
Transport Model for Scotland

End of Term Report

Prepared for
The Scottish Executive

June 2005

Contents

| Chapter | | Page |
|----------|--|-----------|
| 1 | Introduction | 1 |
| | 1.1 Background | 1 |
| | 1.2 TMfS Model Objectives | 2 |
| | 1.3 TMfS Audit | 2 |
| | 1.4 Project Team and Steering Group | 3 |
| 2 | Review of Model Use | 5 |
| | 2.1 Applications | 5 |
| | 2.2 Performance | 5 |
| 3 | Current Model Status | 7 |
| | 3.1 Introduction | 7 |
| | 3.2 Model Documentation | 7 |
| | 3.3 Age of Constituent Data | 8 |
| | 3.4 Changes since Calibration | 9 |
| | 3.5 Software | 10 |
| | 3.6 Hardware | 10 |
| | 3.7 Run Times | 11 |
| 4 | Access to the Model | 13 |
| | 4.1 List of Users | 13 |
| | 4.2 Level of Use | 13 |
| 5 | Model Enhancements | 15 |
| | 5.1 Recommendations | 15 |
| | 5.2 Use of Scottish Household Survey and Census Data | 15 |
| | 5.3 Trip End Modelling | 15 |
| | 5.4 Extension of Model Study Area to Aberdeen | 15 |
| | 5.5 Base Model Data | 16 |
| | 5.6 Mixed Mode Modelling | 16 |
| | 5.7 Land Use Model | 16 |
| | 5.8 Improved Goods Vehicle Forecasting | 17 |
| | 5.9 Hardware and Software | 17 |
| | 5.10 Long Distance Travel Model | 17 |
| | 5.11 Extension of Model Study Area to the Highlands | 18 |
| | 5.12 Trip Frequency Modelling | 18 |
| | 5.13 Peak Spreading | 18 |
| | 5.14 Congestion Mapping | 18 |
| | 5.15 Public Transport Model | 19 |
| | 5.16 Highway Assignment Model | 19 |
| | 5.17 DfT National Model | 19 |
| | 5.18 Supply Demand Convergence | 20 |
| | 5.19 Tolling Model Assignment Procedure | 20 |
| | 5.20 Parking Charges | 20 |
| | 5.21 Weekend Traffic Model | 21 |
| | 5.22 TMfS database | 21 |
| | 5.23 Level of Spatial Detail | 21 |
| | 5.24 Demand Model Structure | 22 |
| | 5.25 Highway Generalised Cost Parameters | 22 |

Contents

| | | |
|-------------------|---|-----------|
| 5.26 | Survey Data Preparation | 22 |
| 5.27 | Macro Time of Day Choice | 22 |
| 5.28 | High Occupancy Vehicle Modelling | 23 |
| 6 | Future Data Collection | 25 |
| 6.1 | Data Collection Since Model Calibration | 25 |
| 6.2 | Future Roadside Interview Data Collection Recommendations | 25 |
| 6.3 | Future PT Data Collection Recommendations | 26 |
| 6.4 | Other Data Collection Recommendations | 27 |
| Figures | | |
| Figure 1.1 | TMfS Family Tree | 1 |
| Figure 3.1 | RSI Data Used in the Development of TMfS | 8 |
| Figure 3.2 | Public Transport Surveys Undertaken for TMfS | 9 |
| Figure 6.1 | Proposed RSI locations | 25 |
| Tables | | |
| Table 2.1 | Uses of TMfS to Date | 5 |
| Table 3.1 | Example Model Run Times | 11 |
| Table 3.2 | Demand Model Run Time | 12 |
| Appendices | | |
| A | TMfS Constituent Data – Roadside Interviews | |
| B | TMfS Constituent Data – PT survey locations | |

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1 Introduction

1.1 Background

- 1.1.1 The Central Scotland Transport Model (CSTM3) was developed by MVA for the Scottish Executive (then the Scottish Office) during 1997 and early 1998. The model has subsequently been enhanced and maintained by MVA as part of the term commission that covered the original model development.
- 1.1.2 CSTM3 and a derivative CSTM3A (developed by MVA for the Central Scotland Transport Corridor Studies - CSTCS) have been used extensively for major scheme appraisals by MVA, other consultants, by local authorities and the Scottish Executive.
- 1.1.3 In August 2001, the Scottish Executive appointed MVA to a four year term commission to maintain and further enhance CSTM3. This commission has been named Transport Model for Scotland (TMfS) and is due for completion in August 2005. Figure 1.1 illustrates the family tree of TMfS.

