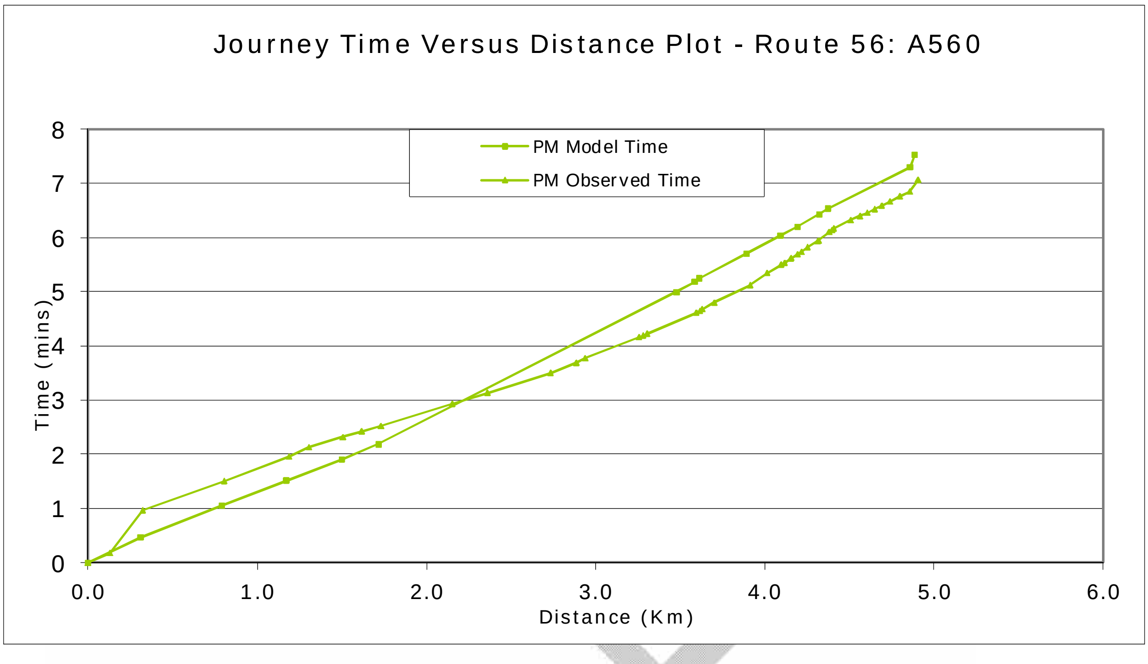

Journey Time Versus Distance Plot - Route 55: A560
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
9
0.0
1.0
2.0
3.0
4.0
5.0
6.0

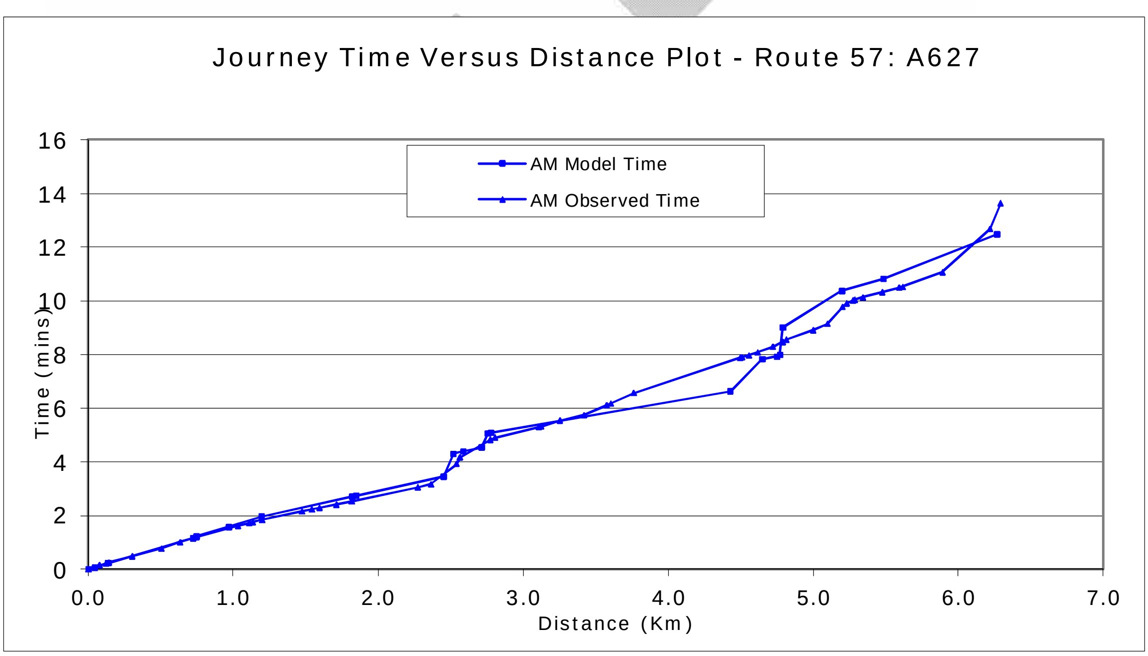

Journey Time Versus Distance Plot - Route 55: A560
OP Model Time
OP Observed Time
Time (mins)
0
1
2
3
4
5
6
7
8
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Distance (Km)

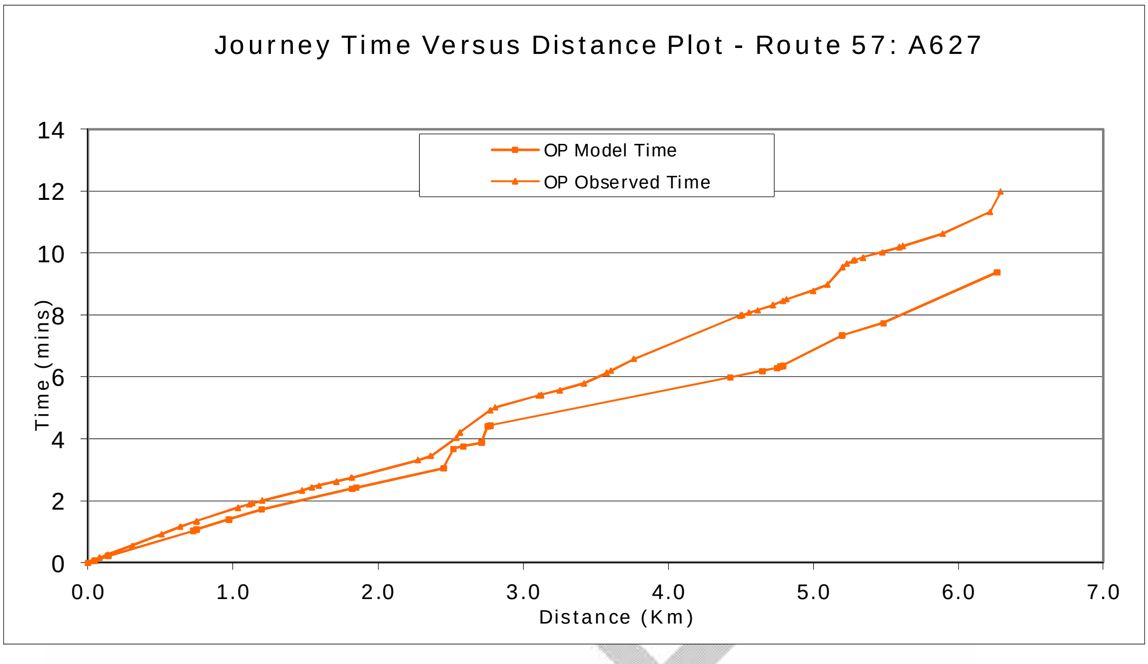

Journey Time Versus Distance Plot - Route 55: A560
PM Model Time
PM Observed Time
Time (mins)
0
1
2
3
4
5
6
7
8
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Distance (Km)

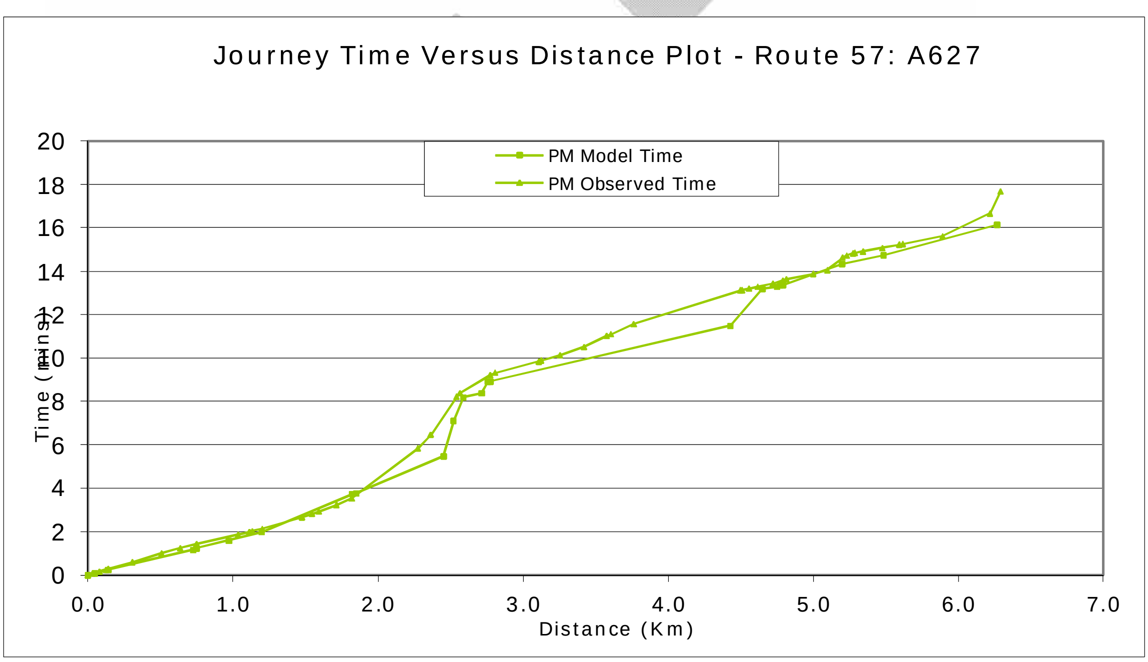

Journey Time Versus Distance Plot - Route 56: A560
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
0.0
1.0
2.0
3.0
4.0
5.0
6.0

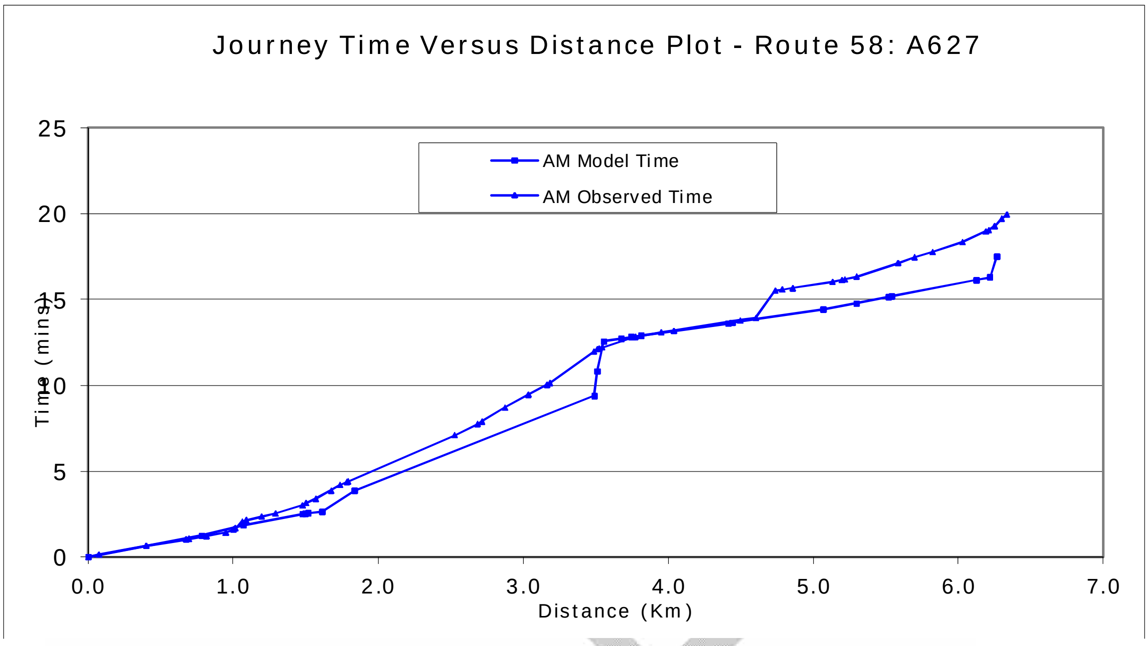

Journey Time Versus Distance Plot - Route 56: A560
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
0.0
1.0
2.0
3.0
4.0
5.0
6.0

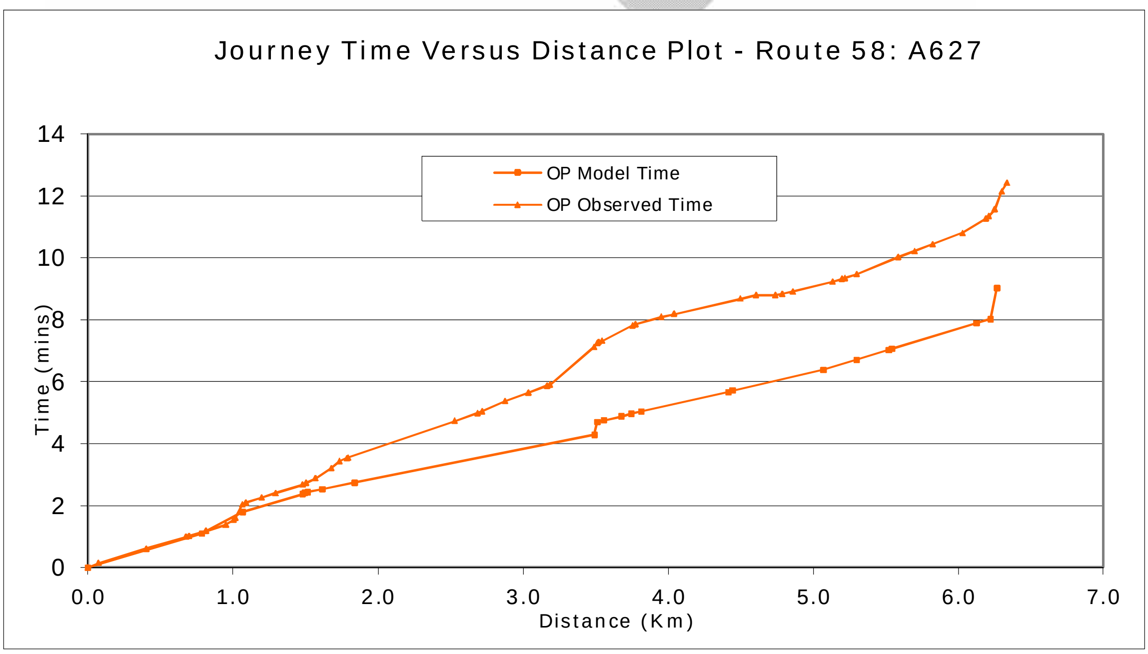

Journey Time Versus Distance Plot - Route 56: A560
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
1
2
3
4
5
6
7
8
0.0
1.0
2.0
3.0
4.0
5.0
6.0

