PUBLISHED PROJECT REPORT PPR644

Assessing the resilience of transport networks to climate change: Data collection
FUTURENET WP2 Progress Report 2: Databases and route parameters

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Executive Summary

This progress report relates to Work Package 2 of the project FUTURENET- Future resilient transport networks, an Engineering and Physical Science Research Council (EPSRC) funded project under the Adaptation and Resilience to Climate Change (ARCC) programme. TRL was a partner in FUTURENET together with the University of Birmingham, who led the project, the Universities of Loughborough and Nottingham, HR Wallingford and the British Geological Survey. The project ran from June 2009 to March 2013.

FUTURENET aims to develop methods of quantitatively assessing the resilience of transport networks to climate change impacts. This was carried out through the following work packages:

- WP1 – Development of possible socio-economic scenarios for the UK transport system in 2050
- WP2 – Identification of a transport corridor and collection of baseline data for this corridor
- WP3 – Development of conceptual models of transport failures due to climate effects
- WP4 – Development of a modelling methodology to enable the impacts of climate change on the network to be modelled
- WP5 – Development of generic models and dissemination

TRL led the second work package, and produced two reports describing the progress on this work package up to March 2012. The report PPR645 (Reeves et al, 2013) describes the identification of a suitable transport corridor on which to base the development of the models and methodologies. This report describes the task of collecting information and data on the corridor from transport operators to inform these.

The transport corridor from London to Glasgow along the west coast including road, rail and air travel was selected as a suitable corridor to utilise in the development of the models and methodologies. The aim was not to assess the resilience of this corridor, but develop a methodology that would enable this. Data and information on the use and infrastructure within this corridor was collected to use in the development and validation of the models.

Development of the models requires data at two levels; at a corridor level to model the impact of weather events on the users of the corridor and at a more detailed level for areas identified as vulnerable in order to model specific failure mechanisms, such as flooding, landslides and bridge scour. Transport operators are a key source of information for both types of data, as they collect a wide range of information to aid them in maintaining and managing their assets. TRL liaised with the transport operators with assets within the corridor to obtain information and access to data.

The focus of the data collection was the principle routes within the corridor, consisting of the trunk roads (including both the M40 and M1), the West Coast Mainline, and Heathrow and Glasgow International airports. At a corridor level shapefiles were obtained providing the location of key transport assets within the corridor, such as the north and south bound carriageways, the railway centreline, bridges and large culverts. GIS information was also acquired on the vegetation alongside trunk road and rail assets, as this affects landslide risk and run-off. In addition, information was sought on areas of vulnerability to weather events within the corridor already identified by the
transport operators to help select the areas for detailed study. This information included shapefiles of flooding hotspots, records of past weather events and vulnerable assets identified by the transport operators and their contractors. Access was gained to asset databases which can provide additional data for the failure mechanism modelling once the vulnerable areas have been selected.

If a severe weather event occurs completely blocking the principle routes, alternatives would need to be sought. In order for the models to be realistic, these alternatives need to be included in the models. Rail and air have limited potential for diversion, but there are numerous options for road. However, within the past six years diversion routes have been established for the closure of each trunk road link. The diversion routes direct traffic onto the most suitable local roads and then re-join the trunk road at the next appropriate junction. The diversion routes were requested from the Highways Agency and Transport Scotland and at the time of writing the Transport Scotland routes and some HA routes had been received.

The data gathering exercise revealed a number of issues surrounding the availability of data to use in the assessment of transport resilience. The necessary data is often not collected or stored in a format suitable for this use; it can be incomplete and vary in detail and accuracy. Transport operators are starting to address some of these data issues and now record incidents of flooding and geotechnical instability, however the availability of suitable data remains a significant issue when assessing the resilience of transport networks, as does the collation of information from different sources even within organisations and making the best use of information already collected for different purposes.
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1 Introduction

1.1 Futurenet

FUTURENET (Future Resilient Transport Networks) is a research project investigating the characteristics required for a climate resilient UK transport system (in terms of both infrastructure and usage) in 2050. The project is funded under the UK Research Councils’ “Adaptation and Resilience to Climate Change” programme (ARCC) and runs from June 2009 to March 2013. ARCC is part of Living With Environment Change (LWEC) – a ten-year programme to provide decision makers with information to manage and protect vital ecosystem services. ARCC projects are supported by the Engineering and Physical Science Research Council (EPSRC), The Economic and Social Research Council, the UK Climate Impacts Programme and LWEC. Futurenet is being carried out by researchers from the University of Birmingham, the University of Nottingham, The University of Loughborough, TRL, HR Wallingford and the British Geological Society.

