Appendix 1 I.01: DEPARTMENT FOR TRANSPORT (DFT) ROAD INVESTMENT STRATEGY (2014)

Department for Transport

Road Investment Strategy: Overview

December 2014

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Contents

The Road Investment Strategy suite of documents (Strategic Vision, Investment Plan, Performance Specification, and this Overview) are intended to fulfil the requirements of Clause 3 of the Infrastructure Bill 2015 for the 2015/16 – 2019/20 Road Period.

Foreword

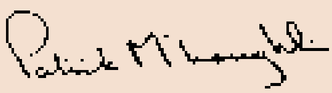
Roads should never be at a standstill. This is true at the best of times, and it could not be more true than today.

Our Strategic Road Network (SRN or the network) has suffered from insufficient and inconsistent investment, and is currently unable to meet the social, economic and environmental aspirations we have as a nation. As we look to the future, the steady increase in population, the need to drive economic growth, the development of new technology and the availability of smart infrastructure will all serve to change what we need from our strategic roads.

With this first Road Investment Strategy (RIS), we are firmly grasping the chance to deal with these opportunities and challenges to deliver a network that will underpin our nation's prosperity and progress for generations to come. Through the first RIS, we are:

- Providing *certainty*, with over £15 billion to be invested in our major roads from 2015/16 – 2020/21
- Transforming *connectivity*, through the likes of our commitment to dual the A303 to the South West
- Increasing *capacity*, with projects that will deliver over 1,300 additional lane miles
- Improving the *condition* of the network, including resurfacing 80% of the SRN
- Enabling *construction* and creating jobs, with almost £5 billion invested in 50 schemes that will help connect housing sites, enterprise zones and other industrial developments.

This document provides an entry point into the RIS, giving an overview of our vision and plans for the network. It focuses in particular on the tangible improvements that our investment will make, and seeks to show how the transformational level of investment will be just that – transformational.



The Rt Hon Patrick McLoughlin MP
Secretary of State for Transport

More detail on what underpins these aspirations and plans can be found in the accompanying three documents: the Strategic Vision, the Investment Plan and the Performance Specification.

The SRN is a key part of our national infrastructure

Connecting the nation

The SRN is made up of...

Motorways **1,865** miles

Trunk A-roads **2,571** miles

The SRN accounts for **2%** of all roads but carries...

33% of all traffic

66% of all freight

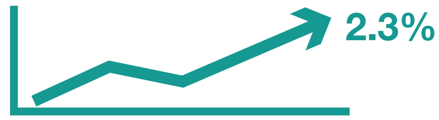
The SRN carries, on average, **4** times as many vehicles a day per mile than locally managed roads

Locally managed roads = **SRN**

Driving the economy

In our recent social research, **nine** in **ten** individuals surveyed recognised the importance of the SRN to the economy

A record **16.3 billion** miles were travelled on British motorways between July and September 2014, 2.3% higher than the previous year



20.4 billion miles were driven on the SRN by HGVs and light vans in 2013

11.6 billion miles

8.8 billion miles

Supporting the wider transport network by...

Ports

Delivering smooth access to ports

Local transport

Complementing local networks and connecting nationally

Rail and HS2

Supporting access to rail and the development of HS2

Aviation

Enhancing access to airports

Cycling and walking

Enabling active travel options

Investment in the network will bring tangible benefits

We estimate that the investment made in the first Road Period will:

Benefit up to 250,000
people by reducing the noise impact of the SRN

Help prevent over 2,500
deaths or serious injuries on the network over five years

Build over 1,300 additional lane miles

Improve 200 sections of the network for cyclists

Bring forward 127 schemes, with a total construction value of £15.7 billion

Resurface 80% of the network with low noise, quick-to-fix surfacing

Save 46 million hours of time lost in traffic every year by 2030

Deliver over £4 of benefit for every £1 spent

The Strategic Road Network

As a nation we rely on our roads

Roads are fundamental to our nation's wellbeing. They keep the population connected and the economy flowing. Central government is responsible for the busiest, strategic roads – a network which contains England's motorways and major A-roads. While only accounting for 2% of the road network as a whole, the SRN carries one third of all road traffic and two thirds of freight.

Investment has reduced and traffic has grown

The network we have today was primarily built in the 1960s and 1970s. The intervening decades have seen traffic on the SRN drastically increase, but investment in the network has reduced – in contrast to many of our international competitors. Now, in certain places, the SRN has reached capacity, and congestion currently costs £2 billion each year. With traffic expected to grow steadily over the coming decades, this situation will worsen – the cost of congestion is set to rise to around £10 billion per year in lost time by 2040 unless action is taken.

But there is real cause for optimism

While rising traffic will place more pressure on the network, the future does hold exciting opportunities to harness innovations, increase performance and improve journey quality. Developments in technologies, such as Ultra Low Emission Vehicles (ULEVs), driver-assisted and autonomous systems, big data and smart infrastructure all have the potential to dramatically change how we use our roads.

The opportunity to transform our network is one we cannot miss

As we look to the future, we must invest to address today's issues, and also to meet our future needs. So, with this RIS, we are taking a markedly different approach, focusing on longer term investment and planning, underpinned by the step-change in funding announced at the 2013 Spending Round. At the same time, the Highways Agency is transforming into the goverment-owned Strategic Highways Company (the Company), which will enable it to operate like the best-performing infrastructure providers in other sectors.

"While rising traffic will place more pressure on the network, the future does hold exciting opportunities to harness innovations, increase performance and improve journey quality"

The challenges

Key problems being addressed include...

CONDITION	The condition of our network needs to be both maintained and improved – a lack of investment in our roads has left our network paying the price. A large percentage of the SRN's road surface will come to the end of its natural life in the next five years, so the funding in this Investment Plan is required to keep the network in a safe and serviceable condition.
CAPACITY	The capacity of many of our roads is increasingly inadequate, with approximately 85 billion vehicle miles driven on the SRN in 2013. By 2040, traffic on the SRN will be between 27% and 57% higher than it was in 2013. Our road traffic forecasts indicate that, by 2040, around 25% of the entire SRN and 32% of the motorway network will experience severe congestion at peak times and suffer poor conditions at other times of the day.
CONNECTIVITY	The connectivity of our road network is inconsistent. The last truly new road built in this country was the A1-M1 link in the 1990s; the last wholly new motorway was the M25. The geography of the road network reflects the economy of the past, neglecting many of our fastest growing cities. East-West routes, which are critically important to our modern economy, are often poorly served.
CERTAINTY	Investment has been stop-start for generations. Insufficient and inconsistent plans and funding have made it difficult to build for the future and work with the supply chain to generate efficiencies. International comparisons suggest this has cost us billions of pounds in lost savings.
CONSTRUCTION	The construction of housing and creation of jobs has been held back by poor transport connections. Too often bottlenecks on the SRN, at places like the A1 around Newcastle, have limited or even blocked local developments from taking place. Lack of certainty in investment has hampered the expansion and upskilling of the construction sector.

The Strategic Vision

Our strategic roads will underpin future wellbeing and prosperity

The network of the future will be smoother, smarter and more sustainable. It will deliver the safer, more stress-free journeys that everyday users desire, and the enhanced reliability and predictability that is so important to business users and freight. The SRN will also work more harmoniously with its surroundings, impacting less on local communities and the environment, and doing more for those who live and work near the network.

"By 2040, we will have transformed the busiest section of the network to enable improved safety levels, smoother traffic flow, and increased capacity"

The network of the future will require different infrastructure

Our aim is that, by 2040, we will have transformed the busiest sections of the network to enable improved safety levels, smoother traffic flow, and increased capacity. Smart Motorways, which use technology to expand capacity and regulate the flow of traffic, will form the core of the SRN, while the most strategically important A-roads will be upgraded to Expressways. This enhanced infrastructure should not, however, come at the expense of the environment. Instead, by 2040, we will have completed a wide-ranging retrofit of the network to improve environmental outcomes and help the network fit more seamlessly with its surroundings.

Better information and communication will be essential

Control will be returned to drivers, with personalised and predictive travel information leading to improved journeys at more reliable speeds. Intelligent vehicles, which communicate with the infrastructure and each other, are also likely to become the norm by 2040, and we will look to capitalise on their momentum to deliver a network that can fully exploit technological advances.

Efficient and effective management of the network will be needed

Our vision is deliberately ambitious, and will take time to achieve in full. The Company will make strides towards transforming the network during the first and second Road Periods (a RIS covers the duration of a Road Period), through creative, responsive and efficient management of the network, driven by the needs of customers.

The Company will also take into account customers' needs across transport modes. It will work with others, for example with Local Authorities on links between local and strategic roads, and Network Rail to support the likes of sustainable rail freight.

We believe these changes will deliver a network that is fit to face the future

We have bold aspirations for the network. By 2040, our aim is for it to be...

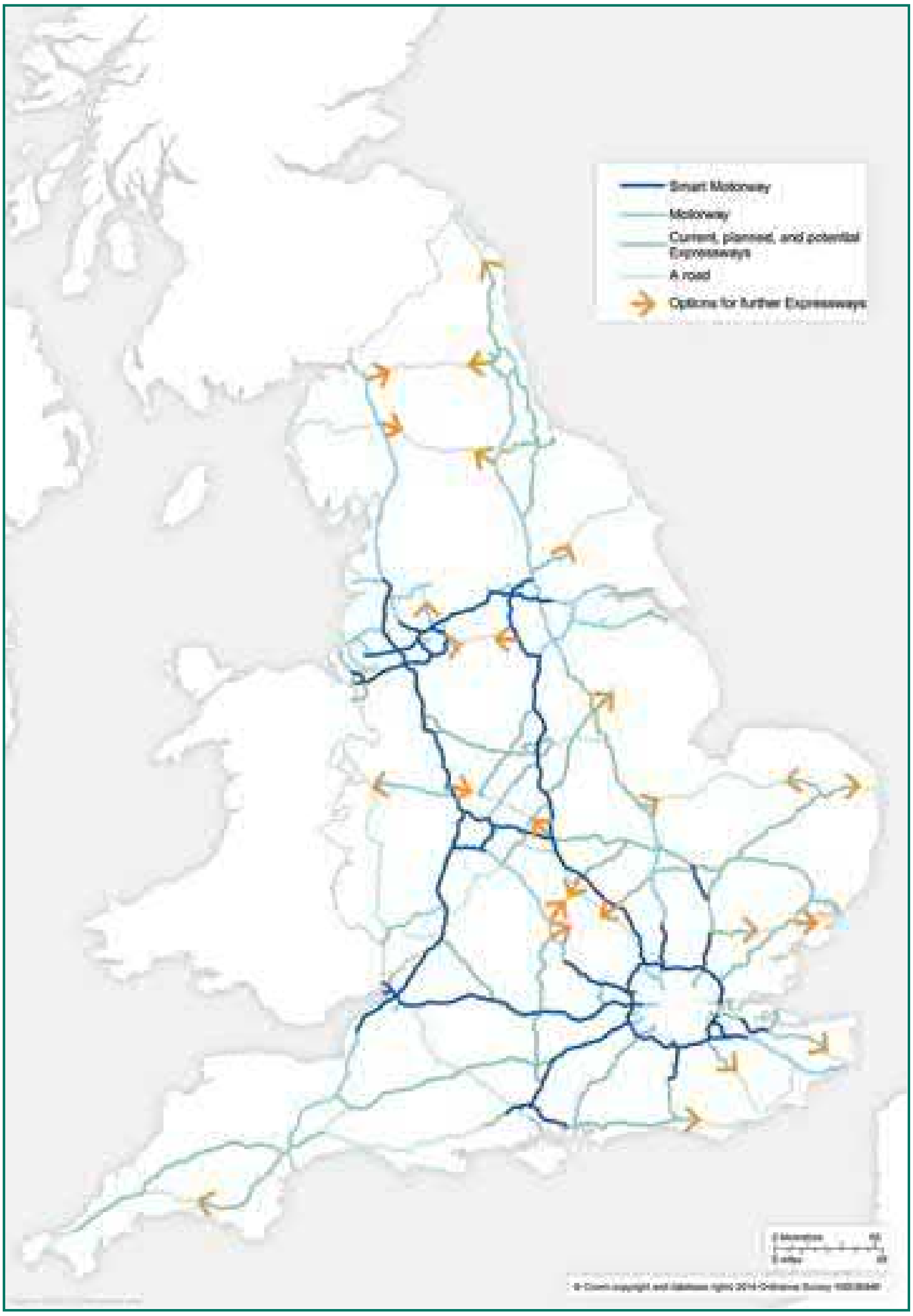
SMOOTHER	• The number of people killed or seriously injured on the SRN **approaching zero** • More users, more happy with more journeys, leading to road user satisfaction levels of **95%** • A **free-flow core network**, with mile a minute speeds increasingly typical
SMARTER	• A network that enhances the UK's global competitiveness, and is recognised as one of the **top 10** global road networks by business • A step-change in efficiency, with road projects and maintenance delivered **30% – 50%** cheaper than today
SUSTAINABLE	• A better neighbour to communities, with **over 90%** fewer people impacted by noise from the SRN • **Zero** breaches of air quality regulations and major reductions in carbon emissions across the network • Improved environmental outcomes, including a **net gain** in biodiversity from the Company's activities

The network towards 2040

As we look to 2040, we want an upgraded network, supported by technology. This means:

- **Smart Motorways** becoming the standard for the busiest sections of the network, delivering smoother traffic flow, increased capacity and improved safety
- Turning our busiest A-Roads into **Expressways**, providing improved standards and technology to manage traffic
- Enhanced safety and reduced congestion across the network, upgrading junctions, tackling bottlenecks and introducing new technology
- Improved design standards with greater consideration of the needs of walkers, cyclists, and local communities.

The map opposite shows what our network could look like by 2040.



Improved East-West connectivity and better access to our cities and international gateways

A largely free-flowing network that supports a growing population and thriving economy

Smoother, quieter, more reliable journeys and a more resilient network

The Investment Plan

A transformational level of investment in the SRN

In 2013, we announced a substantial level of investment in the SRN as part of the 2013 Spending Round, including:

- **Over 400 extra lane miles of Smart Motorways**, including a 'smart spine' linking London, Birmingham and the North West
- **54 major roads projects** to be built across this Parliament and the next
- Schemes to improve critical freight routes, such as the **£1.5 billion A14 scheme in Cambridgeshire** and the **M6 in Cheshire**
- **£6 billion set aside to resurface 80%** of the SRN and keep our network in top condition.

With this RIS, we are now announcing the next round of investment that will transform our roads through **84** wholly new schemes. This includes:

- **£3.5 billion on 20 new schemes** that will address some of the most long-standing and notorious network hotspots, including building a **tunnel at least 1.8 miles long at Stonehenge** and dualling the whole of the **A303**, transforming connectivity to and from the South West
- **£3.7 billion on a further 64 schemes** across the length and breadth of the country to improve safety, ease congestion, unlock growth and add nine additional Expressways to the SRN. **49** of these are schemes expected to start construction by 2020.

This means a total of **127** major road schemes will come forward in this Road Period – the largest programme of investment for a generation.

A transformational impact

The new schemes will deliver improved local and regional journeys, whilst also addressing critical challenges faced by the country and the SRN. Key areas of impact include:

- Developing a core network of Smart Motorways and Expressways
- Supporting the Northern Powerhouse
- Enabling growth and housing

"With this RIS, we are now announcing the next round of investment that will transform our roads through 84 wholly new schemes"

- Creating better connectivity
- Improving safety and reducing congestion.

A series of new strategic studies will also explore options to address some of the SRN's emerging challenges, the results of which will inform the second RIS.

Our investment will help to create a better network

We are committed to creating a better network – one that works for drivers and the communities that live around it. So we are establishing a series of ring-fenced investment funds, including a £250 million Cycling, Safety, and Integration Fund, a £300 million Environment Fund, a £150 million Innovation Fund, a £100 million Air Quality Fund, and a £100 million Growth and Housing Fund. These will target a range of areas, including:

Noise: We are investing £75 million in noise barriers and allied improvements to minimise the SRN's impact on nearby communities and reduce the number of people affected by noise by up to 250,000. This is in addition to the £6 billion which will be invested to resurface 80% of the network with lower noise surfaces.

Cycling: In line with the government's commitment to 'shift cycling up a gear', we are investing £100 million to improve cycling provision on at least 200 sections of the network, as well as ensuring all new schemes are cycle-proofed.

New vehicle technology: We are investing almost £40 million to support the development of driverless and co-operative vehicle technologies.

Carbon: We will support the increasing uptake of ULEVs, investing in rapid chargers to help ensure people will rarely be more than 20 miles from a charger on the SRN. The Company will also convert the majority of the Traffic Officer Service fleet to ULEVs.

Flooding and water: We are investing £70 million to improve the resilience of the SRN and reduce flooding risks to neighbouring communities – which is part of a broader £100 million water improvement package.

Landscape, heritage and biodiversity: We will invest over £100 million to enhance the network's landscape, address areas where there are negative impacts on sites of historic or cultural heritage, and improve the impact on local biodiversity.

The following section outlines how the Investment Plan will have a transformational impact across the country.

More detail on the investment per region is included in the appendices to this document. A full breakdown can be found in the Investment Plan.

Environment

The Department and the Highways Agency have learnt a great deal in the past twenty years, and today's road schemes are very different to their predecessors. They are designed in far greater sympathy with their surroundings and with a much smaller environmental footprint. Thanks to improvements in design, there is no longer a forced trade-off between a well-functioning road network and a well-protected environment:

- **Advances in environmental mitigation measures** offer new ways to limit the impact of new developments on the local environment
- **Partnerships with environmental bodies** make sure that the Company will be doing all it can to prevent damage
- **Redesigning or replacing parts of the network** built when environmental issues were poorly understood, and unsympathetic designs were common, allowing us to improve the overall state of the network.

Considered design and efforts to minimise the negative impacts of the network have been firmly embedded into the RIS, as outlined below.

Like most road improvements over the past decade, the Investment Plan focuses on upgrades to the network we already have, rather than on building entirely new roads. Many of the upgrades involve improving junctions to drive greater performance without expanding the network, including developing the Smart Motorway network to increase capacity without significantly enlarging the network's physical footprint.

The RIS supports the development of an ultra low-emission network. Having already committed £500 million to support the take up of ULEVs at Spending Round 2013, the RIS brings a commitment to support the development of charging facilities on the SRN, so that drivers will rarely be more than 20 miles from a rapid charger anywhere on the SRN, as well as switching the majority of the Traffic Officer Service fleet to ULEVs by 2020.

The RIS delivers an unprecedented commitment to undertake a range of activities to support the environment, with a ring-fenced £300 million Environment Fund and a £100 million Air Quality Fund. These will allow the Company to work with partners to take action to reduce noise and carbon, improve water and air quality, and improve the network's impact on nearby landscapes, cultural heritage sites and biodiversity. In addition to this, we anticipate spending £100 million on improving cycling facilities at 200 sections of the network and to cycle-proof all new road schemes as standard. This is all on top of the environmental measures built into all new road schemes as standard.

The Performance Specification element of the first RIS also requires the Company to deliver better environmental outcomes, including the mitigation of at least 1,150 Noise Important Areas and demonstrating how it is reducing the net loss of biodiversity. The Company's Statutory Directions and Guidance will reinforce this commitment to the environment and require the Company to embed protecting and enhancing the environment into its business and decision-making processes.

1. A core network of Smart Motorways and Expressways

The SRN is a national network that serves different people, places, and purposes

Part of the SRN's strength lies in its versatility and responsiveness. It performs a range of functions – some vital to supporting the national economy, others required to enable regional connectivity and encourage local growth. Certain areas need a high-capacity motorway; others need a consistently good quality A-road that links them to the rest of the country.

We are improving infrastructure quality in the areas that need it the most

Our busiest and most economically important routes should benefit from technology-enabled Smart Motorways, which offer safer, more reliable journeys and an extra lane of capacity, while avoiding the need to physically widen the road. We are, therefore, transforming the core of the network so the busiest motorways are upgraded to Smart Motorway standard, starting with the M62 across the Pennines and ultimately creating uninterrupted Smart Motorway connectivity between London, Birmingham, Manchester and Yorkshire.

Equally, our key A-roads should be developed to a high standard throughout, with inconsistencies, bottlenecks and pinch-points tackled. We are, therefore, upgrading our most strategically important A-roads to Expressways to deliver performance levels similar to those seen on our motorways and improve national and regional connectivity.

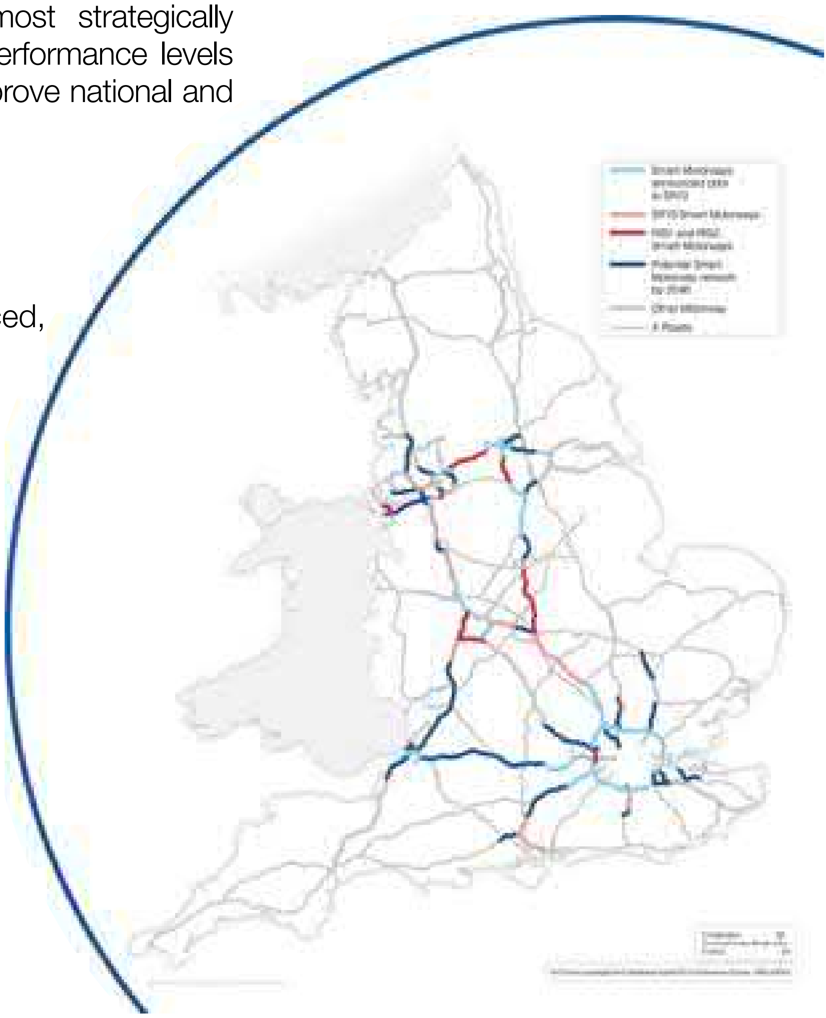
We have announced:

- Eight new schemes worth over £1.6 billion which, in addition to those already announced, will bring us closer to completing the network's Smart Motorway core
- 12 roads raised to Expressway standard through schemes worth £4 billion

New strategic study

The A1 is one of the most famous and least consistent roads in England. In addition to upgrading the stretch in Yorkshire to motorway, a new study on the **A1 in the East of England** will investigate upgrading the road south of Peterborough, possibly to full motorway standard.

Current Smart Motorway network and potential future plans



Expressways: The future for the South West

A key focus of our Investment Plan is on building a core network of Smart Motorways and Expressways. While the former is a relatively well-established concept, Expressways are a new idea for England's roads. The South West will be one of the first regions to feel their impact in full.

The challenge

The strategic roads of the South West present significant challenges in connectivity and consistency. While much of the country is linked by motorways, the South West is one of a number of areas that rely heavily on A-road connections. Roads like the A303, A30 and A417 have long sections of high-quality dual carriageway – but most people remember these roads for their bottlenecks and delays. These inconsistent roads have knock-on effects for businesses, communities and families.

The Expressway solution

Users of a motorway expect a consistent quality from the road. Users of these most important A-roads need to have the same confidence that they will have a consistently good journey. We therefore intend to designate and develop these roads as 'Expressways' – roads that match the quality and safety of motorways and provide world class connections and a dependably good service to users.

Expressways will generally be dual carriageway – safe, well-built and more resilient to delay. Junctions will be largely grade-separated, so traffic can move freely from the start of the Expressway to its end. This means an end to tailbacks as roads narrow or slow-moving traffic blocks the carriageway. Given the volumes of traffic, many of these roads will be able to provide drivers with a motorway-quality journey.

Two major corridors in the South West are pioneering this new approach:

- The A30 in Devon and Cornwall is a critical link for communities in the far west of the region. Work will start soon to dual the single carriageway section at Temple, and our commitment in this RIS for further dualling at Carland Cross will mean a continuous Expressway link all the way to Camborne – 15 miles from Land's End
- The A303/A358 will provide an Expressway corridor from London to Exeter via the M5 at Taunton, creating a second strategic corridor to the region. Starting with improvements at Sparkford, Taunton and Stonehenge, the route will be converted to an Expressway over the next 14 years.

This represents the most fundamental improvement to the roads of the region since the creation of the M5. These roads will cease to be sources of delay and frustration and become foundations for growth. Fifty years after the first motorways opened, Expressways will transform roads in our regions.

For more details on investment in the South West, see the appendices to this document.

2. The Northern Powerhouse

The cities of the North have the potential to make a global impact

Government is dedicated to creating a Northern Powerhouse – connecting our key northern cities so that they are greater than the sum of their parts and can work smoothly together to enhance not just our economy, but the country as a whole.

Better transport is a key ingredient

Transport is vital to realising this aspiration. Fast, effective and reliable connections are needed so that the different cities in the North can join together to forge a single, world-leading economy. The SRN has crucial role to play in this, working closely with rail, HS2 and HS3.

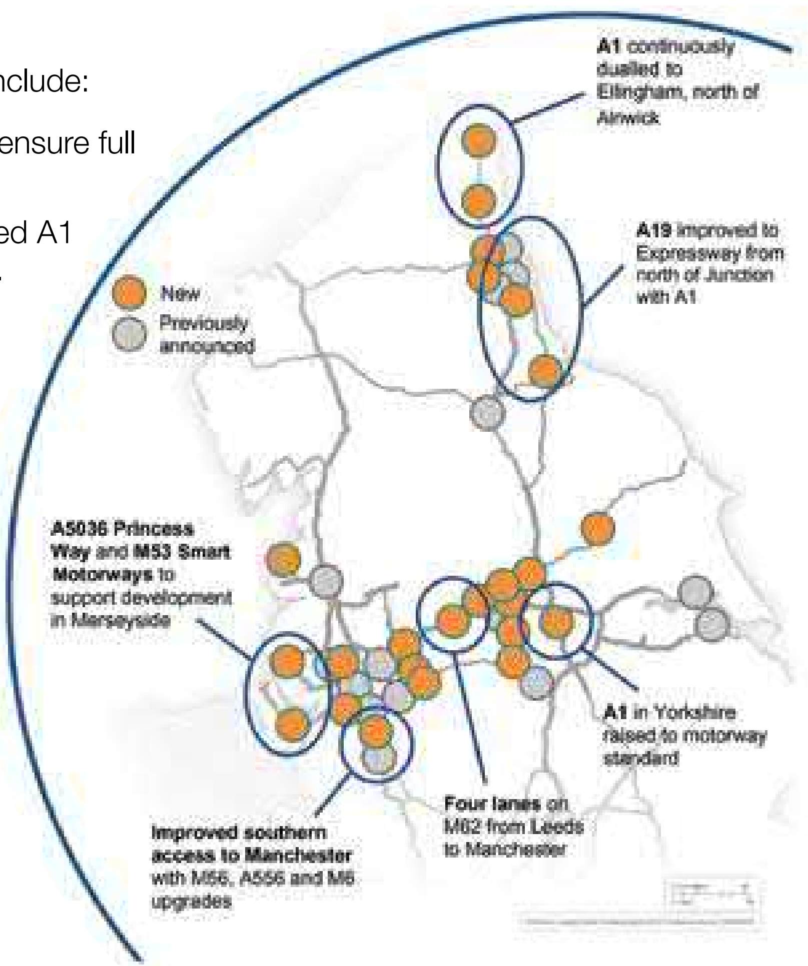
Our investments will ensure the SRN plays its part

Existing plans are already bringing major improvements to the network around our northern cities. The RIS builds on this with a total package of investment in the North, including 26 schemes worth approximately £1.4 billion in Yorkshire and North East, and 16 schemes worth approximately £1.5 billion in the North West. This includes a four lane Smart Motorway across the Pennines to link Manchester and Leeds, plus upgrading the A1 in South Yorkshire to motorway standard throughout. Improvements to the A19, raising the road to Expressway standard, will help industry and exports in the North East.