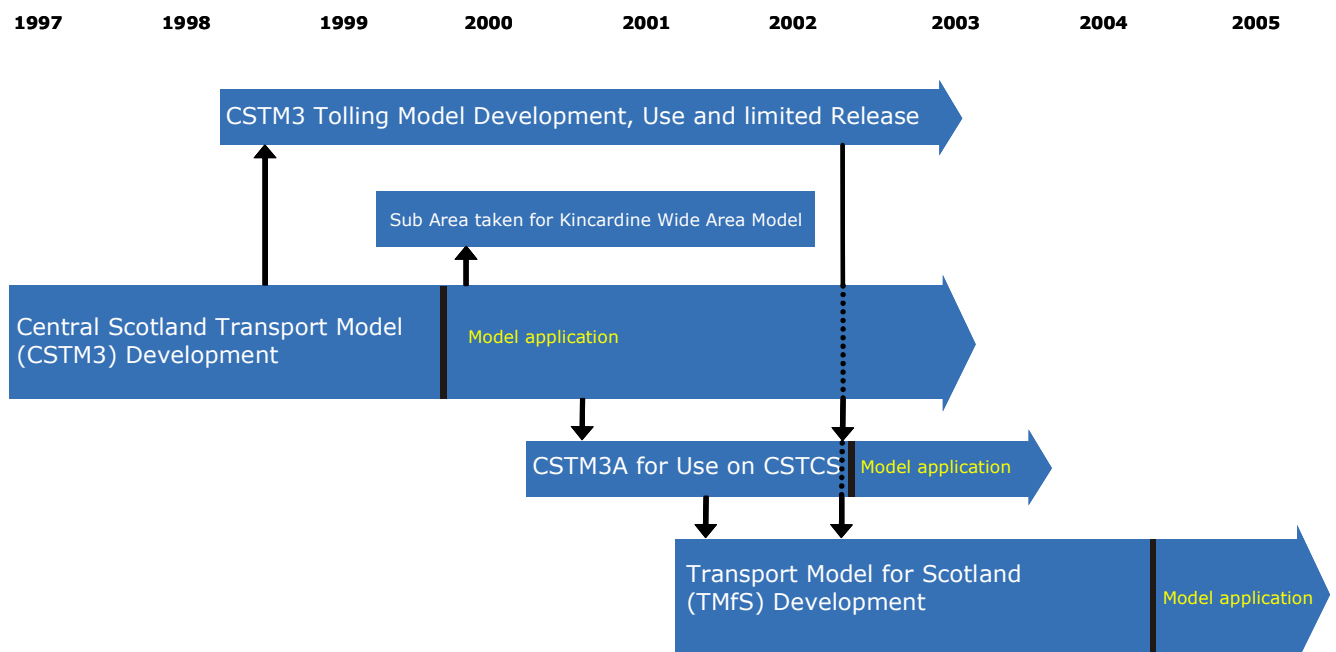


Figure 1.1 TMfS Family Tree

- 1.1.4 The TMfS Inception Report (MVA, December 2001) identified the modelling objectives and set out the programme of Work Packages. The Enhancement Report (MVA, October 2002) defined the detailed specification of TMfS. The contents of each report were discussed and agreed with the TMfS Steering Group. Thereafter, MVA progressed the development of TMfS.
- 1.1.5 The development of TMfS was completed in August 2004 and has since been used by MVA, other consultants, by local authorities and the Scottish Executive.
- 1.1.6 This report contains a review of the models use, the current model status and proposed enhancements to both the transport and land use models. It also discusses potential additional data sources and surveys that, if included, would improve the quality of model output.

1.1.7 Finally, this report contains a summary of staff resources used in the Time and Materials aspects of this commission to date. A more detailed analysis of the staff resourcing and costings of both the actual commission and proposed enhancements is included in the TMfS Financial Report August 2001 - April 2005 (MVA, May 2005).

1.2 TMfS Model Objectives

1.2.1 The objectives of the Commission are included in Section 6 of the project brief and are included here in summary:

- to **run, maintain and support CSTM3** to ensure that the model can be used by the Executive and to provide support and maintenance to other model users;
- to **recommend a programme for the development and enhancement of the model**, including innovative ideas, and to implement the agreed programme; and
- to **run, maintain and support the enhanced model (TMfS)**.

1.2.2 The objectives of the model are also included in Section 6 of the project brief and are included here in summary:

- provide **robust traffic forecasts on all Trunk Roads** within the model area over a 20 year horizon;
- **enable** traffic, economic and land-use **assessments of proposed major inter-urban road schemes** for Stages 1 (corridor assessment) and 2 (route option assessment) of the roads design process, as specified in the Design Manual for Roads and Bridges;
- **test the effects** of and/or interaction between **major inter-urban road and public transport schemes** and **major transport policy options**, such as:
 - schemes to improve inter-urban public transport;
 - schemes or policies aimed at reducing congestion in accordance with the Road Traffic Reduction Act, National Targets Act and the Transport White Papers;
 - schemes which introduce road user charging (road tolls or congestion charging); and
- **provide consistent information** and a **framework** for **local scheme models**, as a basis for the development of Local Transport Strategies or with a view to testing potential strategies.

1.3 TMfS Audit

1.3.1 As part of the Scottish Executives quality assurance procedures for transport modelling, an independent technical audit of TMfS is being undertaken and is nearing completion.

1.3.2 Throughout the development of TMfS, the Traffic and Transport Auditor and Adviser (TTAA) has undertaken an audit of each of the model components that make up TMfS (namely, Highways Assignment Model, Public Transport Model, Demand Model and Park and Ride Model) against the model objectives and against best modelling practice.

1.3.3 The TTAA findings have been reported on and have not shown there to be any significant issues thus far. The remaining task to complete the audit is for both MVA and the auditor to agree a final audit report.

1.4 Project Team and Steering Group

1.4.1 The TMfS project team is presented below, showing each members individual role within the team.

- **Scottish Executive Project Manager:** Alan Clark;
- **Scottish Executive Project Engineer:** Diarmid Lindsay;
- **MVA Project Director:** Steve Williamson;
- **MVA Project Manager:** Kevin Lumsden;
- **Core Model Development and Support Team:**
 - MVA (Transport Model):** Andrew Reid, Chris Robinson, Jeff Davidson, Mutia Tjokronegoro, Ian Wilkinson;
 - David Simmonds Consultancy (Land Use Model):** Andrea Aramu, Vicki White, Simon Sutcliffe;
- **Specialist Advisors:**
 - Mike Brewer, MVA:** Demand, Economic and Highways Modelling;
 - Ian Burden, MVA:** Public Transport Modelling;
 - David Connolly, MVA:** Environmental and Accessibility Modelling;
 - Dougie McDonald, MVA:** CSTCS and other historical CSTM3 model applications; and
 - David Simmonds, DSC:** Land Use Modelling and planning information.

1.4.2 Due to the longevity of the commission and various post changes within the Executive, the Scottish Executive members of the Steering Group have changed since the Inception and Enhancement phase of 2001/2002. The current TMfS Steering Group is comprised of the following members:

- **Alan Clark (Chair), SE:** Technical Support and Transport Research (TS&LD);
- **Diarmid Lindsay, SE:** Technical Support and Transport Research (TS&LD);
- **Graham Laidlaw, SE:** Transport Division 4 (Ferries);
- **Neil Wands, SE:** TRDCD – Standards, Traffic and Environment;
- **Andy Park, SE:** Analytical Services Division (Transport Economics);
- **Alison Bell, SE:** Strategy and Policy (RP&GFD);
- **Angus MacInnes, SE:** Roads Policy and Traffic Management (TS&LD);
- **Ken Crawford, SE:** Transport Division 2 - Aviation, Freight;
- **Paul Teasdale, SE:** Transport Division 3 – Railways;
- **Roy Brannen, SE:** TRNMD - Traffic Controller; and
- **Tom Williamson/Graham Marchbank, SE:** Planning Division 4
- **Steve Williamson, MVA:** Consultants Project Director;
- **Kevin Lumsden, MVA:** Consultants Project Manager; and
- **David Simmonds, DSC:** Consultants Land Use Specialist Advisor.

2 Review of Model Use

2.1 Applications

2.1.1 Table 2.1 lists the main projects for which TMfS has so far been used. These are split by project type, using the following categories:

- Scheme Appraisal (S);
- Policy (P); and
- Database (D). (Note: Database is where the database of information stored within TMfS (eg Network Data, Survey Data, Zonal Data etc), has been extracted for other purposes).

2.1.2 It should be noted that the model has currently only been available since August 2004 and as a result the usage has so far been fairly modest.