FUTURENET is examining how transport in the UK will change from the current day to 2050 by exploring different socio-economic scenarios and then assessing how these changes will impact on the resilience of the UK’s transport system to climate change. Generic models and methodologies will be produced to help stakeholders assess the resilience of the transport network they are responsible for. The models will provide information on the future resilience of their network under different scenarios, helping to inform their decision making.

The aim of the project is to determine:

- What will be the nature of the UK transport system in 2050, both in terms of its physical characteristics and its usage?
- What will be the shape of the transport network in 2050 that will be most resilient to climate change?

Futurenet is divided into the following work packages:

WP1 – Development of possible scenarios for the UK transport system in 2050

Work Package 1 developed a number of different possible socio-economic scenarios for the UK transport network in 2050 based on a literature review of foresight work in all relevant areas; a series of workshops with stakeholders; and data from the travel behaviour studies carried out in Work Package 4.

WP2 – Identification of a transport corridor and the collection of baseline data for this corridor

In order to develop the methodologies, a real section of the network needs to be modelled. Work Package 2 involved the identification of a transport corridor to base the study on and the collection of baseline data on the corridor including an asset inventory, hydrological and geological data and topography.

WP3 – Development of conceptual models of transport failures due to climate effects

Work Package 3 involved collating and, where required developing, models of transport failures, in a form that can be used in Work Package 4. This includes both damage and disruption from extreme events and also changes in deterioration rates. It identified the
meteorological and climate failure triggers and/or thresholds that affect transport infrastructure, travelling conditions or ground conditions. Models were developed using specific areas of vulnerability within the corridor identified in Work Package 2.

**WP4 – Development of a modelling methodology to enable the impacts of climate change on the network to be modelled**

The outputs of WP 1-3 will feed into Work Package 4. Work Package 4 is developing a modelling methodology for assessing the resilience of future transport networks. This analysis will be driven by a suite of scenarios (plausible narratives) that describe possible pathways of change in a wide range of model components. It includes developing current and future climate scenarios (using UKCP09) for the chosen corridor, and a travel behaviour scenario to ascertain how people react when transport is disrupted due to climate impacts. The models will look at how resilience of the selected route within the different future scenarios can be assessed and what adaptation measures can be taken to increase resilience. The methodology is being developed using the transport corridor identified in Work Package 2 but will produce generic components that can be developed into models for the analysis of the wider transport network in the UK in WP5.

**WP5 – Development of generic models and dissemination**

Work Package 5 involves the development of generic models that can be applied to other transport corridors to support decision making. WP5 also includes composing a description of the methodology and dissemination of the models and outcomes of the project.

More information can be found on the project website [http://www.arcc-futurenet.org.uk](http://www.arcc-futurenet.org.uk).

**1.2 Work package 2 progress**

The aims of Work Package 2 are:

1. To identify a suitable route corridor for the study;
2. To collect baseline data on this route;
3. To select a GIS system to manage all of the spatial data, and populating it with the data collected.

This report summarises the progress made on the second of these aims; collecting information and data from transport operators to inform the modelling. A second progress report (Reeves et al., 2013) describes the selection of the corridor.

Work Package 2 commenced at the beginning of the project (June 2009) and is nearly complete at the time of writing (March 2012). The report describes the types of data obtained on the study corridor (London to Glasgow along the west coast), their source and discussions on their accuracy and reliability.
2 Transport information and data

2.1 Types of transport information

The majority of the detailed information on transport systems is collected and held by the transport operators and their contractors in order to manage and maintain the asset. There are two main types of data collected:

- Information on the use of the network, e.g. train/air timetables, road traffic counts, passenger details etc.
- Information on asset condition and maintenance, e.g. asset inventories, condition assessments and surveys etc.

In addition to being used to manage and maintain the network, data may also feed into Government targets and KPIs, and summary data is published by the Department of Transport (e.g. as Transport Statistics) – this (published summary data) tends to be on the use of the network rather than the assets.