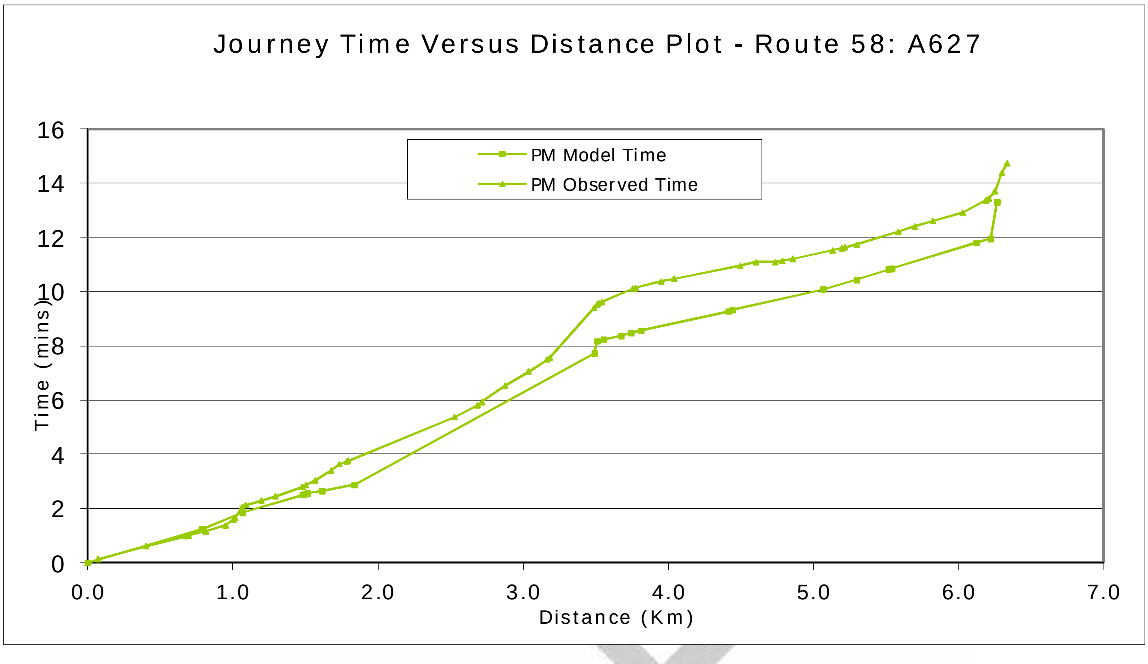

Journey Time Versus Distance Plot - Route 57: A627
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

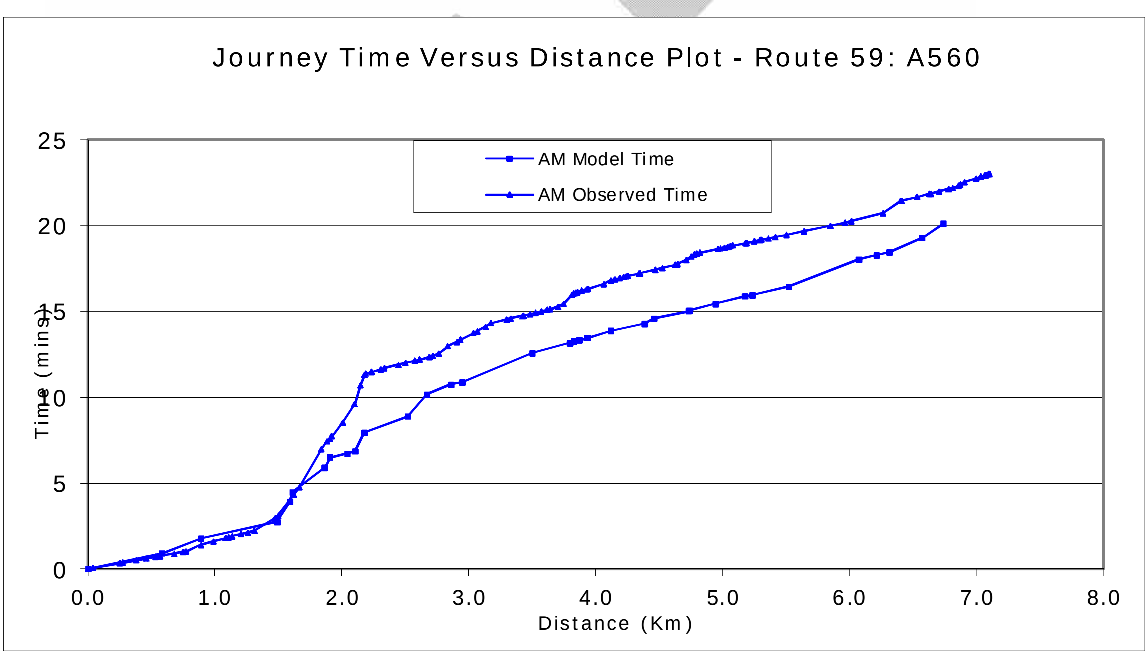

Journey Time Versus Distance Plot - Route 57: A627
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

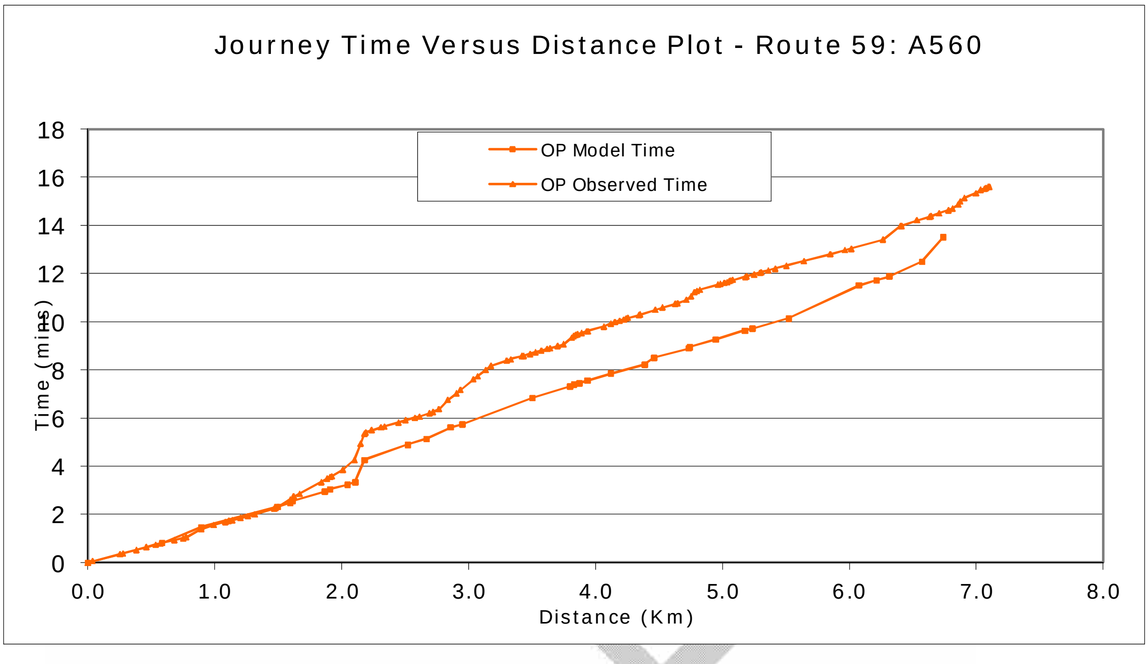

Journey Time Versus Distance Plot - Route 57: A627
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
18
20
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

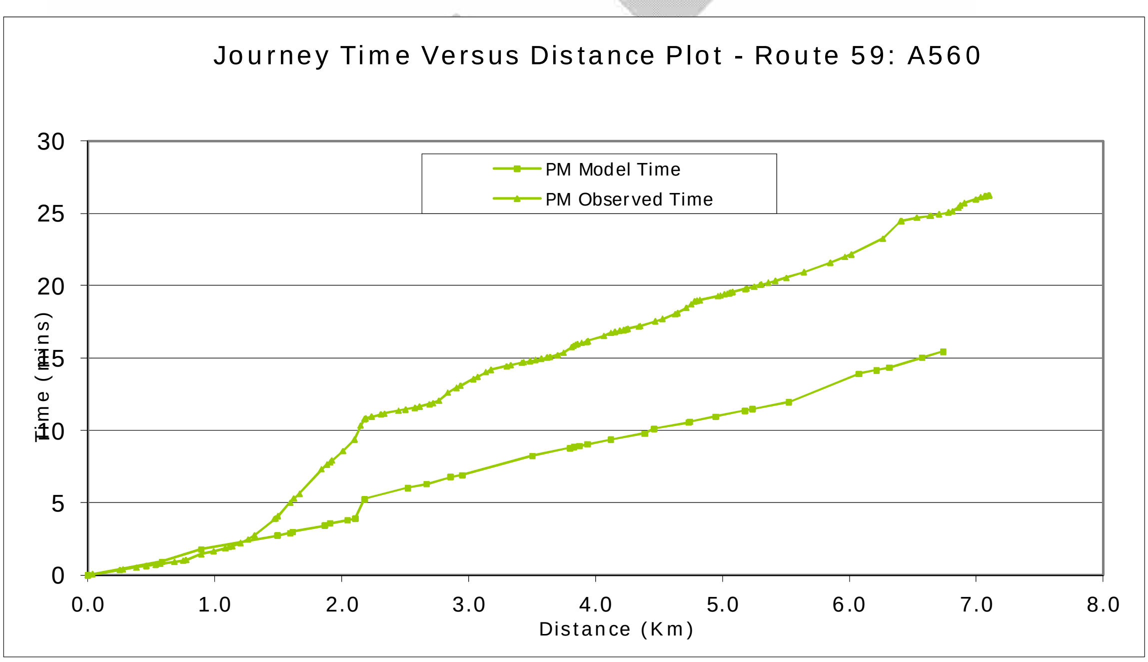

Journey Time Versus Distance Plot - Route 58: A627
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

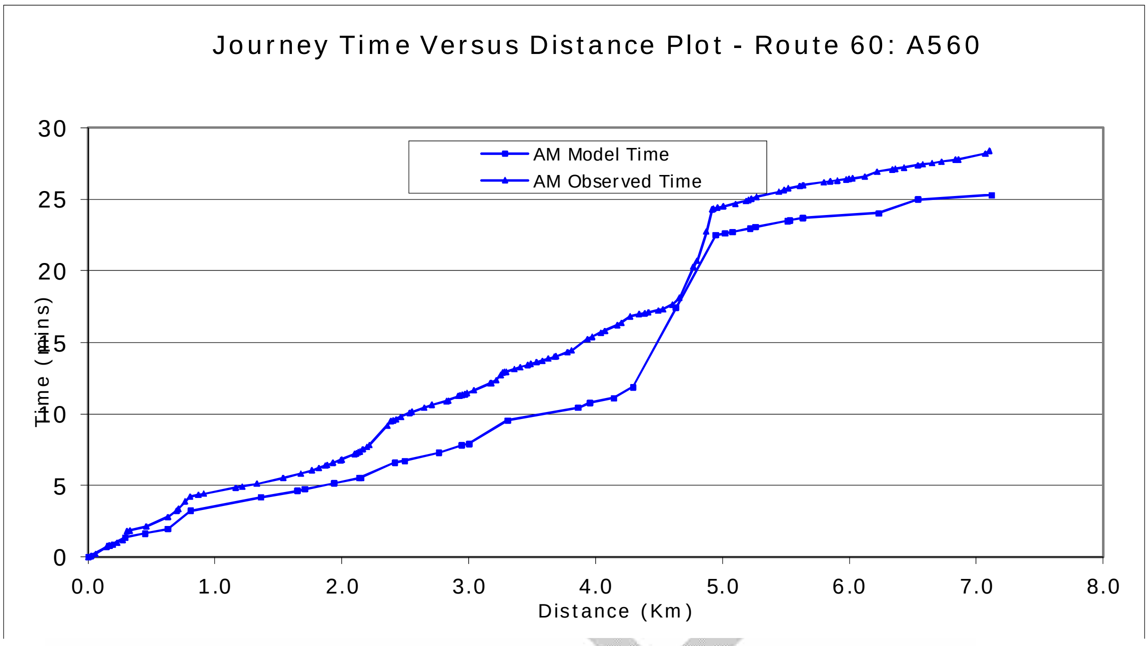

Journey Time Versus Distance Plot - Route 58: A627
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

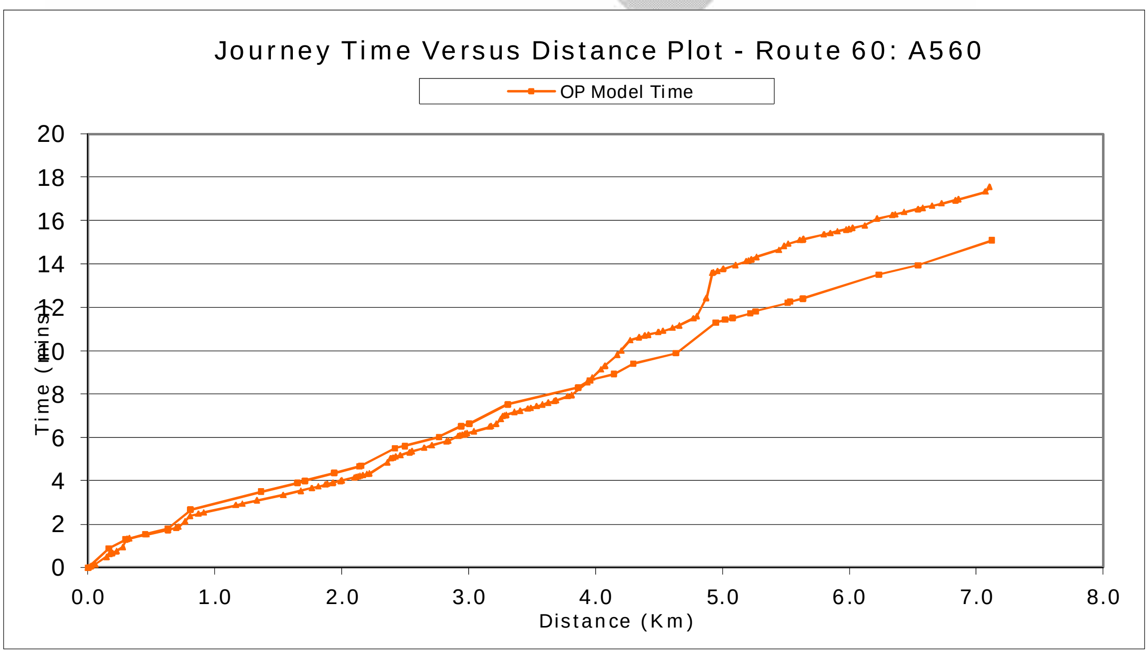

Journey Time Versus Distance Plot - Route 58: A627
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

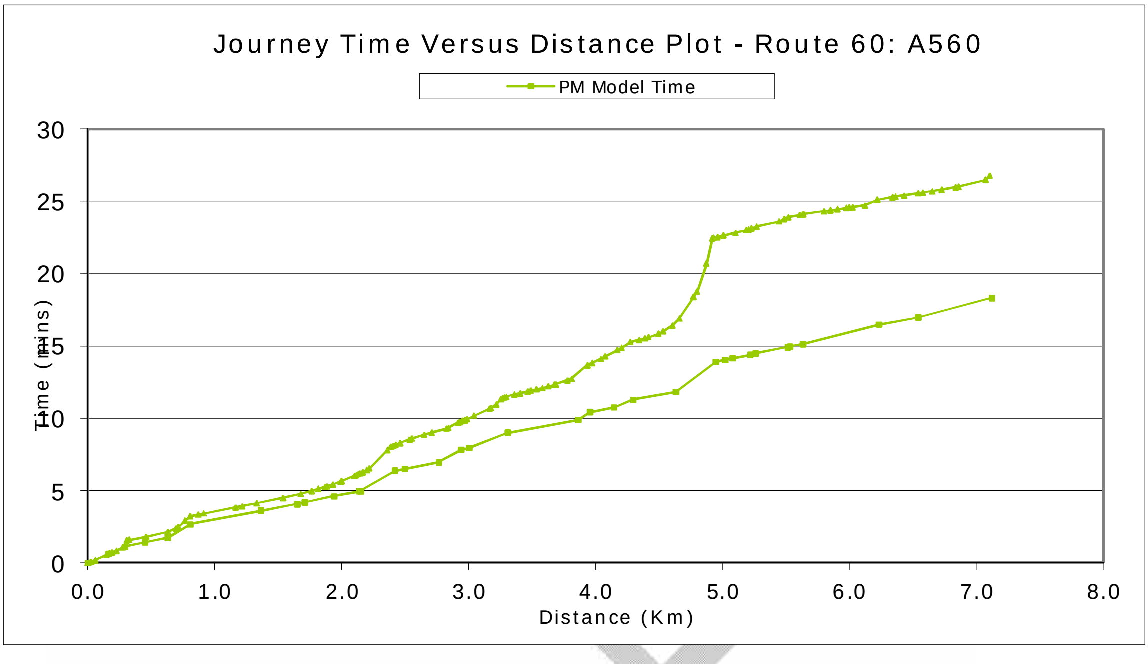

Journey Time Versus Distance Plot - Route 59: A560
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
5
10
15
20
25
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