Table 2.1 Uses of TMfS to Date

| Project | Consultant | For Client | Type |
|------------------------------------|-------------------|------------------------------------|-------------|
| A80 Upgrade Analysis | MVA | Jacobs Babbie/Scottish Executive | S |
| A90 Tipperty | Carol Bro | Scottish Executive | D |
| Aberdeen Western Peripheral Route* | MVA | Scottish Executive | S |
| Airdrie Bathgate Rail Link Study | MVA | Scottish Executive | S |
| Allandale Study | MVA | Scottish Executive\Falkirk Council | S |
| Edinburgh Airport Rail Link | Scott Wilson | | D |
| Glasgow Airport Rail Link | SKM | | D |
| Glasgow Car Park Requirement Study | MVA | Glasgow City Council | P |
| Glasgow Hospital Accessibility | Jayress | | D |
| Glasgow Pre-LRT | MVA | Glasgow City Council | D |
| Heartlands Development Study | WSP | | D |
| Kilmarnock Park and Ride Study | MVA | Stagecoach | S |
| Lothians Structure Plan | MVA | Lothian Councils | D |
| Ravenscraig Development | Jayress | Carl Bro | D |
| Tolled Bridges Study | MVA | Scottish Executive | P |

* As part of the TMfS contract, a separate Aberdeen Sub Area Model was prepared in the early stages of the contract. This sub area model was used to undertake the initial appraisal of the Aberdeen Western Peripheral Route (AWPR).

2.2 Performance

2.2.1 TMfS was developed to meet the model objectives as defined by the Scottish Executive and noted in paragraph 1.2.2. It is normal practice to build a specific model for a specific objective (eg a scheme appraisal). However, TMfS is a strategic model that has not been prepared for such pre-defined specific objectives, but for general objectives covering a range of possible uses and a wide geographical area. Therefore, it may be the case that specific applications of the model require further enhancement (detail\data) to undertake an appraisal.

2.2.2 The calibration and validation reports of the Highways, Public Transport, Park and Ride and Demand models document the models performance in terms of the Base Year analysis. Detailed information on model performance in forecast mode is not available at this time as only nominal applications of the model in forecast mode have been undertaken to date. Chapter 7 of this report provides background on potential applications of the model that will assist in preparing guidance on the performance of the model in forecast mode.

2.2.3 Chapter 6 of this report discusses areas of the model which would benefit from more up to date survey data and therefore improve the robustness of both Base Year and forecast model performance.

3 Current Model Status

3.1 Introduction

3.1.1 The model was completed in August 2004 following inclusion of additional Census data into the development of the Trip End and Land Use Model (TELMoS). The model is also available as a Release Version for the Executive and Local Authorities.

3.1.2 The model has a Base Year of 2002 and contains the following key components:

- Highways Assignment Model;
- Public Transport Assignment Model;
- Demand Model;
- Park and Ride Model;
- Congestion Mapping functionality;
- Geographical Information System (GIS) tables; and
- Graphical User Interface (GUI) for model control.

3.2 Model Documentation

3.2.1 The model development is documented in the following reports:

- TMfS Extension Report, MVA 2002;
- TMfS Final Highway Assignment Model, Calibration and Validation Report, MVA 2004;
- TMfS Final Public Transport Model, Calibration and Validation Report, MVA 2004;
- TMfS Demand Model Development Report, MVA 2004; and
- TMfS Park and Ride Assignment Model, Calibration and Validation Report, MVA 2005.

3.2.2 For the purpose of making the model available for release to other parties, the following documentation has also been prepared:

- TMfS Release Version, Operators Manual, MVA 2005;
- TMfS Release Version, Park and Ride Model Operators Manual, MVA 2005;
- TMfS Release Version, ENEVAL Operators Manual, MVA 2005; and
- TMfS Release Version, Congestion Mapping Operators Manual, MVA 2005.

3.2.3 In addition to the documentation noted above, further information relating to the model development, background, presentations and general information can be found on the TMfS web site: www.TMfS.org.uk

3.3 Age of Constituent Data

3.3.1 Figure 3.1 below illustrates the geographical spread and age of the RSI data used in the development of the Highway Assignment Model. This information can be found in tabular form in Appendix A. (NB In the key, the number in brackets records the number of RSI sites in that year).

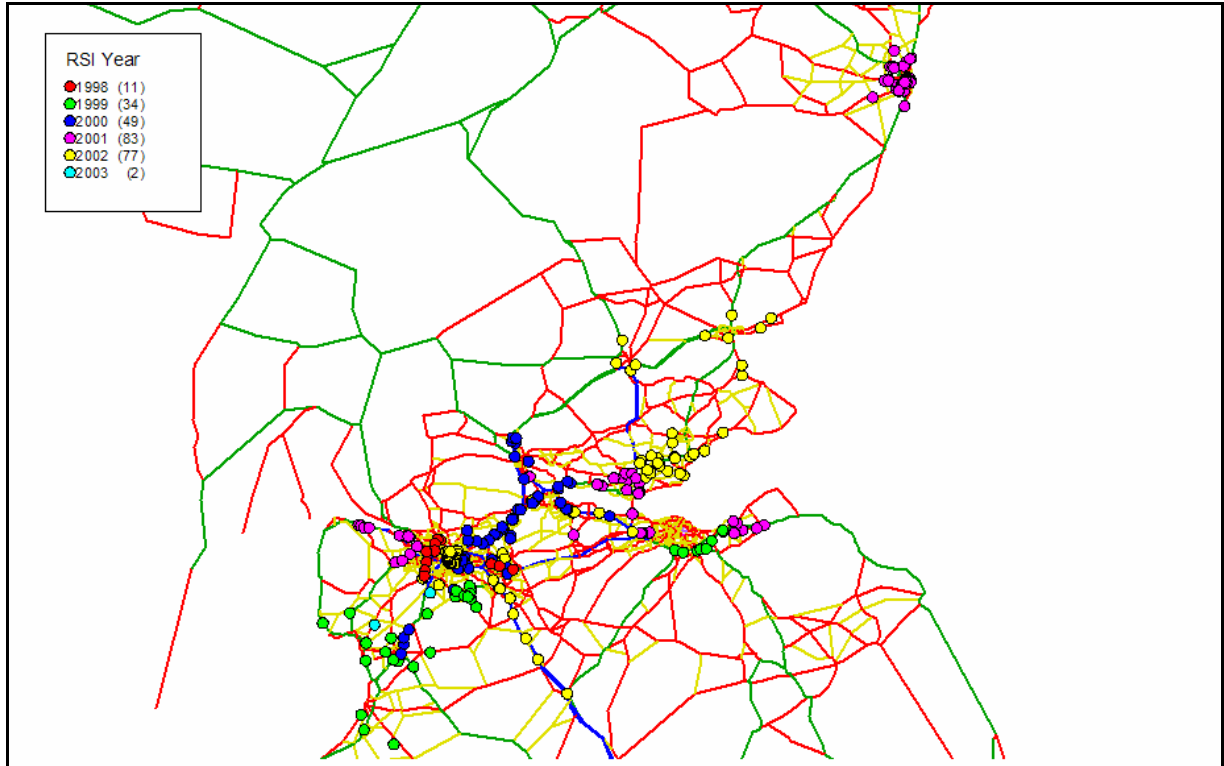


Figure 3.1 RSI Data Used in the Development of TMfS

3.3.2 TMfS Journey Time surveys and Manual Classified Counts used in the calibration and validation are unlikely to be used in any future projects and are therefore not covered in this report. They are described fully in the TMfS Final Highway Assignment Model Calibration and Validation Report (MVA 2004).

