3 Performance Assessment Methodology

3.1 Defining the Performance Indicators

The National Transport Strategy (NTS) has defined three KSOs, which are to:

- **Improve journey times and connections**, to tackle congestion and the lack of integration and connections in transport;
- **Reduce emissions**, to tackle the issues of climate change, air quality and health improvement; and
- **Improve quality, accessibility and affordability**, to give people a choice of public transport, where availability means better quality transport services and value for money or an alternative to the car.

The STPR aims to identify a range of interventions that will make a significant contribution towards delivering the strategic outcomes of the National Transport Strategy; therefore the methodology adopted **for assessment** has centred **on presenting and summarising** the performance of the network against these KSOs. For each KSO, key questions about the performance of the network have been posed and performance indicators, **both quantitative and qualitative,** have been developed to present an evidence base that provides answers to these questions. Table 3.1 lists the key questions in relation to the KSOs.

This combination of quantitative and qualitative indicators not only allows an assessment of any particular urban network, strategic node or corridor but also comparisons between them.

Following the development of the individual indicators, a brief summary analysis is presented, targeted towards the following questions:

- Overall, how well does the transport network perform?
- Will the transport network meet future demand, particularly in areas of economic activity?
- What are the key drivers that will impact on performance in the future? and
- What are the key problems associated with delivering the KSOs?

Table 3.1: Performance Indicators for KSOs

KSO	Question	Performance Indicators	Data Source
Improve Journey Times & Connections	Where are the delays, and when do they occur? Where will they be in the future?	Data on delays for road traffic. Average speeds.	Observed data for existing conditions. TMfS and Regional Model for future conditions.
	Is the network operating efficiently?	Available capacity (rail and roads, time & space).	Measure of delays, ratio of flow to capacity for road. Use of LENNON data to determine existing rail levels, and use TMfS to forecast future levels.
	Is the network reliable?	Journey time variability (rail and roads). Average speeds throughout the day, comparison between congested and uncongested conditions.	Ratio of free flow speed to average speed on roads (TMfS). For rail, published performance statistics exist.
	Does the network offer competitive journey times?	Comparison of public transport v car journey times. Comparison of times between corridors. Assessment of changes in times between existing and future years. How do journey times compare with selected international benchmarks?	Agglomeration Potential Index. Comparison of journey times by mode from TMfS Internal and external benchmarks.

KSO	Question	Performance Indicators	Data Source
Reduce Emissions	What emissions are generated and what are their impacts?	CO_2 emissions per person km. Total CO_2 emissions. NO_2 emissions. Number of Sensitive Receptors.	TMfS / ENEVAL.
Improve Quality, Accessibility and Affordability	Is public transport provision matched to demand?	Mode share between key attractors/generators.	TMfS. Highlands Regional Model. LENNON data.
	How competitive is public transport compared with the car?	Accessibility. Frequency of service. Quality of service. Pricing issues. Journey time.	Comparison of cost per km by mode Scottish Household Survey for qualitative data
	How integrated is the transport network?	Physical integration. Fares integration.	Statistics on multi-modal journeys can be taken from TMfS. Qualitative assessment of physical integration.
	Is public transport capacity constrained?	Journey times, delays, physical constraints.	Operational review of rail network. TMfS and TMfS:05H.
	Is the network safe?	Security and safety of users. Accident rates.	Household surveys. Accident statistics. Public Transport User Surveys.

3.2 Future Demand Scenarios

Forecasting of future travel demand and the consequential impacts on the transport network is heavily dependent on the assumptions that are made regarding core inputs, the planning and policy frameworks and wider, world events.

The forecasts used in our analysis to date are based on national population and employment forecasts and observed travel behaviour. These relate to expectations that were developed in recent years as part of local, regional and national planning processes. These land use and development expectations are then used in the TELMoS to forecast trip generation and thus travel demand across the country. The impact of this demand is then assessed using the TMfS.

The planning data assumptions used in TELMoS are inevitably broad estimates that will be influenced by evolving circumstances. Any significant change in economic circumstances (e.g. significant in-migration, a major new oil or gas discovery, identification of a new regeneration zone) could not only alter local impacts on the network but could have ramifications well beyond the immediate vicinity. While the TMfS provides a consistent basis for examination of likely operation of the transport system, and therefore a framework for assessing various interventions, it must be recognised that its results are dependent on the inputs fed into it.

The inputs used in the present assessments represent one possible scenario of the future. In appraising potential interventions, and more particularly the way in which these support economic development and social inclusiveness, the impact of a number of different scenarios relating to diverse environmental, economic and spatial planning policy approaches, will need to be tested.