Further schemes from the feasibility studies include:

- Dualling additional stretches of the A1 to ensure full dualling to Ellingham, north of Alnwick
- Widening sections of the heavily congested A1 Newcastle – Gateshead Western Bypass.

Current and new RIS schemes



New strategic studies

One study will investigate the case for a potential **Trans-Pennine tunnel** to transform connectivity in the North. A second study will decide whether to upgrade the **A69 and/or A66** to Expressway standard across the Pennines.

3. Growth and housing

The SRN is integral to economic growth

The SRN is a key enabler of economic growth. Proposed developments, such as new housing sites and enterprise zones, need effective links to people and places. For large developments, the SRN has a critical role to play in increasing connectivity and providing the required capacity.

We are increasing connectivity to enterprise zones

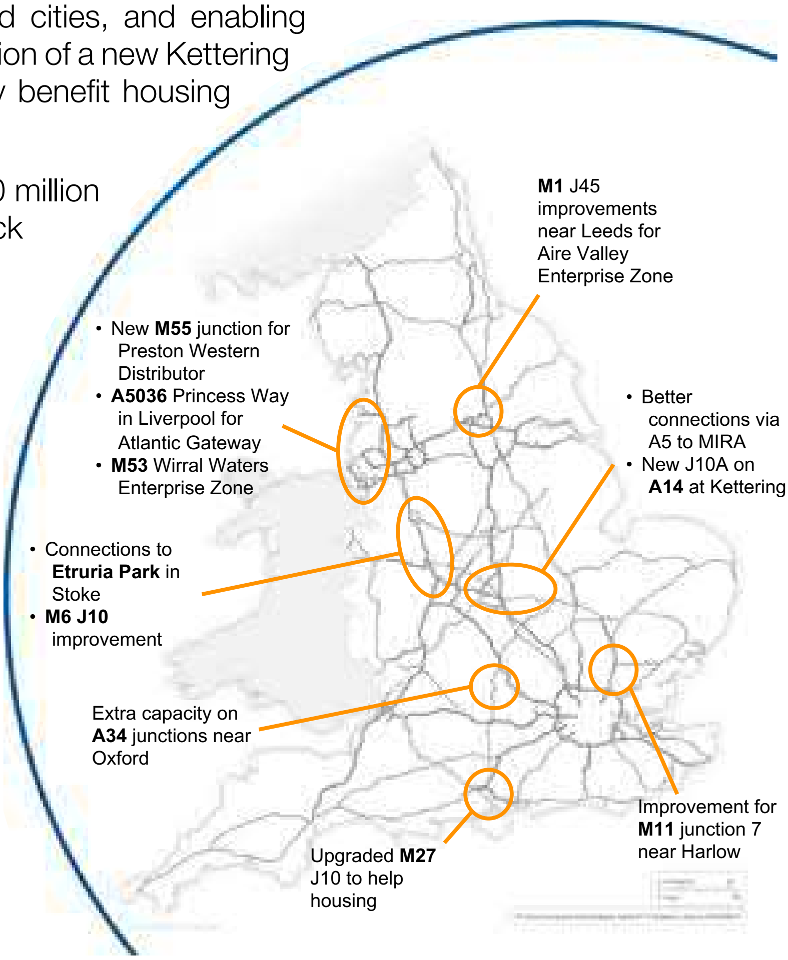
In 2011, the government announced its support for building 24 enterprise zones across the nation. The SRN provides vital connectivity to support the growth of these areas, helping unlock investments and create jobs. In this RIS, we are extending this support. Upgrades to the M53 around Ellesmere Port will remove a barrier to growth and directly support the local enterprise zone, a new junction on the M49 corridor will provide strategic access to the Avonmouth Severnside Enterprise Area, and improvements on the A5 will support the MIRA Enterprise Zone.

We are enhancing our network to support housing growth

The SRN enables the planning and delivery of new housing. Alongside providing capacity for future economic developments, we will also invest with developers to ensure that housing growth means better journeys, not longer tailbacks. This means upgraded junctions, improvements around towns and cities, and enabling works for potential Garden Cities. The provision of a new Kettering A14 Junction 10a, for example, will directly benefit housing development in the area.

This investment will be supported by a £100 million fund, committed to help the Company unlock housing and growth projects.

Example schemes to support growth and housing



New strategic study

Development in Manchester will put more pressure on the surrounding roads. Planning is needed now to make sure the **Manchester Orbital** is ready to support the national and local economies. This work needs to consider the full range of modal options, and the new combined Manchester authorities will play a key part.

4. Better connections

The SRN is an essential network for both people and freight

Our strategic roads reach all four corners of England, and play a central role in linking our different modes of transport at airports, ports and rail freight interchanges. But the SRN, in large part, reflects the geography and technology of the 1960s. We must ensure that it meets the needs of today and prepare it to meet the demands of tomorrow.

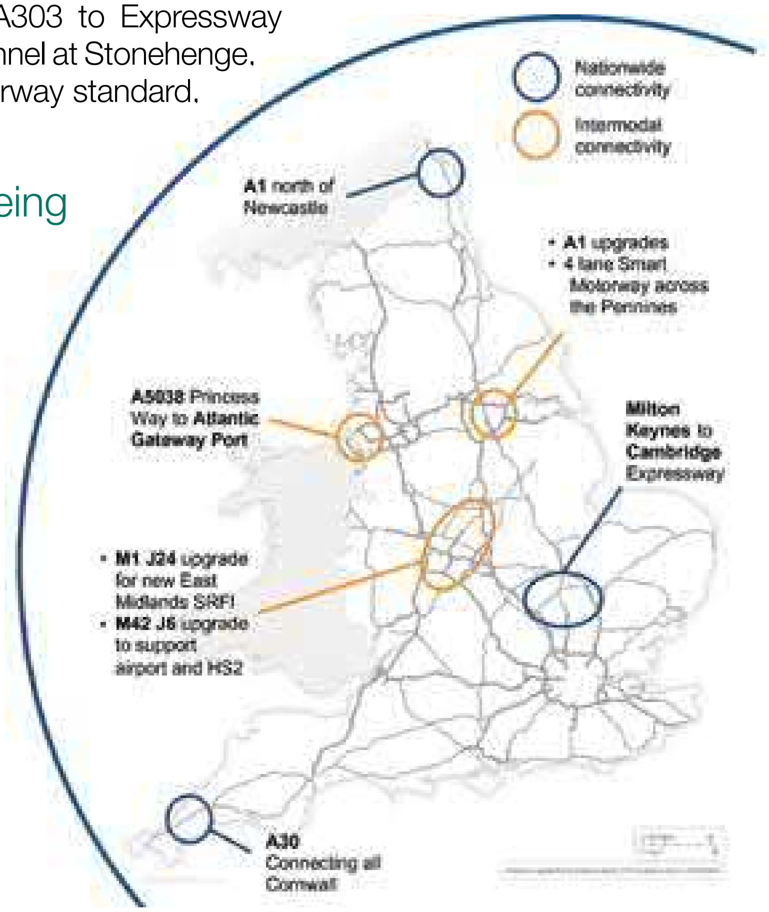
We are enhancing links to other modes

Existing and new investments will provide world class road links to and from our international gateways, freight hubs and modal interchanges by eliminating the bottlenecks that blight major interchanges. For example, improvements on the A19 will enhance access to Teesport, and schemes on the A180 and A160 will improve links to the Port of Immingham. A453 improvements are already providing better access to Nottingham Tram Park and Ride, and a range of schemes are putting capacity in place for new strategic rail freight interchanges (SRFI) and HS2. Indeed, through the RIS, we will transform access to seven major ports and five airports.

And filling gaps in the network to boost connectivity

This RIS is allowing us to target bottlenecks and raise the standard of sections of road to improve performance on whole routes. For instance, upgrading the A428 to create an Expressway link between Cambridge and Milton Keynes. We are also committing to transforming connections to and from the South West by upgrading the A303 to Expressway standard, which includes re-routing the A303 in a tunnel at Stonehenge. as well as raising the A1 in south Yorkshire to motorway standard. to create an alternative route to the North East.

New RIS schemes to increase connectivity



Projects of all shapes and sizes are being undertaken

Over this RIS and the next, we will improve connectivity between our major cities and the core and edges of the network. This will involve a range of interventions from transformative major projects to smaller schemes targeting key bottlenecks.

New strategic study

This study will investigate the case for linking existing roads and creating an **Oxford to Cambridge Expressway**, which would create a high-quality link between Oxford and Cambridge, via Bedford and Milton Keynes.

5. Safety and congestion

High quality infrastructure is only a means to an end

The most important outcome of investment and improvements to infrastructure is the impact on users. In this regard, safety is of the utmost importance, and minimising congestion is integral to making journeys easier and more reliable.

While, safety on the SRN is good and has improved considerably in recent years, we take nothing for granted and will strive to improve it still further. Congestion is a growing problem and certain points on the network have already reached capacity. With long term trends indicating a further increase in traffic, we must act now.

Our planned investments and ring-fenced funding demonstrate our determination

The drive to improve safety and reduce congestion underpins the vast majority of our schemes. Several schemes, however, are specifically focused on alleviating these problems – the two of which often go hand in hand. On the M25, upgrades to Junction 10 will create a free-flowing interchange with the A3, improving an area which has a high casualty rate. In the North, planning work will start for upgrades to two of the region's most important interchanges: the M62/M1 Lofthouse interchange and the M60/M62/M66 Simister Island junction. Strategic studies will explain the long term options for the M60 and M25.

The ring-fenced Cycling, Safety, and Integration Fund and Innovation Fund will also enable us to remain at the forefront of road technology and continue to improve safety, for example, by funding research into collision avoidance and casualty reduction systems.

New strategic study

The **M25 South-West Quadrant** is the busiest part of the network. We are commissioning a study to plan for its future, supporting local people, strategic travellers and those using Heathrow. It will need to look at all options, including different modes and extra capacity, to make sure the route is resilient for the generation to come.

£105 million set aside for safety measures in addition to RIS scheme investment

Schemes and studies to tackle severe congestion on M25, M60, A1 and A12

40% reduction in deaths and serious injuries on the network by the end of 2020

The Performance Specification

Measuring performance in a balanced way

In the Performance Specification, we have identified eight areas where we will measure SRN and Company performance over the first Road Period, focusing on the needs of road users and the country. We have set Key Performance Indicators for each of these areas. We also require the Company to provide Performance Indicators for each area to give more information about performance and to deliver specific products, including improved performance measures for future Road Periods.

Making the network safer for our customers

The fact that the SRN is considered one of the safest networks in the world is no reason to rest on our laurels. We know there is more that we could and should be doing; the human and economic cost of incidents is still far too high. We want the Company to help achieve a 40% reduction in deaths and serious injuries on the network by the end of 2020 to help deliver our ultimate aim: nobody should be killed or seriously injured as a result of incidents on our network.

Ensuring user satisfaction

Drivers' satisfaction with their journeys is at the heart of our vision. We know road users want stress free journeys, with minimal delays and good information. Achieving our target of 90% customer satisfaction will also reflect achievement in other areas of the Company's performance. Roadworks, for instance, are a key cause of concern and a significant programme of maintenance and enhancement will be undertaken during the next five years; a positive journey experience will be a key measure of success.

Supporting the smooth flow of traffic

We want to see a network that is free flowing and where disruption caused by congestion and other incidents is kept to a minimum. Our vision is that mile a minute speeds on the network will become increasingly common. We require the Company to manage roadworks in a way that keeps at least 97% of the network open for use, and to clear unplanned incidents as quickly as is practicable.

"Underpinning roads reform is a desire for the network to be more efficient. We expect the new Company to deliver over £1.2 billion efficiency savings over the first Road Period, to be re-invested into the network"

Encouraging economic growth

A free-flowing network is vital to helping our economy flourish. Measuring the average delay on the network is an indicator of the extent to which congestion acts as a brake on economic growth. We also want the Company to demonstrate what it is doing to support developers, small and medium-sized enterprises, and the construction sector as a whole.

Delivering better environmental outcomes

We have made a clear commitment to improving environmental outcomes and we want the Company to build on recent progress. Noise can adversely impact people living and working near the network so the Company should seek to mitigate 1,150 Noise Important Areas, reducing the impact of noise for around 250,000 people. The Company is also required to demonstrate how it is working to halt the loss of biodiversity so that its activities in the second Road Period deliver no net loss of biodiversity.

Helping cyclists, walkers, and vulnerable network users

Roads are not just for drivers; we want to help people to be more active by providing more choice for cyclists, walkers and other vulnerable users. Initially, that means providing additional crossings to reduce severance between communities and improve safety for vulnerable users. We also want the Company to work with other key stakeholders to improve facilities for users of all kinds.

Achieving real efficiency

We expect the new Company to deliver over £1.2 billion efficiency savings over the next Road Period, which will be re-invested into the network. It should also show it is delivering its programme of investment on time and within budget. A step change in the way that the Company operates will benefit the tax payer and deliver better roads for users.

Keeping the network in good condition

The SRN is an essential piece of national infrastructure so must be kept in good condition. During the first Road Period, we want the Company to measure and report on how well it is maintaining road surfaces, and develop new condition indicators, including for bridges and earthworks.

The following pages show the specific KPIs relating to each of the eight performance areas.

Further details can be found in the Performance Specification.

The Performance Specification

Safety

Our focus is always on providing a safer network for all road users and reducing the number of casualties

SAFETY SAFETY

40%

Reduction in the number of people **killed or seriously injured** on the network

SAFETY SAFETY

User satisfaction

Customer satisfaction is a measure of overall performance across a number of areas, assessed through the National Road Users' Satisfaction Survey

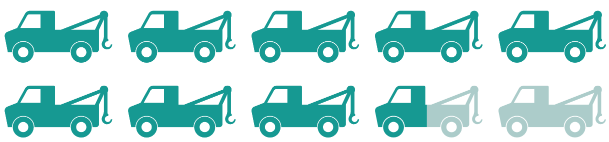
Overall satisfaction of at least 90%

Traffic flow

Free-flowing traffic is essential and we have two KPIs to enable the evaluation of the Company's impact:

97%
Network availability
at a minimum, to keep traffic flowing and reduce the impact of roadworks

85% **Motorway incidents**
cleared within the hour



Economic growth

The SRN will support economic growth. We have focused on **average delay**, monitoring time lost per vehicle per mile to illustrate the cost of delay

Environment outcomes

Improving environmental outcomes is a key requirement of this Roads Investment Strategy, with a twin focus on the built and natural environment

1,150

Noise important areas, as identified by DEFRA, mitigated by the end of the first Road Period

Reducing net loss of biodiversity during the first Road Period to achieve no net loss during the second Road Period

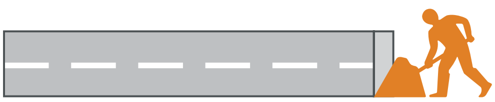
Cyclists, walkers, and vulnerable users

The company will report on the number of new and upgraded crossings they deliver during this Road Period

Efficiency

We expect the Company to show how it is delivering the Investment Plan in a **timely and efficient manner** to save over £1.2 billion across 5 years

Network condition



During Road Period 1, the Company will develop new improved metrics for the condition for all aspects of the asset

95% Of road surface – 'pavement' – in adequate condition

Transforming our roads

It is no exaggeration to say that without the SRN the country would grind to a halt. Implementing a new road investment and planning process, underpinned by a step change in funding, is therefore not just desirable, but essential.

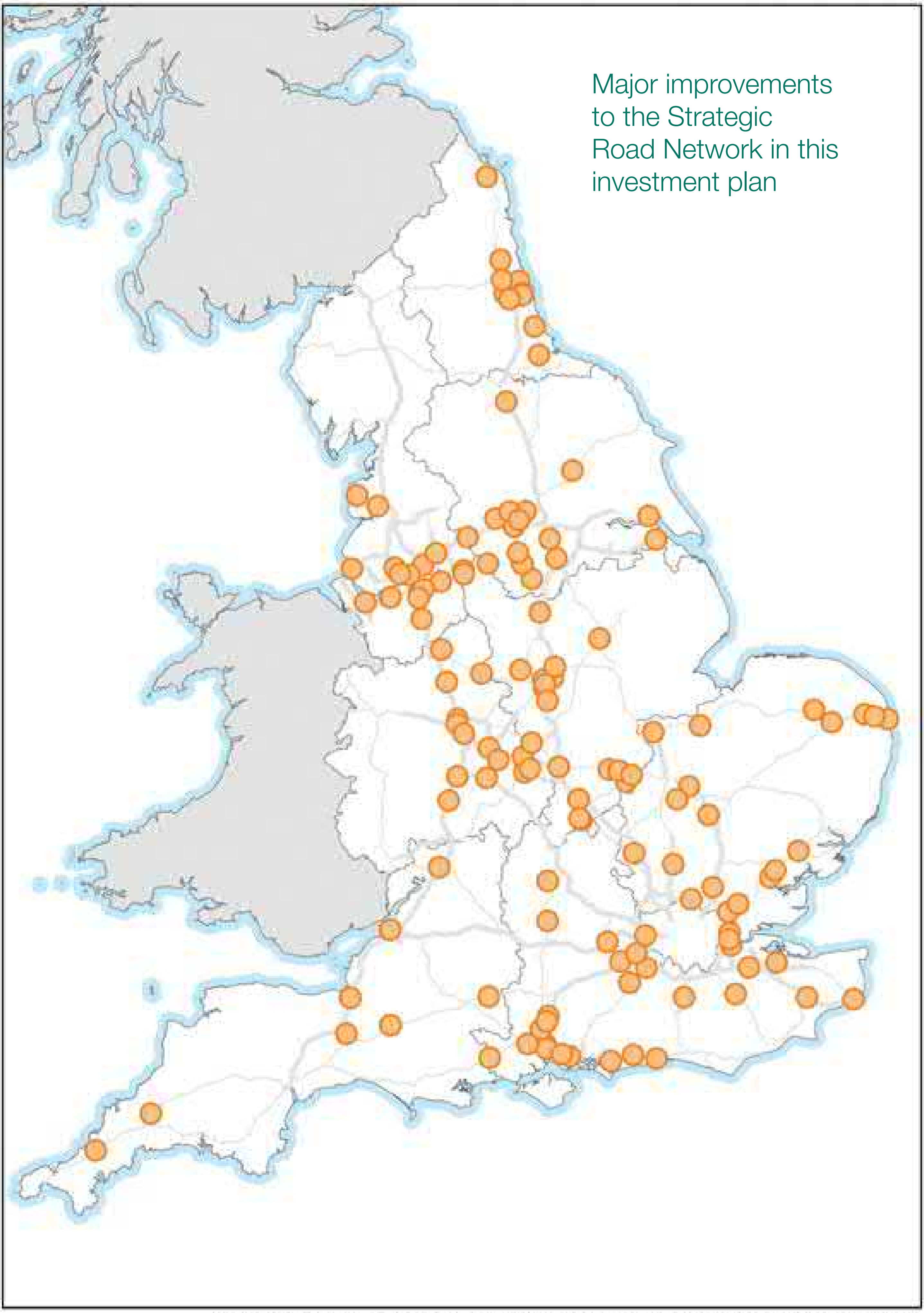
We have been deliberately ambitious in our aspirations for the long term and demanding in the progress we are seeking over the first Road Period. This is reflected both in the investments we are making and the outcomes targeted by the Performance Specification, which will put us on course to deliver a smoother, smarter, and more sustainable network.

This is undeniably a long term process; the transformation we are striving for cannot be achieved overnight, but will require time, foresight and forward planning. In that light, consideration of the second Road Period and beyond has begun and will ramp up over the coming years so that the next RIS will continue this transformation.

As this Road Investment Strategy proves, government has both the will and the plans to transform the SRN. Now is the time for action, as we work in concert with the Company to make this strategy a reality.

Appendices: regional profiles

Investment Plan regional profiles


Major improvements
to the Strategic
Road Network in this
investment plan

Investment Plan – North East England and Yorkshire

The roads of Yorkshire and the North East are largely defined by four major corridors – the M1, M62, A1 and A19. Since 2010, each of these has seen the start of major improvements:

- Construction has started on the A1 motorway upgrade between Leeming and Barton. This means that, in 2017, there will finally be an all-motorway link from Newcastle and Teesside to the rest of England
- Three stretches of Smart Motorways are now under construction on the M1 – from Chesterfield to south Sheffield, between Sheffield and Rotherham, and from Wakefield to the M62. On the M62 itself, a 15 mile stretch of Smart Motorway is already open, adding a lane to the most congested section of the road
- The second Tyne Tunnel opened in 2011, effectively widening the A19 under the river to two lanes in each direction.

These are improvements that will transform transport, particularly for the North East. However there is also more work to do. We have now completed two feasibility studies into the future of the A1 around and north of Newcastle. At present, the A1 Western Bypass from Newcastle to Gateshead is heavily congested. A £300 million widening scheme has already been announced between Coal House and Metro Centre. We now propose to go further by widening the adjacent section between Coal House and the junction with the A194(M), replacing the decaying Allerdene bridge in the process, and by widening the section between Junctions 74 and 79 north of the Tyne.

To the north of Newcastle, the capacity of the A1 has been a longstanding issue. We therefore plan to widen the A1 to create a new Expressway standard road to Ellingham. The length of continuous dual carriageway north of Newcastle will more than double to 33 miles; further safety improvements will enhance the rest of the route.

Major junction improvements will be built along the length of the A19. Improvements to the Coast Road and Testos roundabouts will improve access to the north and south of the Tyne Tunnel. This will remove the final at-grade junction between the Tyne and the Tees, and will raise the A19 to Expressway standard from the north of Newcastle to its junction with the A1 in Yorkshire. Improvements to the Down Hill Lane junction at Sunderland, coupled with widening for the A19 between Norton and Wynyard, will fix two of the

26 major schemes

£1.4 billion invested from 2021 – 2015

Motorway from Newcastle to London complete by 2017

Smart Motorways across the Pennines

bottlenecks on the route, significantly helping the region's industry and exports, as well as replacing a noisy concrete surface.

Ambitious plans will also transform journeys in and through Yorkshire. Planning work will start to upgrade the last non-motorway section of the A1 in Yorkshire, between Redhouse and Darrington, to motorway standard. Together with supporting improvements to the neighbouring A1(M) Doncaster Bypass, this will create a new strategic route to the North East, reducing congestion around Sheffield and Leeds.

Work will begin on further Smart Motorways for the region, crossing the Pennines on the M62 and linking Leeds to Manchester with four lanes – the first comprehensive increase in Trans-Pennine capacity since 1971. More smart motorways will connect Leeds to Sheffield, and Sheffield southwards to London at the same standard.

Key junctions will be addressed. Junction 26 of the M62, vital for access to Bradford, will receive a new fly-under sliproad. An improved Junction 45 on the M1 to the East of Leeds will support the new Aire Valley enterprise zone. Planning will also begin for a major upgrade to the M1/M62 Lofthouse Interchange.

Two major improvements will strengthen access to the region's ports. An upgrade to the A180 and A160 will provide a dual carriageway to link Immingham and its associated refineries. Simultaneously, improvements to the A63 Castle Street will improve access to the port of Hull.

Last, and potentially most significant of all, our feasibility study on Trans-Pennine connectivity has highlighted the gap in the SRN between Sheffield and Manchester. We are commissioning a study into whether this gap can be filled by a multi-billion pound tunnel, travelling under the Peak District and transforming both the regional economy and the National Park for the better.

North East and Yorkshire

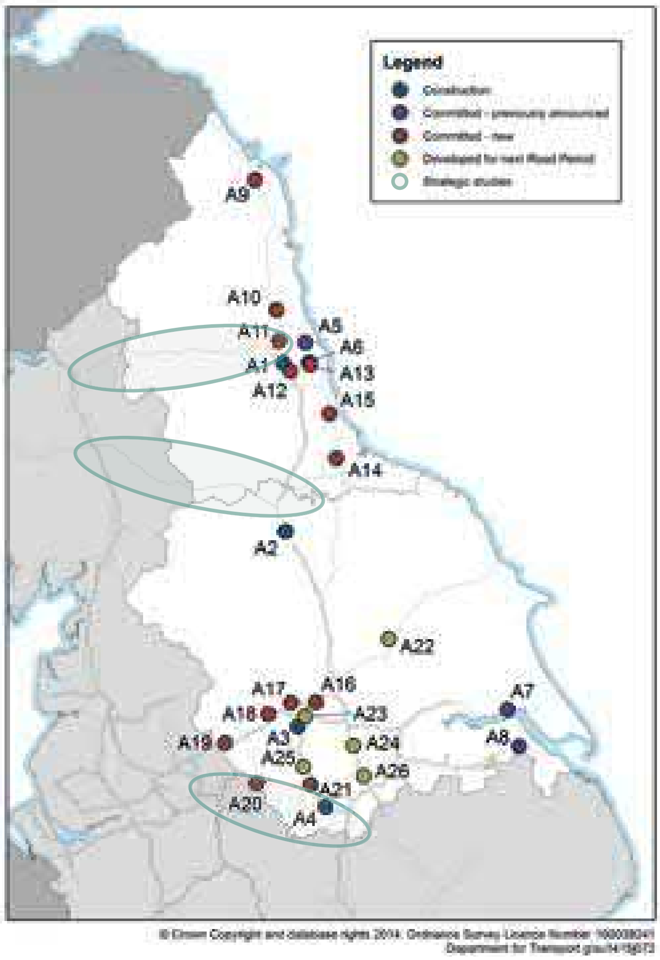
Construction
A1 A1 Coal House to Metro Centre
A2 A1 Leeming to Barton
A3 M1 Junctions 39-42
A4 M1 Junctions 32-35A

Committed – previously announced
A5 A19 Coast Road
A6 A19 Testos
A7 A63 Castle Street
A8 A160/A180 Immingham

Committed – new
A9 A1 North of Ellingham
A10 A1 Morpeth to Ellingham dualling
A11 A1 Scotswood to North Brunton
A12 A1 Birtley to Coal House widening
A13 A19 Down Hill Lane junction improvement
A14 A19 Norton to Wynyard
A15 A1 & A19 Technology enhancements
A16 M1 Junction 45 Improvement
A17 M621 Junctions 1-7 improvements
A18 M62/M606 Chain Bar
A19 M62 Junctions 20-25
A20 A628 Climbing Lanes
A21 A61 Dualling

Developed for next Road Period
A22 A64 Hopgrove Junction
A23 M1/M62 Lofthouse Interchange
A24 A1 Redhouse to Darrington
A25 M1 Junctions 35A-39
A26 A1(M) Doncaster Bypass

Strategic studies
Northern Trans-Pennine
Trans-Pennine Tunnel



Investment Plan – North West England

The North West is the home of Britain's motorway network and, even today, the area around Manchester and Liverpool has a greater number of motorways than all of the South East of England combined. Manchester's M60 is second only to the M25 in its peak traffic, which is why major upgrades are now taking place between Junctions 8 and 18 and onward to Junctions 18 – 20 of the M62 to bring Smart Motorways to the northern side of the ring.