3.3.3 A number of Public Transport surveys were undertaken for TMfS as illustrated in Figure 3.2 below. These new surveys were used in conjunction with existing surveys to calibrate the Public Transport model. This information can be found in tabular form in Appendix B.

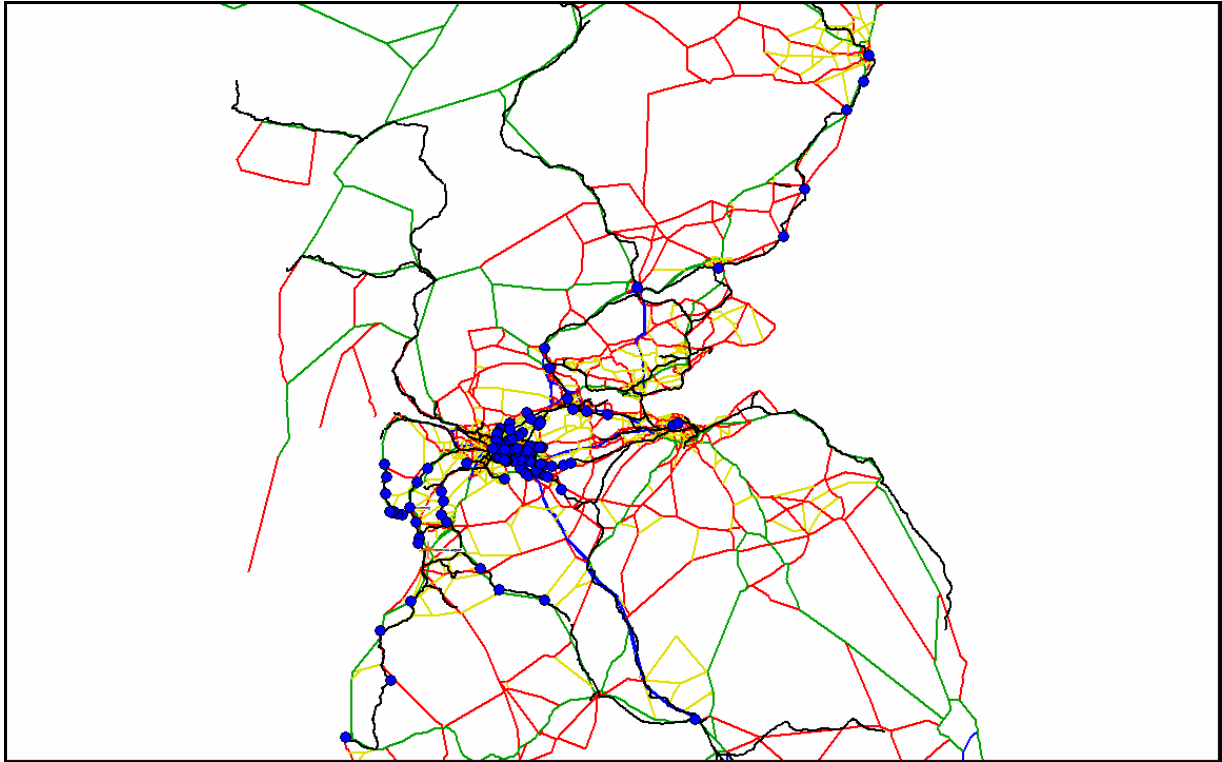


Figure 3.2 Public Transport Surveys Undertaken for TMfS

3.4 Changes since Calibration

- 3.4.1 Since the original calibration of the model a number of changes have been made to the model networks and structure.
- 3.4.2 During the Tolerated Bridges (Phase 1) study the Assignment Model was found to be over sensitive to changes in tolls. Some desk research was undertaken into the distribution of value of time (willingness to pay tolls) and as a result the parameters used in the calculation of generalised costs for assignment were amended to achieve a more realistic result. The changes as a result of this are documented in Chapter 5 of the TMfS Final Highway Assignment Model, Calibration and Validation Report, MVA 2004.
- 3.4.3 There have also been changes to the Base and Future Year 'Do Minimum' Highway and PT networks that have come about as a result of:
- experience through application of the model;
 - audit findings; and
 - schemes that have opened since the model was calibrated.

3.4.4 The principal schemes which have opened since the calibration of the model, and have been included in the future year 'Do Minimum' networks are as follows:

- Edinburgh Park Rail Station;
- M77 Extension (Fenwick to Malletsheugh);
- Glasgow Southern Orbital Road;
- £1 toll for cars on Forth Road Bridge;
- Holyrood Road Amendments;
- Bus Priority Schemes in Edinburgh;
- Straiton to Leith Quality Bus Corridor;
- A1 Dualling between Haddington and Dunbar;
- WEBS – West Edinburgh Guided Busway;
- Increased number of carriages on Fife Circle trains;
- Bus Priorities within Edinburgh; and
- Ferrytoll Extension.

3.5 Software

3.5.1 TMfS has been developed using the Citilabs Cube software suite within a Windows XP operating system. The TMfS is run through a Visual Basic Interface and as a result requires the installation of Microsoft .NET Framework 1.1 on the host PC.

3.6 Hardware

3.6.1 TMfS is a large model with significant processing requirements. At the outset of the commission, the recommended minimum PC specification of PC to run TMfS was as follows:

| Component | Recommended Minimum |
|------------------|---|
| Processor | 500 MHz (Pentium/Athlon) |
| RAM | 192 MB |
| Hard Disk | 40.0 GB Free Space |
| Monitor | SVGA compliant (Screen Resolution 1024x768) |
| DVD-Rom | N/A |

3.6.2 However, as computing specification has advanced considerably since 2001, MVA is currently running TMfS on PC's with the following specification:

Component

| | |
|-----------|---|
| Processor | 3.6 GHz (Pentium 4) |
| RAM | 1 GB |
| Hard Disk | 65.0 GB Free Space |
| Monitor | SVGA compliant (Screen Resolution 1024x768) |
| DVD-Rom | N/A |

3.6.3 As time goes by PC hardware performance is expected to improve and prices of such hardware may fall. Therefore, it is recommended that, at this time, the specification noted in Section 3.6.2 is the minimum specification for running TMfS.

3.7 Run Times

3.7.1 Table 3.1 provides a set of indicative TMfS model run times for the different elements of a Demand Model run, for a 2006 Do Nothing test, using a PC with the specification described in paragraph 3.6.2.