3.3 Review of Data Sources

3.3.1 Introduction

The purpose of this section is to describe the approach taken during the review of the performance of the national strategic transport network. It outlines the various data sources available and comments on the robustness of these. Before covering the specific technical areas it is relevant to review the context of the STPR, in particular with respect to the scope and appropriate level of detail.

Being a review of the national strategic transport network it is important to cover the full extent of the network, both in terms of geographical coverage and mode of transport. In this respect many different data sources are available providing detailed information on all aspects of travel on our strategic network. These include:

- TMfS:05;
- TMfS:05H;
- LENNON data on rail patronage;
- Network Rail Documents;
- Published regional and national transport statistics;
- Transport Scotland / Scottish Government Policy Documents and associated studies;

- Congestion monitoring reports;
- SRTDb;
- Scottish Transport Statistics;
- Transport Scotland SERIS database;
- Public transport user surveys;
- Transport Scotland's Accident Database;
- Local and Regional Transport Strategies;
- Scottish Household Surveys;
- Data and reports produced on behalf of Public transport operators;
- Environmental mapping; and
- The ENEVAL module for undertaking an environmental evaluation of the data output from TMfS.

Given the strategic nature of the study, it is important to consider the appropriate level of detail for the assessment. The final report from STPR will contain a number of recommendations for taking forward various transport interventions. These recommendations will cover stand-alone interventions, packages of physical measures and / or behavioural and policy related measures. While it will be necessary to undertake a strategic appraisal of each of these measures to ensure an effective programme is developed, it must be recognised that further detailed design development and appraisal work will be required as the adopted programme of interventions or packages are progressed. Therefore, when considering the performance of the network, STPR will focus on the strategic nature rather than the matters of detail.

3.3.2 Data Sources

The following paragraphs summarise the main sources of data, highlighting the strengths and weaknesses of each.

TMfS

TMfS has been used to provide a consistent investigative tool for estimating the existing and future conditions on the transport network. This model represents the latest national strategic multi-modal transport model and covers approximately 95 per cent of Scotland's population.

Based on current and planned transport networks, current and forecast population, employment and car ownership levels, TMfS estimates travel demand, traffic levels and journey times. The future year land use forecasts are determined using TELMoS. This model translates forecast planning data into a forecast of the number of journeys likely to originate from or be attracted to each of the zones within TMfS (trip ends). Local authority planning data is used by TELMoS to forecast travel demand, which in turn is fed into TMfS.

TMfS is a multi-modal model which incorporates land use interaction to generate patterns of travel, volumes of demand for all modes of travel (cars, goods vehicles, and bus and rail services), and helps to identify areas or points of sub-standard performance on the strategic network. The areas identified may be for example areas of congestion or overcrowding. TMfS is considered to be the best tool for the job as it provides an insight into the strategic movements on Scotland's national transport network.

While TMfS is capable of providing information across most of the country it must be recognised that it is a strategic model and therefore it is not appropriate for assessing some points of detail, particularly in the urban networks. In addition, the current version of TMfS, six of the 20 national strategic transport corridors lie either partially or wholly outside of the modelled area. Assessment of transport in these areas is through:

- use of the preliminary output from the regional model covering the Highlands which is currently under development. The full version of the Highland Regional Model will be used as this study progresses.
- A new version of TMfS:05H incorporates information from transport surveys conducted in spring 2007 which will be used during the remaining stages of the STPR commission

Highland Regional Model

As outlined previously, a stand-alone transport model covering the Highlands has been developed for use on this particular commission. Preliminary information from this model has been incorporated within Work Package 3 and it will be used extensively as the study progresses.

Public Transport Provision

To supplement the data within TMfS, information on bus services was obtained from a number of sources, including Bus Users UK, the Confederation of Passenger Transport, Stagecoach Scotland and Scottish Citylink. Reference was also made to the Traveline Scotland website (journey planner and timetable sections), the Transport Scotland website and the websites of a number of bus and coach operators. Some local authority websites were also used where relevant. Hard copy timetable leaflets were also obtained for many services. These sources enabled the key services to be identified and the numbers of vehicle journeys to be calculated. Most information on the corridors is based on timetables operating over the winter 2006 / 2007 period, although Scottish Citylink provided some data on summer services.

Strategic bus services were defined as those operating along most or significant parts of each corridor, serving the key settlements along each corridor. Services and journeys of purely local significance are not included, but local services to the five principal airports are identified.