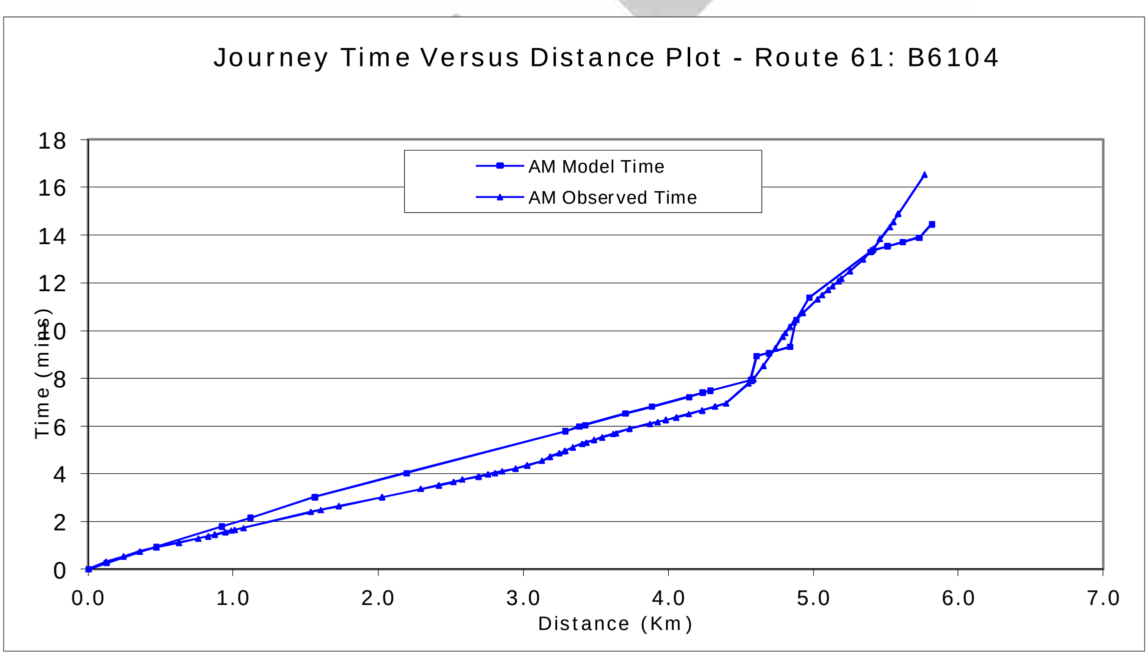

Journey Time Versus Distance Plot - Route 59: A560
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)

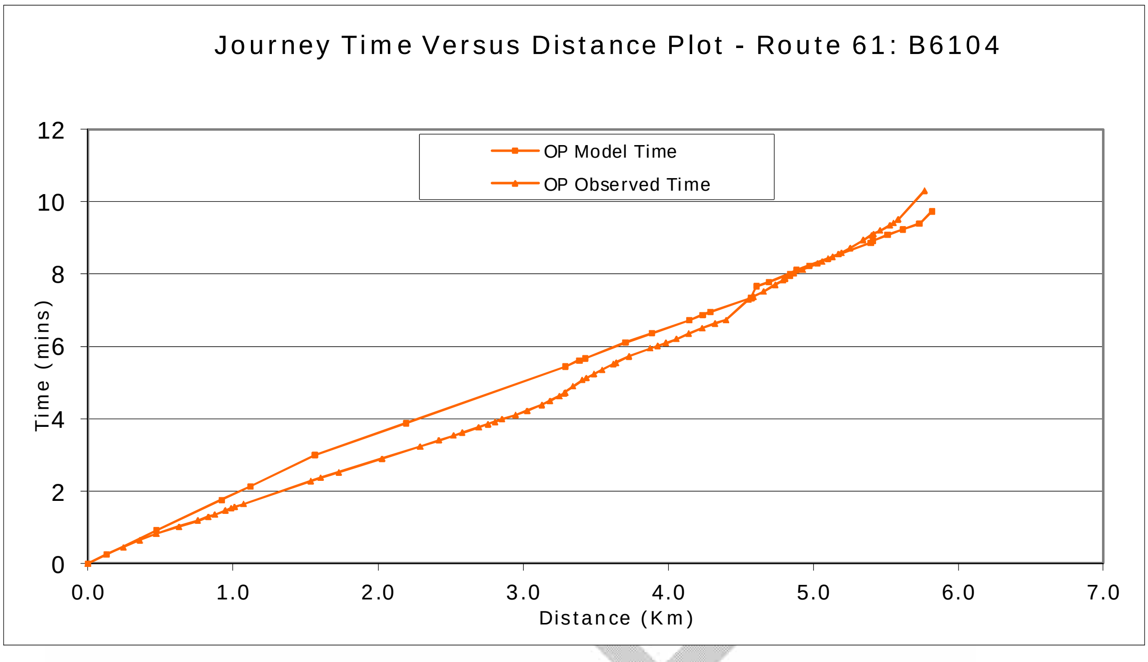

Journey Time Versus Distance Plot - Route 59: A560
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)

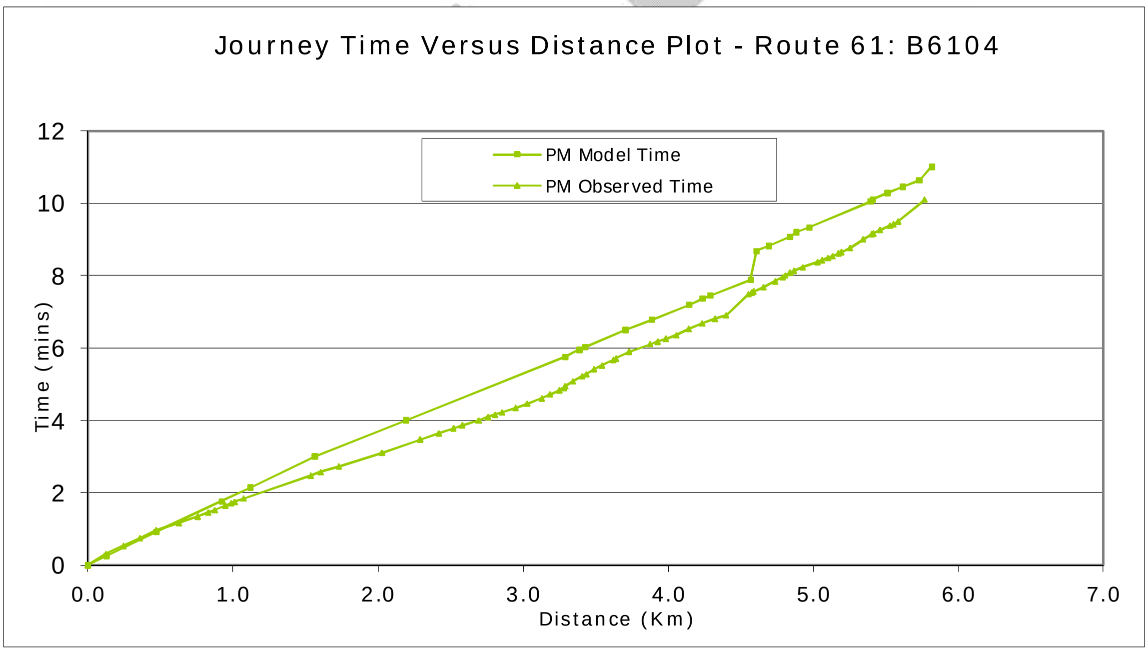

Journey Time Versus Distance Plot - Route 60: A560
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
30
25
20
15
10
5
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

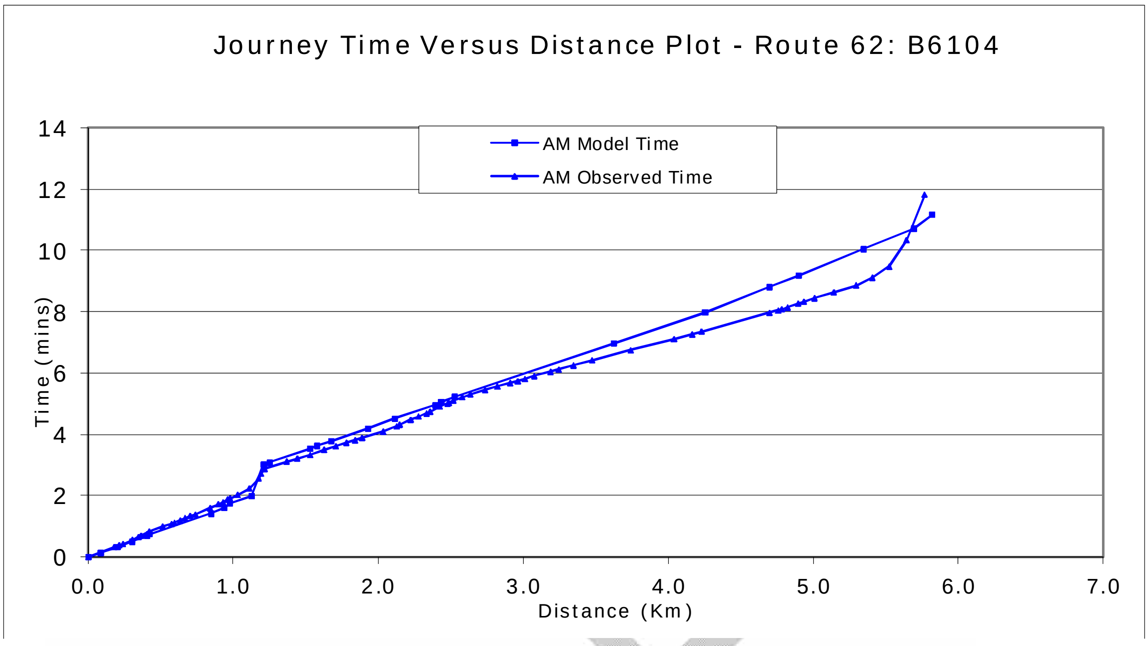

Journey Time Versus Distance Plot - Route 60: A560
OP Model Time
Time (mins)
Distance (Km)
20
18
16
14
12
10
8
6
4
2
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

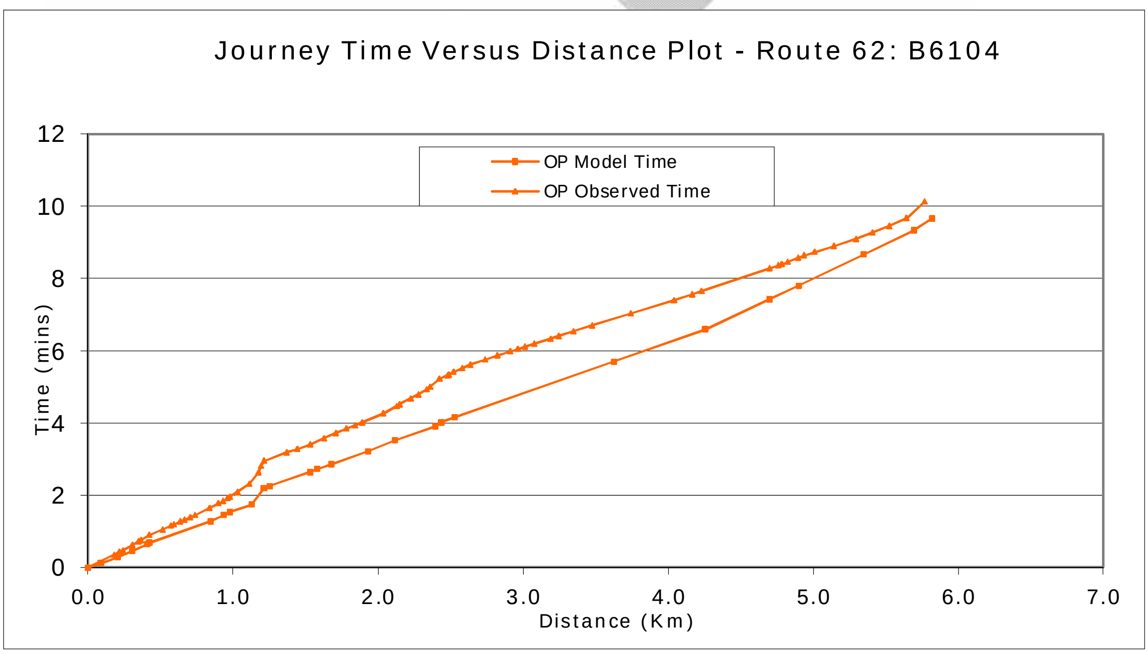

Journey Time Versus Distance Plot - Route 60: A560
PM Model Time
Time (mins)
0
5
10
15
20
25
30
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
Distance (Km)

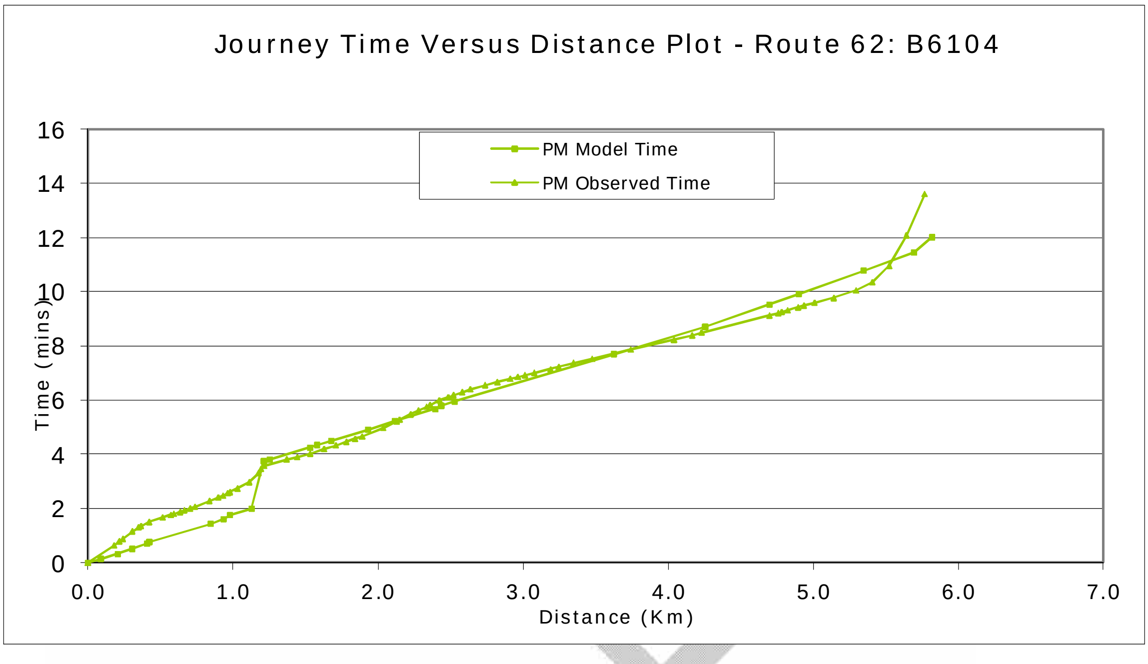

Journey Time Versus Distance Plot - Route 61: B6104
AM Model Time
AM Observed Time
Time (mins)
0
2
4
6
8
10
12
14
16
18
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Distance (Km)


Journey Time Versus Distance Plot - Route 61: B6104
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0


Journey Time Versus Distance Plot - Route 61: B6104
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0


Journey Time Versus Distance Plot - Route 62: B6104
AM Model Time
AM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0


Journey Time Versus Distance Plot - Route 62: B6104
OP Model Time
OP Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0


Journey Time Versus Distance Plot - Route 62: B6104
PM Model Time
PM Observed Time
Time (mins)
Distance (Km)
0
2
4
6
8
10
12
14
16
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0

Appendix 9

TRAFFIC FORECASTING REPORT

Report	HFAS Report 1915
Client	A6 to M60 Relief Road Project Board
Project	A6 to M60 Relief Road
Subject	Forecasting Report

This Report describes the derivation of the scheme traffic forecasts used for the appraisal of the A6 to M60 Relief Road. The forecasts produced are for an assumed opening year of 2024 and for a design year of 2039, assuming three potential growth and highway infrastructure scenarios.