Now that Smart Motorways are proven technology, their value for the roads of the region is clear. This was why last year the government committed to a further 60 miles of Smart Motorway in the Manchester area. This includes the south-east quarter of the M60, between Junctions 24 and 4, the M62 between the M60 and the M6, and the adjoining stretch of the M6 itself from the M62 to Wigan. Planning work will also begin to improve M60 Junction 18, the gateway to the Trans-Pennine M62, and to raise the M62 to Yorkshire to a full four-lane Smart Motorway. A new study will make sure that the M60 is ready for more development in the region.

To the south of Manchester, additional capacity is also coming into play. The A556 has long served as the de facto southern approach to Manchester, despite being a local road that runs through Mere village. Last month construction of a new Expressway-quality bypass began, which will provide a proper gateway to the North's largest city. The rest of this route into Manchester will receive further upgrades – with Smart Motorways widening the M56 from the A556 to the M60 to four lanes, and with an improved Junction 19 linking it to the M6.

Improvement to the M62 from Junction 20 eastwards will provide a fourth land across the Pennines extending all the way to Leeds. Further south, the 'smart spine' along the M6 and M1 will massively improve connections to Midlands and beyond. Smart Motorways will control over 145 miles of motorway, ensuring easy journeys from Liverpool and Manchester to Leeds, Birmingham and London. This represents the biggest single increase in capacity into the North West since the opening of the M62 in 1970.

16 major schemes

£1.5 billion invested from 2015 – 2021

Four lane motorways from Manchester to Leeds

Biggest increase in capacity into the region since 1971

This record may not stand long – following the findings of our Trans-Pennine feasibility study there is a need to address the strategic gap between Manchester and Sheffield. The direct route between the two cities is only 35 miles long, but traffic taking the M62 – the only high performance Trans-Pennine route – must travel more than 65 miles. This means that traffic from Manchester has to travel further to get to Sheffield than it does to reach the Lake District. This can only be answered by bold thinking, and we are commissioning experts to assess whether there is a tunnelling option which can bring these cities together while still enhancing the tranquillity of the Peak District. For the short term, improvements to the A57, bypassing the village of Mottram, will provide relief for local communities and road users.

In Merseyside, road improvements have an important role to play in promoting local development. In its 2014 city growth deal, Liverpool stressed the importance of upgrades to the A5036 Princess Way, which links Liverpool's port to the motorway network. Extra capacity on this route is vital to enhancing the port and developing the area, and we are pleased to confirm funding for the comprehensive improvement of this link. South of the Mersey, Smart Motorways on the M53 will help journeys into Birkenhead, supporting new housing and office space at the Wirral Waters development.

Development in northern Lancashire also requires further support. Preston is situated at the nexus of four different motorways. The new western distributor road, funded in the 2013 growth deal, will be linked to the M55 with the construction of the 'missing' Junction 2.

Road capacity in Cumbria remains good, but strategic connections are heavily biased to North-South movements. We intend to start a strategic study to examine the case for dualling the A69 and A66, to further Trans-Pennine capacity and improve connections between East and West in the North of England.

North West England

Construction
B1 M60 Junction 8 to M62 Junction 20: Smart Motorway
B2 A556 Knutsford to Bowdon

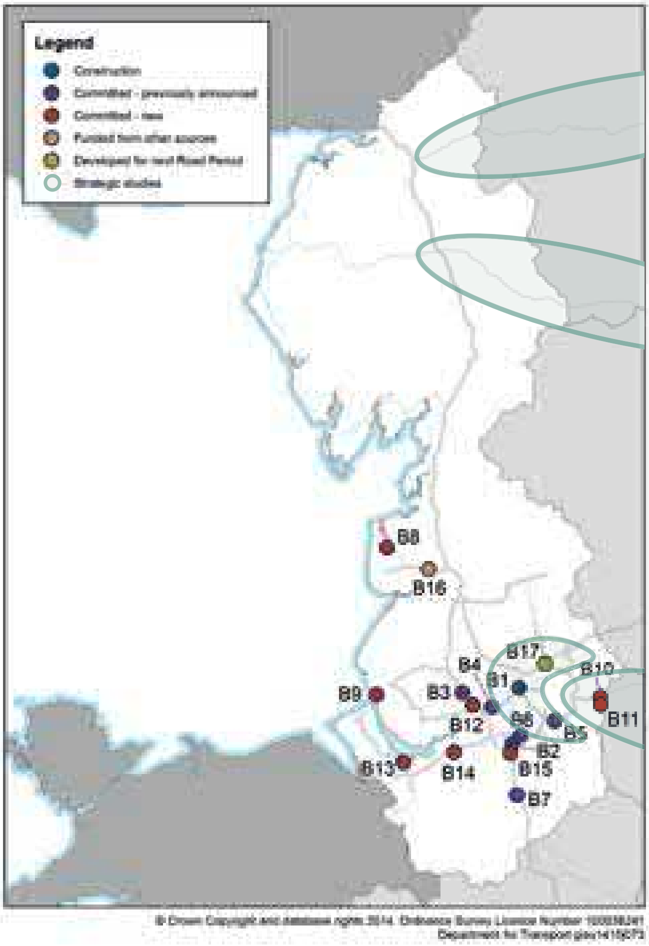
Committed – previously announced
B3 M6 Junctions 21A-26
B4 M62 Junctions 10-12
B5 M60 Junctions 24-27 & J1-4
B6 M56 Junctions 6-8
B7 M6 Junctions 16-19

Committed – new
B8 A585 Windy Harbour – Skippool
B9 A5036 Princess Way – Access to Port of Liverpool
B10 Mottram Moor link road
B11 A57(T) to A57 Link Road
B12 M6 Junction 22 upgrade
B13 M53 Junctions 5-11
B14 M56 new Junction 11A
B15 M6 Junction 19 Improvements

Funded from other sources
B16 M55 Junction 2

Developed for next Road Period
B17 M60 Simister Island Interchange

Strategic studies
Northern Trans-Pennine
Manchester North-West Quadrant
Trans-Pennine Tunnel



Investment Plan – Midlands

The Midlands is the keystone of England's road network. Catthorpe, where the M1, M6 and A14 meet, is the most strategically important junction on the network, and is mid-way through a £190 million upgrade. The region's motorways have benefitted from the introduction of Smart Motorways.

The M42 east of Birmingham has been the test bed for the development of Smart Motorways. What was a pioneering technology ten years ago is now a fact of life across the West Midlands. Half of the 'Birmingham Box', on the M6 and M42, is now able to open up the hard shoulder to traffic or in the process of being upgraded to do so. Work to complete the Box will begin during the next Road Period, starting with improvements to Junction 6 and Smart Motorways around M40/M42 interchange.

Further stretches of Smart Motorway will also connect Worcester to the 'Birmingham Box', and will be backed by extra capacity on local junctions to support further development. New slip roads will fully connect the M54 to the M6 and M6 Toll, meaning traffic heading north will no longer have to make their way through nearby A-roads.

So far, Smart Motorways have been used to improve the journeys around cities. Now, we will use them to link cities together. The improvement of the M1 from Junction 28 to 31 means that, from 2016, there will be a Smart Motorway link between Nottingham and Sheffield – the first time the technology has linked two major urban areas.

This is just the beginning. Further sections of Smart Motorway will soon be rolled out to the north and south of Birmingham. To the north, they will connect Stoke, and from Stoke go onward towards Manchester. Southbound, improvements to the M6 and M1 north of Milton Keynes will create a similar link to London. This 'smart spine' will link the South East to the North West, with Birmingham at its heart.

Further Smart Motorways will also be added to the East Midlands to open up the hard shoulder between Junctions 23A and 25. Planning will also start to fill in the gap between Junctions 19 and 23A, completing the London to Yorkshire Smart Motorway. M1 Junction 24 is one of the most important junctions in the East Midlands connecting Derby, Stoke, Birmingham, and East Midlands Airport, as well as Nottingham via the soon-to-open A453 dual carriageway. As part of the

31 major schemes

£1.8 billion invested from 2015 – 2021

145 miles of Smart Motorways to link London, Birmingham and Manchester

11 schemes to help housing and growth

deal for approving a new rail freight interchange at Roxhill, the developer is proposing to fund a major improvement to Junction 24/24A, including a direct link from the A50 to the M1 southbound. If approved, this will solve one of the worst bottlenecks in the East Midlands.

The region's A-roads will also receive real attention:

- Grade separation of three junctions in Derby will mean the A38 will become a full Expressway from North Derbyshire to the West Midlands
- Ongoing upgrades to the Tollbar junction, coupled with two new junction improvements, will do the same to the A46 between the M6 and the M40
- Widening the A14 around Kettering will keep the route from the Midlands to Felixstowe from closing up, as will the £1.5 billion improvement between Huntingdon and Cambridge
- In Nottingham, a series of upgrades to roundabouts on the A52 will smooth flows around the city's ring road
- Planning will begin to dual the Newark northern bypass, and replace the A46 Junction with the A1.

The Midlands is expecting substantial growth, in terms of housing and industry. We will support this by adding capacity with new schemes funded by developers, local growth deals and central government funding:

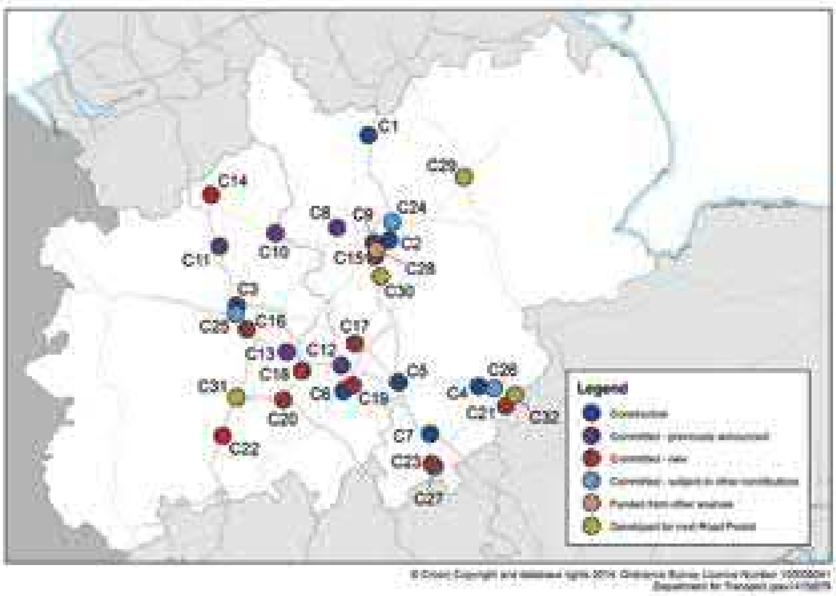
- Improvements to the A500 in Stoke, the A50 in Uttoxeter and the A5 at Hinkley will support development at Etruria Park, JCB and MIRA
- Expansion of M6 Junction 10 will help 10 key employment sites within a 10 minute radius, and unlock 2,500 new homes
- In Northamptonshire, widening of the A45 to the A14, a new A14 Junction 10A and improvement to the Chowns Mill roundabout on the A45 and A6 will allow growth in Kettering and Rushden
- As part of the Towcester southern extension, we will part-fund a new southern relief road, taking traffic out of the town centre and enabling 2,750 new homes.

Midlands

Construction
C1 M1 Junctions 28-31
C2 A453 Widening
C3 M6 Junctions 10a-13
C4 A14 Kettering bypass widening
C5 M1 Junction 19 improvement
C6 A45-A46 Tollbar End
C7 M1 Junctions 13-19

Committed – previously announced
C8 A38 Derby Junctions
C9 M1 Junctions 24-25
C10 A50 Uttoxeter
C11 M6 Junctions 13-15
C12 M6 Junctions 2-4
C13 M5 Juntions 4A-6

Committed – new
C14 A500 Etruria widening
C15 M1 Junctions 23A-24
C16 M6 Junction 10 improvement
C17 A5 Dodwells to Longshoot widening
C18 M42 Junction 6
C19 A46 Coventry junction upgrades
C20 M40/M42 interchange Smart Motorways
C21 A45/A6 Chowns Mill junction improvement
C22 M5 Junctions 5, 6 & 7 junction upgrades
C23 A43 Abthorpe Junction



Committed – subject to other contributions
C24 A52 Nottingham junctions
C25 M54 to M6/M6 Toll link road
C26 A14 Junction 10a
C27 A5 Towcester Relief Road

Funded from other sources
C28 M1 Junctions 24-24A improvement

Developed for next Road Period
C29 A46 Newark Northern Bypass
C30 M1 Junctions 19-23A
C31 M5/M42 Birmingham Box Phase 4
C32 A45 Stanwick to Thrapston

Investment Plan – East of England

The East of England is where many of our exports begin their journey to the wider world. With major ports at Felixstowe and Tilbury, and a third under construction at London Gateway, good connections to and from the region are crucial for the national economy.

To speed up these journeys, government confirmed in 2012 that it would deliver a £1.5 billion, 21 mile improvement to the A14 between Cambridge to Huntingdon. This stretch has been cited as the biggest single choke point for British business, and from 2016 work will begin to bypass Huntingdon and bring the whole affected stretch up to three-lane standard. This is the single biggest project in the entire roads programme.

To further support access to our major ports, we are now turning to the A12, which links Felixstowe and Ipswich with Essex and London. Key elements include:

- The widening of the stretch between Chelmsford and the junction with the Westbound A120 (Junction 25) to three lanes
- Preparation to widen the stretches between London and Chelmsford, and around the Colchester bypass
- Reconstruction of the junction with the M25
- A package of technology measures to smooth congestion on the rest of the route.

The last stage of dualling the A11 to Norwich will finish this month, completing England's newest Expressway and providing the first-ever dual carriageway link to Norfolk. We will build on this with a package of improvements along the length of the A47, including:

- Further dualling around Norwich, to the east between Blofield and North Burlingham, and to the west to link the Norwich and Dereham bypasses. This will mean thirty miles of continuous dual carriageway around Norwich. The Company will work with Norfolk County Council to consider improvements to the Thickthorn junctions with the A11 to aid growth in Norwich
- Junction improvements at Great Yarmouth, as well as safety improvements and work with Natural England to explore environmentally accessible options for upgrading the Acle Straight. The A12 from Yarmouth to Lowestoft will be renumbered as the A47

16 major schemes

£2.0 billion invested from 2015 – 2021

£1.5bn to upgrade the A14

Dualling the Cambridge to Milton Keynes link

- Dualling the link between Peterborough and the A1, improving northern and western access to the city
- Upgrading the Guyhirn junction with the A141, to improve safety and reduce congestion.

The East of England is also home to some of our fastest growing cities. The transport network does a poor job of linking some of these places together, and we will start a new study examining the case for an Expressway link between Cambridge, Milton Keynes and Oxford. This will make the best use of existing dual carriageway on the A421 and A428 and, to make sure we deliver results rapidly, we will begin by dualling the 'missing link' between Cambourne and the A1, completing the Cambridge to Milton Keynes leg of the route.

The A1 is one of the best known roads in England, but suffers from outdated standards and sharp variations in quality. We intend to fix this. In the short term, we plan to bring Smart Motorways to the two-lane section of the A1(M) around Stevenage, and grade separate the notorious Black Cat roundabout. For the long term, we are starting a study into raising this part of the A1 to a modern standard, and restoring its status as the Great North Road.

Roads must also play their part in strengthening the economy of the region:

- A link road from the A5 to the M1 near Dunstable, including a new Junction 11A, will allow for 7,000 new homes at Houghton Regis
- At Harlow on the M11, £50 million of extra improvements to Junction 7 will make development easier and provide quicker access to and from the town.

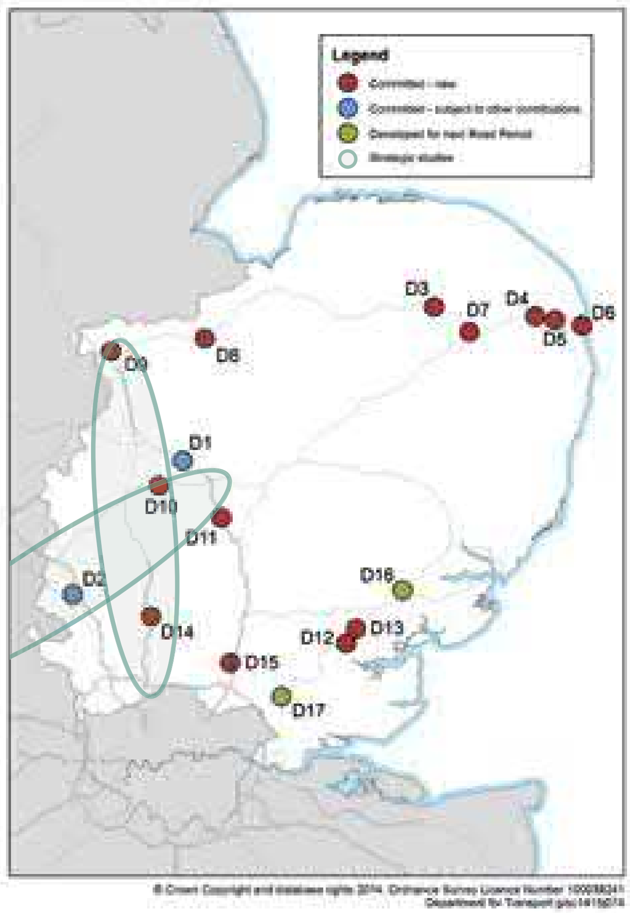
East of England

Committed – subject to other contributions
D1 A14 Cambridge to Huntingdon
D2 A5-M1 Link Road

Committed – new
D3 A47 North Tuddenham to Easton
D4 A47 Blofield to North Burlingham dualling
D5 A47 Acle Straight
D6 A47/A12 junction enhancements
D7 A47/A11 Thickthorn Junction
D8 A47 Guyhirn Junction
D9 A47 Wansford to Sutton
D10 A428 Black Cat to Caxton Gibbet
D11 M11 Junctions 8 to 14 – technology upgrade
D12 A12 Chelmsford to A120 widening
D13 A12 whole-route technology upgrade
D14 A1(M) Junctions 6-8 Smart Motorway
D15 M11 Junction 7 junction upgrade

Developed for next Road Period
D16 A12 Colchester Bypass widening
D17 A12 M25 to Chelmsford

Strategic studies
Oxford to Cambridge Expressway
A1 East of England



Investment Plan – London and the South East

The M25 remains the busiest motorway in the UK, and one of the busiest roads in the world. 2014 marks an important milestone – the upgrading of the whole route to four lanes throughout[1]. Smart Motorways have filled the last gaps, fulfilling a pledge first made in 1989.

Work is now underway to improve the links that radiate out from the M25. Smart Motorways can provide more reliable journeys and more peak-time capacity, both of which will be valuable on the M3, M4, M20 and M23. The stretch on the M20 will support housing growth and new jobs around Maidstone, as will improvements to junctions on the A2 at Bean and Ebbsfleet, and a further new junction in south Kent near Ashford. The M23 Smart Motorway will provide better access to Gatwick airport. We will also carry out improvements to Junctions 25 (Cheshunt) and 28 (Brentwood) to fix longstanding congestion hotspots.

The south west quadrant of the M25, between Junctions 10 and 16, remains the busiest section. Congestion remains bad and, to improve conditions, we will bring forward a package of improvements for this stretch, including four-lane through-running at Junctions 10 to 12 and hard shoulder running from Junctions 15 to 16. Coupled with this, a major rebuild of the A3/M25 Wisley interchange will fix one of England's least safe motorway junctions.

This will improve conditions in the medium term. Looking to the future, further widening of the road would require major re-engineering, and would have significant consequences for those living nearby. The improvements announced in this document buy some time to find a lasting solution to the problems of the south-west quadrant – one which makes use of all available transport modes and takes proper consideration of the environment. Inaction is not an option, and the Department will begin a wide-ranging study to look at how this section of the network can keep working into the future.

Smart Motorways are not limited to London. Around Southampton and Portsmouth, from Junction 11 on the M27 to Junction 9 on the M3, Smart Motorway technology

29 major schemes

£2.2 billion invested from 2015 – 2021

Improvements around 10 out of 31 junctions on M25

Smart technology on seven motorways

1 While the stretch between Junctions 3 and 5 remains unwidened, the parallel M20 and M26 means there is six lanes of capacity in each direction

will provide an extra lane at peak times throughout the Solent area. Further improvements around Junctions 5, 8 and 10 of the M27 and Junctions 9, 10 and 14 of the M3 will mean far easier movement on and off of the motorway.

Upgrades to junctions will make access to key ports across the region easier:

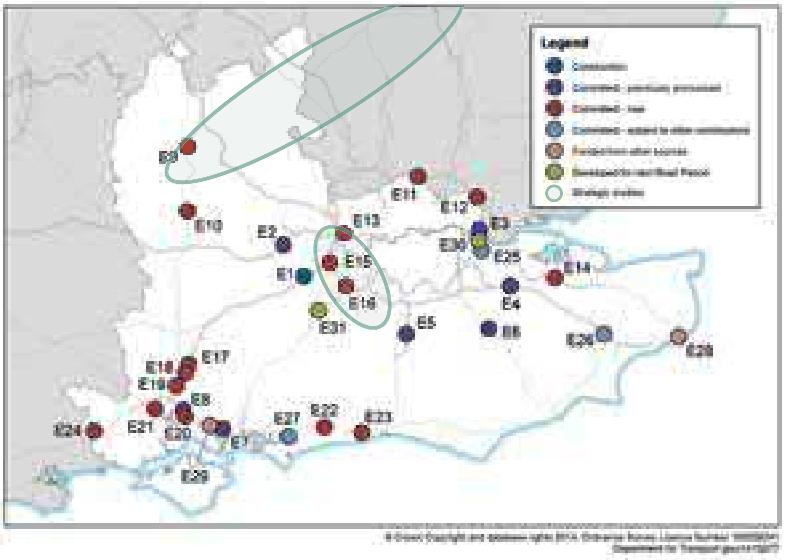
- M25 Junction 30 will be rebuilt to improve access to the new London Gateway port
- Junctions on the A20 in Dover will be upgraded to improve access to the port and support new homes and jobs
- The M271 Redbridge Junction, required to get to Southampton docks, will be improved.

The A34, the main route from the Midlands to Southampton, must be kept open for freight. To ensure this happens, we will invest £30 million in new route-management technology in the short term and enhanced junctions, including a free-flowing link to the M3, will improve journeys around Oxford and Winchester.

South of London, the widening of the trunk road network continues to improve access. The newly widened A23 has opened south of Crawley, and the dualling of the Tonbridge bypass is expected to begin next year. The A27 feasibility study has recommended a new dual carriageway bypass of Arundel and extra improvements in Worthing and Lancing, which will fix one of the most notorious 'missing links' in the region, while junction improvements in Chichester will ease journeys on the western part of the route. Smaller bottlenecks will also be targeted, for example with a short widening of the A31 at Ringwood to remove the conflict between local and long-distance traffic, and through improvements to the A27 through Worthing and Lancing.

To the north of London, the M1 has benefitted from heavy investment over the past decade. East-West connections have not received the same attention. To link up the fastest growing towns in England, we will start a new strategic study on creating an Expressway link between Oxford and Cambridge via Milton Keynes, fixing a longstanding gap in the network and bringing new capacity to support growth in the 'Brain Belt'.

London and South East England



Construction
E1 M3 Junctions 2-4A

Committed – previously announced
E2 M4 Junctions 3-12
E3 M25 Junction 30
E4 M20 Junctions 3-5
E5 M23 Junctions 8-10
E6 A21 Tonbridge to Pembury
E7 M3 Junctions 9-14
E8 M27 Junctions 4-11

Committed – new
E9 A34 Oxford Junctions
E10 A34 Technology enhancements
E11 M25 Junction 25 improvement
E12 M25 Junction 28 improvement
E13 M4 Heathrow slip road
E14 M2 Junction 5 improvements
E15 M25 Junctions 10-16
E16 M25 Junction 10/A3 Wisley interchange
E17 M3 Junction 9 improvement
E18 M3 Junction 10-11 improved sliproads
E19 M3 Junctions 12-14 improved sliproads
E20 M27 Southampton Junctions
E21 M271/A35 Redbridge roundabout upgrade
E22 A27 Arundel Bypass
E23 A27 Worthing and Lancing improvements
E24 A31 Ringwood

Committed – subject to other contributions
E25 A2 Bean & Ebbsfleet junctions
E26 M20 Junction 10a
E27 A27 Chichester Improvement

Funded from other sources
E28 A20 Access to Dover
E29 M27 Junction 10

Developed for next Road Period
E30 Lower Thames Crossing
E31 A3 Guildford

Strategic studies
Oxford to Cambridge Expressway
M25 South-West Quadrant

Investment Plan – South West England

The major roads of the South West face a challenge unlike any other region of the UK. Although fewer hours are wasted in congestion in total, the road network across the region does not always play its part in connecting the economy together. Too often poor or inconsistent roads mean jams and delays, with knock-on effects for businesses, communities and families.

This is why the South West will lead the country in the introduction of new Expressways. These will deliver the safety and speed of a motorway journey, providing world-class connections for the places that they serve. Above all they will provide a consistently good service to road users, without the bottlenecks that have defined too many roads in the South West.

The biggest of these Expressways will be the A303, stretching from the M3 via the M5 to Exeter. There have long been calls for new strategic corridor to the South West, but concerns about damage to Stonehenge have stopped past proposals. There is only one way to fix this: a bored tunnel to take the A303 away from the surface. This will reunite the landscape and environment around Stonehenge, and will also unlock the rest of the A303 for upgrade to Expressway standard. A total of six widenings over the next 14 years will mean a new corridor to the South West – starting with the sections at Stonehenge, Sparkford and the A358 link from the A303 to Taunton.

Further west, the A38 to Plymouth already provides Expressway-quality access. The A30 into Cornwall does not. Work has already been announced to dual the stretch between Temple and Higher Carblake. In this strategy, we will also fund dualling of the stretch between the A39 and the A390 – the last single carriageway gap in the road. With this complete, the Expressway will stretch all the way to Camborne – 40 miles further than it does at present and finishing only 15 miles from Land's End.

In Gloucestershire, the A417 and A419 provide an Expressway-quality journey between Swindon and Gloucester, with the exception of a three mile gap near the Air Balloon roundabout. This 'missing link' has been a source of frustration for many years, as well as an accident blackspot. The site runs through a sensitive environmental

8 major schemes plus £500 million further investment in the A303

£2.0 billion of investment open or underway by by 2021

Tunnel at Stonehenge to allow dual A303

A30 and A417 upgraded to new Expressway standard

area, and previous proposals have struggled to find an appropriate balance between these contrasting requirements. We are committed to working with all interested parties to find and deliver a solution that can meet economic and social needs, while being sensitive to the special environment of the Cotswolds. Indeed, recent schemes, such as the Hindhead tunnel, show that 'win-win' solutions are possible. We intend to bring forward a solution in the first Road Period, that is suitable for delivery.

These major enhancements will fundamentally change the way in which the South West is linked together. Further work will help to support the wider regional economy:

- Smart Motorways have helped tackle congestion through the Almondsbury interchange between the M4 and M5, addressing the single biggest congestion hotspot in the region
- A new junction on the M49 will help the creation of a new enterprise zone at Avonmouth, with good connections to England and Wales
- Enhancements along the M5 will unlock further development sites near Hinkley Point.