Table 3.1 Example Model Run Times

| Component | Sub Model | Time Period | Approximate Run Time (mins) |
|--------------------------|------------------------|-------------------------|-----------------------------|
| Demand Model | Inner Loop | AM or Inter Peak Period | 8 |
| | Matrix Creation | All time periods | 22 |
| Highway Assignment Model | Assignment | AM Peak | 53 |
| | Assignment | Inter Peak | 22 |
| | Assignment | PM Peak | 53 |
| | Full Economic Skimming | AM Peak | 250 |
| | Full Economic Skimming | Inter Peak | 100 |
| | Full Economic Skimming | PM Peak | 250 |
| PT Assignment Model | Assignment | AM Peak | 13 |
| | Assignment | Inter Peak | 13 |
| | Assignment | PM Peak | 15 |
| | Demand Model Skimming | AM Peak | 30 |
| | Demand Model Skimming | Inter Peak | 30 |

3.7.2 It should be noted that run times will change depending on the options selected by the user when setting up the test and for which modelled year it is being run.

3.7.3 Table 3.2 below shows the typical run time for a five loop Demand Model run for one forecast year, to prepare operational analysis.

Table 3.2 Demand Model Run Time

| Stage | Time | No | Total Time |
|---------------------------------|-------------|-----------|---------------------------|
| Inner Loop | 8 | 5 | 40 |
| Matrix Creation | 22 | 5 | 110 |
| Highway Assignment – AM Peak | 53 | 5 | 265 |
| Highway Assignment – Inter Peak | 22 | 5 | 110 |
| Highway Assignment – PM Peak | 53 | 1 | 53 |
| PT Assignment – AM Peak | 13 | 2 | 26 |
| PT Assignment – Inter Peak | 13 | 2 | 26 |
| PT Assignment – PM Peak | 15 | 1 | 15 |
| Total | - | - | 645mins (10.75hrs) |

4 Access to the Model

4.1 List of Users

4.1.1 The full Release Version of TMfS is available, but has not yet been issued to any external organisations. Outwith the Scottish Executive, but with authorisation from the Executive, the following have received data, matrices, sub area models and/or networks from TMfS:

- Aberdeen Council;
- Aberdeenshire Council;
- Dundee City Council;
- East Lothian Council;
- Edinburgh City Council;
- Fife Council;
- Glasgow City Council;
- Midlothian Council;
- West Lothian Council;
- Carl Bro;
- Halcrow;
- Jacobs Babbie;
- Jayress;
- JMP;
- Mouchel Parkman;
- Scott Wilson;
- SDG;
- Sinclair Knight Mertz;
- SIAS;
- Stagecoach;
- WS Atkins; and
- WSP Group.

4.2 Level of Use

4.2.1 In general, the majority of users are currently using the model as a database for RSI data, Trip Ends and summarised planning data which is relevant and consistent for their own studies. In some cases, sub area models and matrices have been extracted to support local detailed models and there have also been model runs commissioned to feed into specific studies within the TMfS modelled area.

5 Model Enhancements

5.1 Recommendations

- 5.1.1 The TMfS Enhancement Report (MVA, 2002) detailed a list of recommendations to enhance the CSTM3 model to prepare what has become TMfS. The scope of model enhancements was agreed with the Steering Group. This Chapter discusses each of these Enhancement Items and provides a brief description of how they have been implemented.
- 5.1.2 For more detailed information on these Enhancement Items, please refer to the relevant documents noted in Section 3.2.

5.2 Use of Scottish Household Survey and Census Data

Brief: Annex 2 Section 2 Item 1 (LS5)

Inception Report: Task 5.1

Enhancement Report: Sections 2.10 and 2.11

- 5.2.1 The data from the 2001 Census has been used in the development of TMfS and within the preparation of Planning Data inputs. The use of this Census data has significantly improved the quality of the base year model data. In addition, the Census data has also been used in the preparation of the Trip End and Land Use Model (TELMoS) model.
- 5.2.2 Some elements of the 2001 Census were not available at the time of Highways and Public Transport Matrix preparation (circa November 2004), most notably, the census travel to work information. Potential use of this data is discussed further in Chapter 7 of this report.
- 5.2.3 Scottish Household Survey (SHS) data has also been used in the development of the TMfS for preparing a number of Demand Model parameters.

5.3 Trip End Modelling

Brief: Annex 2 Section 2 Item 1 (LS5)

Inception Report: Task 5.1

Enhancement Report: Chapter 3

- 5.3.1 Trip End modelling in TMfS is based on the new DfT Trip End Model, the National Trip End Model (NTEM). The model is used to calculate Trip Ends from the TELMoS output, which are then used in the Demand Model procedure.

5.4 Extension of Model Study Area to Aberdeen

Brief: Annex 2 Section 2 Item 2 (LS5)

Inception Report: Task 5.2

Enhancement Report: Section 5.7

Also Refer To: TMfS Extension Report, MVA 2002

- 5.4.1 The Steering Group required that the modelled area of CSTM3 was extended to include Aberdeen and surrounding areas for the purpose of appraising the Aberdeen Western Peripheral Route (AWPR). MVA suggested that it would not be appropriate to use TMfS to appraise the AWPR (due to the large strategic nature of TMfS) and proposed three alternative options to the Steering Group for undertaking this appraisal.
- 5.4.2 Agreement was reached to prepare a detailed local sub area model of Aberdeen and the surrounding area would be prepared for the AWPR appraisal. This model became known as ASAM (Aberdeen Sub Area Model).
- 5.4.3 Thereafter, a less detailed level of network and matrix definition, consistent with the rest of TMfS was incorporated from ASAM into TMfS.

5.5 Base Model Data

Brief: Annex 2 Section 2 Item 3 (LS5)
Inception Report: Task 5.3
Enhancement Report: Chapter 2

- 5.5.1 TMfS has incorporated the most up to date origin and destination data available at the time of development, both for Highway, Public Transport and Park and Ride. This has benefited the accuracy of the base model and the calibration of the parameters for the Demand Model.
- 5.5.2 Due to constraints on the funds available for new data collection, the TMfS modelling team provided advice to the SE on where the limited resources would best be allocated.

5.6 Mixed Mode Modelling

Brief: Annex 2 Section 2 Item 4 (LS5)
Inception Report: Task 5.4
Enhancement Report: Section 5.5
Also Refer To: TMfS Park and Ride Assignment Model, Calibration and Validation Report, MVA 2005

- 5.6.1 Mixed-Mode modelling for the appraisal of Park and Ride schemes has been included within the TMfS as an optional procedure carried out after the convergence of the supply/Demand Model and in accordance with the procedures developed during the Central Scotland Transport Corridor Study (CSTCS). During tests where Park and Ride is not a feature, this module is not implemented.