This Report	HFAS_1915_A6M60 _ForecastingReport_V1.0.docx		
Originator	Michael Reese		
Version	Comments	Date	Check / Approve
V1.0	Draft For Comment	010617	MR
V2.0	Incorporate SMBC Comments	101117	MR

Contact	HFAS:	E-mail	Tel:
	Michael Reese	michael.reese@tfgm.com	+44 (0) 161 244 1414

Issued	Organisation	FAO
010717	WSPPB	v1.0 – Draft for comment
101117	SMBC	V2.0 Incorporate SMBC Comments

CONTENTS

1. Introduction

1.1 In 2016, Transport for Greater Manchester Highways Forecasting and Analytical Services (TfGM HFAS) was commissioned by the A6 TO M60 Relief Road Project Board to develop traffic models for the appraisal of the proposed A6 to M60 Relief Road.

1.2 The development of the base demand and traffic assignment models was carried out in partnership with WSPPB Consultancy, with WSPPB Transportation managing the modelling work on behalf of the client.

1.3 This report summarises the work undertaken to produce the traffic forecasts for scheme appraisal. It has seven main sections:

- Introduction;
- Description of the A6 to M60 Relief Road Scheme;
- Development of the forecast year highway networks;
- Demand forecasting;
- Forecast year scenarios;
- Traffic impacts.

2. The A6 to M60 Relief Road

Scheme Description of the proposed preferred scheme

Overview

2.1 The A6 M60 Relief Road scheme includes a new 2-lane dual carriageway connecting the A6 to the M60 at Bredbury with a spur to Stepping Hill Hospital The scheme bypasses Stockport Town Centre, Hazel Grove, Offerton and Bredbury.

2.2 The scheme improves access to / from Manchester Airport and its employment areas as well as Hazel Grove, Newby Road, Bramhall Moor Lane, Poynton and Stanley Green employment areas. Access to a number of regeneration areas is also improved by the scheme, including Stockport Town Centre M60 Gateway, and Wythenshawe.

2.3 The proposed scheme consists of approximately 7.5km of new dual 2-lane and will include two new junctions and amendments to junctions at the A6 and at the M6A560 roundabout at Bredbury as well as a new junction with the A6 at Stepping Hill.

2.4 The location and extent of the scheme is shown in Figure 2.1.

2.5 The scheme has been designed to Department for Transport standards and adheres to the Design Manual for Roads and Bridges (DMRB). Any departures from approved standards will be authorised by the Director of the Overseeing Organisation.

Mitigation Measures

2.6 It is recognised that building the A6 to M60 Relief Road will have an impact on the adjacent existing road network and that on some routes or locations mitigation measures will be required. The mitigation measures assumed in this tranche of modelling include Improvements to the junction of the A6 with Windlehurst Lane to provide additional capacity for traffic to/from Windlehurst Lane.

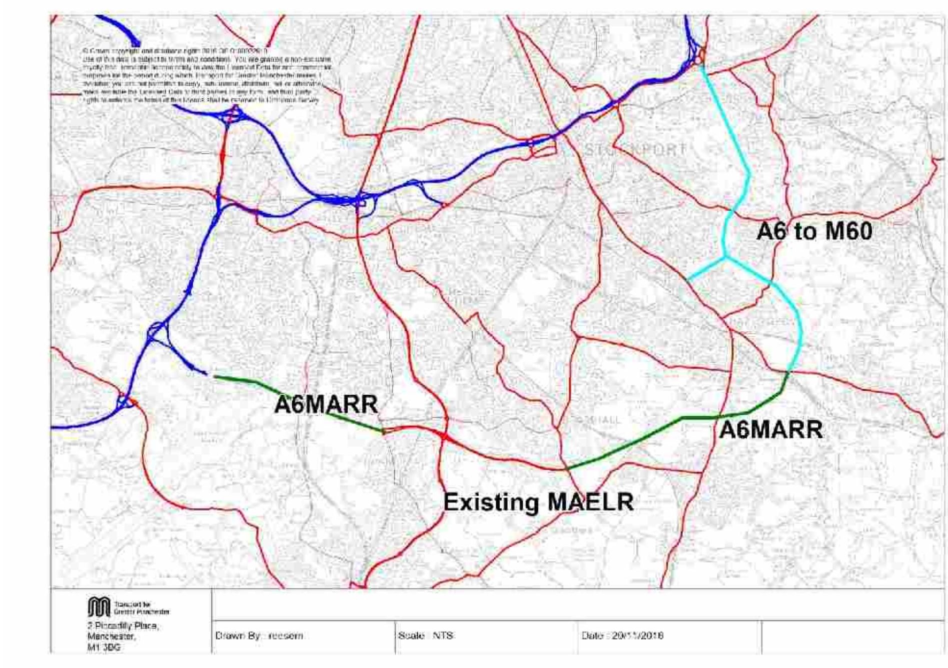


Figure 2.1 Proposed Alignment of scheme

3. Development of Forecast Year Highway Networks

3.1 The Do-Minimum networks for 2024 and 2039 were derived from the 2015 base year network. The starting network therefore contained a representation of the network structure in the base year together with traffic signal data provided by the GM traffic signals unit, Greater Manchester Urban Traffic Control (GMUTC). Further information on the content and construction of the base year networks can be found in the A6 to M60 Relief Road LMVR.

3.2 WSPPB made contact with the relevant local authorities, the Highways Agency and Manchester Airport in order to ascertain which highway schemes should be included in the Do-Minimum networks at 2024 and 2039. A package of schemes deemed to be "committed" was added to the base year network to create the new network for 2024 and 2039. To be included in this package, a scheme had to meet one or more of the following criteria:

- Scheme completed since 2015;
- Scheme construction in progress;
- Scheme funding allocated;
- Scheme is part of the Highways Agency programme; and
- Scheme likely to be completed by the forecast year(s).

3.3 HFAS subsequently coded these schemes into the validated base year SATURN assignment networks and provided them to MVA for inclusion in the Variable Demand Model (VDM).

3.4 Table 3.1 lists highway schemes identified that are either within the Core Area of Influence or outside the Area of Influence but could affect or be affected by the A6 to M60 Relief Road Scheme in each of the forecast years and development scenario.

3.5 Besides adding these schemes, the traffic signal timings in the networks were "optimised" after convergence of the initial traffic assignment, and then subjected to a further traffic assignment convergence; automatic SATURN procedures were used to adjust the green times and offset times to minimise delays. This was done to reflect the adjustment of signals that inevitably occurs as traffic flows change over time, as well as the continuing rollout of demand-responsive control mechanisms such as SCOOT and MOVA.

3.6 Bus service and frequency data were left unaltered from 2009 because there was no information available on future changes. While a number of Quality Bus Corridor (QBC) routes are being implemented or planned in GM, in many cases the QBC measures are still in development and are insufficiently well specified to incorporate them in the model.

Table 3.1: A6 to M60 Relief Road Do-Minimum Highway Scheme Assumptions			
Highway Scheme	Status	Core	
		2024	2039
M6 Junctions 21A-26	Committed	Y	Y
M56 Junctions 6-8	Committed – Advanced in Budget 2016	Y	Y
M60 Junction 8 to M62 Junction 20 Smart Motorway	Under Construction; completion Summer 2017	Y	Y
M60 Junctions 24-27 & J1-4	Committed	Y	Y
M60 Junction 18	Development in RIS 1 for build in RIS2 – Advanced in Budget 2016	Y	Y
M62 Junctions 10-12	Committed – Advanced in budget 2016	Y	Y
M62 Junctions 20-25	Committed – Advanced in Budget 2016	Y	Y
Mottram Moor Link Road	Committed	Y	Y
Poynton Relief Road	Likely to be completed by opening	Y	Y
A57(T) to A57 Link Road	Committed	Y	Y
A556 Knutsford to Bowdon (Cheshire East)	Under construction; completion by end-March 2017	Y	Y
A6-Manchester Airport Relief Road	Under construction;	Y	Y
A49 Link Road	Likely to be completed by opening	Y	Y
M58 Link Road	Likely to be completed by opening	Y	Y
South Heywood Link Road	Likely to be completed by opening	Y	Y

Manchester Airport Future Growth Assumptions

3.7 The following section airport assumptions to feed into the highway modelling for outline assessment of the A6 to M60 road scheme. This builds on the Manchester Airport assumptions used in the development of the A6MARR model that has been used in a number of recent transport assessments, including A6 MARR, Airport City and the Manchester Airport Transformation Programme (MTP). This material has been drawn from the Manchester Airport Sustainable Development Plan (Land Use Plan and Economy and Surface Access Plan)1 and includes:

- Future Passenger Numbers
- Future Employee Numbers
- Future Developments
- Future Surface Access Proposals

Passenger Growth

3.8 Manchester is the third busiest airport in the UK and is the major international gateway for the north of England. In 2015 the Airport handled 23,136,000 passengers and 104,000 tonnes of cargo. The population within the 1 hour drive-tie catchment is some 8.9 million people and this increases to 22 million within the 2hour drive-time catchment. The forecasts for future growth at Manchester Airport are consistent with those prepared by the Department for Transport (DfT)2 and those used by the UK Airports Commission3. This suggests that by 2040, Manchester Airport could be handling some 45 million passengers a year. This is the forecast assumption used in the Manchester Airport Land Use Plan.

3.9 For the modelling of airport activity, the Airport's passenger and aircraft throughput is better expressed in hourly rather than annual terms. Aircraft and passenger traffic at the Airport shows significant peaks across the day with the runway demand peak between 06:00 and 08:00. This reflects aircraft that are based at the Airport and park overnight and the high proportion of passengers that are UK originating. Whilst some spreading of the peak is expected as traffic grows, the Airport's general daily traffic profile will remain similar to that of today. The 2014 and 2018 design day passenger profiles are included in the Land Use Plan, part of the Sustainable Development Plan.

[1] www.manchesterairport.co.uk/developmentplan

[2] UK Aviation Forecasts – Department for Transport - 2013

[3] Airports Commission – Final Report – July 2015

Manchester Airport Terminating Passengers in 2015

Region	*Passengers (millions)*	*%*
North West	13.62	60%
North East	0.5	2%
Yorkshire and the Humber	4.3	19%
The Midlands	2.15	9%
Wales	0.98	4%
Other Regions	0.47	2%
Total	*22*	*97%*
Connecting Passengers	0.68	3%
Grand Total	*23*	*100%*

CAA Passenger Survey

Staff Growth

3.10 The on-site working population at the Airport in 2015 is estimated to be 20,600. The majority of Airport staff live in Greater Manchester and in areas close to the Airport. Because of the large number and the wide variety of businesses operating on the site, detailed staff travel profiles are difficult to obtain, however the majority of the on-site workforce work shift patterns that are significantly different to a usual 9-5 operation.

3.11 The data on staff place of residence shows that around 87% of the Airport's employees live in the North West region, with around 73% of these living in Greater Manchester and 17% in Cheshire. The distribution of Manchester Airport's employees within the Greater Manchester region is shown in the table below.

Distribution of Airport Employees living within Greater Manchester

District	*Percentage*
Bolton	4.3%
Bury	2.7%
Manchester	37.3%
Oldham	3.9%
Rochdale	2.4%
Salford	5.3%
Stockport	19.5%
Tameside	7.1%
Trafford	11.7%
Wigan	5.9%
Total	100%

Source: Manchester Airport

3.12 The number of on-site employees will grow as the Airport's passenger and cargo activity grows. On-site employment is expected to be some 41,838 by 2040[4] when the Airport is handling some 45 million passengers a year. A high proportion of staff work shifts, with early shifts in the passenger operation requiring access to the Airport from 04:00.

Developments

3.13 The Airport's Operational Area is defined in the Land Use Plan[5], and for the land in Manchester, and the land use is set out in the Manchester City Council Core Strategy[6]. The Core Strategy defines the Airport Strategic Site and the Operational Area includes the core airport operational facilities and infrastructure along with other developments that are required for the amenity of the Airport.

3.14 In March 2016, the Airport secured planning consent for the Manchester Airport Transformation Programme. This is centred on a significant expansion to Terminal 2 and the demolition of Terminal 1. Expanding Terminal 2 and demolishing Terminal provides the most efficient airfield operation and provides more flexible terminal capacity. Access to Terminal 2 will be from the existing M56 Spur and the existing T2 Elevated Roundabout.

[4] Economy & Surface Access Plan – Manchester Airport 2015
[5] Land Use Plan – Manchester Airport 2015
[6] Manchester Core Strategy – Manchester City Council July 2012

3.15 The Airport plays an important role within the Greater Manchester economy and it sits at the heart of the Greater Manchester Enterprise Zone. This includes two sites known as Airport City.

3.16 Immediately to the north of the Airport's Operational Area, is Airport City Manchester. This is a commercial mixed use development that will include a range of uses such as offices, hotels, advanced manufacturing and support activity. To the west of the Airport is the World Logistics Hub that is being developed for freight and logistics uses.

Airport City Manchester:

- 26.3 hectares
- 113,433 sq m B1
- 49,046 sq m B1c (Advanced Manufacturing)
- 1,293 hotel beds
- 5,761 sq m of support retail and ancillary
- 4,182 car parking spaces
- Direct links to The Station (public transport)

World Logistics Hub:

- 36.9 hectares
- 140,000 sq m of B1 logistics
- Car parking to MCC parking standards

3.17 The assumptions on the scale and the activity of the Airport City development sites were included within the A6MARR highway model.

Surface Access

3.18 The approach to public transport `and future passenger and staff mode-share is set out in the Economy and Surface Access Plan. It also identifies a range of future transport measures at the Airport and in the local area. These include:

- A6 MARR to open in 2017
- A556 Knutsford to Bowdon in 2017
- M56 – Jct 6 – 8 Smart Motorway – planned 2020
- Manchester Airport Western Access improvements – improving the link between Terminal 2 and M56 Jct 6. To be complete by the time the Airport is handling some 30 million passengers a year.
- Completion of the Northern Rail Hub
- HS2 and a Manchester Airport Parkway station by 2033
- Metrolink extension to T2
- Metrolink Western Extension
- Improvements to local bus and national coach services

3.19 The Surface Access Plan includes targets for public transport use. Achieving these targets depends on the future public transport schemes. The Airport passenger mode-share targets are:

Mode	Current	30 mppa	45 mppa
Kiss & Fly / Taxi	52%	40%	30%
Park on Site	21%	18%	15%
Rail	14%	18%	25%
Park & Ride	8%	14%	17%
Coach & Bus	3%	4%	5%
Car Hire	2%	3%	3%
Metrolink	0%	3%	5%

Currently around 80% of Airport employees use a car, either as a driver or passenger. The future staff mode-share is:

Mode	Current	45 mppa
Bus	12%	10%
Rail	4%	10%
Car	79%	57%
Cycle / Walk / Other	5%	8%
Metrolink	See footnote*	15%

Initial estimates are some 5% of employees that have switched from other modes to Metrolink

4. Demand Forecasting

4.1 Demand forecasts were derived using TEMPRO v7 and the development uncertainty logs provided by local authorities and other relevant organisations.

4.2 Assumptions on population and employment growth used to derive the Core forecasts came from a variety of sources, namely :

- The relevant planning departments in High Peak, Cheshire East, Manchester, Stockport, Trafford for specific developments included in their Local Development Frameworks;
- Manchester Airport Group (MAG) for passenger and employee growth and development at and around Manchester Airport;
- Local Development Framework datasets for developments elsewhere in Greater Manchester;
- The National Trip End Model (NTEM) dataset 6.2 forecasts; and
- The National Transport Model forecasts (for freight traffic).