2.2 Storage of transport data

A range of database and management systems have been developed to store and manage the large amounts of inventory and condition data collected on transport assets. These are normally bespoke systems tailored to the requirements of the organisation and there are often different databases for different assets, e.g. pavements and structures. The databases tend to be map based, where users can click on displayed features to display more detail (see examples in Figure 1 and Figure 2). Some systems contain third party datasets such as the Environment Agency Detailed River Network (DRN) and British Geological Society maps and borehole reports.

Figure 1. Image from Highways Agency Drainage Data Management System
Figure 2. Image from the Network Rail Corporate Network Model

Data is uploaded and updated into these systems largely by the transport operator's contactors who manage and maintain the asset. Different individuals have their own approaches and interpretations of the system, therefore the quality of the data, in terms of scope, accuracy and level of detail, can vary considerably. In addition, some of these databases are relatively new and still being populated during the timeframe of the project. For example, within Highways Agency Drainage Database Management System (HADMS), drainage inventory data is available for only 65% of the network and condition data for only 3%. Surveys are on-going to fill in these gaps. It is worth noting that these databases are live systems, and are constantly being updated and new functions added. As a result, data that are currently unavailable at the time the Futurenet models are being developed may be available in the future for users of the models to input.
3 Collection of data on the corridor

3.1 The types of data required

Information on the transport assets present within the corridor and the characteristics that affect them is needed to develop and validate the models. These include data on:

- Asset type, location (including elevation) and condition;
- The underlying geology;
- Hydrology and flood risk;
- Landscape and adjacent vegetation; and
- Traffic flows for road, rail and air.

Data are required at two levels of detail; information on the whole corridor to input into the corridor model and more detailed data on vulnerable areas to develop and validate the failure models.

3.1.1 Corridor level data

The information required at the corridor level includes:

- Location of key assets (preferably in the form of shapefiles – GIS vector data that can be used by mapping software to display the location and attributes of different geographical features)
- Knowledge of the characteristics of land adjacent to the asset that could affect the asset, e.g. the level of vegetation effects run-off and slope stability
- Traffic flow along the corridor
- Areas of known vulnerability and past occurrences of climate events within the corridor
- Diversion routes and incident management procedures

3.1.2 Failure modelling data

The type of data required at the detailed level depends on the climate change impacts being modelled, for example:

For flooding, the required information includes:

- Elevation
- Drainage design capacity and condition
- River maps
- Flood risk maps
- Land-use

For landslides:

- Geology
- Slope composition
- Slope height and angle
- Vegetation
- Drainage
For heat affects on track:
- Track type
- Load and speed
- Ballast condition

Subsidence and heave:
- Geology (expansive soils)
- Depth of foundations

Scour:
- Type of bridge foundations
- River flow

Overheating passengers and electronics:
- Temperature inside train and stations
- Air conditioning limits

Information on thresholds, maintenance and inspection regimes are also useful. Examples of climate change impacts that could be included in the Futurenet modelling are given in Table 1.

### Table 1. Failure models

<table>
<thead>
<tr>
<th>Failure Model</th>
<th>Type of study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooding/ponding</td>
<td>• road links</td>
</tr>
<tr>
<td></td>
<td>• rail sections</td>
</tr>
<tr>
<td></td>
<td>• stations including access</td>
</tr>
<tr>
<td></td>
<td>• control centres including access</td>
</tr>
<tr>
<td></td>
<td>• depots including access</td>
</tr>
<tr>
<td></td>
<td>• airports including staff and public access</td>
</tr>
<tr>
<td>Landslides</td>
<td>• Road links</td>
</tr>
<tr>
<td></td>
<td>• Rail sections</td>
</tr>
<tr>
<td>Bridge scour</td>
<td>• Road bridges over water</td>
</tr>
<tr>
<td></td>
<td>• Rail bridges over water</td>
</tr>
<tr>
<td>Buckling rail track</td>
<td>• Rail sections</td>
</tr>
<tr>
<td>Subsidence and heave</td>
<td>• Road links</td>
</tr>
<tr>
<td></td>
<td>• Rail sections</td>
</tr>
<tr>
<td>Heat stress on passengers and staff</td>
<td>• Rail</td>
</tr>
<tr>
<td></td>
<td>• Road</td>
</tr>
<tr>
<td></td>
<td>• Air</td>
</tr>
</tbody>
</table>
3.2 Acquiring suitable data