Data on the operation and use of the railways was obtained from published railway sources including 2006/07 timetables, the Scottish Planning Assessment (SPA) published October 2005, Scotland's Railways published December 2006 and industry database such as LENNON. Information relevant to the performance of the rail infrastructure has been taken mainly from Network Rail's Route Utilisation Strategy (RUS) published in March 2007. However, as infrastructure information for far north corridors was not sufficiently covered within the Route Utilisation Strategy, information was also extracted from the Highlands Room for Growth Study[6].

Accidents and Safety

The accident rates and fatal accident rates supplied by Transport Scotland cover a ten year period from 1996 to 2005. To allow comparison with national statistics, rates for trunk roads in Scotland were taken from the Road Accident Scotland 2005 publication. This is a robust data set covering the strategic road network. However, by definition, the data set relates to historic data. Forecasting future levels of accidents is done by relating accident rates to the forecast levels of transport within TMfS. Where necessary, national rates based on the Design Manual for Roads and Bridges Volume 15 Economic Assessment of Road Schemes in Scotland, have been used for comparative purposes to distinguish between single and dual carriageway roads.

Rail safety data is sourced from the Rail Safety and Standards Board Annual Safety and Performance Report, 2006[7]. The Rail Safety and Standards Board was established in April 2003. The organisation's primary objective is to lead and facilitate the railway industry's work to achieve continuous improvement in the health and safety performance of the railways in the UK and thus to facilitate the reduction of risk to passengers, employees and the affected public. Perceptions of personal safety on bus and rail services were taken from Scottish Household Surveys and from on-mode surveys carried out by ScotRail.

Forecasting of Transport Related Noise and Emissions

ENEVAL software has been used to derive noise and air emissions from the road based transport network using data from the TMfS. At a national level this data is similar to the latest data in Scottish Transport Statistics, the difference being largely explained by the omission of some local trips in the transport modelling, particularly in the Highland area.

The modelled road based emission data, along with road based person kilometre data obtained from TMfS, was then disaggregated to determine road based CO_2 emissions per person kilometre for each of the study corridors, urban networks and strategic nodes.

Rail based emissions were derived from data relating to the most common types of diesel multiple units operated in Scotland and consider emissions from the majority of timetabled services operated outside of the urban networks. Electric trains were assumed to produce no CO_2 within a corridor, although they will contribute to emissions from the power generation industry.

6 Highlands - Room for Growth Study6 March 2006
7 http://www.rssb.co.uk/pdf/reports/ASPR_2006.pdf.

A number of information sources are available for transport noise emissions, including the noise maps currently being produced and data projections that have been provided by ENEVAL software. This was used to derive noise emissions from the road transport network using data from the TMfS. With the publication of noise maps, baseline traffic noise information for Scotland will become more accessible. However, as this mapping does not currently cover the whole of Scotland, the ENEVAL model was used as a basis for baseline vehicle noise emissions. Data for rail was not available nationally.

It is important to note that the ENEVAL data has a number of limitations. The calculations are based on road vehicle emissions 10m from the road and do not take into account dispersal effects or the location and sensitivity of receptors. The latter issue is particularly relevant in the case of noise, where even high vehicle noise emissions may not be a concern if there are no sensitive noise receptors to experience any resulting potential impacts. No account is taken of gradient, road surface, the effect of buildings, the presence of screening, or the type of ground cover in the calculation of road traffic noise.

A review of available data on CO_2 emissions was undertaken for the *Scotland's Railways – Environmental Report*, which found that average CO_2 emissions per passenger kilometre for rail and bus services were similar and were around two thirds of those for car passengers per kilometre. The same report suggests that freight transported by rail produces around one eighth of the CO_2 emissions per tonne kilometre compared to road based HGV.

Figures taken from the National Atmospheric Emission Inventory 2004, as quoted on the Transport 2000 website, identify a substantial difference in the CO_2 emissions of different transport modes. For example, on a journey from Edinburgh to London, travel by rail results in a reduction in CO_2 emissions of around 88 per cent compared to air travel and around 83 per cent compared to the private car. However, it is important to note that the comparisons were based on average figures and that the relative emissions characteristics of all modes of transport will vary according to their loadings. Nevertheless the figures support the policy of *Scotland's Railways* which encourages a modal shift from road to more sustainable means of transport including rail.

A similar review of available data was undertaken in relation to the emissions factors of diesel and electric trains. This data showed an electric train as emitting around 15 per cent fewer emissions of CO_2 than the equivalent diesel service on a similar route. Again, this information is based on averages but this and other supporting data in the *Scotland's Railways – Environmental Report* provides a strong evidence base to support the promotion of electrification of the rail network to help reduce carbon emissions from the rail sector[8].

[8] Scotland's Railways – Environmental Report, Scottish Executive December 2006