4.3 The methodology used to derive the Core forecasts involved:

- Application of NTEM adjusted TEMPRO growth by district to 2024 and 2039
- Addition of development growth in appropriate zone based on information provided by districts and utilising trip generation rates utilised for the A6MARR scheme
- constraining the population and employment growth forecasts to the overall growth level implied by TEMPRO at the district level within Greater Manchester the pre-2009 district level for Cheshire East and at the county level elsewhere; and

4.4 Freight growth was applied uniformly across the whole A6 to M60 Relief Road area using data from the National Transport Model 2015 forecasts. This resulted in no difference in freight growth between the three scenarios.

5. Forecast Year Scenarios

5.1 This section of the report summarises the production of the forecast year scenarios for the preferred scheme and the lower cost alternative. It describes:

- assumptions about the progress of proposed developments in the vicinity of the scheme
- generalised costs used in the assignment process
- the strategy used for assigning forecast year networks (Do-Minimum and Do-Something); and
- the levels of convergence achieved for all assignments.

Development Assumptions

5.2 The data collection process involved engaging with the various stakeholders to introduce the uncertainty log concept and the nature of the data which we required to enable the uncertainty logs to be compiled. The stakeholder parties included;

- Cheshire East Council
- High Peak Borough Council
- Transport for Greater Manchester (TfGM)
- Highways England(HE)
- Manchester Airport Group
- Manchester City Council
- Stockport Metropolitan Council
- Tameside Council; and
- Trafford Council.

5.3 Information was collected for developments which were likely to be implemented by the opening and design years of 2024 and 2039 respectively. The information received was reviewed and where necessary, alterations were undertaken and, or additional information requested, to ensure the most up to date data was collated in a format appropriate for the purposes of the uncertainty log and alternative scenario creation.

5.4 As the number of development sites is extensive and covering six districts they have not been detailed in this report but are reported in detail in WSPPB uncertainty log which is available on request.

5.5 Table 5.1 and Table 5.2 summarise total pcu tripends in the 2024 and 2039 forecast year Do-Minimum and Do-Something matrices for each of the scenarios.

Table 5.1: A6MARR Forecasts - Matrix Totals - 2024		
Time Period	User Class	Do-Minimum Core & Do-Something Core
		Grand Totals
AM Peak Hour	Car Commute	87,890
	Car Employers Business	13,052
	Car other	83,314
	LGVs	20,133
	OGVs	9,330
	Total	213,720
Average Inter Peak Hour	Car Commute	20,178
	Car Employers Business	13,242
	Car other	104,316
	LGVs	19,248
	OGVs	10,595
	Total	167,579
PM Peak Hour	Car Commute	76,464
	Car Employers Business	12,039
	Car other	105,077
	LGVs	17,037
	OGVs	4,876
	Total	215,493

Table 5.2: A6MARR Forecasts - Matrix Totals - 2039		
Time Period	User Class	Do-Minimum Core & Do-Something Core
		Grand Totals
AM Peak Hour	Car Commute	81,064
	Car Employers Business	12,993
	Car other	75,682
	LGVs	23,456
	OGVs	8,873
	Total	202,069
Average Inter Peak Hour	Car Commute	19,177
	Car Employers Business	12,838
	Car other	98,338
	LGVs	22,163
	OGVs	10,088
	Total	162,605
PM Peak Hour	Car Commute	70,454
	Car Employers Business	11,055
	Car other	96,844
	LGVs	19,378
	OGVs	4,621
	Total	202,353

Generalised Cost Parameters

5.6 The generalised cost parameters used in the assignment process are derived using an Excel spreadsheet prepared by MVA for the A6MARR study. They are consistent with data taken from TAG Unit 3.5.6 (Autumn 2015).

5.7 User inputs to the spreadsheet consist of:

- Average network speed, used in the calculation of vehicle operating costs; and
- Proportions of distance travelled by each of three car-based user classes (i.e. commute, employers business and other) as output from a five user class assignment; these are used in the calculation of the cost parameters for the all-car user class (i.e. as a weight).

5.8 All other inputs (e.g. values of time, fuel consumption parameters and fuel costs, fuel price growth rates etc) were taken directly from the appropriate section of WebTAG.

5.9 The 2024 and 2039 values of time (pence per minute – PPM) and distance (pence per kilometre – PPK) as output from the spreadsheet and used in the assignments are shown in Table 5.3 below.

Table 5.3 Generalised Cost Parameters Used in the Forecast Assignments

Period	User Class	2024		2039	
		PPM	PPK	PPM	PPK
AM Peak Hour	Commuting Car	22.98	6.15	31.02	5.74
	Employer's Business Car	34.32	13.92	46.33	13.47
	Other Car	15.87	6.15	21.42	5.74
	LGV	24.15	13.84	32.6	13.81
	OGV	24.65	60.72	33.28	63.76
Inter-Peak Hour	Commuting Car	23.39	5.66	31.57	5.29
	Employer's Business Car	35.23	12.65	47.56	12.24
	Other Car	16.89	5.66	22.8	5.29
	LGV	24.15	13.17	32.6	13.15
	OGV	24.65	54.01	33.28	56.71
PM Peak Hour	Commuting Car	23.18	6.04	31.3	5.64
	Employer's Business Car	34.93	13.63	47.15	13.19
	Other Car	16.61	6.04	22.42	5.64
	LGV	24.15	13.66	31.6	13.64
	OGV	24.65	59.23	33.28	62.19

Forecast Year Assignments

5.10 Forecast year assignments of the A6 to M60 Relief Road model were run differently for Do-Minimum and Do-Something networks. Do-Minimum tests were assigned in the following way:

- assign Do-Minimum network with corresponding Do-Minimum matrix
- optimise traffic signal green splits and offsets across the full modelled area; and
- re-assign incorporating the optimised traffic signal settings.

5.11 Do-Something tests by contrast, were assigned in the following way:

- incorporate optimised traffic signal settings from the Do-Minimum network at common junctions across the full modelled area
- assign updated network with corresponding Do-Something matrix
- optimise traffic signal green splits and offsets on and in the A6 To M60 Relief Road area of influence; and
- re-assign incorporating the optimised traffic signal settings.

5.12 The full model assignments were then cordoned before economic appraisal of the schemes was undertaken. This was done:

- to speed up model run times while fine-tuning scheme performance (for example testing different traffic signal green splits and staging arrangements)
- to improve run times for the economic appraisal programs TUBA and COBA; and
- to reduce the possibility of including user benefits accruing in areas remote from the scheme as a result of assignment ‘noise’.

Forecast Year Assignment Convergence

5.13 Webtag states that ‘convergence is the key to robust economic appraisal’ because, with a poorly converged base and/or test network, it is impossible to distinguish scheme effects from assignment ‘noise’. Consequently, particular efforts were made to ensure that the networks were as highly converged as possible.

5.14 The DMRB criteria for an acceptable level of network convergence are that:

- the Delta statistic should be less than 1% on the final assignment; and
- at least 90% of links should have a flow that changes by less than 5% on the final 4 iterations.

5.15 For this work, we adopted a tighter convergence criteria than required by DMRB, requiring the perecentage Gap to be less than 0.02. Table 5.4 summarises the convergence statistics for all scenarios and shows that all model assignments are extremely well converged.

Table 5.4: A6 to M60 Relief Road Convergence Statistics

Scenario	Year	Test	AM Peak Hour					Average Inter-Peak Hour					PM Peak Hour				
			Delta	% Gap for Iteration		% Flows for Iteration		Delta	% Gap for Iteration		% Flows for Iteration		Delta	% Gap for Iteration		% Flows for Iteration	
				N	N-4	N	N-4		N	N-4	N	N-4		N	N-4	N	N-4
Core	2024	Do-Min	0.01	99.73	99.66	99.74	99.66	0.0053	99.51	99.38	99.4	99.32	0.017	99.69	99.59	99.67	99.63
		Do-Som	0.012	99.75	99.76	99.73	99.59	0.0049	99.76	99.65	99.34	99.01	0.014	99.77	99.79	99.68	99.69
	2039	Do-Min	0.01	99.77	99.61	99.79	99.7	0.0048	99.69	99.64	99.72	99.28	0.015	99.68	99.8	99.56	99.32
		Do-Som	0.14	99.8	99.77	99.81	99.76	0.006	99.89	99.85	99.7	99.59	0.022	99.91	99.88	99.89	99.88

6. A6 to M60 Relief Road Traffic Impacts

6.1 This section of the report summarises the main traffic impacts of the Core A6 to M60 Relief Road scheme, in terms of:

- impact on overall network performance
- broad re-assignment impacts
- changes in journey times.

Junction Operation

6.2 All junctions along the proposed scheme have been assessed at various stage of the design process both within the SATURN model and in junction models such as LINSIG. This work has indicated that the junctions will operate within capacity in the opening year of 2024. Detailed assessments will be repeated following completion of the public consultation process and reflecting any consequent change in scheme design.

Overall Network Performance

6.3 Table 6.1 summarises the network performance statistics for the Do-Minimum (DM) and Do-Something (DS) scenarios. Briefly, these statistics are aggregated over the whole modelled area (for the modelled peak-hour and the period after the peak-hour to allow the completion of any trips delayed by queues or congestion) and represent the following:

- Over-Capacity Queues – this is the time spent in queues resulting from turning movements in excess of capacity, resulting in the build-up of a permanent queue that is unable to clear in a single signal cycle;
- Total Travel Time – this is the sum of the time spent in transient and over-capacity queues plus the link cruise time;
- Travel Distance – this is the total distance travelled by all vehicles during the modelled hour; and
- Average Speed – this is simply the total distance divided by the total travel time.

6.4 The statistics shown in Table 6.1 demonstrate a decrease in the amount of time spent in over capacity queues and travel in each time period in the DS scenario compared to the DM scenario in both 2024 and 2039. This is reflected in the overall network average speed, which increases and the total number of vehicles queued at the end of the modelled hour, which decreases slightly between the DM and the DS.

These statistics demonstrate that there is an overall improvement in network performance in both test scenarios when compared against the Do-Minimum. In particular, the decrease in time spent in over-capacity queues.

Table 6.1: A6 to M60 Relief Road SATURN Model – Network Simulation Summary Statistics										
Year	Network Data	AM			IP			PM		
		DM	DS	Diff (DS-DM)	DM	DS	Diff (DS-DM)	DM	DS	Diff (DS-DM)
Core										
2024	Over capacity queuing (pcu hours)	1,705	1,616	-89	208.7	171	-37.7	1,403	1,110	-292
	Total travel time (pcu hours / hour)	43,639	42,920	-719	27,438	27,113	-324.9	45,398	44,388	-1,010
	Total travel distance (km / hr)	1,821,458	1,822,931	1,473	1,336,741	1,338,129	1388.2	1,894,566	1,896,101	1,535
	Average network speed (km/hr)	41.7	42.5	1	48.7	49.4	0.7	41.7	42.7	1
2039	Permanent queuing (pcus)	4,188	3,424	-764	469.5	318.3	-151.2	3,535	3,052	-483
	Total travel time (pcu hours per hour)	54,728	52,985	-1,743	32,976	32,313	-663.4	56,231	54,577	-1,654
	Total distance travelled (km per hr)	2,060,133	2,059,223	-910	1,530,341	1,528,216	-2125.4	2,141,039	2,140,979	-60
	Average network speed (km/hr)	37.6	38.9	1	46.4	47.3	0.9	38.1	39.2	1

6.5 Tables 6.2 to 6.3 below summarise the performance of major junctions in the A6 to M60 Relief Road area of influence at 2024 and 2039 for the morning and evening peak hours. Again, the performance figures are based on the worst turn at each junction, i.e. If a junction has a single turn in excess of 100% it is placed in the VCR>100% category. It should be noted that the figures quoted for the Do-Something scenario include junctions along the scheme.

Table 6.2 – Junction Performance in the A6 to M60 Relief Road Area of Influence in 2024

Junction Control	Morning Peak Hour				Evening Peak Hour			
	Do-Minimum		Do-Something		Do-Minimum		Do-Something	
	At Capacity	Over Capacity	At Capacity	Over Capacity	At Capacity	Over Capacity	At Capacity	Over Capacity
	V/C = 85 -100%	V/C > 100%	V/C = 85 -100%	V/C > 100%	V/C = 85 -100%	V/C > 100%	V/C = 85 -100%	V/C > 100%
Signals	71	38	64	31	69	28	58	22
Roundabouts	6	4	7	3	7	7	7	7
Total	119		105		111		94	

6.6 Table 6.2 shows that in 2024 the introduction of the A6 to M60 Relief Road scheme is forecast to result in a reduction in the number of junctions (both signalised and roundabouts) with a turn that is operating at overcapacity (VC >100%) from 42 to 33 and for junctions operating at capacity (VC 85-100%) from 77 to 71 in the morning peak hour. In the evening peak hour, the number of junctions with a turn that is operating at overcapacity (VC >100%) is forecast to fall from 35 to 29 and for junctions operating at capacity (VC 85-100%) from 76 to 65.

Table 6.3 – Junction Performance in the A6 to M60 Relief Road Area of Influence in 2039

Junction Control	Morning Peak Hour				Evening Peak Hour			
	Do-Minimum		Do-Something		Do-Minimum		Do-Something	
	At Capacity	Over Capacity	At Capacity	Over Capacity	At Capacity	Over Capacity	At Capacity	Over Capacity
	V/C = 85 -100%	V/C > 100%	V/C = 85 -100%	V/C > 100%	V/C = 85 -100%	V/C > 100%	V/C = 85 -100%	V/C > 100%
Signals	93	63	77	55	91	46	79	41
Roundabouts	8	6	9	5	7	8	4	10
Total	170		146		152		134	

6.7 Table 6.3 shows that in 2039 the introduction of the A6 to M60 Relief Road scheme is forecast to result in a reduction in the number of junctions (both signalised and roundabouts) with a turn that is operating at overcapacity (VC >100%) from 69 to 54 and for junctions operating at capacity (VC 85-100%) from 101 to 86 in the morning peak hour. In the evening peak hour, the number of junctions with a turn that is operating at overcapacity (VC >100%) is forecast to fall from 54 to 51 and for junctions operating at capacity (VC 85-100%) from 98 to 83.

Scheme Re-Assignment Impacts

6.8 The analysis of the traffic impacts of the A6 to M60 Relief Road scheme is based on an analysis of traffic flows crossing five screenlines across the study area. The screenlines are illustrated in Figure 6.1.

Screenline 1 Tameside to Stockport to Manchester North of Scheme Screenline to intercept North-South traffic movements through in the Northern area of influence.

Screenline 2 Bredbury to High Lane East-West traffic movements through the area of influence. It extends from Disley in the East to Wilmslow in the West.

Screenline 3 Bredbury to Heald Green North-South traffic movements through the Southern area of influence.

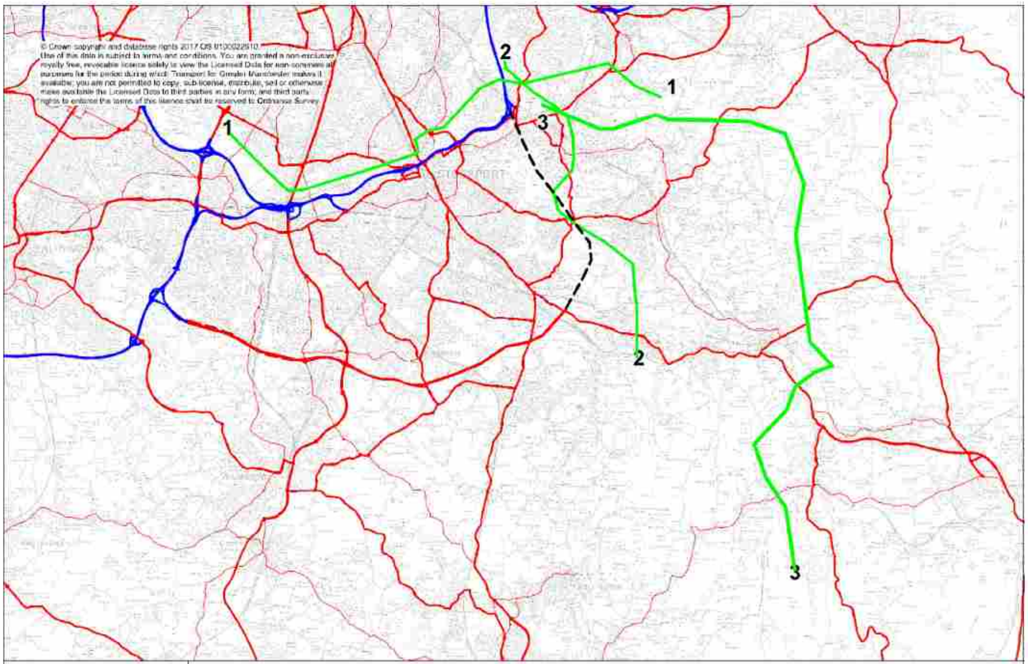
6.9 Tables 6.4 to 6.6 summarise 2024 and 2039 actual flows (in pcus) on all links crossing Screenlines 1 to 5 respectively in the Do-Minimum and Do-Something scenarios.