The most detailed asset data is available from the asset management systems of the transport operators, so their co-operation is essential to the project. TRL liaised with the Highways Agency, Transport Scotland, Network Rail, Transport for London, local authorities and BAA to gather information for the models. Meetings were held with the following stakeholders:

- Network Rail – track
- Network Rail – buildings
- BAA
- Transport Scotland
- Transport for London
- Highways Agency - General
- Highways Agency – Diversion routes (teleconference)
- Leicestershire County Council (the lead local authority on this issue for ADEPT (formerly CSS) and an area which the corridor passes through)
- Strathclyde Partnership for Transport and Glasgow City Council

At these meetings the stakeholders provided information and insight into the type of data collected on their assets, how it is stored, who within their organisation manages the different types of data, the vulnerabilities of the different assets and the process and issues around dealing with the impacts of weather events on their systems. They also granted access or provided data from the databases listed in Table 2.

The Department for Transport was contacted with regard to freight data. They provided information on the number of journeys, and amount and type of freight moved by road from London and the south east to Scotland each year. The exact route they took is not known, but it is likely that many of these journeys used the Futurenet corridor.

The data was passed onto the other Futurenet team members to develop the corridor and failure models and for use in the selection of vulnerable areas for detailed study. Other team members also used their own contacts within the transport operators to obtain information specific to their needs, for example Network Rail’s Washout and earthflow risk mapping online system (WERM) and TRUST (Train Running System TOPS (Total Operations Processing System)) which contains train delays and their cause.

<table>
<thead>
<tr>
<th>System Owner</th>
<th>Database</th>
<th>Relevant data within the database</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA</td>
<td>HAPMS (Pavement Management System)</td>
<td>Location of HA surface assets in the form of shapefiles.</td>
</tr>
<tr>
<td>HA</td>
<td>HAGDMS (Geotechnical Data Management System)</td>
<td>Location, type and inspection reports on geotechnical assets. Geology (BGS datasets), HA borehole reports, LIDAR and aerial photos.</td>
</tr>
<tr>
<td>HA</td>
<td>HADDSMS (Drainage Data Management System)</td>
<td>Location and in a few places condition of drainage assets. Location and details of past flood events, identification of flooding hotspots and priority drainage assets. The river network, flood risk areas and flood</td>
</tr>
<tr>
<td>Database Code</td>
<td>Database Name</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>HA</td>
<td>HATRIS (Traffic Information System)</td>
<td>Traffic flow, % HGV per link for specific dates. Free flow speed and journey delay, level of congestion for each link.</td>
</tr>
<tr>
<td>HA</td>
<td>SMIS (Structures Management Information System)</td>
<td>Location and condition of structures. Includes an indication if it is at risk of scour.</td>
</tr>
<tr>
<td>HA</td>
<td>EnvIS (Environmental Information System)</td>
<td>Type of vegetation alongside the network, water sources and outlets affected by road drainage.</td>
</tr>
<tr>
<td>TS</td>
<td>TS PMS (Pavement Management System)</td>
<td>Location of TS surface assets in the form of shapefiles</td>
</tr>
<tr>
<td>TS</td>
<td>TS SMS (Structures Management System)</td>
<td>Location and condition of structures.</td>
</tr>
<tr>
<td>TS</td>
<td>Scottish Roads Traffic Database (SRTDb)</td>
<td>Traffic flow, % HGV.</td>
</tr>
<tr>
<td>NR</td>
<td>Rail Centreline</td>
<td>Location of rail line in the form of shapefiles.</td>
</tr>
<tr>
<td>NR</td>
<td>Leaf Fall Survey</td>
<td>Type of vegetation adjacent to rail line.</td>
</tr>
<tr>
<td>DfT</td>
<td>Continuing Survey of Road Goods Transport</td>
<td>Average number of journeys made by GB registered HGVs above 3.5 tonnes, tonnage moved and types of goods between London and SE, and Scotland.</td>
</tr>
</tbody>
</table>

### 3.2.1 Corridor level data

From these databases and the contacts provided the following information was obtained for use in the corridor level modelling:

**Table 3: Corridor data**

<table>
<thead>
<tr>
<th>Data obtained</th>
<th>Coverage</th>
<th>Database/source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shapefiles of the location of the carriageway and key assets such as bridges, gullies and embankments</td>
<td>HA roads in the corridor</td>
<td>HA PMS</td>
</tr>
<tr>
<td>Shapefiles of the location of the carriageway and key assets such as bridges, gullies and embankments</td>
<td>TS roads in the corridor</td>
<td>TS PMS</td>
</tr>
<tr>
<td>Shapefiles of the vegetation adjacent to roads</td>
<td>HA roads in the corridor</td>
<td>EnvIS</td>
</tr>
</tbody>
</table>
### Databases and Route Parameters

<table>
<thead>
<tr>
<th>Shapefile of rail centreline</th>
<th>West Coast Mainline</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shapefiles of the vegetation adjacent to rail line</td>
<td>West Coast Mainline</td>
<td>NR Leaf fall survey</td>
</tr>
<tr>
<td>Areas of vulnerability</td>
<td>Transport Scotland roads in the corridor</td>
<td>TS and their contractor's knowledge</td>
</tr>
<tr>
<td>Shapefiles of flooding hotspots</td>
<td>HA roads in the corridor</td>
<td>HA DDMS/HA contractor</td>
</tr>
<tr>
<td>Details of past flood events</td>
<td>HA roads in the corridor</td>
<td>HA flood register in HA DDMS</td>
</tr>
<tr>
<td>Diversionary routes</td>
<td>Transport Scotland roads in the corridor</td>
<td>Route cards from Traffic Scotland</td>
</tr>
<tr>
<td>Freight data on average no. of journeys, tonnes lifted and tonnes moved per year</td>
<td>Between the South East and London, and Scotland. 2004 to 2008.</td>
<td>Continuing Survey of Road Goods Transport (DfT)</td>
</tr>
</tbody>
</table>

#### 3.2.2 Detailed modelling

For the detailed modelling the data required depends on the impact and vulnerable area being modelled. Access has been granted to the databases listed in Table 4 which could be used to obtain additional data to use in the failure mechanism modelling.

**Table 4. Data available for detailed modelling**

<table>
<thead>
<tr>
<th>Data available</th>
<th>Coverage</th>
<th>Database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage type, location and in some places condition surveys</td>
<td>HA roads in the corridor</td>
<td>HA DDMS</td>
</tr>
<tr>
<td>Earthwork type, location, dimensions, condition surveys, borehole reports</td>
<td>HA roads in the corridor</td>
<td>HA GDMS</td>
</tr>
<tr>
<td>Structure reports on large structures such as bridges and culverts. Includes characteristics and condition surveys.</td>
<td>HA roads in the corridor</td>
<td>SMIS</td>
</tr>
<tr>
<td>Traffic counts between specific junctions at a specific time and day</td>
<td>HA roads in the corridor</td>
<td>HATRIS</td>
</tr>
</tbody>
</table>

Similar information could be requested from Transport Scotland, when the vulnerable areas are selected.
4 Data suitability, reliability and accuracy

Although a vast range of data is collected on transport assets, it does not always include the data required for assessing the resilience of an asset. The type of the data collected is designed to be the most suitable for monitoring and maintaining the transport assets, and although there is some overlap with project requirements, not all the data required by the Futurenet modellers is currently collected. If the necessary data is present, it is not always recorded in the most useful form or format and may take manipulation for it to be able to be incorporated into the models. Data is collected, stored and analysed for a particular purpose i.e. maintaining the network and may not easily be used in other ways.

Some of the types of issues identified whilst trying to use existing data systems to gather information to assess resilience were:

- The data is variable in its quality and coverage across the network;
- Detail can be missing or incomplete;
- For landslides the date of inspection is recorded, not the date the defect appeared (although from March 2012 the HA are recording geological incidences in a similar manner to flood events);
- Location accuracy is variable, which can make it difficult to align transport asset location with other data e.g. EA flood risk maps, BGS geological maps etc.;
- The search criteria in the databases were not always suitable for this purpose, which resulted in the need to trawl through maps and asset details to locate the information required;
- There is a lack of drainage data in particular, e.g. the inaccurate location of assets, unknown capacity and condition (this is being addressed by the HA, but is a problem for many LAs especially as the ownership of drainage assets is not always clear);
- Elevation data was lacking or inaccurate;
- There is no linking of weather information with defects;
- There is a lack of knowledge of the land use outside boundary; and
- Some data could not be acquired as there were issues of confidentiality (especially in the private sector) or due to the level of time and effort required by the operator to retrieve it. For example, there were gaps in some road data where there is a DBFO and BAA was unable to provide disaggregated flight delay data.