5.7 Land Use Model

Brief: Annex 2 Section 2 Item 4 (LS5)
Inception Report: Task 5.4
Enhancement Report: Section 5.3

- 5.7.1 TMfS uses TELMoS, which is based on the DELTA land use model to predict future year planning data. The outputs of this are then fed back into the Trip End Model.
- 5.7.2 TELMoS uses a combination of output costs from TMfS, planning data supplied by the local authorities and assumptions on economic growth to predict future year growth in travel within the modelled area.

5.8 Improved Goods Vehicle Forecasting

Brief: Annex 2 Section 2 Item 4 (LS5)
Inception Report: Task 5.4
Enhancement Report: Section 5.4

- 5.8.1 The DELTA model is also used to forecast growth in Goods vehicle traffic. This growth is predicted by TELMoS on a matrix cell by cell basis and not at a Trip End level for internal zonal movements.
- 5.8.2 The external zones (1097-1133) (outwith the modelled area) have their growth predicted by NRTF for all vehicle types.

5.9 Hardware and Software

Brief: Annex 2 Section 2 Item 5 (LS5)
Inception Report: Task 5.5
Enhancement Report: Chapter 6

- 5.9.1 TMfS has been developed to run in a Windows XP environment. The control of the model procedures has been undertaken using Visual Basic and the Cube software suite of programs.
- 5.9.2 At the Inception Phase of TMfS, it was originally intended to use Voyager software for the calibration and validation of the model (Voyager is the next generation of Cube). However, Voyager was in its infancy at that time (2002) and not capable of undertaking the modelling processes required by the TMfS process.
- 5.9.3 Section 3.5 and 3.6 of this report discusses recommended hardware required to run TMfS. During the course of the commission, standard model run times for TMfS have reduced from 24 hours to approximately 10 hours and economic analysis run times have reduced from 28 hours to approximately nine hours through a combination of hardware and software improvements. It is envisaged that model run times will continue to fall as both hardware and software improvements are made.

5.10 Long Distance Travel Model

Brief: Annex 2 Section 2 Item 6 (LS5)
Inception Report: Task 5.6
Enhancement Report: Section 5.8

- 5.10.1 MVA advised that there was not a strong case for developing a long distance model to cover the rest of Scotland. Hence the Steering Group decided not to include it within the TMfS.

5.11 Extension of Model Study Area to the Highlands

Brief: Annex 2 Section 2 Item 6 (LS5)
Inception Report: Task 5.6
Enhancement Report: Section 5.8

5.11.1 It was determined that the model would not be extended to include the Highlands and Islands as discussed with the Steering Group. This is principally because of the different travel patterns that exist in these areas from the rest of Scotland. These areas have subsequently been modelled as externals to the modelled area and have a very basic network structure although full planning data was obtained for this area for input to TELMoS.

5.12 Trip Frequency Modelling

Brief: Annex 2 Section 2 Item 7 (LS5)
Inception Report: Task 5.7
Enhancement Report: Section 4.4

5.12.1 The Trip Frequency module which was developed for CSTM3 has been included in the TMfS Demand Model structure. Testing has taken place as part of the development of the Demand Model to determine the sensitivities and hence finalise the parameters to be used. This is the least sensitive to generalised cost changes of the choice modules within the TMfS Demand Model.

5.13 Peak Spreading

Brief: Annex 2 Section 2 Item 7 (LS5)
Inception Report: Task 5.7
Enhancement Report: Section 4.5

5.13.1 Peak Spreading for the AM peak hour is included within TMfS. It has been updated from the module included in CSTM3 so that it works on individual matrix cells (ie therefore being able to determine the effects of a particular scheme).

5.14 Congestion Mapping

Brief: Annex 2 Section 2 Item 8 (LS5)
Inception Report: Task 5.8
Enhancement Report: Section 7.6
Also Refer To: TMfS Release Version, Congestion Mapping Operators Manual, MVA 2005

5.14.1 The congestion mapping procedure implemented in CSTM3 within MapInfo has been enhanced and applied for use with TMfS. This process extracts speeds from the network to demonstrate where the model has higher levels of congestion. The process is currently set up to analyse levels of congestion. However, other link and zonal based parameters can also be presented in this way.

5.15 Public Transport Model

Brief: Annex 2 Section 3 Item 10 (TR1)

Inception Report: Task 6.2

Enhancement Report: Section 4.9

Also Refer To: TMfS Final Public Transport Model, Calibration and Validation Report, MVA 2004

5.15.1 The main focus for improvement of the Public Transport model was the gathering of new origin and destination data at key locations in the model, to improve the realism of the base model.

5.16 Highway Assignment Model

Brief: Annex 2 Section 3 Item 11 (TR1)

Inception Report: Task 6.3

Enhancement Report: Section 4.6

Also Refer To: TMfS Final Highway Assignment Model, Calibration and Validation Report, MVA 2004

5.16.1 The main focus of development of the Highways Assignment (other than to include the most up to date available survey and count data) was to disaggregate the assignment user classes from two (in CSTM3) to four:

- Car In-Work – travelling during work time and on work business;
- Car Non-Work – travelling to work and other Home-Based purposes;
- LGV's; and
- HGV's.

5.16.2 In addition the Highways Assignment Model was also improved to cater for road tolling assessments (see below).

5.17 DfT National Model

Brief: Annex 2 Section 3 Item 12 (TR1)

Inception Report: Task 6.4

Enhancement Report: Section 5.10

5.17.1 In the Enhancement Report MVA advised and the Steering Group accepted not to develop a DfT-type National Transport Model as it was not compatible with the Executive's objectives for the TMfS.

5.18 Supply Demand Convergence

Brief: Annex 2 Section 3 Additional Items (TR2)
Inception Report: Task 7.1
Enhancement Report: Section 4.7

- 5.18.1 TMfS was initially developed with a trip damping method to control the convergence of the Demand Model. This uses 50% of the current demand loop matrix and 50% of the previous matrix to create a new Trip Matrix.
- 5.18.2 Investigation into the use of DfT's DIADEM algorithm to control the Supply Demand convergence has been undertaken during the development of TMfS. This procedure has now been included within the model and tested using a subset of example test model runs. However, use of the model when instigating the DIADEM control of Supply Demand Convergence is still very much in its infancy (in terms of behavioural response of the model to various test scheme options). As a result, the parameters and options used in the MVDIADEM module are still somewhat untested and could possibly change as a result of further model use.
- 5.18.3 It is also advised that users of the TMfS will start 'Do Something' tests with the output costs of their 'Do Minimum' runs and thereby ensuring a greater degree of convergence can be achieved.

5.19 Tolling Model Assignment Procedure

Brief: Annex 2 Section 3 Additional Items (TR2)
Inception Report: Task 7.2
Enhancement Report: Section 4.6
Also Refer To: TMfS Final Highway Assignment Model, Calibration and Validation Report, MVA 2004

- 5.19.1 The tolling model developed for CSTM3 relied on having an increased number of user classes in order to increase an element of distribution in the value of time (willingness to pay tolls). In TMfS, an alternative procedure has been implemented based on the Cost versus Time Equilibrium method as described by Fabien Leurent in the European Journal of Operational Research. Rather than create additional user classes, the distribution effects of value of time are included by selecting values of time randomly from pre-specified distributions at each iteration of the highway assignment model. This means that there is no need to have a separate version of the model for tolling applications.