6.10 Table 6.4 shows that in the Northbound direction flows are forecast to increase on the M60 North of Brinnington in all time periods at 2024 and 2039. The remaining links are forecast to remain broadly neutral or to reduce particularly on the A5145 Didsbury Road in the morning peak in both forecast years.

6.11 In the Southbound direction, flows are forecast to significantly increase on the M60 North of Brinnington Bypass in all time periods at 2024 and 2039in some cases by over 100 pcu's. Overall, the forecast change in flow across the screenline in either direction ranges from -3% to -+10% in any one time period and forecast year.

6.12 Table 6.5 shows that in both directions flows are forecast to decrease particularly on the A6 Buxton Road and Otterspool Road for all time periods in 2024 and 2039. Overall, the forecast change in flow across the screenline in either direction ranges from 0% to +7% in any one time period and forecast year.

6.13 Table 6.6 shows that in the both directions flows are forecast to decrease on the A6 Wellington Road South and Longshut Lane West with the maximum decrease of up to 30% in either direction. Overall, the forecast change in flow across the screenline in either direction ranges from +1% to -12% in any one time period and forecast year.



Transport for Greater Manchester 2 Piccadilly Place, Manchester, M1 3BG	Figure 6.1 Scheme reassignemnt Screenlines		
	Drawn By : reesem	Scale : NTS	Date : 16/07/2017

Table 6.4: A6 to M60 Relief Road Screenline 1 Tameside / Stockport / Manchester Screenline - Crossing Flows in pcu's

Crossing Links	Time Period	Northbound								Southbound							
		2024				2039				2024				2039			
		DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff
1. Werneth Low Road	AM	242	216	-26	-11%	309	259	-50	-16%	181	216	35	19%	251	259	8	3%
2. A560 Stockport Road		135	117	-18	-13%	182	128	-54	-30%	265	117	-148	-56%	290	128	-162	-56%
3. A627 Dowson Road		540	488	-52	-10%	680	596	-84	-12%	491	488	-3	-1%	555	596	41	7%
4. Ashton Road		539	536	-3	-1%	655	647	-8	-1%	1097	536	-561	-51%	1336	647	-689	-52%
5. M60 North of Brinnington		6036	6176	140	2%	6657	7005	348	5%	4861	6176	1315	27%	5966	7005	1039	17%
6. B6167 Sandy Lane		995	986	-9	-1%	1060	1008	-52	-5%	917	986	69	8%	963	1008	45	5%
7. A626 Manchester Road		524	598	74	14%	641	611	-30	-5%	851	598	-253	-30%	858	611	-247	-29%
8. Belmont Way		195	230	35	18%	132	270	138	105%	243	230	-13	-5%	277	270	-7	-3%
9. A6 Wellington Road North		1053	1011	-42	-4%	1083	1146	63	6%	1298	1011	-287	-22%	1460	1146	-314	-22%
10. A5145 Didsbury Road		1113	1197	84	8%	1231	1294	63	5%	1197	1197	0	0%	1314	1294	-20	-2%
11. B5095 Wilmslow Road		985	743	-242	-25%	1276	1102	-174	-14%	722	743	21	3%	814	1102	288	35%
12. A34 Kingsway		1503	1665	162	11%	1291	1508	217	17%	1729	1665	-64	-4%	1896	1508	-388	-20%
13. B5167 Palatine Road		872	819	-53	-6%	1005	973	-32	-3%	727	819	92	13%	1003	973	-30	-3%
Total		14732	14782	50	0%	16202	16547	345	2%	14579	14782	203	1%	16983	16547	-436	-3%
1. Werneth Low Road	IP	92	75	-17	-18%	108	95	-13	-12%	122	75	-47	-39%	180	95	-85	-47%
2. A560 Stockport Road		153	154	1	1%	198	198	0	0%	174	154	-20	-11%	199	198	-1	-1%
3. A627 Dowson Road		463	456	-7	-2%	491	515	24	5%	406	456	50	12%	473	515	42	9%
4. Ashton Road		510	503	-7	-1%	586	585	-1	0%	457	503	46	10%	564	585	21	4%
5. M60 North of Brinnington		4697	4772	75	2%	5600	5676	76	1%	4598	4772	174	4%	5318	5676	358	7%
6. B6167 Sandy Lane		957	936	-21	-2%	1035	1069	34	3%	1011	936	-75	-7%	1001	1069	68	7%
7. A626 Manchester Road		807	848	41	5%	806	838	32	4%	711	848	137	19%	788	838	50	6%
8. Belmont Way		290	383	93	32%	317	390	73	23%	331	383	52	16%	377	390	13	3%
9. A6 Wellington Road North		929	872	-57	-6%	1029	997	-32	-3%	930	872	-58	-6%	1094	997	-97	-9%
10. A5145 Didsbury Road		901	930	29	3%	1045	1065	20	2%	1194	930	-264	-22%	1101	1065	-36	-3%
11. B5095 Wilmslow Road		437	440	3	1%	548	508	-40	-7%	516	440	-76	-15%	687	508	-179	-26%
12. A34 Kingsway		1385	1378	-7	-1%	1606	1604	-2	0%	1101	1378	277	25%	1302	1604	302	23%
13. B5167 Palatine Road		496	498	2	0%	634	608	-26	-4%	538	498	-40	-7%	699	608	-91	-13%
Total		12117	12245	128	1%	14003	14148	145	1%	12089	12245	156	1%	13783	14148	365	3%

Table 6.4 Continued: A6 to M60 Relief Road Screenline 1 Tameside / Stockport / Manchester Screenline - Crossing Flows in pcu's																	
Crossing Links	Time Period	Northbound								Southbound							
		2024				2039				2024				2039			
		DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff
1. Werneth Low Road	PM	179	109	-70	-39%	279	187	-92	-33%	234	109	-125	-53%	267	187	-80	-30%
2. A560 Stockport Road		370	357	-13	-4%	349	356	7	2%	229	357	128	56%	268	356	88	33%
3. A627 Dowson Road		467	462	-5	-1%	563	714	151	27%	634	462	-172	-27%	729	714	-15	-2%
4. Ashton Road		945	1045	100	11%	982	1120	138	14%	602	1045	443	74%	624	1120	496	79%
5. M60 North of Brinnington		6204	6413	209	3%	7241	6990	-251	-3%	5303	6413	1110	21%	6322	6990	668	11%
6. B6167 Sandy Lane		1065	1025	-40	-4%	1079	1047	-32	-3%	920	1025	105	11%	1005	1047	42	4%
7. A626 Manchester Road		756	780	24	3%	813	779	-34	-4%	798	780	-18	-2%	742	779	37	5%
8. Belmont Way		187	261	74	40%	367	408	41	11%	278	261	-17	-6%	303	408	105	35%
9. A6 Wellington Road North		1055	982	-73	-7%	1167	1161	-6	-1%	961	982	21	2%	1110	1161	51	5%
10. A5145 Didsbury Road		1313	1328	15	1%	1355	1378	23	2%	1091	1328	237	22%	1304	1378	74	6%
11. B5095 Wilmslow Road		670	544	-126	-19%	808	690	-118	-15%	1096	544	-552	-50%	1154	690	-464	-40%
12. A34 Kingsway		1546	1689	143	9%	1691	1902	211	12%	1734	1689	-45	-3%	1812	1902	90	5%
13. B5167 Palatine Road		1054	1098	44	4%	1046	1121	75	7%	714	1098	384	54%	947	1121	174	18%
Total		15811	16093	282	2%	17740	17853	113	1%	14594	16093	1499	10%	16587	17853	1266	8%

Table 6.5: A6 to M60 Relief Road Screenline 2 Bredbury to High Lane - Crossing Flows in pcu's																	
Crossing Links	Time Period	Northbound								Southbound							
		2024				2039				2024				2039			
		DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff
1. A6 Buxton Road	AM	881	962	81	9%	978	1136	158	16%	962	1098	136	14%	832	929	97	12%
2. Windlehurst Road		232	148	-84	-36%	278	168	-110	-40%	347	221	-126	-36%	242	118	-124	-51%
3. A626 Buxton Road		976	788	-188	-19%	1144	931	-213	-19%	1443	1415	-28	-2%	1271	1198	-73	-6%
4. A627 Otterspool Road		661	462	-199	-30%	828	600	-228	-28%	704	347	-357	-51%	955	732	-223	-23%
5. B6104 Stockport Road		542	545	3	1%	603	613	10	2%	840	835	-5	-1%	744	659	-85	-11%
6. Stockport Road East		529	498	-31	-6%	626	588	-38	-6%	1084	1115	31	3%	896	874	-22	-2%
7. Ashton Road		539	536	-3	-1%	655	647	-8	-1%	1097	1062	-35	-3%	624	681	57	9%
Total		4360	3939	-421	-10%	5112	4683	-429	-8%	6477	6093	-384	-6%	5564	5191	-373	-7%
1. A6 Buxton Road	IP	859	930	71	8%	1112	1210	98	9%	776	937	161	21%	832	929	97	12%
2. Windlehurst Road		270	192	-78	-29%	333	228	-105	-32%	174	123	-51	-29%	242	118	-124	-51%
3. A626 Buxton Road		1006	837	-169	-17%	1280	1014	-266	-21%	1134	1067	-67	-6%	1271	1198	-73	-6%
4. A627 Otterspool Road		600	499	-101	-17%	626	518	-108	-17%	748	419	-329	-44%	955	732	-223	-23%
5. B6104 Stockport Road		636	658	22	3%	678	729	51	8%	575	616	41	7%	744	659	-85	-11%
6. Stockport Road East		706	703	-3	0%	766	826	60	8%	750	746	-4	-1%	896	874	-22	-2%
7. Ashton Road		510	503	-7	-1%	586	585	-1	0%	457	447	-10	-2%	624	681	57	9%
Total		4587	4322	-265	-6%	5381	5110	-271	-5%	4614	4355	-259	-6%	5564	5191	-373	-7%

Table 6.5 Continued: A6 to M60 Relief Road Screenline 2 Bredbury to High Lane - Crossing Flows in pcu's																	
Crossing Links	Time Period	Eastbound								Westbound							
		2024				2039				2024				2039			
		DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff
1. A6 Buxton Road	PM	1063	1191	128	12%	1112	1368	256	23%	856	950	94	11%	832	929	97	12%
2. Windlehurst Road		474	323	-151	-32%	603	460	-143	-24%	191	103	-88	-46%	242	118	-124	-51%
3. A626 Buxton Road		1483	1274	-209	-14%	1495	1419	-76	-5%	1005	936	-69	-7%	1271	1198	-73	-6%
4. A627 Otterspool Road		663	419	-244	-37%	829	474	-355	-43%	937	610	-327	-35%	955	732	-223	-23%
5. B6104 Stockport Road		834	879	45	5%	962	1051	89	9%	655	639	-16	-2%	744	659	-85	-11%
6. Stockport Road East		879	850	-29	-3%	901	1044	143	16%	806	786	-20	-2%	896	874	-22	-2%
7. Ashton Road		945	1045	100	11%	982	1120	138	14%	602	594	-8	-1%	624	681	57	9%
Total		6341	5981	-360	-6%	6884	6936	52	1%	5052	4618	-434	-9%	5564	5191	-373	-7%

Table 6.6: A6 to M60 Relief Road Screenline 3 Bredbury to Heald Green Screenline - Crossing Flows in pcu's

Crossing Links	Time Period	Eastbound								Westbound							
		2024				2039				2024				2039			
		DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff
1. Ashton Road	AM	539	536	-3	-1%	655	647	-8	-1%	1097	1062	-35	-3%	1336	1244	-92	-7%
2. Stockport Road West		1604	1396	-208	-13%	1704	1592	-112	-7%	1047	892	-155	-15%	1109	1008	-101	-9%
3. Osborne Street		534	535	1	0%	488	498	10	2%	183	237	54	30%	261	269	8	3%
4. A626 Offerton Lane		543	720	177	33%	550	772	222	40%	226	649	423	187%	318	699	381	120%
5. Dialstone Lane		565	472	-93	-16%	622	451	-171	-27%	455	285	-170	-37%	438	305	-133	-30%
6. Nangreave Road		193	170	-23	-12%	253	195	-58	-23%	195	173	-22	-11%	274	186	-88	-32%
7. Hillgate		621	451	-170	-27%	719	507	-212	-29%	521	428	-93	-18%	514	496	-18	-4%
8. Longshut Lane		336	323	-13	-4%	503	444	-59	-12%	226	249	23	10%	250	297	47	19%
9. A6 Wellington Road South		498	362	-136	-27%	589	424	-165	-28%	515	364	-151	-29%	558	453	-105	-19%
10. B5465 Longshut Lane West		1322	1108	-214	-16%	1401	1228	-173	-12%	808	863	55	7%	900	930	30	3%
11. Dale Street		559	524	-35	-6%	676	536	-140	-21%	402	383	-19	-5%	384	349	-35	-9%
12. Councillor Lane		578	530	-48	-8%	635	660	25	4%	389	417	28	7%	461	450	-11	-2%
13.Cheadle Road		673	651	-22	-3%	872	756	-116	-13%	393	371	-22	-6%	414	471	57	14%
14. A34 Bypass		2870	2598	-272	-9%	2546	2437	-109	-4%	2726	2423	-303	-11%	2777	2452	-325	-12%
Total		8565	7778	-787	-9%	9667	8710	-1066	-11%	6457	6373	-84	-1%	7217	7157	-60	-1%
1. Ashton Road	IP	510	503	-7	-1%	586	585	-1	0%	457	447	-10	-2%	564	540	-24	-4%
2. Stockport Road West		1334	1164	-170	-13%	1517	1306	-211	-14%	1673	1502	-171	-10%	1744	1722	-22	-1%
3. Osborne Street		347	272	-75	-22%	396	337	-59	-15%	339	475	136	40%	288	463	175	61%
4. A626 Offerton Lane		293	348	55	19%	372	398	26	7%	295	591	296	100%	439	732	293	67%
5. Dialstone Lane		545	471	-74	-14%	610	525	-85	-14%	419	303	-116	-28%	392	327	-65	-17%
6. Nangreave Road		121	112	-9	-7%	121	129	8	7%	210	186	-24	-11%	266	262	-4	-2%
7. Hillgate		616	594	-22	-4%	687	698	11	2%	647	581	-66	-10%	705	673	-32	-5%
8. Longshut Lane		280	236	-44	-16%	360	285	-75	-21%	213	289	76	36%	232	334	102	44%
9. A6 Wellington Road South		374	237	-137	-37%	547	298	-249	-46%	343	229	-114	-33%	459	274	-185	-40%
10. B5465 Longshut Lane West		1216	1172	-44	-4%	1231	1196	-35	-3%	1172	1212	40	3%	1231	1301	70	6%