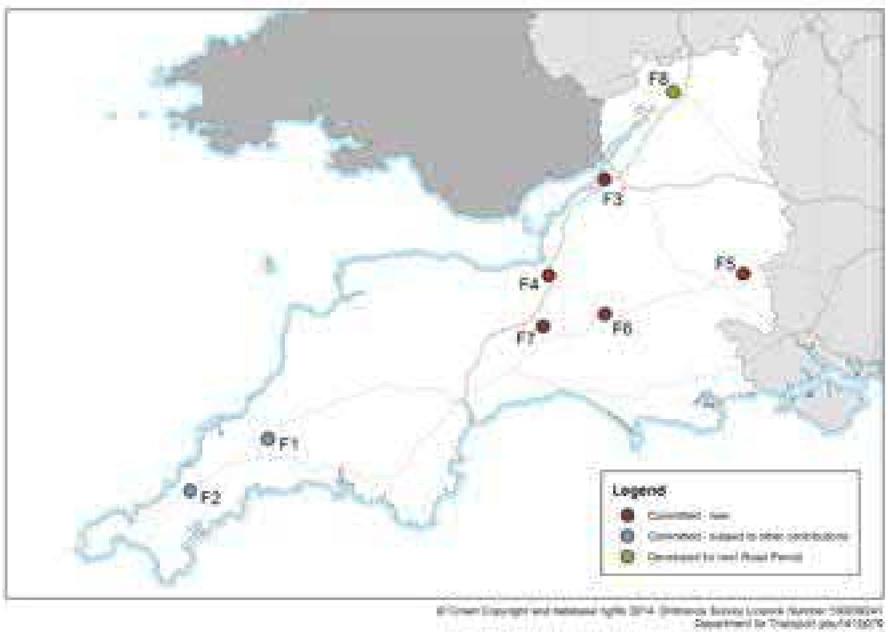
This investment period is also likely to see the conclusion of the Severn Crossings concession agreement, under which the concessionaire responsible for building the new bridge has been recouping their costs. The government will work with its counterpart in Wales, and other stakeholders, to find a future for the crossings that can both ensure the long-term maintenance of the bridge and provide the best support to the economies of the region and Wales.

South West England

Committed – subject to other contributions
F1 A30 Temple to Higher Carblake
F2 A30 Chiverton to Carland Cross

Committed – new
F3 M49 Avonmouth Junction
F4 M5 Bridgwater Junctions
F5 A303 Amesbury to Berwick Down
F6 A303 Sparkford – Ilchester dualling
F7 A358 Taunton to Southfields

Developed for next Road Period
F8 A417 'Missing link' at Air Balloon



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Appendix 1 I.02: A46 BINLEY STAGE 4 TRANSPORT DATA PACKAGE

Technical Note: Survey Specification

Project name	Date	Project number	Prepared by
A46 Coventry Junctions	24th January 2019	60547444	Laura Brooks; Daniel Almazan

Approved by	Checked by
Jon Forni	Mark Chadwick

Introduction

This note outlines the specification for undertaking traffic surveys for the A46 Coventry Junctions Scheme. Where a contractor believes that variations in this specification may be required to accommodate the data collection safely and/or practically, these concerns should be raised at when submitting a quotation. If there are any sites that are deemed unsafe these should be highlighted and the reasons for their unsafety given.

General

Before the commencing of the surveys, the following are required to be undertaken:

- Where required, all site staff must acquire the necessary permits for working on the scheme. This may include:
    - Local Authority Approvals, which should be secured by the survey contractor
    - Appropriate permissions for working on the Highways England network
- The survey contractor shall also liaise with the Highways England Managing Contractor, Local Authorities and Police to ensure that they are aware of the contractors presence on the network; and,
- Confirm that there are no works or events that could interfere with the proposed survey dates.

The successful contractor will be required to provide a risk assessment methods statement (RAMS) that considers each site in turn; AECOM expect that the contractor will make realistic judgements for each site in advance of submitting its quote; which must include for any Traffic Management requirements where these are considered necessary.

The contractor will be required to operate under the AECOM standard terms and conditions for sub-contractors. When located on over bridges, camera equipment must not overhand the live carriageway.

Traffic Survey Specification

For estimation purposes, the specification for the traffic surveys is set out, below.
Survey data will be required as follows:

- Manual Classified Turning Counts (MCTCs): Full analysed turning movement classified vehicle counts. Data collection for 12 hours (07:00-19:00) in 15-minute periods on 2 neutral weekdays (Tuesday to Thursday). The sites are listed in **Table 1**.
- Manual Classified Link Counts (MCLCs): Fully analysed classified vehicle counts. Data collection for 12 hours (07:00-19:00) in 15-minute periods on 2 neutral weekdays (Tuesday to Thursday). The sites are listed in

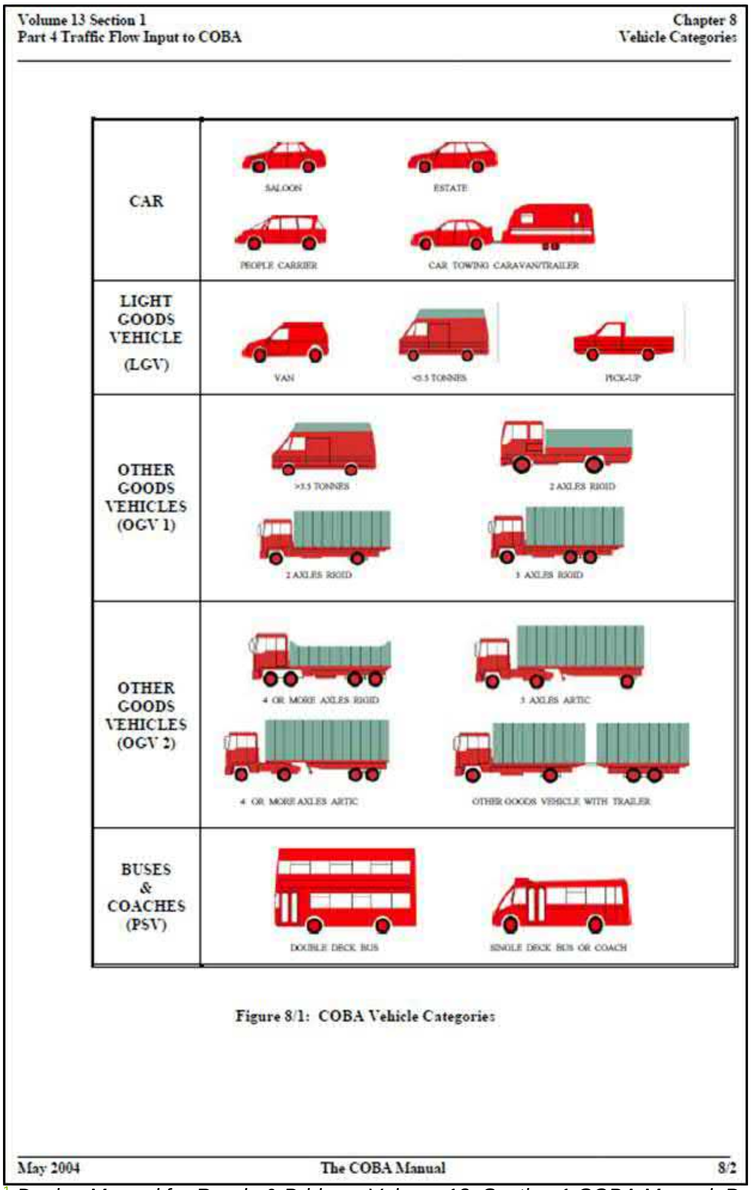
- Table 2.
- Automatic Traffic Counts (ATCs): Automatic traffic counters installed for a two-week period (14 consecutive days). Data collection in 15-minute periods. The ATC sites are listed in

- Table 3.

All turning counts will use the COBA classification indicated in Figure 1 with Powered 2 Wheelers and Pedal Cycles also required. Clarification for the LGV category is given below:

Light Goods Vehicles (LGV) Include all goods vehicles up to 3.5 tonnes gross vehicle weight (goods vehicles over 3.5 tonnes have sideguards fitted between axles), including those towing a trailer or caravan. This includes all car delivery vans and those of the next larger carrying capacity such as transit vans. Included here are small pickup vans, three-wheeled goods vehicles, milk floats and pedestrian controlled motor vehicles. Most of this group are delivery vans of one type or another;

Figure 1 COBA Classification[1]



[1] *Design Manual for Roads & Bridges, Volume 13, Section 1 COBA Manual, Part 4 Traffic Input to COBA* (Department for Transport, May 2004). This information is licensed under the terms of the Open Government Licence (http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3).

Cameras used for the junction counts will be in the locations and angles needed to allow direct observation of vehicle movement through the junction.

Any changes to the proposed locations of the survey sites will need to be agreed with AECOM beforehand.

Deliverables

As part of the cost submission, Contractors are obliged to provide AECOM with the delivery date of the survey data.

A full site-specific Risk Assessment Methods Statement (RAMS) will be required, which, before works commence of site, must be provided to AECOM in order to be signed off.

Once all the survey data has been collected, it is imperative that **all video information is provided to AECOM digitally.**

In addition to the presentation of the data for each movement in 15-minute intervals by vehicle type, a summary shall also be provided in PCUs using the factors provided. U-turns should be included where these can be made.

Presentation of turning movements in MS Excel should record data across the page in a single block and not down it (i.e. movements and vehicle class across columns with time periods in rows).

A spreadsheet listing each piece of survey equipment, the survey type it was used for and the OSGR of its location during the survey period should also be provided.

Please provide an incident report detailing any event that impedes a correct collection of data.

Programme

Surveys must be started on site the week starting on **Monday 25th of February**. The ATC surveys will last 14 days from that date.

The MCTC and MCLC surveys will take place on the week starting on **Monday 25th of February** as well.

Data will be provided to AECOM within a **3-week** period after the completion of the surveys (by **1st April 2019**).

Table 1 MCTC Sites

Survey	Type	Location	Easting	Northing
1	MCTC	B4118/A444 Junction	434093	282489
2	MCTC	A4600/Gosford St Junction	434195	278965
3	MCTC	A45/B4101 Herald Avenue Junction	430113	278346
4	MCTC	A45/B4101 Tile Hill Lane Junction	430101	278529
5	MCTC	A45/Broad Lane Junction	430087	278872
6	MCTC	A45/B4113 junction	433039	275864
7	MCTC	A45/A429 junction	431746	276586
8	MCTC	A45/Sir Henry Parkes Road junction	430618	277298
9	MCTC	A444/Shopping centre junction	434289	283066
10	MCTC	A444/B4113 Junction	434483	282092
11	MCTC	A444/B4109 Junction	435061	281474

Table 2: MCLC Sites

Survey	Type	Location	Easting	Northing
12	MCLC	M42 south of J6 (northbound), Solihull	419571	282456
13	MCLC	M42 south of J6 (Southbound), Solihull	419596	282437
14	MCLC	B4102, Hampton in Arden,	420469	281239
15	MCLC	Bradnocks Marsh Lane, south A452, Solihull	422206	279383
16	MCLC	A452 Kenilworth Road, bridge over railway, Coventry	423320	278404
17	MCLC	Lavender Hall lane, bridge over railway, Coventry	423883	278065
18	MCLC	Station Road, Berkswell, Coventry	424544	277632
19	MCLC	Wolfe Road, Coventry	429006	277751
20	MCLC	B4101 Nailcote Lane, Coventry	426334	277344
21	MCLC	A45 Fletchamstead Highway, railway bridge, Coventry	430236	277890
22	MCLC	Beechwood Ave, Coventry	431285	278217
23	MCLC	B4107 Earlsdon Ave N, Coventry	431959	278303
24	MCLC	Albany Road, Coventry	432293	278336
25	MCLC	B4110 Humber Road, Coventry	435151	277701
26	MCLC	A4082 Allard Way, Coventry	435978	277371
27	MCLC	St James Lane/Willenhall Lane, Coventry	437387	276845
28	MCLC	Main Street, Brandon Castle, Coventry	440933	276025
29	MCLC	B4455 south of Bretford, Rugby	442727	276115
30	MCLC	B4029 Bulkington Road/King Road, Bedworth	436225	286922
31	MCLC	Blackhorse Road, Exhall, Coventry	435511	284886
32	MCLC	M6 east of J3, Coventry	435288	284541
33	MCLC	B4113 Bedworth Road/Longford Road, Coventry	435130	284438
34	MCLC	Woodshires Road/Sydnall Road, Coventry	434772	284092
35	MCLC	B4118 Holbrook Lane/Lockhurst Lane, Coventry	433755	281741
36	MCLC	Sandy Lane, Coventry	433132	280265
37	MCLC	B4098 Radford Road, Coventry	432992	279976
38	MCLC	A4114 Holyhead Road (underpass), Coventry	432399	279399

Survey	Type	Location	Easting	Northing
39	MCLC	B4101 Spon End, Coventry	432256	279040
40	MCLC	Albany Road, Coventry	432389	278553
41	MCLC	The Hiron, Coventry	433368	277613
42	MCLC	B4113 Leamington Road, Coventry	433042	277365
43	MCLC	Coat of Arms Bridge Road/Stivichall Croft, Coventry	432489	276740
44	MCLC	Warwick Road, west of A452, Kenilworth	429185	270848
45	MCLC	A46 south of A452 Junction, Kenilworth	429564	269762
46	MCLC	B4115, North of Hill Wootton, Kenilworth	429815	268934
47	MCLC	Sandy Lane, north of Royal Leamington Spa	430174	267487
48	MCLC	A445 Rugby Road (underpass), Royal Leamington Spa	430581	265944
49	MCLC	A452 Park Dr, Victoria Park, Royal Leamington Spa	431106	265403
50	MCLC	Windmill Road, Coventry	434930	283047
51	MCLC	B4082 Old Church Road, Coventry	434822	282161
52	MCLC	A444 over Coventry Canal, Coventry	434742	281904
53	MCLC	B4110 Harnall Lane E, Coventry	434579	279852
54	MCLC	King William St/Berry Street, Coventry	434386	279587
55	MCLC	Raglan St/East Street, Coventry	434277	279246
56	MCLC	Far Gosford Street, south of A4600, Coventry	434248	278926
57	MCLC	Gulson Road (river Sherbourne), Coventry	434313	278754
58	MCLC	A4082 London Road, east of A444, Coventry	434930	277132
59	MCLC	A45 Stonebridge Highway, east of Stivichall, Coventry	434551	275613
60	MCLC	Mill Hill, south of A46, Coventry	433826	275289
61	MCLC	B4113 Coventry Road, Stoneleigh	433186	272733
62	MCLC	Wall Hill Road, Allesley, Coventry	430508	282812
63	MCLC	Long Lane, Allesley, Coventry	430954	282696
64	MCLC	B4098 Tamworth Road, Coventry	431636	282507
65	MCLC	Bennetts Road S, Coventry	431937	282486
66	MCLC	Halford Lane, Coventry	432260	282452

Survey	Type	Location	Easting	Northing
67	MCLC	Beake Ave, Coventry	432538	282387
68	MCLC	Holbrook Lane, Holbrook Park, Coventry	433564	282423
69	MCLC	B4109 Bell Green Road, Coventry	435448	281839
70	MCLC	Purcell Road, Coventry	435721	281659
71	MCLC	Wyken Croft, Nature Park, Coventry	436663	280971
72	MCLC	A452 outh of Balsall Common, Coventry	424951	275323
73	MCLC	Crackley Lane, Kenilworth	428828	274533
74	MCLC	Red Lane, Kenilworth	427590	274724
75	MCLC	B4113 St Martin Road, south of A46, Coventry	433159	274323
76	MCLC	A46 King's Hill, Coventry	432865	274343
77	MCLC	Coventry Road, west of Coventry Airport, Coventry	434690	274474
78	MCLC	A445 Leamington Road, west of A423, Coventry	437754	273021
79	MCLC	A423 Oxford Road, east of A445, Coventry	438889	272585
80	MCLC	B4455 Fosse Way, Stretton-on-Dunsmore	440723	271850
81	MCLC	A5 High Cross, Rugby	447490	288414
82	MCLC	Coal Pit Lane, east of B4455, Lutterworth	446537	286209
83	MCLC	M6, east of J2, Rugby	445029	281871
84	MCLC	B4027 Stretton under Fosse, Rugby	444572	281081
85	MCLC	B4112, Street Ashton, Rugby	445267	282470
86	MCLC	A428 Coventry Road, east of Bretford, Rugby	443219	276676
87	MCLC	A45 London Road, east of B4455, Rugby	441814	273155
88	MCLC	B4453 Rugby Road, east of A423, Rugby	440524	270778
89	MCLC	A423 Oxford Road, Princethorpe, Rugby	440270	270369
90	MCLC	Long Itchington Road, west of B4455, Leamington Spa	438401	267166
91	MCLC	Welsh Road, west of B4455, Offchurch, Leamington Spa	437254	264916
92	MCLC	A425 Southam Road, west of B4455, Leamington Spa	436425	263206
93	MCLC	M40 east of J13	433555	258201
94	MCLC	Chesterton Road, west of B4455, Leamington Spa	434611	260142

Survey	Type	Location	Easting	Northing
95	MCLC	Church Lane, south of M6, Coventry	434182	285136
96	MCLC	A444, south of M6 J3, Coventry	434194	284497
97	MCLC	Wilsons Lane, south of M6, Coventry	434776	284541
98	MCLC	Grange Road, south of M6, Coventry	435697	284120
99	MCLC	B4109 Aldermands Green Road, south of M6, Coventry	436190	283805
100	MCLC	Shilton Lane, west of M6, Coventry	437397	282986
101	MCLC	B4027 Brinklow Road, east of A46, Coventry	438664	278727
102	MCLC	B4110 London Road, north of A45 Tollbar, Coventry	436399	275845
103	MCLC	A444, north of Stivichall Interchange, Coventry	434349	276062
104	MCLC	Leaf Lane, off Stivichall Interchange, Coventry	434028	275784
105	MCLC	Baginton Road, north of A45,Coventry	433507	275792
106	MCLC	Burnsall Road, east of A45, Coventry	430496	277668
107	MCLC	Dunchurch Highway south, east of A45, Coventry	430118	278957
108	MCLC	Dunchurch Highway north, east of A45, Coventry	430083	279100
109	MCLC	A4114 Pickford Way, east of A45, Coventry	429459	280550
110	MCLC	Rye Hill, east of A45, Coventry	429332	280714
111	MCLC	Washbrook Lane, Allesley, Coventry	429168	282698
112	MCLC	B4098 Tamworth Road, Allesley, Coventry	430650	283918
113	MCLC	Fivefield Road, Keresley, Coventry	430906	284391
114	MCLC	Bennetts Road N, Keresley End, Coventry	431364	285280
115	MCLC	Newton Lane, Newton, Rugby	453007	278804
116	MCLC	A426 Southam Road, north of M45, Rugby	448254	270971
117	MCLC	A4071, north of A45, Rugby	445853	272440
118	MCLC	B4112 Rugby Road, Rugby	448214	277692
119	MCLC	A429 Coventry Road, south of A46 junction, Warwick	429054	267078
120	MCLC	A425 Banbury Road, Warwick	429432	263717
121	MCLC	A425 Myton Road, west of A452, Royal Leamington Spa	430776	265077
122	MCLC	A429 Stratford Road, east of M40 J15, Warwick	427019	262685

Survey	Type	Location	Easting	Northing
123	MCLC	A4189 Hampton Road, east of A46, Warwick	426892	264018
124	MCLC	M6 north of J4, Birmingham	418529	287788
125	MCLC	M42 northbound north of J7a, Birmingham	419386	288370
126	MCLC	M42 southbound slip road to M6 eastbound, Birm	419412	288381
127	MCLC	M42 southbound, north of J7a, Birmingham	419511	288387
128	MCLC	A446 Stonebridge Road, Coleshill, Birmingham	419932	287553
129	MCLC	A444, Bedworth	435303	288369
130	MCLC	Griffin Bedworth, Coventry Road, Bedworth	435819	288485
131	MCLC	B4114 Lutherworth Road, Whitestone, Nuneaton	439484	289444
132	MCLC	B582 Desford Road, Enderby, Leicester	451862	300909
133	MCLC	M1 J21-21a, Leicester	454334	301648
134	MCLC	B582 Enderby Road, Whetstone, Leicester	455311	298089
135	MCLC	A426 Lutterworth Road, Whetstone, Leicester	455777	293742
136	MCLC	A4304 Lutterworth Road, North Kilworth, Lutterworth	460737	283873
137	MCLC	A14 west of M1 J19, Northampton	461115	277542
138	MCLC	A428 west of M1 J18, Crick, Northampton	458023	272850
139	MCLC	M1 south of J17, Northampton	459326	269031
140	MCLC	A45 east of Asby St. Ledgers, Rugby	459100	268875
141	MCLC	A361 Ashby St. Ledgers, Rugby	456665	267961
142	MCLC	A45 North of Daventry,	454798	264616
143	MCLC	A425 west of Staverton, Daventry	452833	261381
144	MCLC	A423 Southam Road, Ladbroke, Southam	441766	259457
145	MCLC	M40 south of J12, Warwick	437440	254701
146	MCLC	A46 Stratford Road, west of Sherbourne, Warwick	425280	261830
147	MCLC	A4189 Henley Road, west of M40, Warwick	423169	264013
148	MCLC	Warwick Road, west of M40, Warwick	423670	263446
149	MCLC	A3400 Liveridge Hill, Solihull	415762	268918
150	MCLC	M42 west of J3a	411801	272194

Survey	Type	Location	Easting	Northing
151	MCLC	A34 Stratford Road, west of M42 J4, Solihull	414156	276135
152	MCLC	A41 Solihull Bypass, north of M42 J5, Solihull	416910	278855
153	MCLC	A45 Coventry Road, West of M43 J6	419370	283015
154	MCLC	B4438 Bickenhill Parkway, Birmingham	419164	285042
155	MCLC	A452 Chester Road, north of A446, Birmingham	419370	285940
156	MCLC	Coleshill Heath Road (A452 and A446), Birmingham	419124	286519
157	MCLC	Packington Lane, Coleshill, Birmingham	420438	287340
158	MCLC	Proffitt Avenue, Coventry	435291	281904
159	MCLC	Stoney Road, Coventry	433311	278198
160	MCLC	Quinton Road, Coventry	433507	278136
161	MCLC	Quarryfield Lane, Coventry	434049	277999
162	MCLC	A4600 Ansty Road (River Sowe), Coventry	437775	280798
163	MCLC	Red Lane, Coventry	434730	280420

Table 3: ATC Sites

Survey	Type	Location	Easting	Northing
164	ATC	Bradnocks Marsh Lane, south A452, Solihull	422214	279383
165	ATC	Lavender Hall lane, bridge over railway, Coventry	423880	278072
166	ATC	Station Road, Berkswell, Coventry	424551	277625
167	ATC	B4101 Nailcote Lane, Coventry	426334	277344
168	ATC	Wolfe Road, Coventry	429003	277754
169	ATC	A45 Fletchamstead Highway, railway bridge, Coventry	430236	277890
170	ATC	Beechwood Ave, Coventry	431285	278217
171	ATC	B4107 Earlsdon Ave N, Coventry	431959	278303
172	ATC	Albany Road, Coventry	432290	278333
173	ATC	St James Lane/Willenhall Lane, Coventry	437387	276845
174	ATC	B4455 south of Bretford, Rugby	442727	276115
175	ATC	B4029 Bulkington Road/King Road, Bedworth	436225	286922
176	ATC	Blackhorse Road, Exhall, Coventry	435511	284886
178	ATC	B4113 Bedworth Road/Longford Road, Coventry	435130	284438
179	ATC	Woodshires Road/Sydnall Road, Coventry	434772	284092
180	ATC	A444 Jimmy Hill Way, south of stadium, Coventry	434272	282964
181	ATC	Lythalls Lane (railway bridge), Coventry	434233	282750
182	ATC	B4118 Holbrook Way, west of A444, Coventry	433963	282437
183	ATC	B4118 Holbrook Lane/Lockhurst Lane, Coventry	433755	281741
184	ATC	The Hiron, Coventry	433368	277613
185	ATC	B4113 Leamington Road, Coventry	433042	277365
186	ATC	A45 Kenpas Highway, Coventry	432238	276304
187	ATC	Stoneleigh Road, Coventry	430994	274579
188	ATC	Mill End/Dalehouse Lane, Kenilworth	429671	272758
189	ATC	A452 Warwick Road, Kenilworth	429158	271097
190	ATC	Warwick Road, west of A452, Kenilworth	429185	270848
191	ATC	A46 south of A452 Junction, Kenilworth	429564	269762

Survey	Type	Location	Easting	Northing
192	ATC	B4115, North of Hill Wootton, Kenilworth	429815	268936
193	ATC	Sandy Lane, north of Royal Leamington Spa	430174	267487
194	ATC	A445 Rugby Road (underpass), Royal Leamington Spa	430581	265944
195	ATC	B4099 Warwick New Road (underpass), Royal Leamington Spa	430623	265814
196	ATC	Lower Avenue, Royal Leamington Spa	431861	265287
197	ATC	Clemens Street, Royal Leamington Spa	432022	265183
198	ATC	Prospect Road (west of ASDA), Royal Leamington Spa	432841	264368
199	ATC	A425 High Street (railway underpass), Royal Leamington Spa	431988	265205
200	ATC	Oakmoor Road, Coventry	435064	283512
201	ATC	Windmill Road, Coventry	434930	283046
202	ATC	B4082 Old Church Road, Coventry	434822	282161
203	ATC	A444 over Coventry Canal, Coventry	434742	281904
204	ATC	Stoney Stanton Road, south of A444, Coventry	434989	281421
205	ATC	B4110 Harnall Lane E, Coventry	434579	279852
206	ATC	King William St/Berry Street, Coventry	434386	279587
207	ATC	Raglan St/East Street, Coventry	434277	279246
208	ATC	A4600 Sky Blue Way, east of A4053, Coventry	434280	279004
209	ATC	Far Gosford Street, south of A4600, Coventry	434248	278926
210	ATC	Gulson Road (river Sherbourne), Coventry	434313	278754
211	ATC	A45 Stonebridge Highway, east of Stivichall, Coventry	434551	275613
212	ATC	B4113 Coventry Road, Stoneleigh	433186	272733
213	ATC	Long Lane, Allesley, Coventry	430954	282696
214	ATC	Bennetts Road S, Coventry	431937	282484
215	ATC	Halford Lane, Coventry	432260	282452
216	ATC	Beake Ave, Coventry	432538	282387
217	ATC	Holbrook Lane, Holbrook Park, Coventry	433564	282423
218	ATC	B4113 Foleshill Road, north of A444, Coventry	434527	282198
219	ATC	Purcell Road, Coventry	435721	281659