5.20 Parking Charges

Brief: Annex 2 Section 3 Additional Items (TR2)
Inception Report: Task 7.3
Enhancement Report: Section 4.6

- 5.20.1 Parking Charges are applied directly to the Generalised Cost matrices for cars. Therefore these costs are taken into consideration by the Demand Model and affect mode, destination and time of day choices.

5.20.2 Charges are currently added in generalised minutes to the zones representing the centres of the following cities:

- Aberdeen;
- Glasgow;
- Edinburgh;
- Stirling;
- Dunfermline;
- Dundee; and
- Perth.

5.21 Weekend Traffic Model

Brief: Annex 2 Section 3 Additional Items (TR2)

Inception Report: Task 7.4

Enhancement Report: Section 5.9

5.21.1 Without the extension of the model to the Highlands or the development of a Long Distance Travel Model, MVA advised and it was accepted by the Steering Group that it was not practicable to develop a weekend traffic model for general traffic forecasting.

5.22 TMfS database

Brief: Annex 2 Section 3 Additional Items (TR2)

Inception Report: Task 7.5

Enhancement Report: Section 7.7

5.22.1 As was the case in CSTM3, TMfS continues to be a database of consistent and reliable information for a range of users.

5.22.2 The TMfS website has been developed with this in mind. In particular, it contains a database section, with Excel files and reports, and a GIS section with maps of the TMfS area.

5.23 Level of Spatial Detail

Enhancement Report: Section 4.2

5.23.1 The level of spatial detail within the TMfS has been updated from that within CSTM3 to match the boundaries of the census output areas. This has made it easier to calculate zonal characteristics such as population and households.

5.23.2 In addition as an improvement from CSTM3, the Demand Model, Assignment Models and Land Use Model all operate at the same level of zonal detail.

5.24 Demand Model Structure

Enhancement Report: Section 4.3

Also Refer To: TMfS Demand Model Development Report, MVA 2004

- 5.24.1 The Demand Model structure has changed significantly from that within CSTM3. Unlike previously when the Demand Model operated at a 24 hour level it now works on individual time periods (namely AM Peak, Inter Peak and PM Peak Periods).
- 5.24.2 It was decided that the *Home-Based* Other and Home-Based Employers Business trips within the model should be singly-constrained. The *Home-Based* Work trips being doubly-constrained.

5.25 Highway Generalised Cost Parameters

Enhancement Report: Section 4.6

- 5.25.1 Generalised costs for the Highway assignment model have been calculated using standard DfT methodology. These parameters are different for each modelled year. In June 2004, these parameters were updated to be compatible with Web TAG guidance.
- 5.25.2 Willingness to pay distributions are used within the tolling model and are based on DfT guidance on modelling road user charging.

5.26 Survey Data Preparation

Enhancement Report: Section 4.8

- 5.26.1 The development of journey purpose matrices was undertaken using a sector system based on zonal planning data (population and jobs) rather than geographical aggregations used in CSTM3.

5.27 Macro Time of Day Choice

Enhancement Report: Section 5.2

- 5.27.1 Investigation has been undertaken during the development of TMfS into the possible inclusion of a Macro Time of Day choice module. This allocates traffic to time periods according to relative changes in generalised cost. This is in contrast to peak spreading which allocates traffic to the peak hour within the peak period. The process has been programmed into TMfS and a subset of example test model runs has been undertaken.
- 5.27.2 Other studies on-going elsewhere in the UK suggest that Macro Time of Day Choice should be placed elsewhere in the model hierarchy than that which was originally proposed and implemented within TMfS. The finalisation of this process within TMfS would benefit from further analysis into the location of Macro Time of Day Choice in the TMfS model hierarchy. This would also benefit from live application of the model in forecast mode and using differential tolls by time of day.

5.28 High Occupancy Vehicle Modelling

Enhancement Report: Section 5.6

- 5.28.1 This proposed enhancement was rejected and put on hold by the Steering Group at the time of preparing the Enhancement Report, as such, it has not been included in TMfS during the core development stage. This is discussed further as a possible future development in the Chapter 7 of this report.

6 Future Data Collection

6.1 Data Collection Since Model Calibration

- 6.1.1 All known and available data collected up to 2002 was included in the development of TMfS and TELMoS. Since the models were completed, additional survey data (although nominal) has been added to the database of survey data that could be incorporated at the time of any model update.
- 6.1.2 This does not include the substantial rolling program Highway Traffic Counts undertaken for SRTDB and by the majority of Local Authorities within the modelled area. This data would only be added to the TMfS database in the event of a model update or rebase.
- 6.1.3 This section discusses recommended areas of new data collection for the transport model.

6.2 Future Roadside Interview Data Collection Recommendations

- 6.2.1 With any future model likely to have a base year of 2005 at the earliest, it would be beneficial to replace the older data used to prepare the TMfS matrices with more up to date travel pattern data. Any prioritisation of a program to undertake surveys in the recommended areas will largely depend on the anticipated application of TMfS in each of these areas by either the Scottish Executive or the component Local Authorities.
- 6.2.2 Having reviewed the locations of the RSI sites used in TMfS, it is recommended that the following areas, which are illustrated in Figure 6.1, are surveyed.