11. Dale Street		328	313	-15	-5%	435	370	-65	-15%	355	342	-13	-4%	418	336	-82	-20%
12. Councillor Lane		332	353	21	6%	391	376	-15	-4%	435	400	-35	-8%	484	461	-23	-5%
13.Cheadle Road		382	393	11	3%	568	471	-97	-17%	390	401	11	3%	579	481	-98	-17%
14. A34 Bypass		1942	1760	-182	-9%	2257	2159	-98	-4%	1817	1634	-183	-10%	2118	1878	-240	-11%
Total		6678	6168	-510	-8%	7821	6974	-945	-12%	6948	6958	10	0%	7801	7906	105	1%

Table 6.6 Continued: A6 to M60 Relief Road Screenline 3 Bredbury to Heald Green Screenline - Crossing Flows in pcu's																	
Crossing Links	Time Period	Eastbound								Westbound							
		2024				2039				2024				2039			
		DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff	DM	DS	Diff	% Diff
1. Ashton Road	PM	945	1045	100	11%	982	1120	138	14%	602	594	-8	-1%	624	681	57	9%
2. Stockport Road West		1214	962	-252	-21%	1254	994	-260	-21%	1507	1549	42	3%	1712	1607	-105	-6%
3. Osborne Street		312	319	7	2%	340	329	-11	-3%	487	339	-148	-30%	487	556	69	14%
4. A626 Offerton Lane		329	317	-12	-4%	490	377	-113	-23%	586	884	298	51%	786	966	180	23%
5. Dialstone Lane		508	263	-245	-48%	492	264	-228	-46%	523	288	-235	-45%	591	298	-293	-50%
6. Nangreave Road		84	56	-28	-33%	129	79	-50	-39%	201	280	79	39%	381	396	15	4%
7. Hillgate		779	800	21	3%	672	775	103	15%	825	777	-48	-6%	765	810	45	6%
8. Longshut Lane		348	263	-85	-24%	400	361	-39	-10%	414	429	15	4%	486	465	-21	-4%
9. A6 Wellington Road South		397	305	-92	-23%	535	353	-182	-34%	965	645	-320	-33%	1028	781	-247	-24%
10. B5465 Longshut Lane West		1232	1095	-137	-11%	1177	1133	-44	-4%	885	938	53	6%	1006	919	-87	-9%
11. Dale Street		463	419	-44	-10%	525	470	-55	-10%	275	278	3	1%	299	288	-11	-4%
12. Councillor Lane		325	351	26	8%	304	377	73	24%	769	733	-36	-5%	861	837	-24	-3%
13.Cheadle Road		621	548	-73	-12%	736	614	-122	-17%	543	491	-52	-10%	569	525	-44	-8%
14. A34 Bypass		2488	2426	-62	-2%	2532	2605	73	3%	2412	2238	-174	-7%	2555	2503	-52	-2%
Total		7557	6743	-814	-11%	8036	7246	-717	-9%	8582	8225	-357	-4%	9595	9129	-466	-5%

Flow Differences

6.14 Figures 6.2 and 6.3 show forecast changes in AADT flow between the Do-Minimum and the Do-Something and scenario for the 2024 and 2039 in the A6 to M60 Relief Road area of influence. The plots show flow differences represented by variable width bands, where the width of the band is proportional to the magnitude of the change. Increases in actual flows are shown in green and decreases in blue.

6.15 As expected, the most significant forecast increases in flow in the A6 to M60 Relief Road area of influence as a result of the scheme are on:

- A6 Buxton Road (South of its junction with A6to M60 Relief Road)
- A6MARR East of Poynton Relief Road
- M60 North of Brinnington
- A523 Macclesfield Road South of Hazel Grove

6.16 The most significant forecast decreases in flow occur on the local road network in the Heald Green and Wythenshawe area and Bramhall to the North of the scheme. Other routes with significant decreases in flow as a result of the scheme include:

- A6 through Stockport and Hazel Grove
- A627 Otterspool Road
- M60 Junction 25 to 3
- M56
- A34 South of the M60A538 Wilmslow Road

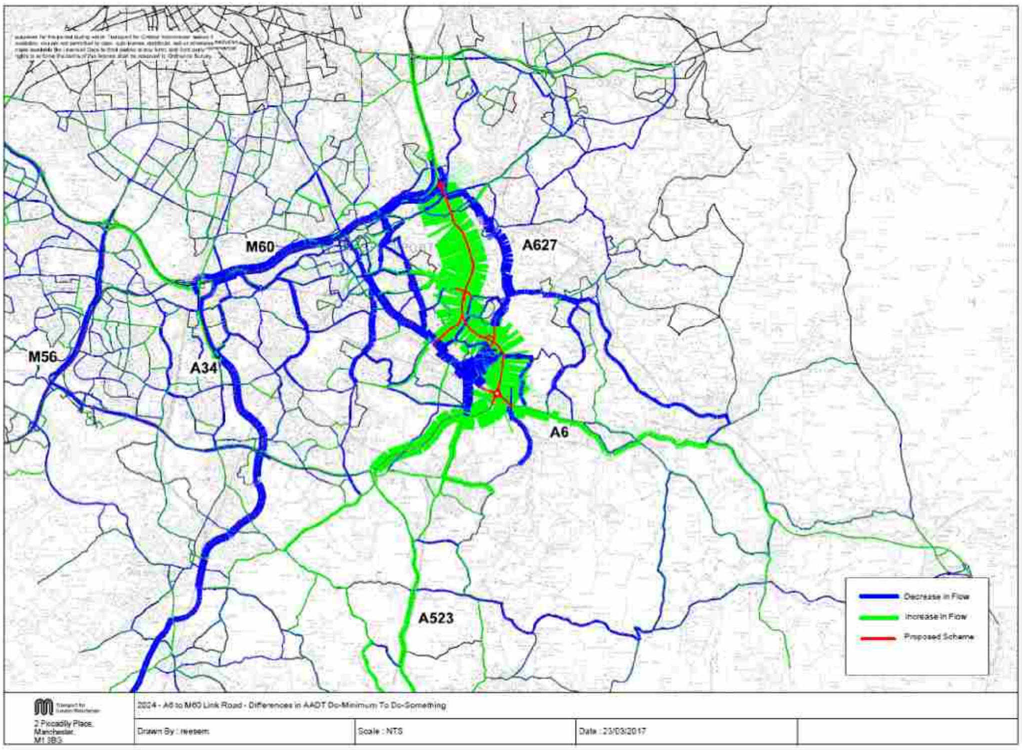


Figure 6.2 2024 AADT Flow Differences (Do-Min to Do-Som)

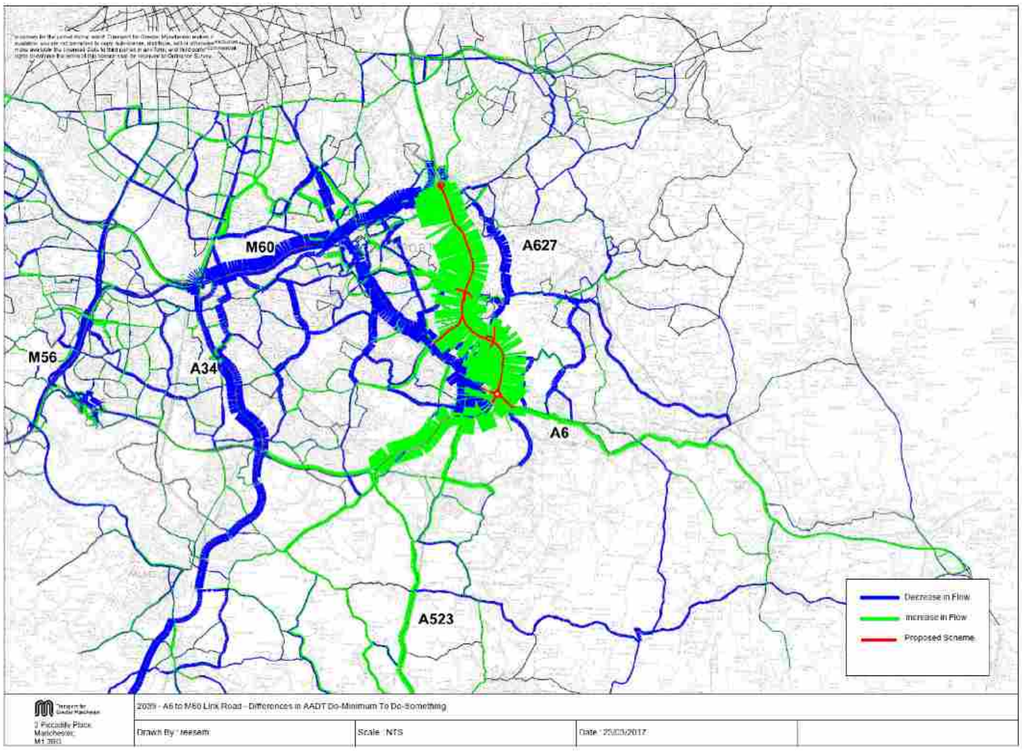


Figure 6.3 2039 AADT Flow Differences (Do-Min to Do-Som)

Journey Time Impacts

6.17 Table 6.7 lists the journey time routes in the area of influence of the A6 to M60 Relief Road scheme and illustrated in Figure 6.4. The journey time data from the AM, IP and PM peak-hour 2024 and 2039 Core Do-Minimum and Do-Something for thirty-one routes in each direction are summarised in Table 6.8 and Table 6.9 for 2024 and 2039 respectively. Differences in travel time (Do-Minimum to Do-Something) greater than plus 60 seconds are highlighted in red and greater than minus 60 seconds in green

6.18 The tables indicate that with A6 to M60 Relief Road in place journey times are forecast to decrease in the northbound directions on the A6 Buxton Road (High Lane to Heaton Moor) in all time periods up to approximately three-to four minutes. In the southbound direction the journey times are forecast to rise in the morning and interpeak by approximately one to two minutes and decrease in the evening peak by two to three minutes

6.19 Journey times are forecast to increase in the morning peak in 2024 on the A523 Macclesfield Road (Prestbury to Hazel Grove) Northbound by approximately one. The route from Chapel-en-le-Frith to Macclesfield is forecast to increase by two minutes in the 2039 evening peak/

6.20 The journey times on the M60 are forecast to remain broadly neutral in 2024 but will decrease more significantly in 2029 particularly in the clockwise direction in the morning peak.

Table 6.7 Journey Time Route Descriptions

Route No.	Description	Direction	Route Length Modelled KM
1	A6 Chapel to Heaton Moor	NW	8.7
	A6 Heaton Moor to Chapel	SE	8.7
2	A537 Knutsford to Macclesfield	E	16.4
	A537 Macclesfield to Knutsford	W	16.4
3	B5085 Knutsford to Alderley Edge	E	10.2
	B5085 Alderley Edge to Knutsford	W	10.2
4	B5087 Macclesfield to Alderley Edge	NW	6.6
	B5087 Alderley Edge to Macclesfield	SE	6.6
5	M56 Manchester Airport to West Didsbury	N	7.3
	M56 West Didsbury to Manchester Airport	S	6.8
6	B5166 Wilmslow to Northenden	N	10
	B5166 Northenden to Wilmslow	S	10
7	M56 J8 to J5	E	8.4
	M56 J5 to J8	W	8.4
8	A5102 Wilmslow to Bramhall	NE	7.6
	A5102 Bramhall to Wilmslow	SW	7.6
9	A34 Alderley Edge to East Didsbury	N	14.4
	A34 East Didsbury to Alderley Edge	S	14.3
10	A523 Prestbury to Hazel Grove	N	10.1
	A523 Hazel Grove to Prestbury	S	10
11	A555 MAELR Poynton to Manchester Airport	W	14.4
	A555 MAELR Manchester Airport to Poynton	E	14.4
12	A538 Prestbury to Hale	NW	22.1
	A538 Hale to Prestbury	SE	22.1
13	M60 J6 to J24	AC	17
	M60 J24 to J6	CW	17.2
14	Heald Green to Cheadle Heath	NE	5.2
	Cheadle Heath to Heald Green	SW	5.2
15	A5149/3 Cheadle Hulme to Hazel Grove	E	5.8
	A5143/9 Hazel Grove to Cheadle Hulme	W	5.8
16	Buxton Old Road / Higher Lane	SB	6
	Buxton Old Road / Higher Lane	NB	6
17	B5470 Chapel To Macclesfield	SB	16.5
	B5470 Macclesfield To Chapel	NB	16.5
18	B5090 / Bakestonedale Rd	WB	8.1
	B5090 / Bakestonedale Rd	EB	8.1
19	Bakestonedale Rd / Brookledge Lane / Mill Lane	WB	9.7
	Bakestonedale Rd / Brookledge Lane / Mill Lane	EB	9.7
20	B5358	NB	8.9
	B5358	SB	8.9
21	Roundy Lane / Middlewood Rd / Waterloo Rd	NB	7.3
	Roundy Lane / Middlewood Rd / Waterloo Rd	SB	7.3
22	B5465 / A626	NB	2.1
	B5465 / A626	SB	2.1
23	A626	NB	4.9
	A626	SB	4.9
24	A560	NB	3.9
	A560	SB	3.9
25	A6017	NB	3.9
	A6017	SB	3.9
26	A560 / A627	NB	6.6
	A560 / A627	SB	6.6
27	A626	NB	11.9
	A626	SB	11.9
28	A560	NB	4.9
	A560	SB	4.9
29	A627	NB	6.4
	A627	SB	6.4
30	A560	NB	7.1
	A560	SB	7.1
31	B6104	NB	5.8
	B6104	SB	5.8