Work to improve data and develop better and more integrated asset management systems is on-going, so the situation is expected to improve in the future.

This data collection exercise focused on the principle routes within the corridor consisting of the trunk road network (including both the M40 and M1), the west coast mainline and Heathrow and Glasgow International airports. However, if a weather related event was severe enough so that the principle route become impassable or unsafe alternative
routes would need to be sought. In order for the modelling to be as realistic as possible, Futurenet also needs to incorporate the potential for diversions and to consider how the transport operators and network users react to incidents.
5 Incident management and diversions

When an incident occurs on the transport network, the transport operator and their contractors play a key role in managing the situation, communicating information to network users, putting temporary measures in place to allow users to continue their journey and trying to clear the incident. Other parties may also be involved such as the police (especially for road incidents), other emergency services and with major incidents potentially Government ministers and officials. Part of Futurenet’s remit includes understanding the consequences of climate events on the transport system, how these are managed and dealt with by the transport operator, and the behaviour of the individual users during these events.

5.1 Road incidents

Until the Traffic Management Act 2004 the police were the only body that had the legal power to close local roads, however HA and Transport Wales traffic officers can now close roads on their networks and direct traffic in the event of an incident. LAs still need to liaise with the police if they need to close a road for any reason. If a trunk road is closed there are set diversionary routes for each link, referred to as EDRs – Emergency Diversion Routes in England and ESDRs – Emergency Standard Diversion Routes in Scotland. The HA and TS operating companies have agreed these routes with the relevant local authorities in their area and they are distributed to the police and traffic control centres. These were put in place relatively recently, around 2006-2008 in both England and Scotland.

There are set procedures for implementing the diversion routes and who needs to be informed at each point and their responsibilities. In Scotland the police make the decision to implement the diversion routes in consultation with the TS operating company and lead the incident management. In England the HA traffic officers decide to implement the diversion and the HA will lead the management of smaller incidents, major incidents are led by the police. The TS operating company/HA traffic officer should check with the relevant LA(s) that there are no problems with the diversion route before it is put in place. If maintenance work is planned on an agreed diversion route the LAs should inform the TS operating company/HA control centres, so they know in advance of an incident. Diversionary routes are only implemented if there is to be a full closure in place for a number of hours. The preference is to keep traffic on the trunk road network rather than divert it onto local roads, so if one lane can be kept open or traffic can be directed onto the hard shoulder this option would be taken. The decision to implement the diversion route could be taken as soon as the incident occurs if it is obviously going to take several hours to clear or after monitoring for some time, at the point when it becomes clear this is an incident which will take time to resolve.

Diversion routes for local roads are not defined in this way. LA duty officers will make the decision to close a road (obtaining permission from the police) based on feedback from the staff on the ground and their local knowledge. They will determine the diversion route using suitable roads based on their own judgement, however often the local police are first on the scene and set up the division route, and this may not always be an appropriate route.

Transport operators can set diversion routes, but there is no guarantee that drivers will follow them. With the wide-spread use of satellite navigation systems drivers may also chose to ignore the official diversion route and instead follow the sat nav suggested
route, which may use inappropriate roads. In the future sat navs may include the official diversion routes.

For the purposes of Futurenet it was decided to use the official diversionary routes determined by the road authorities in the modelling, and this information was sought from the HA and TS. These routes are for junction to junction diversions, larger scale diversions such as traveling up the east coast were not included in the modelling. The link diversions are only appropriate for localised weather events such as landslides. If a wide-spread weather event such as fluvial flooding occurs, trunk roads are less likely to be affected than local roads so the link diversion routes are unlikely to be utilised. If an event is sufficiently severe to completely close the trunk road and surrounding local roads, regional diversions would need to be put in place to avoid the whole of the affected area. These strategic diversions are implemented and controlled by the HA’s national traffic control centre and Traffic Scotland, and they will determine the most appropriate route to avoid the problem area.