Survey	Type	Location	Easting	Northing
220	ATC	Wyken Croft, Nature Park, Coventry	436663	280971
221	ATC	A452 outh of Balsall Common, Coventry	424951	275323
222	ATC	Crackley Lane, Kenilworth	428828	274533
223	ATC	A429 north of Kenilworth	430396	274251
224	ATC	Coventry Road, west of Coventry Airport, Coventry	434690	274474
225	ATC	B4113 St Martin Road, south of A46, Coventry	433159	274323
226	ATC	A445 Leamington Road, west of A423, Coventry	437754	273021
227	ATC	A423 Oxford Road, east of A445, Coventry	438889	272585
228	ATC	B4455 Fosse Way, Stretton-on-Dunsmore	440723	271850
229	ATC	HIgh Cross Road, north of A5, Rugby	447495	288679
230	ATC	A5 High Cross, Rugby	447490	288414
231	ATC	Coal Pit Lane, east of B4455, Lutterworth	446537	286209
232	ATC	B4112, Street Ashton, Rugby	445267	282470
233	ATC	B4027 Stretton under Fosse, Rugby	444572	281089
234	ATC	A428 Coventry Road, east of Bretford, Rugby	443219	276676
235	ATC	A45 London Road, east of B4455, Rugby	441814	273155
236	ATC	Long Itchington Road, west of B4455, Leamington Spa	438401	267166
237	ATC	Welsh Road, west of B4455, Offchurch, Leamington Spa	437254	264916
238	ATC	A425 Southam Road, west of B4455, Leamington Spa	436425	263206
239	ATC	Chesterton Road, west of B4455, Leamington Spa	434611	260146
240	ATC	B4100 west of B4455, Ashorne, Warwick	433234	257864
241	ATC	Royal Oak Lane, Ash Green, Coventry	433343	285479
242	ATC	Church Lane, south of M6, Coventry	434182	285136
243	ATC	A444, south of M6 J3, Coventry	434194	284497
244	ATC	Wilsons Lane, south of M6, Coventry	434776	284541
245	ATC	Grange Road, south of M6, Coventry	435697	284120
246	ATC	Shilton Lane, west of M6, Coventry	437397	282986
247	ATC	B4110 London Road, north of A45 Tollbar, Coventry	436399	275845

Survey	Type	Location	Easting	Northing
248	ATC	A444, north of Stivichall Interchange, Coventry	434349	276062
249	ATC	Leaf Lane, off Stivichall Interchange, Coventry	434028	275784
250	ATC	Baginton Road, north of A45, Coventry	433507	275792
251	ATC	B4113 Leamington Road, north of A45, Coventry	433034	275970
252	ATC	B4113 Leamington Road, north of A45, Coventry	432041	276491
253	ATC	A429 Kenilworth Road, north of A45, Coventry	431809	276671
254	ATC	Burnsall Road, east of A45, Coventry	430496	277668
255	ATC	B4101 Herald Ave, east of A45, Coventry	430213	278377
256	ATC	B4101 Tile Hill Lane, east of A45, Coventry	430205	278515
257	ATC	Broad Lane, east of A45, Coventry	430208	278835
258	ATC	Dunchurch Highway south, east of A45, Coventry	430118	278957
259	ATC	Dunchurch Highway north, east of A45, Coventry	430086	279100
260	ATC	A4114 Pickford Way, east of A45, Coventry	429459	280550
261	ATC	Rye Hill, east of A45, Coventry	429332	280714
262	ATC	Washbrook Lane, Allesley, Coventry	429168	282698
263	ATC	Fivefield Road, Keresley, Coventry	430906	284391
264	ATC	Bennetts Road N, Keresley End, Coventry	431364	285280
265	ATC	Newton Lane, Newton, Rugby	453007	278804
266	ATC	Newton Manor Lane, Clifton upon Dunsmore, Rugby	453823	278082
267	ATC	A428 Crick Road, Rugby	454624	273471
268	ATC	B4038 Kilsby Lane, Rugby	454194	273359
269	ATC	B4429 Daventry Road, north of M45, Rugby	448942	270945
270	ATC	B4429 Coventry Road, north of M45, Rugby	446838	271560
271	ATC	A4071, north of A45, Rugby	445853	272446
272	ATC	A428 Coventry Road, Rugby	446891	275634
273	ATC	B4112 Rugby Road, Rugby	448214	277692
274	ATC	A445 Emscote Road (bridge River Avon), Warwick	430099	265755
275	ATC	A425 Myton Road, west of A452, Royal Leamington Spa	430781	265087

Survey	Type	Location	Easting	Northing
276	ATC	Gallows Hill, east of A425, Warwick	429903	263759
277	ATC	M42 southbound slip road to M6 eastbound, Birmingham	419367	288521
278	ATC	B4117 Coventry Road, south of Coleshill, Birmingham	420025	287473
279	ATC	A446 Stonebridge Road, Coleshill, Birmingham	419930	287553
280	ATC	B4112 Bulkington Lane, Whitestone, Nuneaton	438301	289535
281	ATC	B4114 Lutherworth Road, Whitestone, Nuneaton	439484	289444
282	ATC	A5 Watling Street, Hinkley	441410	292212
283	ATC	Burbage Road, Hinkley	443949	293587
284	ATC	B581 Station Road, Elmesthorpe, Leicester	447028	295891
285	ATC	B582 Desford Road, Enderby, Leicester	451862	300905
286	ATC	A5460 east of M1 J21, Leicester	454949	300604
287	ATC	A426 Lutterworth Road, Whetstone, Leicester	455777	293742
288	ATC	A4304 Lutterworth Road, North Kilworth, Lutterworth	460737	283869
289	ATC	A428 west of M1 J18, Crick, Northampton	458023	272850
290	ATC	A45 east of Asby St. Ledgers, Rugby	459100	268875
291	ATC	A361 Ashby St. Ledgers, Rugby	456661	267961
292	ATC	A45 North of Daventry,	454802	264624
293	ATC	A425 west of Staverton, Daventry	452833	261381
294	ATC	A423 Southam Road, Ladbroke, Southam	441766	259457
295	ATC	A429 south of Barford, Warwick	427041	259937
296	ATC	A4189 Henley Road, west of M40, Warwick	423169	264013
297	ATC	Warwick Road, west of M40, Warwick	423670	263446
298	ATC	A3400 Liveridge Hill, Solihull	415762	268918
299	ATC	A34 Stratford Road, west of M42 J4, Solihull	414156	276135
300	ATC	A45 Coventry Road, West of M43 J6	419372	283014
301	ATC	B4438 Bickenhill Parkway, Birmingham	419164	285042
302	ATC	A452 Chester Road, north of A446, Birmingham	419370	285940
303	ATC	Coleshill Heath Road (A452 and A446), Birmingham	419124	286519

Survey	Type	Location	Easting	Northing
304	ATC	Packington Lane, Coleshill, Birmingham	420438	287340
305	ATC	B4082 Clifford Bridge Road, north, Coventry	435291	281904
306	ATC	A4600 Ansty Road (River Sowe), Coventry	437775	280798
307	ATC	Red Lane, Coventry	434730	280420

Technical Note 19: A46 Coventry Junctions – Traffic Data Collection

Project name A46 Coventry Junctions	**Date** 25 June 2019	**Project number** 60547444	**Prepared by** Daniel Almazan
Approved by Jon Morrow	**Checked by** Martin Rutter		

1 Introduction

Introduction

1.1 Highways England commissioned AECOM to develop a strategic traffic model to enable investigation of options for upgrading the A46 at Binley and Walsgrave Junctions. These junctions form the A46 Coventry Junctions Upgrade scheme encompassing both the Walsgrave and Binley junctions on the A46 east of Coventry. The A46 Coventry Junctions Upgrade scheme is one of a number of schemes set out under the Department for Transport (DfT) Road Investment Strategy (RIS) to be developed by Highways England during the RIS period of 2015 to 2020 as announced in the 2014 Autumn Statement.

1.2 During PCF Stage 1 for the A46 Coventry Junctions scheme, the Binley and Walsgrave junctions were assessed both separately and combined to assess the economic benefits of each junction. Based on the analysis, a decision was made to separate the two junctions, which has now led to the junctions progressing through the PCF process at different stages.

1.3 The focus of the appraisal is both the Walsgrave and Binley Junction improvement schemes. This scheme, hereafter referred to as the proposed scheme, is currently progressing through PCF Stages 2 and 4 for Walsgrave and Binley respectively.

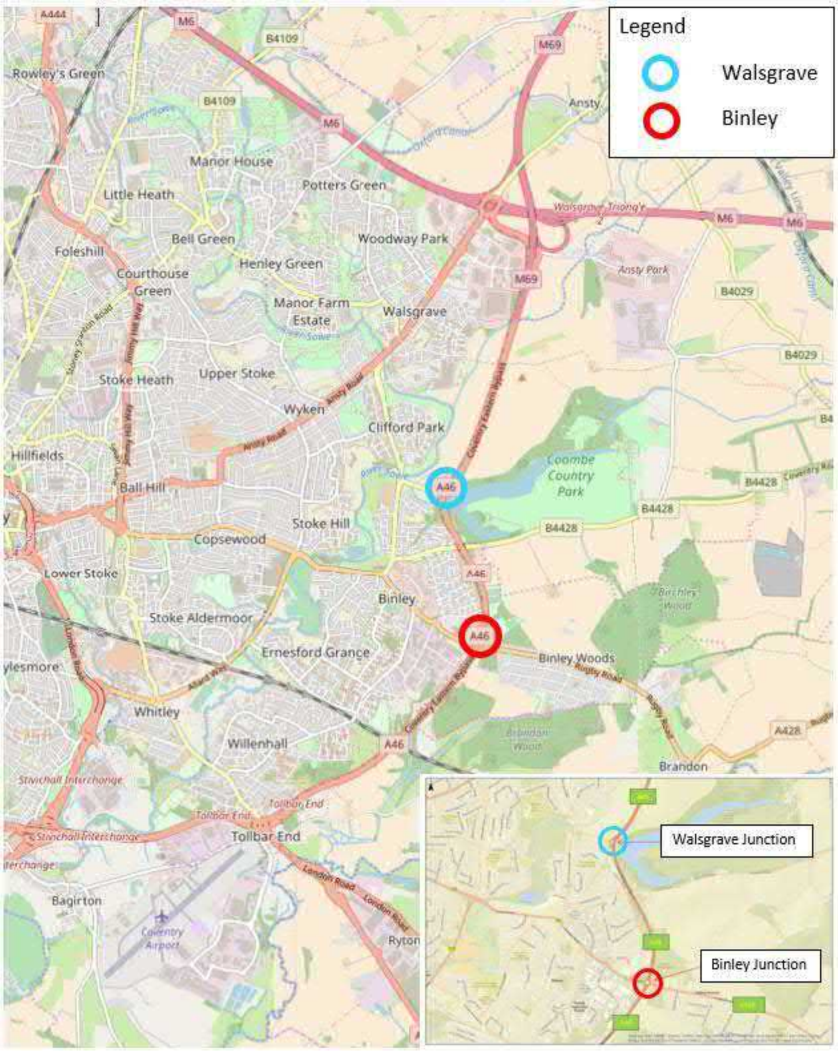
1.4 The purpose of this Technical Note is to list the sources and describe the data processing methodologies used for the traffic data collected for the preparation and subsequent calibration and validation of the 2018 Base Year Coventry Strategic Traffic Model (CoSTM). This model is being developed in SATURN to inform the appraisal of the proposed scheme.

Overview of Scheme

1.5 Alterations to both Junctions form part of a wider scheme of improvements along the A46, a non-continuous route which begins east of Bath and ends in Cleethorpes. Binley Junction is an at grade roundabout junction between the A46 and A428. Walsgrave Junction is an at-grade roundabout junction between the A46 and B4082. Both at-grade roundabouts are along the A46 Coventry Eastern Bypass and are the causes of congestion along the corridor. Upgrades to both Junctions are therefore being proposed by Highways England to ease congestion and reduce queuing along the route.

1.6 Figure 1 shows the location of the scheme and its strategic context.

Figure 1 - Scheme location



The Transport Data Package

1.7 The purpose of this technical note is to describe the elements of the Transport Data Package compiled to develop the CoSTM. The method by which the data was collected and any data processing will be summarised. The Transport Data Package will be submitted to Highways England as a deliverable.

1.8 The rest of this Technical Note is structured as follows:

- Section 2 lists the sources of existing and new traffic data and the methodology followed to process it;
- Section 3 describes the steps followed to combine the traffic data into a single database and to prepare it for the model calibration/validation process; and
- Section 4 describes the steps followed to collect and process journey time data.

2 Traffic data

Introduction

2.1 Existing survey data was identified in the Area of Detailed Modelling, corresponding to the following sources:

- Highways England's WebTRIS data

- Count data from local transport and highway authorities, such as Transport for West Midlands (TfWM), Warwickshire County Council (WCC) and Leicestershire County Council (LCC).
- Previous AECOM surveys undertaken for Walsgrave Stage 1 in May and October 2018.
- Other survey data collected for traffic modelling in the area (Ansty Vectos)

2.2 A gap analysis was undertaken to identify the location of the traffic counts needed in the Area of Detailed Modelling for the calibration screenlines and cordons, as defined in the Appraisal Specification Report (ASR) for Walsgrave Stage 2. These required traffic counts were commissioned in February.

WebTRIS

2.3 Continuous automatic traffic counts were obtained from Highways England's WebTRIS database. 55 relevant sites were identified within the Area of Detailed Modelling in the gap analysis.

2.4 As the Base Year of CoSTM is autumn 2018, data recorded in those months was downloaded when available. In those cases where no data was available in the WebTRIS database for the period September-November 2018, data was collected for May-June 2018, Autumn 2017 or Autumn 2016, in order of preference.

Local Authorities

2.5 Within the Area of Detailed Modelling of the new strategic model, existing count sites were found, belonging to three different local authorities: TfWM, WCC and LCC. Data for several hundred sites were requested, from both temporary and permanent ATC and MCC sites.

2.6 A filtering process was required, given that many of the sites did not have recent data or the data available was incomplete. It was decided to keep those sites with traffic data from 2016, 2017 and 2018.

2.7 A second filter was applied as part of the gap analysis, which meant selecting only those sites that could be associated to the screenlines and cordons defined for calibration and validation purposes. Around 250 sites in total between the three sources remained as a result.

Previous AECOM surveys

2.8 As part of the work undertaken by AECOM in Stage 1 of the Walsgrave scheme, two sets of traffic surveys were commissioned in May and October 2018 in the Binley-Walsgrave area. This is described in more detail in the Stage 1 Transport Data Package (TDP).

2.9 As for the sources already listed, the gap analysis resulted in selection of some of the sites surveyed, for calibration and validation purposes.

Ansty – Vectos

2.10 A local traffic model had been recently produced for Ansty Park, a technology park located to the east of Coventry. Traffic surveys were undertaken for this model and some sites were also selected and processed as part of the data collection for Walsgrave Stage 2 and Binley Stage 4.

Newly commissioned traffic surveys

2.11 New traffic surveys were commissioned in February 2019 to collect the required additional data to fill the count site gaps for the model calibration process. These surveys included the following:

- Manual Classified Turning Counts (MCTCs)
- Manual Classified Link Counts (MCLCs)

- Automatic Traffic Counts (ATCs)

2.12 The detailed specification is described in a technical note (TN16 A46 Coventry Junctions – Survey Specification January 2019).

2.13 These traffic surveys were undertaken by Tracsis in late February through to the beginning beginning of March. However, several sites needed to be surveyed later (March – May) due to roadworks in certain roads and problems with the data collection equipment, including incorrect locations, corrupt video data and equipment theft.

2.14 The total number of sites surveyed by Tracsis was 306. This includes pairs of ATC/MCC sites at the same location (counted as 2).

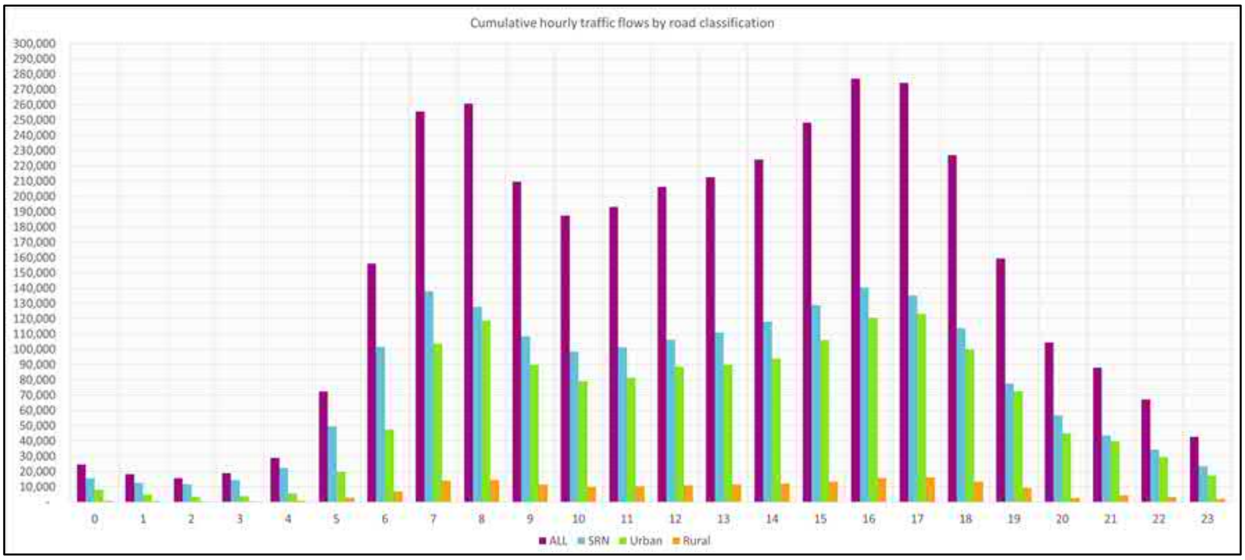
2.15 As part of the checking process, internal checks of the video counts provided by Tracsis were done. Traffic plots were created, showing the flow profiles for each site surveyed, by direction and date. This process was useful to identify areas with missing or incomplete data and also to spot potential issues with the information provided (e.g. wrong directionality or site location), which were communicated and subsequently amended by the survey company.

Model period selection

2.16 The traffic data collected by AECOM was used to determine the time periods to be considered in the Base Year model build. Hourly traffic counts from existing sources (WebTRIS, TfWM, LCC, Ansty Vectos and AECOM surveys), from sites selected in the gap analysis, were used.

2.17 Cumulative hourly flows were calculated, summing the traffic volumes of all sites in each road category (Strategic Road Network, Urban, Rural). Peak periods were identified using the bar chart shown in Figure 2.

Figure 2 - Hourly traffic flows by road classification



2.18 The model time periods were defined as follows:

- AM Peak: 07.00 – 09.00
- Inter-Peak: 09.00 – 16.00
- PM Peak: 16.00 – 18.00

Standard format and data cleaning

2.19 Traffic survey data presents inherent variation from day to day, however on occasion the data collection process experiences errors that generate extreme outliers. These outliers will have important effects on the data and its intended end result. With the purpose of representing as close to average real traffic conditions as possible, a method was devised to improve the quality of the data and the subsequent models by removing these outliers.

2.20 The results of traffic surveys can be considered random, and as such they can be modelled with a Poisson distribution. A benefit of using Poisson distribution is that the variance is equal to the rate of events (λ) which makes it resilient to high variances on the data produced by the existence of outliers. Thus, we use the tails of the Poisson distribution (99.5 confidence interval) multiplied by an arbitrary parameter (z) as acceptable bounds for the data, any data point beyond the limits is labelled as an outlier. We optimise z for each data source upon inspection of the results and we set a limit on the maximum datapoints to be removed.

2.21 Given the different sources of the count data, the information was received in a range of different formats. As the purpose of the data processing was to produce a single traffic database, a standard format was defined and applied across all sources and survey types: source/type/site/direction/period/volume.

2.22 Once the cleaning processes were applied to the count data and all sources were converted to the standard format, they were combined to produce a single database for each survey type: ATC and MCC.

2.23 Survey data collected by AECOM for the purposes described in this technical note will be provided alongside it.

3 Traffic database and summary preparation

Traffic factors

3.1 As the data collected, either existing or newly surveyed, included traffic counts from different months and years, a set of volumetric traffic factors needed to be produced to convert these counts to Autumn 2018-equivalent, to keep consistency with the Base Year CoSTM model.

3.2 A technical note (TN20 A46 Coventry Junctions - Factoring Counts) describes the methodology followed to produce these factors and will be provided alongside this note.

ATC-MCC match

3.3 After producing both ATC and MCC databases, compiling the traffic data described in the previous section, it was then necessary to merge them in a single database, using the factored ATC counts as traffic volumes and the MCC counts as vehicle splits.

3.4 Average flows were calculated for each site and direction. These average figures (unweighted arithmetic mean), were obtained in 3 steps. First, the average volume for each 15-minute period, then for each whole hour and finally for each time period. This methodology was followed to avoid potential oversampling of certain hours/15-minute periods within each of the modelled time periods (AM, IP and PM). This process was done for both the ATC and MCC databases, obtaining a single count figure for each site, direction and model time period.

3.5 A correspondence table of ATC and MCC sites was then created, based on the spatial location of the count sites, and was used to combine both databases into a single database. In those cases where no MCC site was directly linked to an ATC, nearby sites located on roads with similar characteristics and traffic volumes were used. On the other hand, in those cases where more than one MCC site was directly linked to an ATC, an average split was calculated.

SATURN correspondence

3.6 For calibration purposes, it was necessary to match every count site to the model network link representing the road section where the site was located. A correspondence of the ATC sites and the SATURN A-B links (by direction) was created and added to the traffic database.

Match with screenlines and cordons

3.7 Also for calibration purposes, it was required to assign every link/count site to the correspondent screenline or cordon. These screenlines and cordons, which are used for the calibration and validation process of the Base Year model, are defined in the ASR for Walsgrave Stage 2.

3.8 A correspondence table was created, matching each of the ATC sites with the screenline/cordon they belonged to, specifying the direction of the traffic at the site and the direction in which the screenline or cordon was crossed by the road link.

3.9 The final traffic database contains all ATC sites included in screenlines and cordons, with their average traffic volume for each time period (AM, IP and PM), the corresponding vehicle splits (from the MCC sites) and the correspondence with the A-B links in the SATURN network.

3.10 The traffic database in full and a summarised version will be provided with this note.

3.11 A map showing the location of the screenlines and cordons and the count sites selected for the calibration/validation process will be also provided.

4 Journey time data

4.1 TrafficMaster (TM) data was obtained from the DfT for Coventry and the surrounding area for the calendar year 2018. Within this dataset, Autumn 2018 data was selected (September to November).

4.2 The TM data contains GPS data at regular intervals from vehicles aggregated in 15-minute intervals. This information is gathered from fleet management services provided by TrafficMaster from different businesses and the data was provided at monthly intervals.

4.3 The data was filtered according to vehicle type, date, and time of day. Additionally, the data was checked for outliers and these were excluded from the summary calculations. This was done by excluding values outside two standard deviations from the mean journey time and this excludes the vast majority of outliers within the data in a systematic manner.

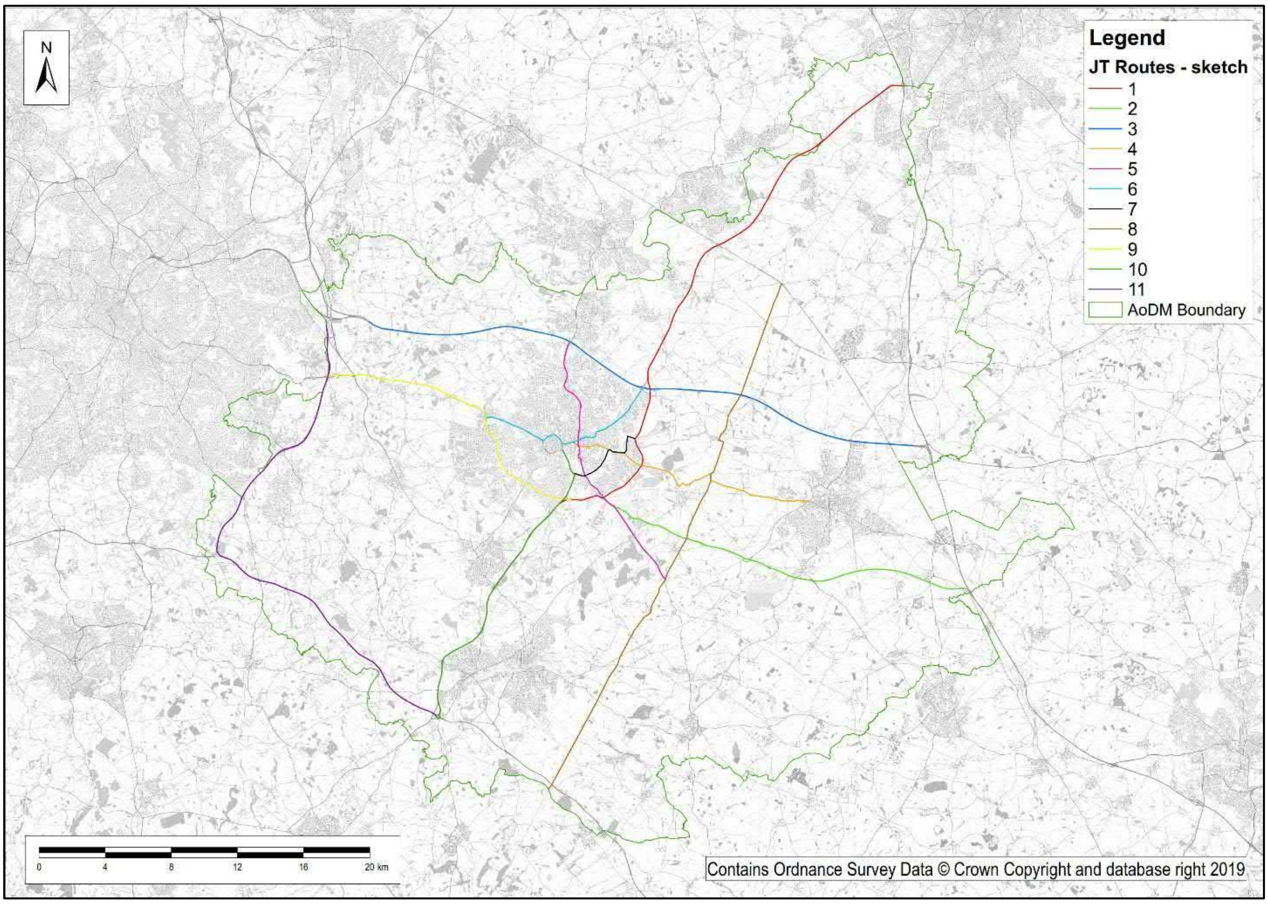
4.4 The data contains nine different types of vehicles. For the calculation of journey times, cars and LGVs were used, as these are by far the most numerous in the dataset and are more homogeneous in terms of behaviour.

4.5 Weekends, bank holidays and school holidays were removed from the dataset as being unrepresentative of typical days of travel.

4.6 Journey time data was extracted for the three model time periods, as defined in Section 2.

4.7 Eleven routes were defined for validating against the Base Year CoSTM model. The journey time routes are shown in Figure 3. The processed TM journey time data for the routes selected will be provided.

Figure 3 - Journey time routes



5 Deliverables

5.1 The following documents/files will be delivered alongside this technical note as part of the Transport Data Package for Binley Stage 4:

- TN16 A46 Coventry Junctions – Survey Specification January 2019
- TN20 A46 Coventry Junctions - Factoring Counts
- Survey data as collected from local authorities, HE and survey companies
- Full ATC database (atc_database_df.csv) and MCC database (mcc_database_df.csv)
- Summary traffic database (traffic_summary_A46.csv)
- GIS map with screenlines, cordons and sites associated with them (A46_sl_cordons_sites.html)
- Processed Journey Time TrafficMaster data (JTR_all_autumn_Final_v2.xlsx)

Technical Note 20: A46 Coventry Junctions – Factoring Counts

Technical Note 20: A46 Coventry Junctions – Factoring Counts

Project name	Date	Project number	Prepared by
A46 Coventry Junctions Upgrade	24 June 2019	60547444	A C Young
Approved by	**Checked by**		
Steven Wood	Martin Rutter		

1 Introduction

1.1 Highways England (H.E.) commissioned AECOM to develop a strategic traffic model to enable investigation of options for upgrading the A46 at Binley & Walsgrave Junctions. These junction form part of the A46 Coventry Junctions Upgrade scheme encompassing both the Walsgrave and Binley junctions on the A46 east of Coventry. The A46 Coventry Junctions Upgrade scheme is one of a number of schemes set out under the Department for Transport (DfT) Road Investment Strategy (RIS) to be developed by H.E. and during the RIS period of 2015 to 2020 as announced in the 2014 Autumn Statement.