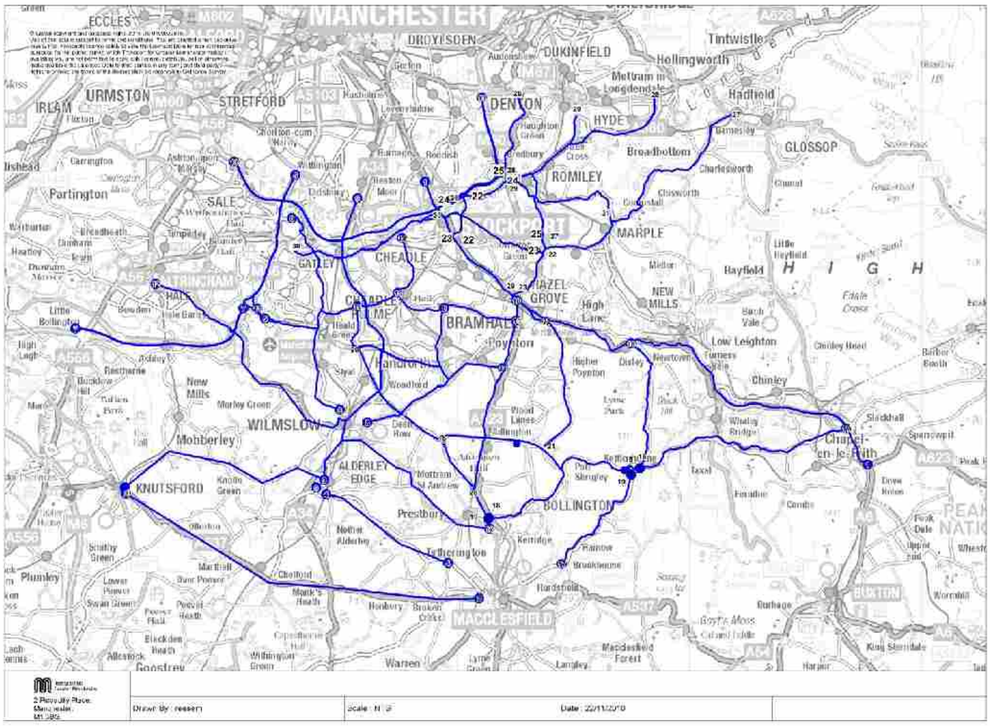


Figure 6.4 Journey Time Routes

Table 6.8: 2024 Forecast Journey Times

Route	Distance	AM Peak			Inter Peak			PM Peak		
		Do-Minimum Time (minutes)	Do-Something Time (minutes)	Difference (minutes)	Do-Minimum Time (minutes)	Do-Something Time (minutes)	Difference (minutes)	Do-Minimum Time (minutes)	Do-Something Time (minutes)	Difference (minutes)
1	25.325	56.8	53.3	-3.5	48.9	45.2	-3.7	53.4	50.0	-3.4
	25.306	50.8	52.1	1.3	44.4	46.3	1.9	50.4	48.3	-2.1
2	16.353	20.6	20.6	0.0	19.8	19.8	0.0	20.3	20.2	0.0
	16.353	20.2	20.2	0.0	19.8	19.8	0.0	20.2	20.2	0.0
3	10.196	14.1	14.1	0.0	12.6	12.6	0.0	14.1	14.0	-0.1
	10.196	13.4	13.4	0.0	12.5	12.5	0.0	14.0	14.0	-0.1
4	6.575	6.9	6.9	0.0	6.5	6.5	0.0	6.8	6.8	0.0
	6.575	6.8	6.8	0.0	6.4	6.4	0.0	6.8	6.8	0.0
5	7.653	7.7	7.4	-0.3	6.4	6.4	0.0	8.2	7.8	-0.4
	6.632	7.2	7.2	0.0	5.7	5.7	0.1	7.0	7.1	0.1
6	9.92	15.5	15.5	0.0	13.9	14.0	0.0	15.8	15.8	0.0
	8.155	13.3	13.1	-0.2	11.5	11.5	0.0	13.7	13.7	0.0
7	7.872	7.4	7.3	0.0	5.5	5.5	0.0	7.3	7.3	0.0
	5.312	4.7	4.7	0.0	3.7	3.7	0.0	7.0	7.1	0.1
8	6.457	9.9	9.9	0.0	8.2	8.2	0.0	10.2	9.8	-0.4
	6.457	10.3	10.3	0.0	8.4	8.4	0.0	9.9	9.9	0.0
9	14.281	21.5	20.0	-1.6	16.0	15.9	-0.1	22.0	20.5	-1.5
	13.541	21.1	20.0	-1.2	15.0	15.1	0.1	20.4	18.6	-1.7
10	10.126	18.8	19.8	1.1	16.4	16.2	-0.2	19.3	18.7	-0.6
	10.098	17.9	18.2	0.4	15.6	15.6	0.0	17.0	17.6	0.5
11	10.578	18.3	18.2	0.0	16.1	16.0	0.0	18.4	18.2	-0.1
	12.589	21.0	20.6	-0.4	18.4	18.4	0.0	21.7	21.5	-0.2
12	22.394	32.9	32.9	0.0	29.5	29.5	0.1	32.7	32.6	-0.1
	22.299	32.7	32.7	0.0	29.6	29.5	-0.1	38.9	38.3	-0.6
13	17.043	16.6	16.3	-0.3	13.9	13.8	-0.2	16.7	16.7	-0.1
	17.817	16.4	16.5	0.1	13.8	13.8	0.0	15.3	15.6	0.3
14	5.173	13.8	12.8	-1.0	10.1	10.0	-0.1	12.1	12.1	-0.1
	5.173	11.8	11.5	-0.3	10.6	10.5	-0.2	12.3	12.1	-0.1

15	5.765	10.6	10.5	-0.1	9.0	9.0	0.0	10.5	10.3	-0.1
	5.765	11.0	10.8	-0.2	9.4	9.4	0.0	11.1	11.0	-0.2
16	5.968	7.6	7.6	0.0	7.6	7.6	0.0	7.7	7.6	0.0
	5.968	7.5	7.6	0.0	7.5	7.5	0.0	7.5	7.5	0.0
17	16.538	20.7	20.7	0.0	20.3	20.3	0.1	20.8	20.7	-0.1
	16.538	20.8	21.1	0.4	20.0	20.0	0.0	20.3	20.1	-0.1
18	4.579	7.6	7.7	0.0	7.5	7.5	0.0	7.5	7.6	0.0
	4.579	7.4	7.4	0.0	7.3	7.3	0.0	7.4	7.4	0.0
19	9.671	13.1	13.5	0.4	13.1	13.2	0.1	13.2	13.5	0.3
	9.671	12.9	13.2	0.3	12.9	13.1	0.2	13.0	13.3	0.3
20	8.934	13.9	13.9	0.1	12.6	12.6	0.0	14.1	14.2	0.1
	8.927	14.5	14.9	0.4	13.2	13.7	0.5	15.3	16.0	0.7
21	7.345	12.8	13.0	0.2	12.0	12.4	0.4	12.2	12.7	0.5
	7.345	12.2	12.2	0.0	11.7	11.7	0.0	11.7	11.8	0.0
22	2.007	6.5	5.5	-1.0	5.0	4.7	-0.3	5.2	5.1	-0.1
	2.035	5.8	5.6	-0.2	4.9	4.8	-0.1	5.8	5.4	-0.4
23	5.071	13.8	12.9	-0.9	12.2	12.0	-0.1	14.6	14.0	-0.6
	5.071	12.8	13.4	0.5	10.9	11.1	0.2	13.1	12.4	-0.8
24	4.012	9.9	10.1	0.3	8.5	8.9	0.4	11.3	9.3	-2.0
	3.968	10.6	9.8	-0.7	7.5	7.4	-0.1	9.2	8.7	-0.5
25	3.898	7.2	7.3	0.1	6.6	6.4	-0.1	7.9	7.5	-0.4
	3.922	6.6	6.7	0.2	5.7	5.7	0.0	6.3	6.6	0.3
26	6.485	13.9	13.6	-0.3	12.5	12.0	-0.5	13.9	13.3	-0.6
	6.485	14.9	13.4	-1.5	12.0	11.5	-0.5	13.5	12.9	-0.6
27	8.729	13.2	13.3	0.1	11.8	11.8	0.0	13.3	13.3	0.0
	8.729	14.3	14.0	-0.3	12.4	12.5	0.1	14.2	13.8	-0.4
28	4.886	9.5	9.8	0.3	7.0	7.0	0.0	7.7	7.7	0.0
	4.886	7.8	7.8	0.0	6.9	6.9	0.0	7.8	7.7	0.0
29	6.267	10.3	10.5	0.2	9.5	9.9	0.4	11.1	11.0	-0.1
	6.267	9.7	9.6	-0.1	9.0	9.1	0.1	10.1	10.5	0.4
30	6.739	16.8	16.4	-0.4	13.1	13.2	0.1	16.3	15.3	-1.0
	7.124	20.0	18.7	-1.3	15.5	15.0	-0.5	20.8	19.2	-1.6
31	5.82	11.3	10.6	-0.7	9.8	9.5	-0.3	10.8	10.3	-0.5
	5.82	10.9	10.3	-0.6	9.8	9.5	-0.3	11.3	10.5	-0.8

Table 6.9: 2039 Forecast Journey Times										
		AM Peak			Inter Peak			PM Peak		
Route	Distance	Do-Minimum Time (minutes)	Do-Something Time (minutes)	Difference (minutes)	Do-Minimum Time (minutes)	Do-Something Time (minutes)	Difference (minutes)	Do-Minimum Time (minutes)	Do-Something Time (minutes)	Difference (minutes)
1	25.3	64.3	60.8	-3.6	48.8	46.0	-2.8	64.6	63.2	-1.4
	25.3	52.8	53.9	1.1	46.5	47.3	0.7	53.7	50.6	-3.1
2	16.4	21.0	21.0	0.0	19.8	19.8	0.0	20.7	20.7	0.0
	16.4	20.4	20.4	0.0	19.9	19.9	0.0	20.6	20.6	0.0
3	10.2	14.4	14.4	0.0	12.7	12.8	0.0	14.6	14.6	-0.1
	10.2	13.8	13.8	0.0	12.6	12.6	0.0	14.6	14.6	0.0
4	6.6	6.9	6.9	0.0	6.5	6.5	0.0	6.9	6.9	0.0
	6.6	6.8	6.8	0.0	6.4	6.4	0.0	6.8	6.8	0.0
5	7.7	9.3	8.8	-0.5	6.8	6.7	-0.1	9.3	8.8	-0.5
	6.6	7.9	8.0	0.1	6.0	5.9	-0.1	7.6	7.8	0.2
6	9.9	18.0	16.8	-1.3	14.2	14.2	0.0	16.6	16.4	-0.3
	8.2	14.0	13.5	-0.5	11.6	11.6	0.0	14.8	14.5	-0.3
7	7.9	8.8	8.7	-0.1	6.0	5.9	-0.1	8.4	8.4	0.1
	5.3	5.2	5.2	0.0	4.2	4.1	0.0	8.0	8.0	0.0
8	6.5	10.5	10.3	-0.2	8.3	8.3	0.0	10.7	10.4	-0.3
	6.5	10.7	10.7	0.0	8.6	8.6	0.0	10.1	10.0	-0.1
9	14.3	26.5	23.2	-3.3	17.8	16.2	-1.6	26.0	22.8	-3.2
	13.5	25.9	23.6	-2.3	16.5	15.7	-0.8	25.1	20.0	-5.1
10	10.1	20.5	20.8	0.4	16.7	16.8	0.2	20.9	20.7	-0.2
	10.1	19.7	19.4	-0.3	15.7	15.6	-0.1	19.5	19.3	-0.3
11	10.6	18.6	18.3	-0.3	16.4	16.5	0.2	19.2	18.7	-0.5
	12.6	21.6	21.4	-0.2	18.5	18.8	0.3	22.2	22.4	0.2
12	22.4	33.8	33.6	-0.2	29.6	29.6	0.0	34.8	33.7	-1.0
	22.3	34.5	34.0	-0.5	29.9	30.0	0.0	41.4	40.8	-0.7
13	17.0	18.4	18.4	-0.1	15.8	15.5	-0.3	20.1	19.8	-0.2
	17.8	18.4	18.2	-0.1	15.6	15.3	-0.2	16.9	17.1	0.2
14	5.2	15.0	13.7	-1.3	10.4	10.2	-0.1	13.1	12.3	-0.8
	5.2	12.5	11.8	-0.7	10.8	10.9	0.0	13.2	12.4	-0.8

15	5.8	10.8	10.7	-0.1	9.1	9.0	-0.1	10.8	10.6	-0.3
	5.8	11.3	11.1	-0.2	9.6	9.5	-0.1	11.5	11.3	-0.2
	6.0	7.6	7.6	0.0	7.6	7.6	0.0	7.8	7.7	0.0
	6.0	7.5	7.6	0.0	7.5	7.5	0.0	7.6	7.6	0.0
17	16.5	21.1	21.3	0.1	20.3	20.3	0.0	22.0	23.9	1.9
	16.5	21.2	21.3	0.1	20.0	20.0	0.0	22.3	21.7	-0.7
18	4.6	7.7	7.7	0.0	7.5	7.5	0.0	7.6	7.6	0.0
	4.6	7.4	7.4	0.0	7.3	7.3	0.0	7.6	7.6	0.0
19	9.7	13.2	13.7	0.5	13.1	13.1	0.0	13.5	13.9	0.4
	9.7	13.0	13.2	0.3	12.9	12.9	0.0	13.4	13.7	0.3
20	8.9	13.8	14.0	0.2	12.6	12.6	0.0	14.5	14.6	0.2
	8.9	14.9	14.9	0.0	13.4	13.4	0.0	16.2	16.2	0.0
21	7.3	13.2	13.0	-0.2	12.1	12.3	0.2	12.4	12.5	0.1
	7.3	12.2	12.2	0.0	11.7	11.7	0.0	11.7	11.8	0.0
22	2.0	6.2	5.4	-0.8	5.4	4.8	-0.6	5.5	5.5	0.0
	2.0	6.5	5.7	-0.8	5.1	4.9	-0.1	6.4	5.5	-0.9
23	5.1	14.4	13.5	-0.8	13.0	12.6	-0.4	15.4	13.9	-1.5
	5.1	12.9	13.5	0.6	11.4	11.2	-0.1	14.9	12.6	-2.2
24	4.0	12.9	11.4	-1.5	9.2	9.2	0.1	12.9	9.7	-3.2
	4.0	12.2	12.3	0.1	8.1	8.1	0.1	9.0	8.7	-0.3
25	3.9	7.4	7.6	0.2	6.7	6.7	0.0	8.6	9.2	0.7
	3.9	6.8	6.9	0.1	5.8	5.7	0.0	7.6	6.6	-1.1
26	6.5	14.3	13.9	-0.4	13.0	12.6	-0.4	15.1	13.6	-1.5
	6.5	14.7	13.6	-1.1	12.7	11.9	-0.8	14.0	13.2	-0.8
27	8.7	13.3	13.5	0.2	12.0	11.8	-0.2	13.3	14.0	0.7
	8.7	16.3	14.4	-2.0	12.7	12.6	-0.1	15.0	14.1	-0.9
28	4.9	10.3	10.7	0.4	7.7	7.7	0.0	7.7	7.7	0.0
	4.9	7.9	7.9	0.0	6.9	6.9	0.0	7.9	7.9	-0.1
29	6.3	10.6	10.7	0.0	10.8	10.5	-0.3	14.0	11.4	-2.6
	6.3	10.4	9.6	-0.7	9.3	9.4	0.1	10.2	10.5	0.3
30	6.7	19.5	17.0	-2.5	13.4	13.5	0.2	17.6	16.7	-0.9
	7.1	22.7	20.0	-2.7	15.9	16.0	0.1	25.3	20.4	-4.9
31	5.8	11.3	10.7	-0.7	10.0	9.9	-0.1	11.0	10.6	-0.4
	5.8	11.0	10.4	-0.7	9.9	9.8	-0.1	11.9	11.2	-0.7

7. Conclusions

7.1 Transport for Greater Manchester (TfGM) has been appointed to undertake the traffic forecasting and economic appraisal of the preferred scheme option for A6 to M60 Relief Road, in Stockport

7.2 The scheme improves access to / from Manchester Airport and its employment areas as well as Hazel Grove, Newby Road, Bramhall Moor Lane, Poynton and Stanley Green employment areas. Access to a number of regeneration areas is also improved by the scheme, including Stockport Town Centre M60 Gateway, and Wythenshawe.

7.3 The proposed scheme consists of approximately 7.5km of new dual 2-lane and will include two new junctions and amendments to junctions at the A6 and at the M6A560 roundabout at Bredbury as well as a new junction with the A6 at Stepping Hill.

7.4 Demand forecasts were derived using TEMPRO v7 and the development uncertainty logs provided by local authorities and other relevant organisations. Assumptions on population and employment growth used to derive the Core forecasts came from a variety of sources, namely :

- The relevant planning departments in High Peak, Cheshire East, Manchester, Stockport, Trafford for specific developments included in their Local Development Frameworks;
- Manchester Airport Group (MAG) for passenger and employee growth and development at and around Manchester Airport;
- Local Development Framework datasets for developments elsewhere in Greater Manchester;
- The National Trip End Model (NTEM) dataset 6.2 forecasts; and
- The National Transport Model forecasts (for freight traffic).

7.5 The methodology used to derive the Core forecasts involved:

- Application of NTEM adjusted TEMPRO growth by district to 2024 and 2039
- Addition of development growth in appropriate zone based on information provided by districts and utilising trip generation rates utilised for the A6MARR scheme
- constraining the population and employment growth forecasts to the overall growth level implied by TEMPRO at the district level within Greater Manchester the pre-2009 district level for Cheshire East and at the county level elsewhere; and

7.6 The A6 to M60 Relief Road SATURN model was cordoned to an identified Area of Influence (AOI) for the assessment of the proposed scheme. This ‘Without Scheme’ cordon model formed the base for the development of a ‘With Scheme’ scenario. The Do-Minimum and Do-something scenarios were assessed using a flat matrix /(i.e. without variable demand modelling)

7.7 The Core Scenario forecasts show that the proposed A6 to M60 Relief Road provides significant additional network capacity and an improved route for trips travelling to and from M60 J24 to Stockport and the surrounding areas. The scheme also provides relief to the A6 corridor through Stockport.

7.8 The proposed scheme provides time savings for travel in the Stockport area and this is most prominent during congested times of the day in 2039. The time savings are largely connected with the transfer of traffic from the A6 corridor and the M60 to the proposed scheme.

7.9 The traffic forecasts demonstrate that the scheme would provide improved accessibility to the Stockport area, reduce levels of congestion on the network local to the scheme and as a result, it will help to promote economic regeneration.