Diversion routes have been received from Transport Scotland for the TS roads within the corridor. The route cards include a list of relevant stakeholders and their contact details including the LAs who manage the diversion roads and police force, a flow chart showing the procedure for implementing the diversion route was also provided. Transport Scotland also has designated alternative routes for roads at risk of high wind. These are implemented when winds reach a specific threshold.

A teleconference was held with the HA Emergency Diversionary Routes Manager, who discussed the EDR programme and it’s embedment. He is working to obtain the EDRs for the HA roads within the Futurenet corridor and some sent through some of the diversionary routes.

5.2 Rail incidents

There are fewer options for diversion on the rail network. However, the alternative routes provided by Network Rail are included in the Futurenet modelling. Again, wider alternative routes, such as travelling up the East Coast, are not included as it is assumed that the incident occurs once the user is en route. Replacement buses could be included in the modelling.

5.3 Air incidents

With air travel the decision is normally to fly or delay/cancel the flight is made before the plane has started its journey. If something occurs during flight, diversions to alternative UK airports could be made, e.g. the plane could land in Edinburgh instead of Glasgow.
6 Future project actions

We will continue to liaise with the HA to obtain the remaining Emergency Diversion Route cards, this will complete the collection of corridor information. We will supply data from the databases listed in this report for the detailed modelling on an ad hoc basis as requested by the modellers.
7 Summary and conclusions

The project Futurenet is developing models and methodologies to study the resilience of UK transport in 2050. In order that the models produced are realistic and relevant an example corridor was selected to study, and data and information was obtained on the corridor to feed into the models. The transport corridor selected for study was from London to Glasgow along the west coast. A key source of information is the operators of the transport assets within the corridor, as they collect a range of information to aid them in maintaining and managing their assets. TRL liaised with these organisations to obtain information, data and their views on the resilience of their network. This also helped to build up stakeholder knowledge of the project and its aims.

Two levels of data are required for the modelling; corridor level information on all the principal routes within the corridor and more detailed data on vulnerable areas to develop the individual failure mechanism models. The corridor information obtained included shapefiles providing the location of major transport assets within the corridor, such as trunk roads, the main railway lines, bridges, tunnels, stations and large culverts and the vegetation alongside the road and rail line. Information on freight movements between London and the South East, and Scotland was obtained. Information was also collected on vulnerable areas within the corridor such as flooding hotspots or areas of high landslide risk identified by the transport operators and their contractors. This helps to inform the selection of areas for more detailed study. Access was obtained to several databases from which more detailed information can be obtained for these areas.

Data collection focused on the principle routes within the corridor, however if a severe weather event resulted in the total closure of a route, an alternative would need to be sought. Therefore information was also obtained on trunk road diversion routes and the procedures for implementing them. The route cards for the official diversion routes were requested from both TS and HA and at the time of this report the TS routes and some of the HA routes had been received. The remaining tasks in WP2 are to obtain the remaining diversionary routes from the HA and to provide any data for the detailed modelling of specific vulnerable areas requested by Futurenet partners from the databases TRL have access to.

The data collection task helped to identify several issues related to the available data to help assess the resilience of transport networks. The transport data currently collected focuses on what is directly required to maintain and manage the assets, it does not include information to help identify long term trends, weather thresholds or aid in planning transport infrastructure for the next forty or more years. Consequently the type of data needed for resilience modelling, was often not collected, not stored in a useful format or was in range of different database systems within different part of the organisation. Also the data obtained had geographical and attribute gaps and varied in detail and accuracy. The lack of quality data available is a significant barrier to assessing transport resilience, and despite the strong influence weather has on transport systems, linking transport failure to weather conditions in terms of thresholds etc. remains a challenge. The situation is improving for example through the implementation of projects surveying drainage assets, recording flooding and geotechnical incidents and improved data management systems. However, some of the key findings of Futurenet are the need for better quality information on the location, characteristics and condition of transport assets and details of their past failures, greater linking of weather and transport data and more integration of different sets of data gathered for different
purposes which combined could provide a better picture of the resilience of an asset or a specific transport corridor or route.
References