1.2 Prior to calibrating and validating the base year model it is necessary to obtain a suitable set of count data to be used for this purpose. It is frequently the case that for some highway links the best data (i.e. in terms of consistency/quality) is from a different month/year for which the base year model is defined. In these instances, it is necessary to apply factors to the count data to account for the changes in traffic demand between the date of the count(s) and the month/year of the model.

1.3 This note details the methodology that has been used in order to construct the factors that were used for this purpose, as well as the checks that have been performed on them. The remainder of the note are arranged in sections as follows:

- Methodology used
- Checks performed

2 Methodology

2.1 The starting point was the set of WebTRIS sites within the Area of Detailed Modelling (AoDM). The flow data was downloaded in 15-minute period format.

2.2 A quality factor was defined as the proportion of valid data available during the relevant set of dates. These were calculated within WebTRIS and supplied as all-day factors. For the purposes of applying quality factors across a month these were combined using the unweighted arithmetic mean. For Autumn 2016, Autumn 2017 and Autumn 2018 the minimum of the three-monthly quality factors was used.

2.3 The full set of sites were filtered as follows:

2.3.1 The quality factor for Autumn 2018 (defined as the entirety of September to November) was calculated for each site. Sites that did not have a quality factor of at least 85% were discarded for factor calculation, and were not used at all in this process.

2.3.2 For the year-to-year factors the quality factors for Autumn 2016 and Autumn 2017 were calculated. Only sites that had quality factors of 80% or more were used for factor calculations for each year (the discarding for Autumn 2016 and Autumn 2017 were carried out independently, so sites that had quality factors of 90% in one year and 70% in the other were used in the calculations of one year only). The 80% figure was chosen to guarantee that there would be enough data availability to produce the factors with a significant level of confidence.

2.3.3 For the factors constructed to translate each month to the relevant Autumn the quality factors for each month were calculated. Only sites that had quality factors of 80% or more in a given time period were used for factor calculations for that month.

2.3.4 Two exceptions were made to the above rule, in June 2018 and May 2017. For June 2018 an issue was found with the data quality stats reported by the WebTRIS database, which incorrectly showed data availability just above 30%. After further investigation, it was deemed that the actual level of data availability was similar to the rest of 2018 (generally above 80%).

2.3.5 For May 2017 it was noted that most sites had quality factors between 60% and 70%, so to generate sufficient data quality factors of 60% or higher were required.

2.4 Only sites that had sufficiently high quality factors to be usable for at least one calculation were taken forward.

2.5 The remaining sites were cleaned. This stripped out data pertaining to school or bank holidays. Note that it was agreed prior to data collection that flow data from the months of January, July, August and December could not be used as these months contained significant periods of school holidays (i.e. non-neutral months). Consequently data for these months were not extracted for this process – hence this cleaning could not strip out all the data for a given month.

2.6 Since the calculations were carried out in the same way irrespective of time period, without loss of generality only the calculations for the AM Peak will be described from this point.

2.7 For the year-to-year factors the average flow in each 15-minute period in the AM Peak for Autumn 2018 was calculated and these averages were summed. The same calculations were made for Autumn 2016 and/or Autumn 2017 (depending on whether the site passed the quality check for both years or only one). The ratio between the two figures was the site factor.

2.8 For the remaining months the average flow in each 15-minute period in the AM Peak for that month was calculated and these averages were summed. The same calculations were made for the Autumn of the relevant calendar year. The month-Autumn ratio was the site factor.

2.9 Since the geographical spread of the sites used in this process was significant, and certain areas had greater concentrations of sites than others, it was decided to calculate sub-factors for each of five regions (labelled north, south, east, west and centre) which would then be averaged using the unweighted arithmetic mean. This would avoid giving undue weight to highly represented regions with significantly higher or lower growth than the less-well represented regions.

2.10 Two methodologies were used to generate the regional sub-factors:

- Methodology 1 used the unweighted arithmetic mean of the site factors for all sites in the region.
- Methodology 2 discarded the site factors, summed the flows across all the sites in the region, and calculated the sub-factor from these sums (this is equivalent to the weighted arithmetic mean using the flows in the denominator as weights).

2.11 These two methodologies generate different factors, although with less than 1% difference overall. In practice Methodology 1 was used to generate the factors that were applied. This is defendable based on the reasoning used above: It is possible that links with high flows and links with low flows have different growth factors. Using Methodology 2 biases the sub-factors towards the growth rates associated with links with high flows. Methodology 1 gives greater weight to the growth rates associated with links with low flows, and therefore should produce a less biased sub-factor.

2.12 To translate the flows associated with a given site to the equivalent volumes for Autumn 2018 the appropriate month-to-Autumn factor was applied. If the counts were from either 2016 or 2017 then the appropriate year-to-year factor was then applied.

3 Checks Performed

3.1 The flow data used to construct the individual site factors have been exported.

3.2 Based upon these flows the regional sub-factors were independently calculated using both methodologies, and these were then averaged as described above. The resultant factors matched the final tabulated factors for both methodologies. Appendix A shows the month and year factors calculated.

Appendix A: Factors

Annual (autumn to autumn) factors

year	period	factor1
2016	AM	1.0625
2016	IP	1.0534
2016	PM	1.0351
2017	AM	1.0025
2017	IP	1.0134
2017	PM	1.0029

Month to autumn factors

month_year	period	factor1
02_2016	AM	1.1235
02_2016	IP	1.1007
02_2016	PM	1.0807
02_2017	AM	1.1017
02_2017	IP	1.0776
02_2017	PM	1.0750
02_2018	AM	1.1046
02_2018	IP	1.0715
02_2018	PM	1.0701
02_2019	AM	1.0799
02_2019	IP	1.0731
02_2019	PM	1.0612
03_2016	AM	1.0498
03_2016	IP	1.0772
03_2016	PM	1.0217
03_2017	AM	0.9671
03_2017	IP	1.0452
03_2017	PM	0.9943
03_2018	AM	1.0567
03_2018	IP	1.0953
03_2018	PM	1.0943
03_2019	AM	1.0186
03_2019	IP	1.0312

month_year	period	factor1
03_2019	PM	1.0284
04_2016	AM	0.9953
04_2016	IP	1.0319
04_2016	PM	1.0154
04_2017	AM	1.1532
04_2017	IP	1.0389
04_2017	PM	1.0901
04_2018	AM	1.0420
04_2018	IP	1.0319
04_2018	PM	1.0302
05_2016	AM	1.0437
05_2016	IP	1.0332
05_2016	PM	1.0221
05_2017	AM	0.9274
05_2017	IP	1.0408
05_2017	PM	0.9997
05_2018	AM	0.9893
05_2018	IP	1.0140
05_2018	PM	1.0149
06_2016	AM	1.0263
06_2016	IP	1.0389
06_2016	PM	1.0265
06_2017	AM	0.9875

month_year	period	factor1
06_2017	IP	1.0175
06_2017	PM	1.0067
06_2018	AM	0.9799
06_2018	IP	0.9978
06_2018	PM	1.0020
07_2016	AM	1.0817
07_2016	IP	1.0095
07_2016	PM	1.0448
07_2017	AM	1.0975
07_2017	IP	1.0361
07_2017	PM	1.0584
07_2018	AM	1.0509
07_2018	IP	1.0107
07_2018	PM	1.0425
09_2016	AM	0.9545
09_2016	IP	0.9761
09_2016	PM	0.9689
09_2017	AM	0.9954
09_2017	IP	0.9928
09_2017	PM	0.9997
09_2018	AM	1.0204
09_2018	IP	0.9954
09_2018	PM	0.9967
10_2016	AM	1.0958
10_2016	IP	1.0015
10_2016	PM	1.0190
10_2017	AM	1.0661
10_2017	IP	1.0049
10_2017	PM	1.0044
10_2018	AM	0.9928
10_2018	IP	0.9973
10_2018	PM	0.9881
11_2016	AM	0.9895
11_2016	IP	1.0056
11_2016	PM	1.0035
11_2017	AM	0.9508
11_2017	IP	1.0037
11_2017	PM	0.9983
11_2018	AM	0.9889
11_2018	IP	1.0087
11_2018	PM	1.0176

Appendix 1 I.03: A46 BINLEY STAGE 4 TRANSPORT MODEL PACKAGE

A46 Coventry Junctions Upgrade (Binley)

Stage 4 Transport Model Package
Local Model Validation Report

Report Number: HE551486-ACM-HGN-A46_SW_000_Z-RP-TR-0004 P02.1 S3
December 2019

A46 Coventry Junctions Upgrade (Binley)

Stage 4 Transport Model Package Local Model Validation Report

Report No: HE551486-ACM-HGN-A46_SW_000_Z-RP-TR-0004 P02.1 S3

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Standard codes for suitability models and documents See BS1192:2007 Table 5 for further details					
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1 INTRODUCTION AND OVERVIEW

1.1 Introduction

1.1.1 AECOM was commissioned by Highways England (HE) in June 2017 to investigate options for upgrading the A46 at Binley and Walsgrave Junctions. The junctions form part of the A46 Coventry Junctions Upgrade scheme encompassing both Walsgrave and Binley junctions on the A46 east of Coventry.

1.1.2 The A46 Coventry Junctions Upgrade scheme is one of several schemes set out under the Department for Transport (DfT) Road Investment Strategy (RIS) to be developed by Highways England during the RIS period of 2015 to 2020 as announced in the 2014 Autumn Statement.

1.1.3 The RIS scheme description is “grade separation of the Binley and Walsgrave roundabouts on the A46 near Coventry, upgrading the trunk road sections of the A45 and A46 between the M6 and M40 to full Expressway standard”

1.1.4 The main scheme objectives for the A46 Coventry Junctions Upgrade scheme are to provide relief from traffic congestion and improve journey times by increasing the capacity of the two remaining at-grade junctions on the A46 between the M6 and the M40, benefiting both the strategic and local traffic needs and supporting future growth forecasts from Coventry City Council.

1.1.5 Stages 1 and 2 of the Project Control Framework (PCF) process (option identification and selection), considered a number of schemes for improving the junctions on this section of the A46. The schemes assessed are summarised below:

- Binley Only: grade separation of Binley roundabout only.
- Binley + Walsgrave: grade separation of Binley and Walsgrave roundabouts.
- Binley 50: grade separation of Binley roundabout and reduction of A46 speed limit to 50 mph through the scheme.

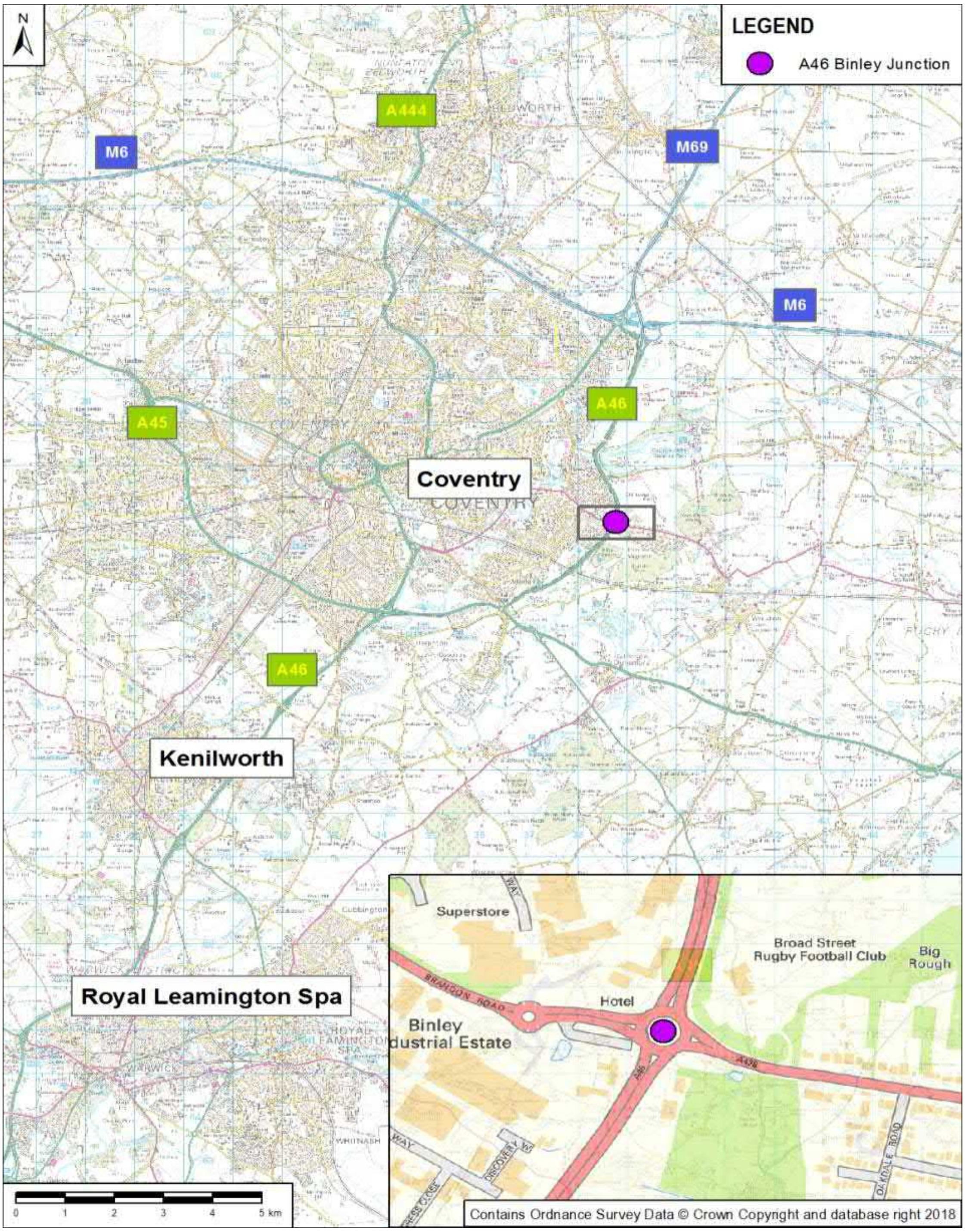
1.1.6 In October 2016 the decision was made to progress to Stage 3 (preliminary design) with the selected option which comprised one grade separated junction at Binley with a 50mph speed limit. The junction connects the A46 to the A428 at Binley roundabout (known locally as TGI junction) and this junction is currently signalised.

1.1.7 In December 2016 this proposal was taken forward to Major Projects Investment Decision Committee (IDC) and was rejected. IDC agreed to the development of one grade separated junction at Binley with the national 70mph speed limit to be provided within the original Road Investment Strategy (RIS) budget.

1.1.8 In December 2016, the A46 Coventry Junctions scheme was split into two separate projects, maintaining Binley Junction as a RIS 1 scheme, and moving Walsgrave into RIS 2 (with a RIS 2 budget) as it would require a Development Consent Order (DCO) to proceed. However, in February 2018, it was decided to continue promoting both elements of the scheme, with Binley Junction proceeding through HA Act Orders to enable a Start of Works before the end of Road Period 1 (RP1) in March 2020 and completion in Road Period 2 (RP2 – From April 2020 to March 2025); and Walsgrave starting and completing in RP2.

1.1.9 Figure 1-1 shows the location of the Binley scheme and its strategic context.

Figure 1-1: Binley Scheme Location



1.2 Purpose of Transport Model Package

1.2.1 This report summarises the work carried out in the development of the 2018 Base Year (BY) model for Binley required for Stage 4 of the PCF process which covers the statutory processes. It forms part of the Transport Model Package for Binley PCF Stage 4. It should be read in conjunction with the other elements of package, which include model analysis spreadsheets covering the calibration and validation of the base year model.

1.2.2 The model will provide the traffic forecasts that will underpin the detailed design and environmental and economic assessment of the scheme. The TMP report describes the context of the scheme, the available data, the development of the supply and demand side of the model and the subsequent model calibration process. It details the extent to which the model has been successfully calibrated and validated against observed data. Finally, it provides details of the development and sense testing of the DIADEM variable demand model using the post Matrix Estimation (ME) validated base matrices.

1.3 Background to Traffic Modelling

1.3.1 The assessment work carried out during PCF Stage 1 for the Binley and Walsgrave combined junction upgrade assessment utilised the Coventry Area Strategic Model (CASM). This model was also used to provide forecasts for the design and assessments for PCF Stages 1, 2 and 3 of the Binley only junction upgrade, when the two projects were initially separated.

1.3.2 The CASM model was identified as being the most appropriate modelling tool available at the time. CASM was originally developed to assess the impact of the M6 Junctions 2 – 4 Smart Motorway programme (SMP) and Coventry City Council's Local Plan proposals. CASM was updated and revalidated in the vicinity of the A46 Coventry Junctions Upgrade scheme area to form the A46 CASM.

1.3.3 Further interrogation of the CASM at PCF Stage 3 in relation to the Binley upgrade highlighted that CASM did not reflect the observed levels of congestion at Walsgrave junction in the base year. Predictions of congestion for the expected opening year (2021) and forecast year (2036) were considered unreliable. It was therefore agreed that an alternative modelling approach would be required for the progression of both Binley (i.e. beyond Stage 3) and Walsgrave projects.

1.3.4 It was decided that a new transport model should be developed from the Midlands Regional Transport Model (MRTM) and enhanced within the local area. It was also determined that the enhanced model would also be sufficiently robust to support all design and appraisals required for Binley Stage 4 and for Walsgrave Stage 2.

1.4 Requirement for Model

1.4.1 The new model, which will be referred to as the Coventry Strategic Traffic Model (CoSTM), has been developed to progress both the Binley and Walsgrave Schemes. It will provide traffic forecasts to support the environmental and economic assessment for both a potential future Public Inquiry and for the Business Case.

1.5 Report Structure

1.5.1 The report is presented in the following sections:

- Chapter 2 provides an overview of the requirements for the model
- Chapter 3 sets out the various standards that are relevant and applicable to the model development
- Chapter 4 highlights the key features of the model
- Chapter 5 describes the data sources used for developing the model
- Chapter 6 describes the network development including the network structure, vehicle classes, simulation periods and traffic parameters chosen for the model;
- Chapter 7 describes the development of the trip matrix and dynamic assignment - outlining the methods used to calculate the trip matrices and the parameters used for the dynamic assignment;
- Chapter 8 describes the model calibration. This includes the output flows of the model runs and the checking process against the observed traffic data;
- Chapter 9 presents the results of the model validation. It describes the journey time routes and the comparison between modelled and observed journey times;
- Section 10 describes the application of the variable demand modelling procedure that takes account of the change in the volume and distribution of trips arising from changes in travel costs;
- Section 11 provides a summary and conclusion;
- Section 12 provides a glossary of terms

2 MODEL REQUIREMENTS

2.1 Introduction

2.1.1 A new traffic model was required in order to progress Binley Stage 4. As noted in section 1.3, CASM used at PCF Stage 3 did not reflect the observed levels of congestion at Walsgrave junction in the base year. Predictions of congestion for the expected opening year (2021) and forecast year (2036) were considered unreliable. It was recognised that the transport modelling would need to be strengthened to provide robust analysis for future forecasting and scheme appraisal.

2.1.2 The CoSTM model was developed from the Midlands Regional Transport Model (MRTM). The MRTM is one of the 5 regional models commissioned by HE covering England. It utilised Mobile Phone Network Data (MND) for development of the Car matrices and was validated to a March 2015 Base Year. The MRTM provided the building block for the development of a detailed local model that focussed on the area likely to be impacted by the scheme.

2.1.3 Hereafter, unless specifically stated otherwise, all references to "the model" relate to CoSTM.

2.2 Model Design Requirements

2.2.1 The model was specifically developed to provide traffic forecasts to support the progression of the Binley Scheme to Stage 4 and beyond. The model was also required, in addition, to progress the further development of a scheme for Walsgrave to Stage 2 and beyond.

2.2.2 The model needs to be capable of assessing 'variable demand' impacts that include trip re-distribution and trip frequency in addition to route choice. Chapter 10 of this report describes the calibration of the variable demand model to ensure that the base year elasticities of responses to overall changes in fuel costs are within the expected ranges as defined in WebTAG.

2.2.3 The model network is sufficiently extensive to include the effects of re-routeing as a result of improvements at both Binley and Walsgrave over a wider area. At a local level it models the A46 in detail between the junction with the M6 to the north (M6 Junction 2) and junction with the A45 to the south (Tollbar End junction). The model also includes the connections of the A46 to the local network, with the B4082 at Walsgrave and the A428 at Binley. The local junctions on the A428 to the west of the Binley junction have been modelled to assess the impact of the trips linked to the business, retail and industrial areas nearby.

2.2.4 The development of the network is described in detail in Chapter 4.

3 MODEL STANDARDS

3.1 Introduction

3.1.1 This section outlines the desired standards required to achieve a model suitable for assessing the Binley and Walsgrave scheme and the tools and metrics used to assess that suitability.

3.1.2 The network coding was carried out with reference to Highways England's Regional Traffic Models Network Coding Manual, Version: 0.8, 11 December 2015.

3.1.3 The UK Department for Transport (DfT) guidelines were used as a measure of the base year model calibration and validation in terms of link flow, screenline (SL) and journey time (JT) route comparisons (modelled versus observed), as well as model convergence criteria.

3.2 Link Flow Validation Criteria and Acceptability Guidelines

3.2.1 The assignment acceptability guidelines are set out in the Department for Transport (DfT) TAG Unit M3.1. These guidelines define what is considered to represent an acceptable match between the modelled and observed datasets, including the flow differences using percentage and GEH statistics, and journey time statistics.

3.2.2 The TAG acceptability guidelines for modelled and observed link flow comparisons are shown in Table 1 for individual links and turning movements.

Table 1: WebTAG Link Flow and Turning Movement Criteria and Acceptability Guidelines

Criteria	Description of Criteria	Acceptability Guideline
1	Individual flows within 100 veh/hr of counts for counts less than 700 veh/hr	> 85% of cases
	Individual flows within 15% of counts for counts from 700 and 2,700 veh/hr	> 85% of cases
	Individual flows within 400 veh/hr of counts for observed flows greater than 2,700 veh/hr	> 85% of cases
2	GEH statistic < 5 for individual flows	> 85% of cases

Source: TAG Unit M3.1 Table 2

3.2.3 It is sufficient for the comparisons to pass either Criterion 1 or 2 listed above. The GEH comparison referred to is explained below.

3.2.4 Differences between the modelled and observed data have been monitored using statistical measures. The GEH statistic, commonly used in highway modelling, is one such measure. It is used as an indicator of 'goodness of fit'. It represents an attempt to account for absolute and percentage differences in a single measure and is calculated as follows:

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

Where M = modelled value; O = observed value.

3.2.5 The GEH statistic acknowledges that where traffic volumes are low, small absolute differences can result in relatively high percentages that implies that differences between modelled and observed flows are significant.

3.3 Trip Matrix Calibration and Validation Criteria

3.3.1 Multiple links are normally combined as screenlines for the purposes of flow comparisons. These have the benefit of capturing area to area movements, and hence provide a good measure to assess the quality of the matrices.

3.3.2 TAG Unit M3.1 (Highway Assignment Modelling, January 2014) recommends that differences between modelled and observed flows and counts should be less than 5% of the counts for all, or nearly all screenlines.

3.4 Journey Time Validation Criteria

3.4.1 WebTAG Unit M3.1 recommends that the modelled times along routes should be within 15% of the surveyed times (or 1 minute, if higher) for more than 85% of the journey time routes.

Table 2: Journey Time Validation Criteria and Acceptability Guideline

Criteria	Acceptability Guideline
Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	> 85% of routes

Source: WebTAG Unit M3.1 Table 3

3.5 Convergence Criteria

3.5.1 TAG Unit M3.1 outlines a set of modelling criteria that must be achieved regarding convergence of an assignment for a model to be considered stable.

3.5.2 It is suggested that global stability indicators alone are not sufficient, as such measures may hide substantial uncertainty at a lower level. Disaggregate and proximity measures of stability have therefore been used.

3.5.3 The following criteria, and their SATURN convergence equivalents, are considered the most appropriate.

Table 3: WebTAG Link Flow and Turning Movement Criteria and Acceptability Guidelines

Measure of Convergence	Acceptability Guideline
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P)<1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2)<1%	Four consecutive iterations greater than 98%

Source: WebTAG Unit M3.1 Table 4

3.6 Demand Modelling Criteria

3.6.1 As noted in TAG Unit M2, once a variable demand model has been constructed, it is essential to check that it behaves ‘realistically’. This is achieved by adjusting various components of travel costs and times and checking that the overall response of demand accords with general experience. The values of the parameters controlling the response of demand to costs should be adjusted until an acceptable response is achieved. This recognises the large and unavoidable uncertainties in some of the parameter values, and the importance of reflecting local conditions in relative values.

3.6.2 In the base model, the criteria apply principally to Realism Testing, and consist of convergence between SATURN and DIADEM, and the elasticity range within which demand responses to changes in fuel costs and public transport costs lie. These are set out in TAG Unit M2.

3.6.3 The convergence criteria that have been used are those as included in TAG Unit M2, paragraph 6.3. The elasticity ranges are as follows, taken from Table 6.2 of Unit M2:

- **Car Fuel Cost Elasticity -** this is the percentage change in car vehicle kilometres with respect to the percentage change in fuel cost. For a 10% increase in fuel cost this should be between -0.35 (high) and -0.25 (low);
- **Car Journey Time Elasticity -** this is the change in car trips with respect to the change in journey time, for one iteration of the demand model. This should be no stronger than -2.0.
- **Public Transport Fare Elasticity -** this is the change in public transport trips with respect to the change in public transport fare. This is expected to be in the range -0.20 to -0.90.

3.6.4 The results of these tests are provided in section 10.12 and 10.13 of this report.

4 KEY FEATURES OF THE MODEL

4.1 Introduction

4.1.1 This section describes the key features of CoSTM. It includes the Area of Detailed Modelling (AoDM), the model network and zoning system, the time periods, user classes, generalised cost formulations and the overall model set-up.

4.2 Area of Detailed Modelling

4.2.1 The Area of Influence (AoI, formerly Likely Region of Impact) is the area within which significant changes in flow and speed may be expected that are due to the Scheme. The extent of the traffic model and level of coding detail needs to be such that it allows for the accurate representation of existing and forecast traffic flows in the AoI of the Scheme, including all such potential diversions as a result of the Scheme.

4.2.2 For the purposes of network development, the Area of Influence is also known as the Area of Detailed Modelling (AoDM) as the latter gives a better description of the network implications of the boundary.

4.2.3 The flow changes used to estimate the AoI were largely driven by thresholds that are significant in terms of environmental impacts, principally Air Quality and Noise. The Air Quality study area is often defined by any of the following:

- Road alignment will change by 5m or more;
- Daily traffic flows (two-way) will change by 1,000 AADT or more;
- HGV (Heavy Goods Vehicle) flows (two-way) will change by 200 AADT or more;
- Daily average speed (two-way) will change by 10 km/h or more; or
- Peak hour speed will change by 20 km/h or more.

4.2.4 The noise study area is defined by:

- 600m either side of the centreline of the proposed scheme (new and altered roads) and the existing junction and A46 mainline altered by the scheme;
- 600m either side of routes within 1km of the scheme with predicted changes in noise of at least 1dB in the scheme opening year (affected routes); and
- 50m either side of existing roads outside the 1km buffer with predicted changes in noise of at least 1dB in the scheme opening year and 3dB in the long term (affected routes).

4.2.5 The AoI was identified using Highways England’s Midlands Regional Traffic Model (MRTM). The 2041 forecast year was selected as it was the closest year to the expected ‘design’ year of the Binley and Walsgrave scheme. The forecast year model files formed the baseline for the RIS2 assessment and therefore contained RIS1 schemes as the Do Minimum scenario.