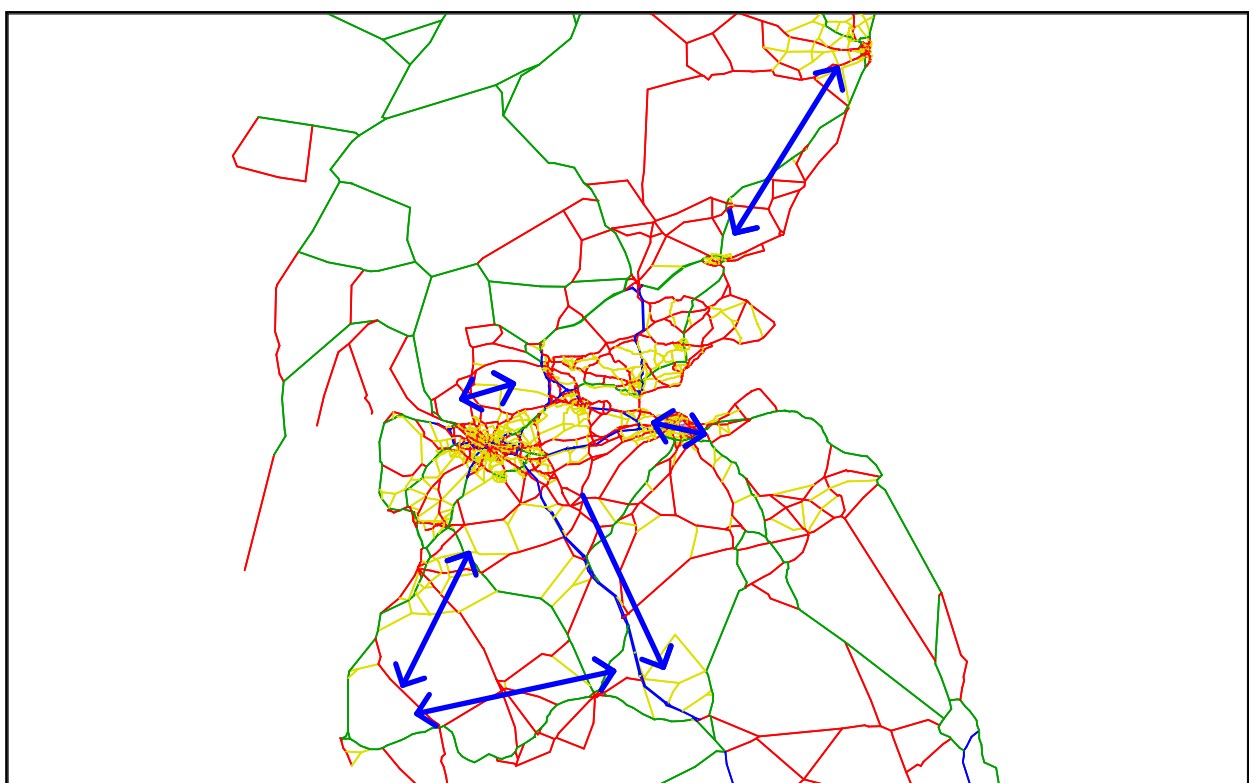


Figure 6.1 Proposed RSI locations

Intra-Edinburgh

- 6.2.3 Intra-Edinburgh movements are not well represented in the model. Whilst trips into and out of Edinburgh are well covered by more recent RSI's, the last time RSI data was collected within Edinburgh was 1989-1990. It is recommended that further surveys be undertaken to improve this situation as the congestion costs within Edinburgh are significant for that element of a longer distance trip.

M74 South

- 6.2.4 There are no southbound RSI's on the M74 to capture traffic from Glasgow to the Borders and further South. Slip roads close to Glasgow were surveyed as part of TMfS, but links with Dumfries and 'The South' would be made more reliable with additional RSIs in this corridor.

Dumfries and Galloway

- 6.2.5 CSTM3 used some data in this area relating specifically to Dumfries. However this has aged too much for use within the TMfS. The TMfS matrices would benefit greatly from new data for this area. Whilst undertaking surveys in this area, it would also be advantageous to survey the A77 coastal route between Stranraer and Ayr and the principal east/west routes across to the Borders.

Dundee to Aberdeen

- 6.2.6 There are a number of RSI sites around Dundee and Aberdeen already included within TMfS from the 2002 program of surveys. However, there are no RSIs in-between Dundee and Aberdeen, which would catch through traffic and also Intra-Angus trips.

North of Glasgow

- 6.2.7 This was identified as an area for improvement within the TMfS Enhancement report. However, it was decided not to undertake surveys in the area as the Scottish Executive was not aware of any schemes or issues in the area.

6.3 Future PT Data Collection Recommendations

- 6.3.1 It is recommended that the oldest data that has been used for the modelling procedure should be updated for any future enhancements of TMfS as much of it was used in the development of CSTM and is therefore eight or more years old.
- 6.3.2 It was identified within the TMfS Enhancement Report that surveys were required for internal movements within the two main conurbations of Edinburgh and Glasgow. Figure 3.2 shows that these have now been undertaken, with a particular focus on Glasgow.
- 6.3.3 TMfS has fairly strong PT data in the central belt between Glasgow, Edinburgh and Stirling. However, outside this area the survey data could be improved significantly, particularly around Fife and the East of Scotland.
- 6.3.4 Permission was sought to use the CAPRI/MOIRA/LENNON ticket-based rail data for Scotland during the development of the Public Transport Model. The permission to use this data was granted after the completion of the Public Transport and therefore the data could only be used for validation purposes. Since then, the ownership of the LENNON ticket data has moved to the Executive. It is therefore recommended that any update of the Public Transport Model should make full use of this data as part of any future calibration of the Public Transport Model.

6.4 Other Data Collection Recommendations

6.4.1 RSI data is the most critical in updating and enhancing the model to meet objectives, but other data that is required for future model development is as follows:

- **Manual classified counts and automatic traffic counts:** Much of this information can be extracted from SRTDB. However, many of the local authorities within the modelled area undertake their own count collection programs, this information was requested during TMfS and this process should be repeated for any update of the model. In addition, it would be envisaged that further specific counts would be required complete the screenlines required for model calibration. The location of these count sites would largely depend on the available SRTDB and local authority data.
- **Public Transport passenger counts:** It is possible to derive some public transport passenger link counts from the LENNON data, however PT corridor counts are relatively inexpensive to undertake and can ensure that a good level of PT usage is represented in the model. It is recommended that PT passenger link counts are undertaken within key Public Transport corridors.
- **Car Journey time surveys:** These are essential in validating the modelled journey times of the Highways Assignment Model.
- **Goods Vehicle surveys:** There is a need to focus on the travel patterns of Commercial Vehicles within the model. It is recommended that, a program of Commercial Vehicle only RSIs are undertaken to either feed into any model update or validate against existing model data. The advantage of this would be to provide more robust Goods Vehicle Matrices and such RSIs would be cheaper than 'all-user-class' RSIs.
- **Park and Ride surveys:** Survey forms to undertake RSI and PT Surveys have been altered during the TMfS contract to cater for formal (at dedicated Park and Ride sites) and informal (at Rail and Bus stations) Park and Ride. Historically, as this information was not included on the forms, older data does not facilitate isolating Park and Ride trips from survey records and as such, the Park and Ride module is an optional extra in TMfS as it is very much an approximation. As more data becomes available for Park and Ride trips, it will be possible to make the Park and Ride module more integral with the main modelling process. Further survey data on use of rail station car parks and survey data from Park and Ride users would enhance the quality of the Park and Ride Model.
- **Stated Preference surveys:** These could be undertaken to provide better model sensitivity to mode choice (for example, a survey concentrating on competition between road and rail for the main inter-urban movements), this could also be enhanced (where relevant) to include willingness to pay tolls at estuarial crossings.

6.4.2 The specification and timing of any future survey work would require direct inputs from the TMfS modelling team. This would allow specific geographical targets to be selected for survey.

6.4.3 Any new data collection would however ultimately depend upon the definition and objectives of any new model specification and the focus of any specific applications of the model.