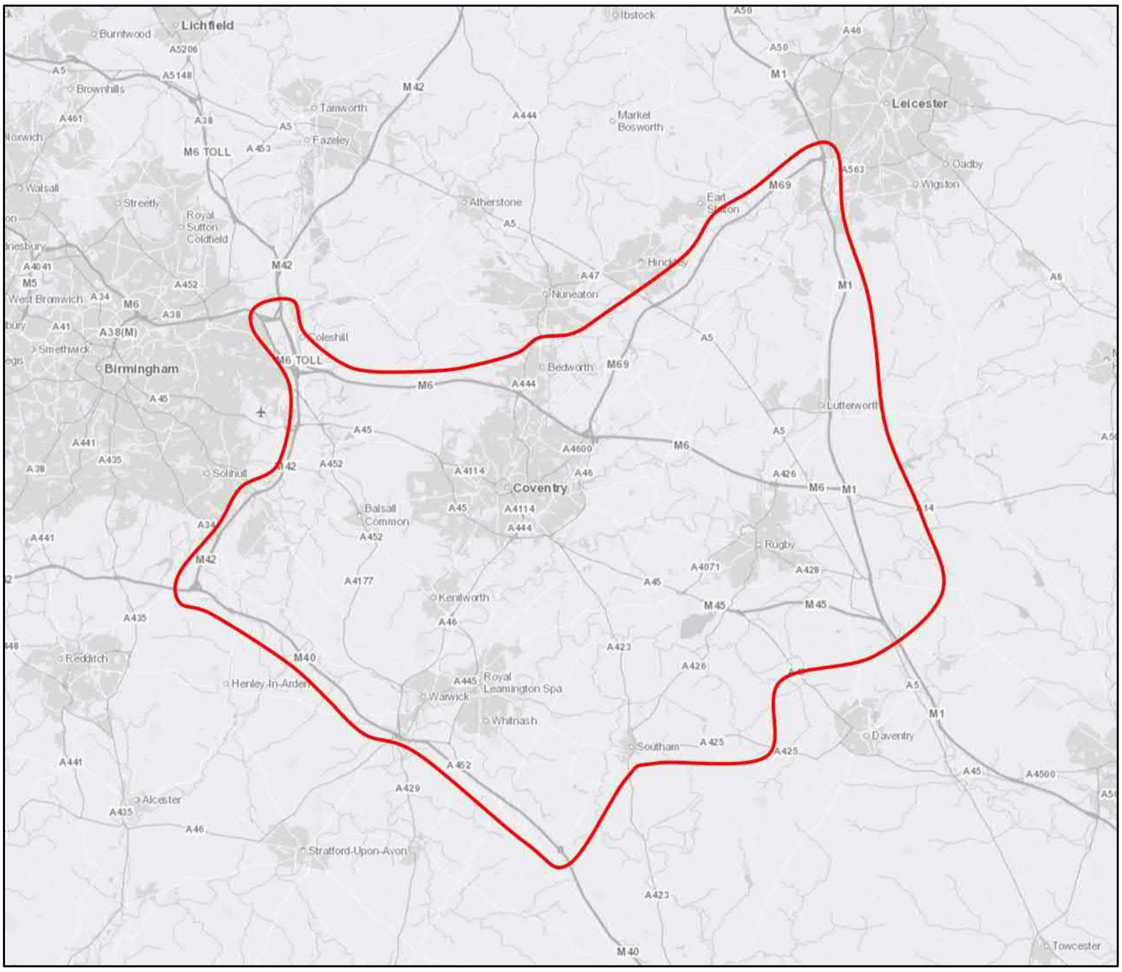
4.2.6 The ‘with’ scheme coding used for the purpose of determining the AoI consisted of the Binley grade separation layout and the Walsgrave ‘dumbbell’ grade separation layout with a modified B4082 alignment (Walsgrave option W211A). This Walsgrave option was used as the option likely to have the widest geographic impact, therefore the AoI derived would cover the impacts from a range of other options tested.

4.2.7 2041 MRTM demand matrices were used in a fixed demand assignment to undertake the assessment. The flow variations between Do Minimum and Do Something (both all vehicle and HGV-only) were processed into 24hr changes.

4.2.8 The impacts of the Binley and Walsgrave scheme were demonstrated to be primarily on a north-south axis with some changes on east-west routes. The AoI boundary is determined by the environmental flow change criteria identified above.

4.2.9 The boundary of the model study area described above is illustrated in Figure 4.1 below.

Figure 4-1: Study Area Boundary: AoI / AoDM



4.3 Model Details

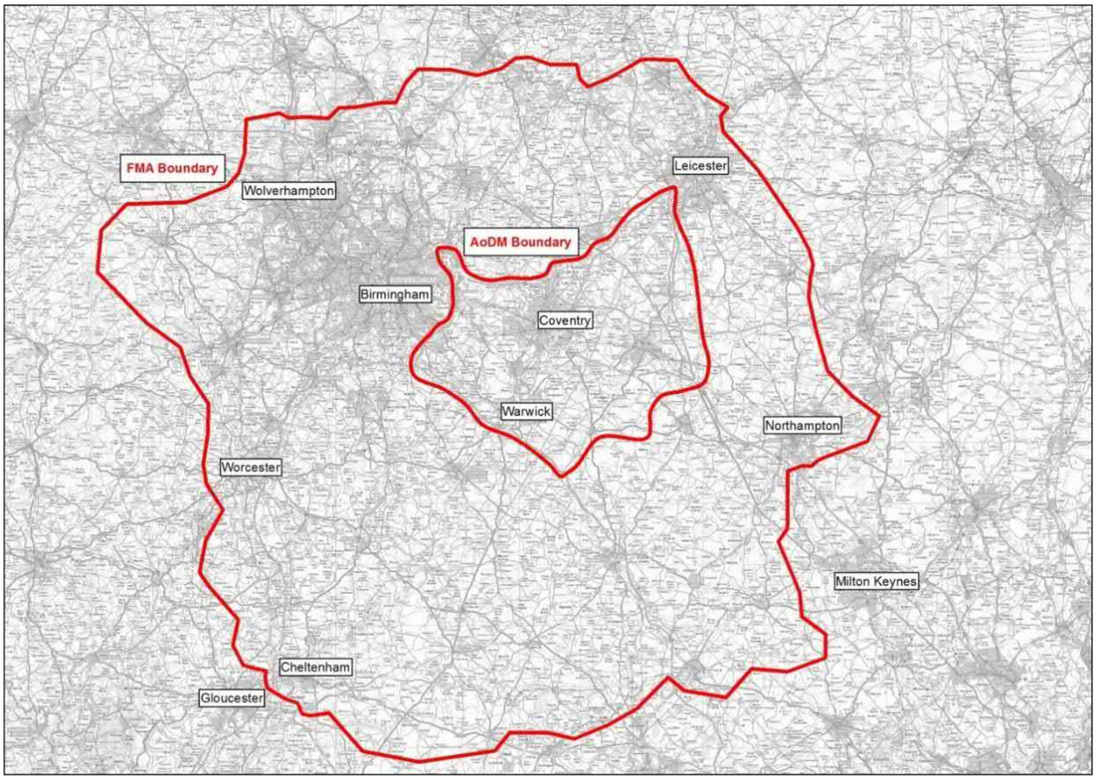
4.3.1 CoSTM was developed with an Autumn (September-November) 2018 Base Year. This is a neutral period post opening of the Tollbar End Junction improvement (A45/A46).

4.3.2 Outside of the AoDM a Fully Modelled Area (FMA) was identified. This was defined through further analysis of scheme impacts in the MRTM internal area. Figure 4-2 below shows the boundaries of the AoI/AoDM and FMA.

4.3.3 The AoDM has been specified as a simulation network. Outside the AoDM but within the FMA, the existing MRTM simulation network has been converted to buffer network with speed flow curves. Any buffer network between the AoDM and FMA boundaries has been retained as such.

4.3.4 Outside of the FMA the remaining MRTM simulation network has been converted to buffer network with fixed speeds. See more detail on this in Section 6.

Figure 4-2: Study Area Boundary: AoI / AoDM and FMA



4.4 Zone and Sectors

4.4.1 The Zoning system in CoSTM is based on MRTM zoning, but with disaggregation of zones in the AoDM area, and aggregation in the external area outside the FMA. The external zones and special generator zones that are present in both MRTM and CoSTM (those located in the buffer area in both models) are identical.

4.4.2 The number of zones in the CoSTM matrices is 896, compared to 1,547 in MRTM. Chapter 7 discusses the base year matrix development in more detail.

4.5 Time Periods

4.5.1 CoSTM was developed to model the AM, inter and PM peak hours. The actual hours modelled were determined from the ATC and MCC data collated (see Data Sources section). MRTM has a 3 hour peak period for AM and PM, but the ATC and MCC data suggested a two hour peak period in the AM and PM:

- AM Peak – 07:00 to 09:00
- PM Peak – 16:00 to 18:00
- Inter Peak –09:00 to 16:00.

4.5.2 Volumes in the hour after the PM peak (18:00 to 19:00) were similar to the IP, so for economic assessment purposes were included. Weekday off peak and Weekend were not modelled.

4.6 User and Vehicle Classes

4.6.1 The Vehicle Classes present in CoSTM were Car, LGV & HGV, as available from the TrafficMaster data (see Data Sources section, Section 5).

4.6.2 These vehicle classes were split into five User Classes. These were consistent with the MRTM matrices from which the CoSTM matrices are derived:

- UC1: Car, Employer's Business
- UC2: Car, Commuting and Education
- UC3: Car, Other
- UC4: LGV
- UC5: HGV (OGV1 and OGV2)

4.6.3 OGV1 and OGV2 will be segregated for other purposes (e.g. for input into TUBA for the economic analysis) by applying proportion factors based on observed data.

4.6.4 Bus services were included in the CoSTM assignment modelling. These were pre-loaded onto the network where bus volumes of five or more buses per hour are present.

4.7 Assignment Procedure

4.7.1 The assignment of trips to the highway network has been undertaken using a user-equilibrium assignment according to the first of Wardrop's principles, which governs the routes chosen by drivers travelling from a given origin to a given destination.

4.7.2 This principle of equilibrium is such that: 'The journey times on all the routes actually used are equal, and less than those which would be experienced by a single vehicle on any unused route'.

4.7.3 User-equilibrium, as implemented in SATURN version 11.4.07H, is based on the Frank-Wolfe algorithm. This employs an iterative process based on successive all-or-nothing assignments to generate a set of combined flows on links that minimise an objective function. The travel costs are re-calculated at each iteration and then compared to those from the previous iteration. The process is terminated when the costs obtained from successive iterations do not change significantly. At this point, the model is said to have converged to a pre-defined degree.

4.8 Generalised Costs

4.8.1 The cost of travel for the assignment process has been expressed in terms of generalised cost, which combines time and money, using a specified 'Value of Time' to convert money into time separately for each defined journey purpose. SATURN uses two parameters: pence per minute (PPM) and pence per kilometre (PPK), and calculates the generalised cost in minutes as:

- Time + PPK/PPM x Distance + Toll (pence)/PPM

4.8.1 Value of Time (VOT, i.e. PPM) and Vehicle Operating Cost (VOC, i.e. PPK) used in the base year model were calculated based on DfT parameters in the May 2019 TAG Data Book v1.12 (in accordance with TAG Unit A1.3, March 2017) to represent perceived costs in the 2018 base year.

5 DATA SOURCES

5.1 Introduction

5.1.1 This section describes the main sources of data used to develop the base year CoSTM. The data used were from both new and existing sources. This chapter also describes the processing of the collected data.

5.1.2 Existing data sources used to build the Base Year model are summarised as follows:

- Highways England observed traffic count data from WebTRIS,
- Traffic count data from local transport and highway authorities (Transport for West Midlands, Warwickshire County Council and Leicestershire County Council),
- Previous AECOM traffic count surveys from May and October 2018 (commissioned for Walsgrave Stage 1),
- Other survey data (Ansty Vectos). This referred to counts undertaken for Ansty Park, a technology park to the east of Coventry. Some sites were selected for the A46 work,
- TrafficMaster journey time data,
- Traffic signal data from local highway authorities, the MRTM and CASM models,
- Automatic Number Plate Recognition (ANPR) data.

5.1.3 A gap analysis was conducted to identify areas of weak or incomplete/missing data required for the model build. This looked at traffic count locations needed in the Area of Detailed Modelling (AoDM) to correspond with the defined calibration and validation screenlines and cordons.

5.1.4 There were 4 cordons and 6 screenlines defined for calibration and validation of CoSTM and 11 journey time routes. These are illustrated in the plots presented in sections 5.3 and 5.4

5.1.5 This analysis resulted in the commissioning of new traffic counts in February 2019.

5.1.6 Automatic Number Plate Recognition data was obtained in February 2019 to assist in the Base Year matrix build. Census Population estimates, National Trip End Model/TEMPRO and National Transport Model / Road Traffic Forecasts 2018 were also used in this process, as well as the ATCs/MCCs described in this section.

5.1.7 As well as input to the strategic highway model, the data was used to form a Transport Data Package (HE551486-ACM-GEN-VTR-A46_SW_000_Z-RP-TR-0001). This product, which was issued in October 2019, details the data gathered and how it was used.

5.1.8 The Transport Data Package comprises:

- Technical Notes prepared by AECOM

- Survey Data as collected by Local Authorities, HE and survey companies
- Full ATC database
- Full MCC database
- Summary Traffic Database (end state of processing)
- GIS maps with screenlines, cordons and associated sites
- Processed Journey Time TrafficMaster data

5.2 Midlands Regional Traffic Model

5.2.1 The Midlands Regional Traffic Model (MRTM) was used as the basis for developing CoSTM. MRTM was originally developed by Highways England using the SATURN software suite. Once the AoDM was defined, the MRTM model was cordoned, and the simulation area outside of the cordon converted to buffer (This was done using SATBUF for simulation links. Simulation centroid connectors were reviewed at the same time as being manually converted from simulation to buffer).

5.2.2 The network was updated to reflect a 2018 base year and the zoning system in the AoDM refined. Using the data described in this section, CoSTM was calibrated and validated to a 2018 base year.

5.3 ATC / MCC Data

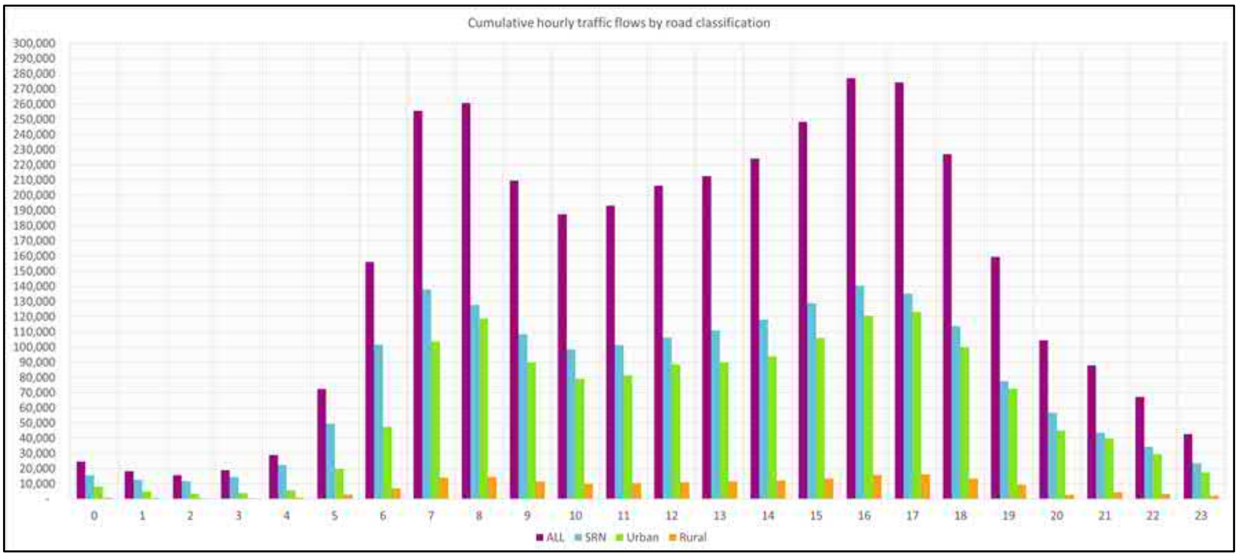
5.3.1 A total of 55 WebTRIS data sites were identified within the AoDM. Where no data was available for Autumn 2018, data was collected for May-June 2018, Autumn 2017 or Autumn 2016 in order of preference.

5.3.2 The existing Local Authority data was filtered to exclude any sites that did not have up-to-date (post-January 2017) data or the data available was incomplete. Traffic data from 2016, 2017 and 2018 was retained (2016 data used only in locations remote from the Tollbar End junction). A second filter was then applied, selecting only sites that were located on calibration and validation screenlines / cordons. This resulted in 250 sites remaining after the basic filtering process.

5.3.3 The new counts commissioned in February 2019 were to fill the location gaps on the calibration / validation screenlines for the model calibration and validation. 306 sites were surveyed by Tracsis, including MCCs and ATCs at the same locations. The surveys were intended to be undertaken from late February to the beginning of March. However, several sites were surveyed at a later date (March-May), due to problems with the data collection equipment.

5.3.4 The existing and new traffic counts were first used to determine the time periods to be considered in the CoSTM Base Year model build. Cumulative hourly flows were calculated, by aggregating the traffic volumes for three road categories: Strategic Road Network, Urban and Rural. Peak periods were then identified for each road type. This analysis is summarised in Figure 5-1.

Figure 5-1: Hourly Traffic Flows by Road Classification



5.3.5 The observed peak time periods were determined to be:

- AM Peak: 07:00 – 09:00
- Inter-Peak: 09:00 – 16:00
- PM Peak: 16:00 – 18:00

5.3.6 Traffic factors were calculated to convert existing / new counts to an Autumn 2018 base as many of the existing and new counts were from years / months other than Autumn 2018.

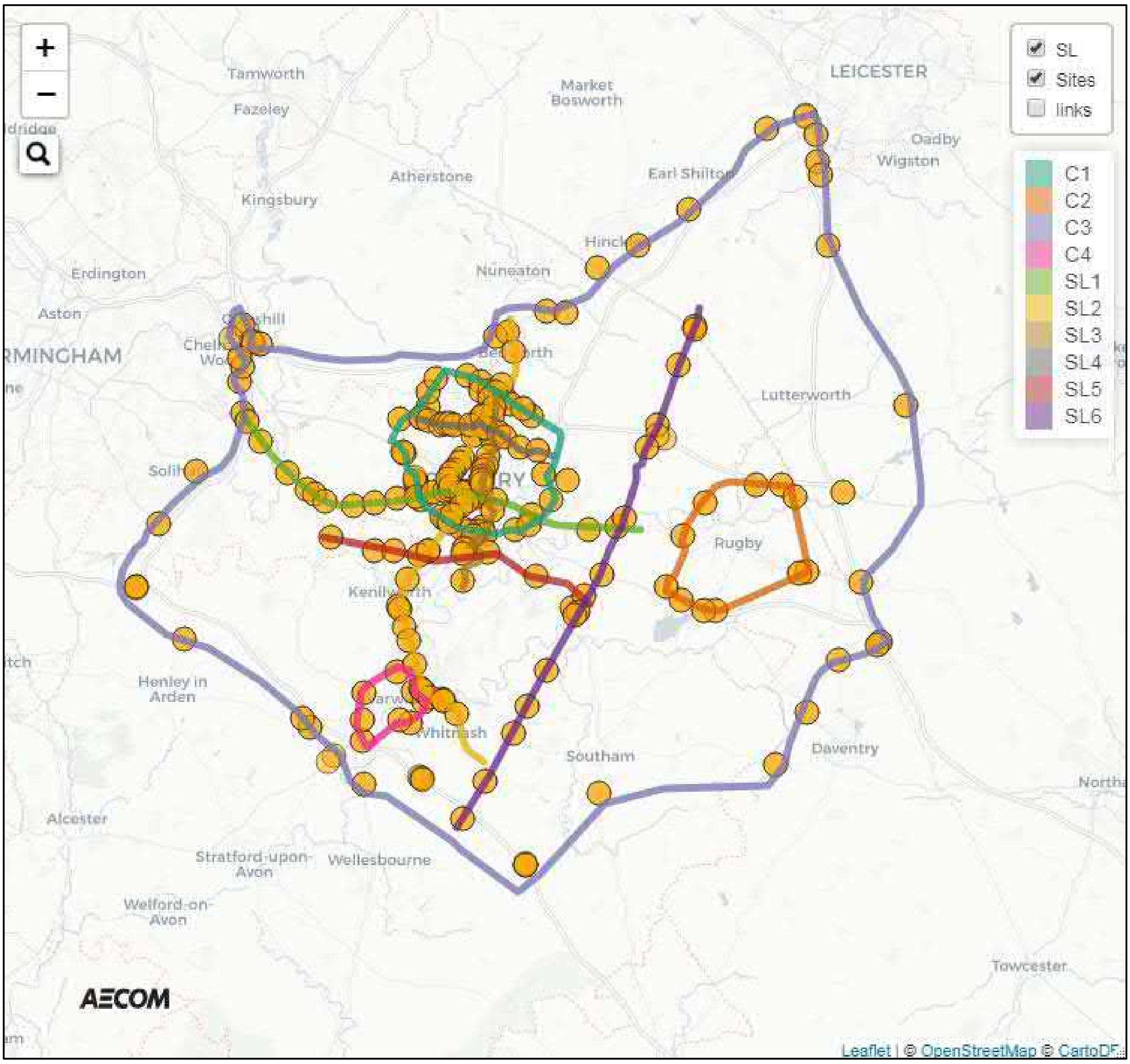
5.3.7 These factors were calculated from the WebTRIS data, using an interim "Quality Factor" to determine which WebTRIS sites should be used in the calculation of Autumn 2018 conversion factors. The Quality Factor was defined as the proportion of valid data available during the relevant set of dates. Further details are given in Technical Note TN20: Factoring Counts.

5.3.8 A correspondence of ATC and MCC sites was then created, based on the spatial location of both. Where no MCC was directly linked to an ATC, nearby sites with similar characteristics and traffic volumes were used. Where more than one MCC was directly linked to an ATC, an average split was calculated.

5.3.9 Each count site was allocated to a model network link. A correspondence of ATC sites and SATURN A-B links by direction was created and added to the traffic database.

5.3.10 Each link / count site was linked to corresponding calibration / validation screenline or cordon. A correspondence table was created, specifying direction of traffic at the site and the direction in which the screenline or cordon is crossed. Figure 5-2 below shows the locations of screenlines, cordons and count site locations for the CoSTM model calibration and validation.

Figure 5-2: Screenlines, Cordons and Count Site Locations



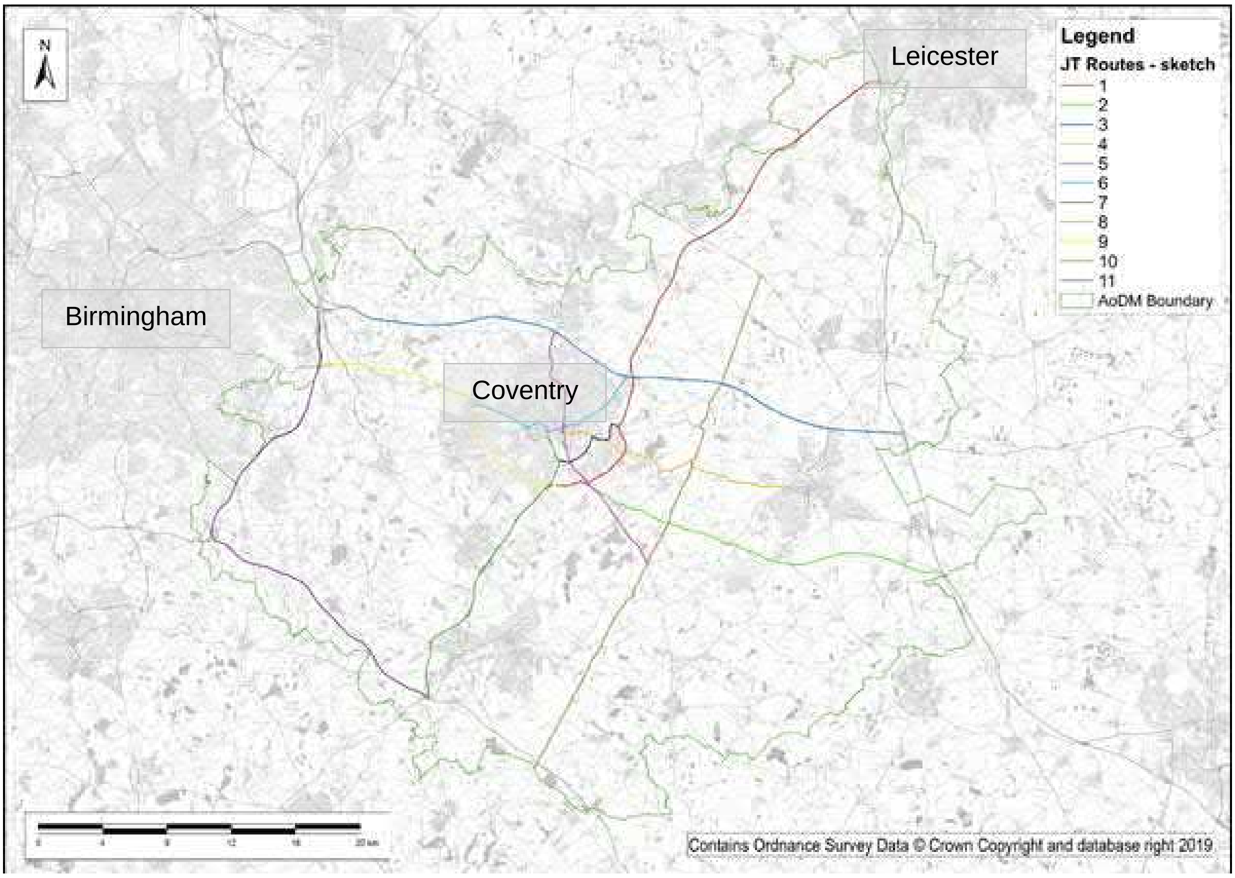
5.4 Journey Time Data

5.4.1 Journey Time data for Coventry and the surrounding area was obtained from TrafficMaster (TM) data supplied by the DfT (for September to November 2018). TrafficMaster data is made up of GPS point data collected at regular time intervals from fleet vehicles.

5.4.2 The data was aggregated in 15 minute intervals and filtered by vehicle type, date and time of day. Outliers, as well as weekends, bank holidays and school holidays were removed. Although the data contained nine types of vehicle, cars and LGVs were used for the calculation of journey times. This was due to these being the most numerous in the dataset, and most homogeneous in terms of behaviour. Journey time data was then extracted for the three model time periods.

5.4.3 Eleven routes were determined for validating journey times within the Base Year CoSTM. These are illustrated in Figure 5-3 below.

Figure 5-3: Journey Time Routes for CoSTM model



6 NETWORK DEVELOPMENT

6.1 Introduction

6.1.1 The CoSTM model network was refined from Highway England's Midlands Regional Traffic Model (MRTM). The model base year was specified as Autumn 2018, which is a neutral month post opening of the Tollbar End junction improvement scheme. It is also post commencement of the M6 Junctions 2-4 All Lane Running construction works. As 2018 is midway between the 2015 and 2021 MRTM model years, the 2021 MRTM was used as a starting point for developing the 2018 CoSTM network.

6.1.2 This section describes the development of the Base Year network, including the model zoning system.

6.2 Network Development / Refinement

6.2.1 Within the Area of Detailed Modelling (AoDM), the existing MRTM SATURN network was enhanced by adding links from the Coventry Area Strategic Model (CASM) network. CASM was previously used for Project Control Framework (PCF) stage 1 for Binley and Walsgrave combined, and PCF stages 1-3 for Binley only upgrade. As CASM was built using VISUM software, the additional links from CASM were coded with the aid of the RTM Network Coding Manual.

6.2.2 Within the AoDM, the simulation network was retained. Outside the AoDM, but within the Fully Modelled Area (FMA), the existing MRTM simulation network was converted to buffer network with speed flow curves. Any buffer network in the FMA was retained. After this any buffer network links in the FMA that were not Motorways or A roads were removed. Speed flow curves were allocated to all remaining buffer links in this area.

6.2.3 Outside the FMA, the simulation network was converted to a buffer network with fixed speeds. All non- Strategic Road Network links were removed. There were also some reductions in terms of link coverage on the Welsh road network.

6.2.4 Figure 6-1, covering the AoDM, shows the stitched together CASM network and MRTM network in red, and the final CoSTM network in blue. Figure 6-2 shows the same network representation for the FMA. These figures shows where CASM / MRTM networks link were removed and where additional network detail was added to create the final CoSTM network.

Figure 6-1: CASM / MRTM (red) and CoSTM (blue) networks in the AoDM

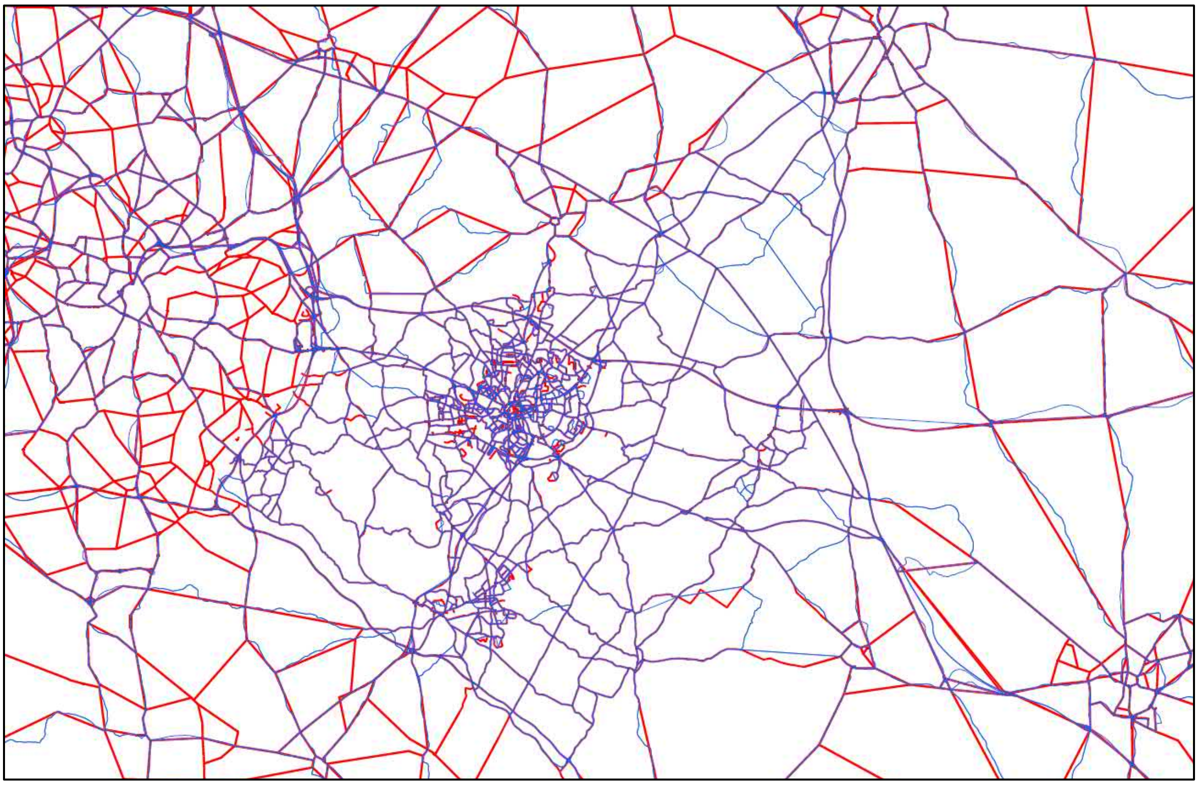
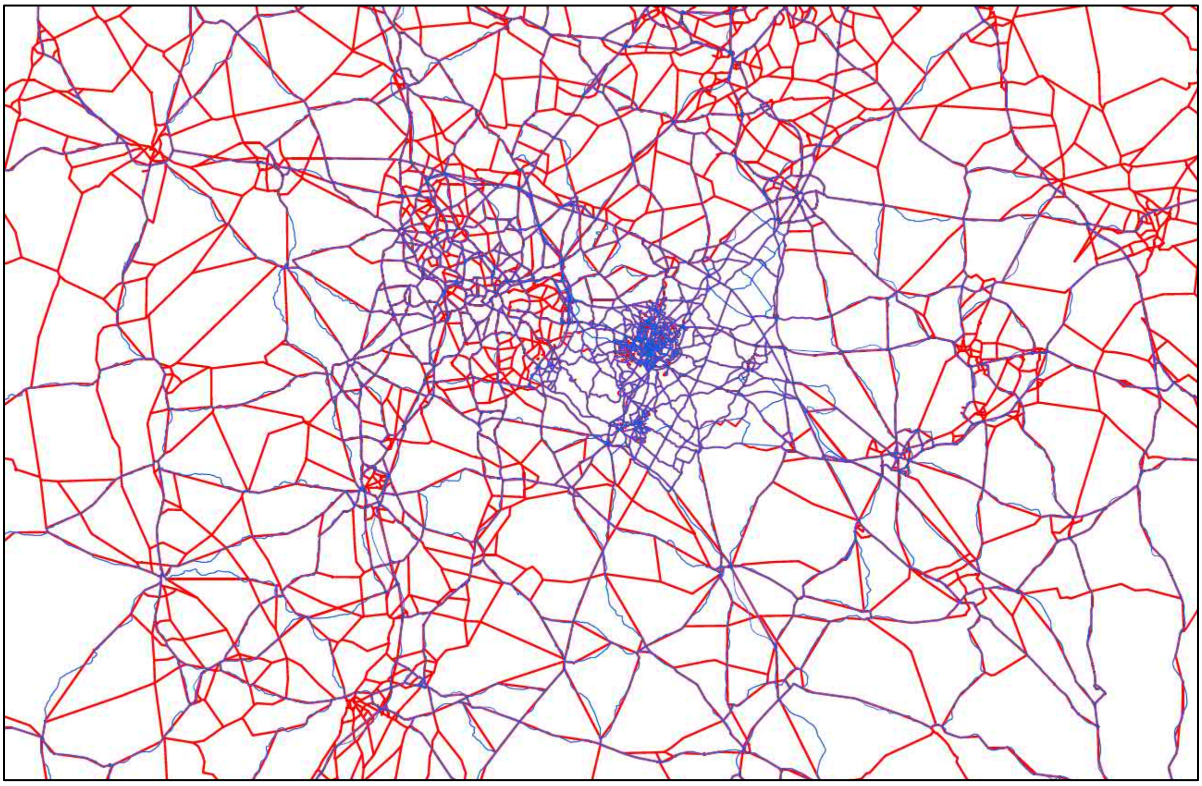


Figure 6-2: CASM / MRTM (red) and CoSTM (blue) networks in the FMA



6.3 Zone System Refinement

6.3.1 The zoning system for CoSTM was based on the MRTM zoning system, with disaggregation of zones in the AoDM and aggregation in the external area outside the FMA.

6.3.2 Initially, zones that were formed of multiple MSOAs (Middle Super Output Areas) were disaggregated to their constituent MSOAs. Within and to the east of Coventry, any zones that were formed of multiple LSOAs (Lower Super Output Areas) were further disaggregated to their constituent LSOAs. In the area immediately surrounding the scheme, the resulting zones were further disaggregated along OA boundaries.

6.3.3 There were a number of zones immediately surrounding and to the east of Coventry that covered large rural areas. These zones were disaggregated along suitable boundaries, (LSOAs being preferred, but OA used where necessary) to ensure that the zonal demand was more accurately assigned to the network.

6.3.4 Warwick and Leamington Spa form Air Quality Management Areas (AQMAs), so the zoning within Warwick and Leamington Spa was disaggregated further along suitable LSOA boundaries, to enable a better understanding of the traffic demand implications on the local air quality. The disaggregation was carried out so that all zones in these two towns contained between one and three LSOAs.

6.3.5 Between the AoDM and FMA boundaries the MRTM zoning system was retained.

6.3.6 Outside the FMA boundary the MRTM zoning system was aggregated. In the areas where the zoning was sub-District, the zones were aggregated to District level (or Unitary Authority level in Wales).

6.3.7 Exceptions to this rule were Powys (where travel between the northern half of the Unitary Authority and the West Midlands would use a different main route to travel between the southern half of the Unitary Authority and the West Midlands) and the Districts that were divided into multiple parts by the FMA boundary. The remaining zones in England and Wales have not been aggregated further. The Scottish zones have been aggregated into one zone.

6.3.8 Images of these zoning system changes may be viewed in progressively wider views from Figure 6-3**Error! Reference source not found.** to Figure 6-5. These images compare both the MRTM and CoSTM zoning systems and show where the boundaries differ between both models.

Figure 6-3: CoSTM Zoning Changes Within Coventry and Rugby

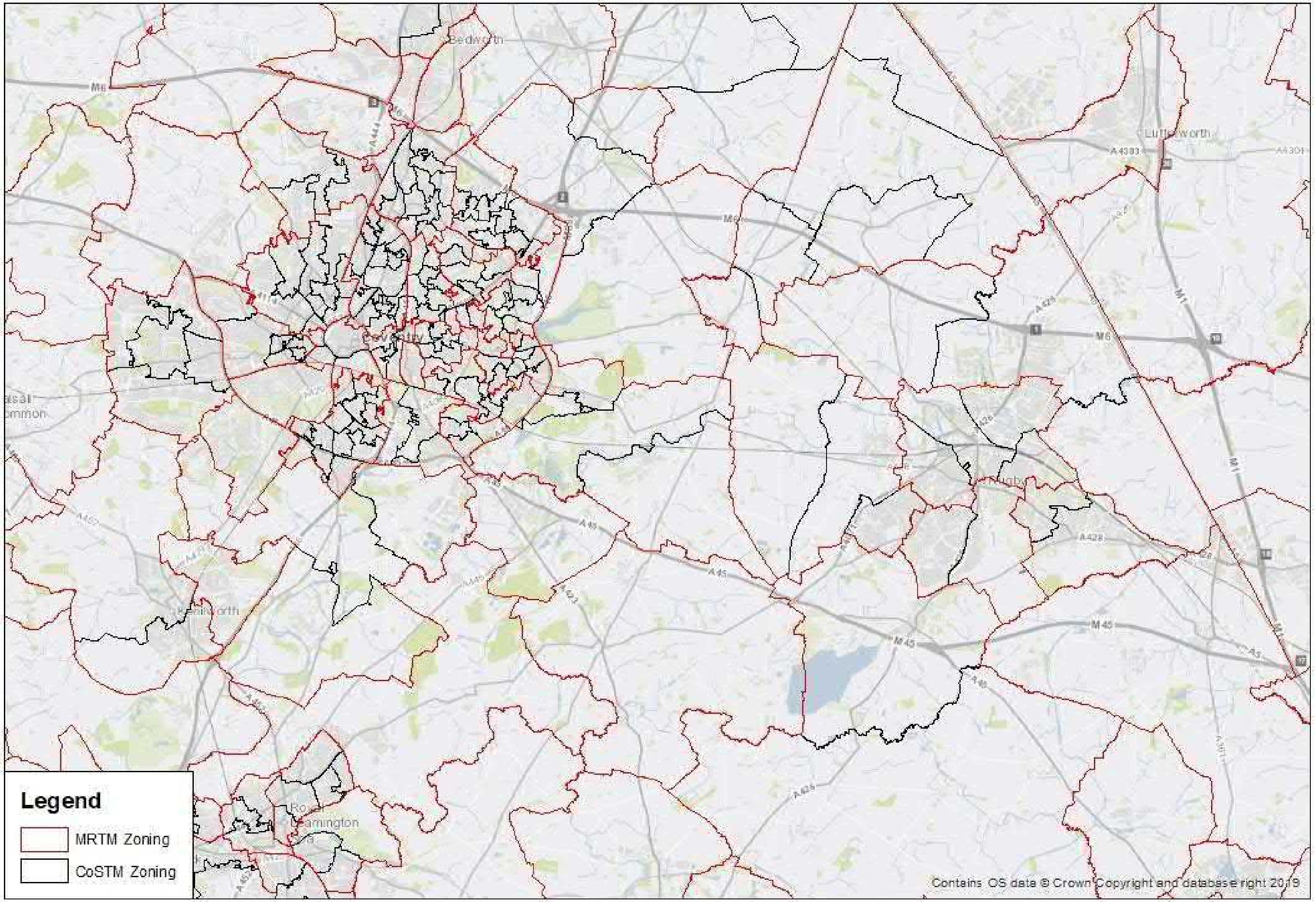


Figure 6-4: CoSTM Zoning System Over MRTM RoF

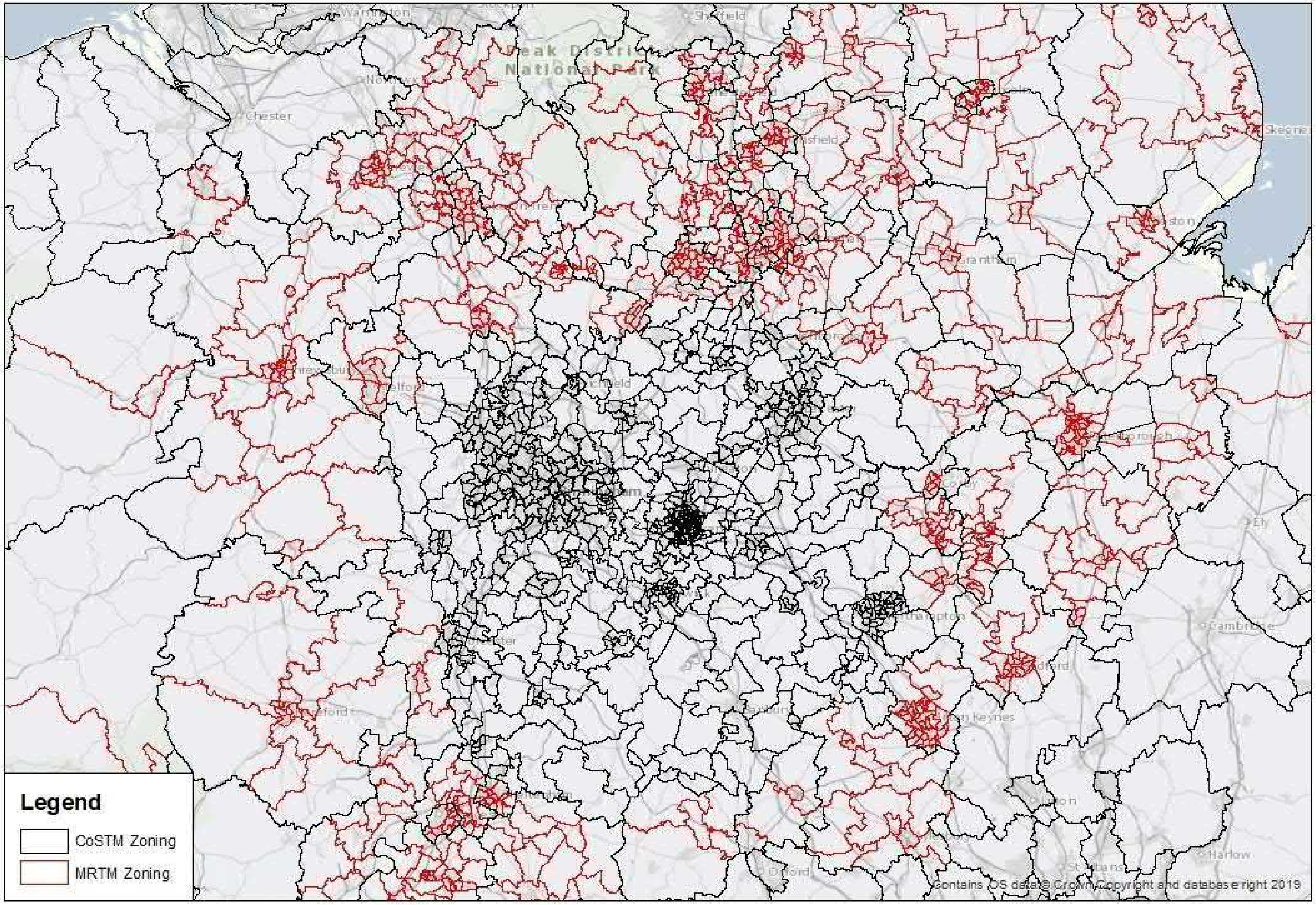
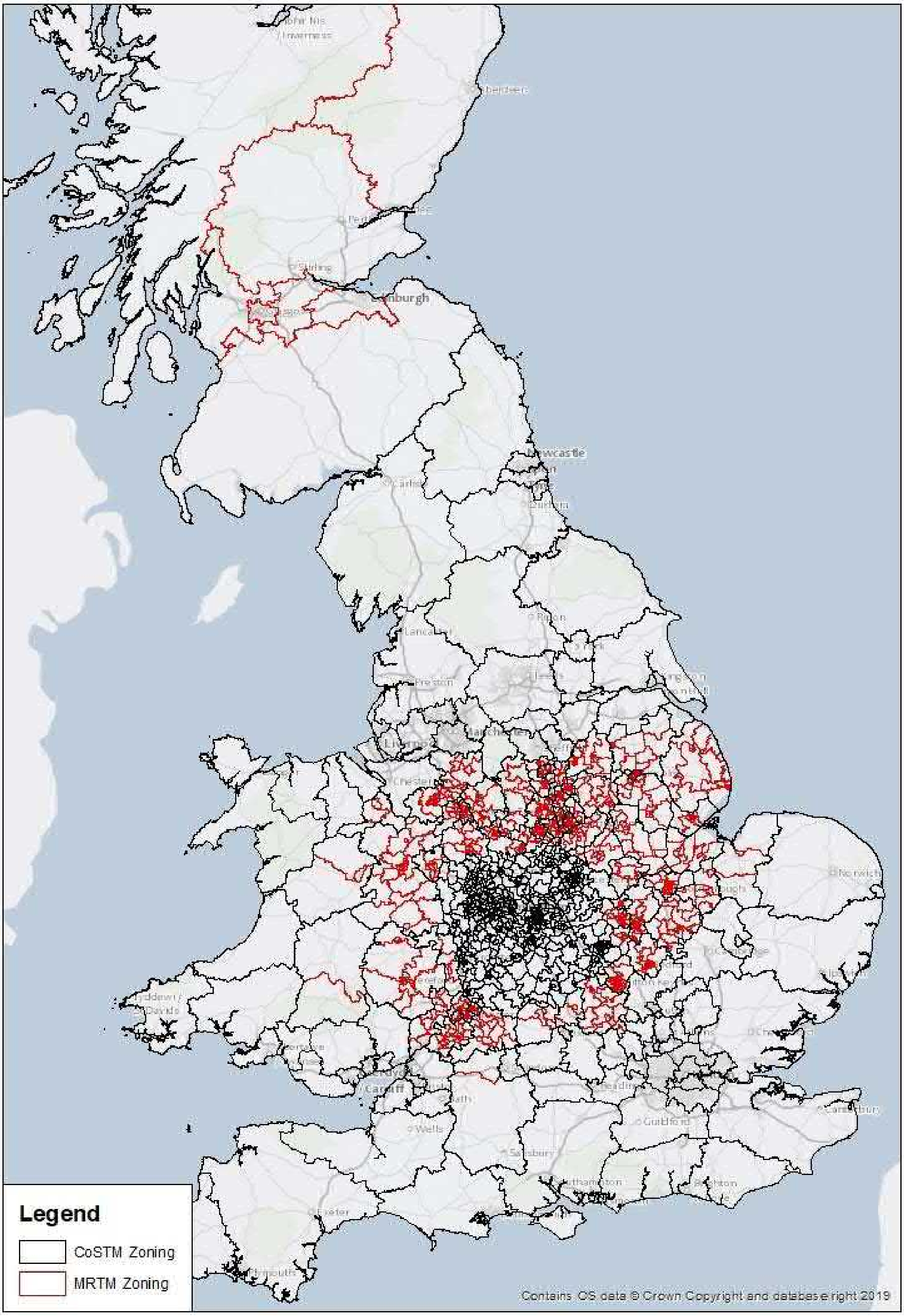


Figure 6-5: CoSTM Zoning Over the Whole of GB



6.4 Bus Services

6.4.1 Bus services have been included in the model, where there are frequencies of five or more services per hour.

6.5 Speed Flow Curves

6.5.1 Speed-flow curves were derived from the MRTM for all the Motorways and A Road dual-carriageways. For other road types, speed-flow curves were applied with the following conditions.

- All links having a free flow speed of 40mph or more will have a SFC.
- No SFC where the speed limit is less than 40mph (this should cover the urban area);
- No SFC for links on gyratory/exploded roundabout junctions
- No SFC for links representing flared approaches to junctions

6.5.2 Free-flow speeds were set according to the following criteria:

- For links with 30mph speed limit set free flow speed to 40kph.
- For links with 20mph speed limit set free flow speed to 30kph.

6.6 Signal Timings

6.6.1 Signal timings from the MRTM were reviewed and adjusted where necessary as part of the model calibration/validation process to ensure that delays were reflected. Signal adjustments were based on observed data gathered from local authorities where available. Other signals were coded using the RTM manual guidance with SATURN signal optimisation where necessary.

6.7 Network Checks / Calibration

6.7.1 The network went through a series of checks as part of the model calibration and validation. Checks were made against aerial photography, and changes made to GAP values and free flow speeds, as well as checks on number of lanes, saturation flows, and link lengths.

7 TRIP MATRIX DEVELOPMENT

7.1 Introduction

7.1.1 This chapter describes the development of the highway demand matrices for the CoSTM. The demand matrices were derived from Highways England's Midlands Regional Traffic Model (MRTM).

7.2 Travel Demand Data

7.2.1 As described in the Appraisal Specification Report (ASR) (document reference HE551486-ACM-GEN-WAL_SW_000_Z-RP-TR-0011), the Highways England Midlands Regional Traffic Model (MRTM) was used as the starting point in the development of the CoSTM with local area enhancements to both the trip matrices and network.

7.2.2 The MRTM Design Freeze 4.3 (DF4.3) “prior” highway assignment trip matrices were used as the starting point for the development of the CoSTM Base Year prior trip matrices. This ensured that the effects of any matrix estimation undertaken as part of the development of the MRTM team were excluded.

7.2.3 The MRTM DF4.3 trip matrices were primarily defined from mobile phone origin-destination (MPOD) data supplied by Telefónica. The matrix Regional Traffic Model (RTM) Technical Consistency Group (TCG) produced an approach to matrix development using MPOD data that was followed by each of the RTMs. The guidance given in that Technical Note formed the basis for the methodology to derive prior trip matrices for the MRTM.

7.2.4 The key data sources used in the development of the MRTM DF4.3 prior matrices included:

- MPOD data collected in March 2015 by the operator Telefónica (subsequently processed to remove LGV, HGV and rail trips from the dataset);
- Trafficmaster origin destination (O-D) data at Lower level Super Output Area (LSOA) resolution, for the periods September 2013 to August 2014 and from March 2015 to August 2015, used for the derivation of LGV matrices;
- the DfT's Base Year Freight Matrices (BYFM), which provide an estimate of daily demand in 2006 at a Local Authority District (LAD) level, with some key special generators separately represented (e.g. ports, airports and key distribution centres);
- MOIRA and National Rail Travel Survey (NRTS) data used to estimate rail demand, both for removal from the MPOD data and to provide Base Year rail demand inputs to the Variable Demand Model (VDM);
- Civil Aviation Authority (CAA) 2014 passenger data and the DfT's National Air Passenger Allocation Model (NAPALM) data to derive airport related demand (not wholly represented in MPOD data, due to higher volumes of 'roaming' phones);
- National Travel Survey (NTS) data, used for the verification of trip rates, trip purposes and trip lengths included in the MPOD data, and as an input to the synthetic matrix build process;

- 2011 Census Journey to Work (JtW) data to provide estimates of origin-destination commuter trips in England, used during the matrix calibration and validation;
- National Trip End Model (NTEM) version 6.2 (NTEM v6.2) data to provide trip-end estimates for comparison with the MPOD data and as an input into the matrix synthesis processes; and
- Business Register and Employment Survey (BRES) data from 2014 used in the derivation of trip end estimates in the matrix synthesis processes.

7.2.5 The processes to derive the prior matrices from these datasets are fully documented in the MRTM Validation Report (MVR).

7.2.6 The process to derive 2018 Base Year CoSTM prior demand matrices involved six stages:

- stage 1 - updates to the 2015 MRTM DF4.3 prior matrices to reflect the refined zone system. This involved both disaggregation and aggregation of model zones;
- stage 2 - uplift of demand from a 2015 Base Year to a 2018 Base Year;
- stage 3 - factoring of demand to observed traffic counts crossing screenlines within the AoDM;
- stage 4 - factoring of local demand to observed traffic counts crossing screenlines within Coventry;
- stage 5 - refinement of local demand using automatic number plate recognition (ANPR) survey data; and
- stage 6 - specific updates to demand to and from the Jaguar Land Rover plant in Gaydon.

7.2.7 These data and methodology used to undertake each of the six stages of prior matrix refinement are discussed in the remainder of this Chapter. Each stage of refinement was applied sequentially, taking the demand from the previous stage as the starting point for analysis.

7.3 Stage 1 - Zone System Refinement

7.3.1 The CoSTM zoning system was developed from MRTM by disaggregating zones in the vicinity of the scheme and aggregating in the hinterland. In both models, the external zones (located within the buffer area of the model) and the special generator zones are identical. Special generator zones represent airports, ports and large factories / distribution centres with significant HGV traffic

7.3.2 GIS layers were used to identify CoSTM zones which were aggregations or disaggregations of MRTM zones.

7.3.3 The principle source of data to distribute trips for disaggregated zones was Census population estimates. Mid-Year 2015 Census usual resident and workplace population data were extracted for each Middle Super Output Area (MSOA), Lower Super Output Area (LSOA), Output Area (OA) and Workplace Zone (WZ) in the areas where zones were disaggregated.

7.3.4 The MRTM, as with the other RTMs, has zone boundaries which align with MSOAs. The refined CoSTM zoning system maintains this alignment of zones to Census geographical area boundaries.

7.3.5 Mid-Year 2015 usual resident and workplace populations were calculated for each MRTM and CoSTM zone. These were used to distribute trips to and from disaggregated zones based on the proportions of population in the disaggregated zone compared to the parent zone. Where zones in the CoSTM were aggregations of the MRTM, demand in the MRTM prior matrices was summed.

7.3.6 To account for the inclusion of specific development sites and associated trips in the Forecast Year models, 20 additional zones were added to the CoSTM trip matrices. These zones are 'empty' in the Base Year matrices with zero trips.

7.3.7 The resulting prior demand matrices have 896 zones, reduced from the 1,547 zones in the MRTM DF4.3 prior trip matrices.

7.4 Stage 2 - Base Year Uplift

7.4.1 The DfT's National Trip End Model (NTEM) dataset, of which version 7.2 (v7.2) is the current version, provides forecasts of population, households, workforce, and jobs at MSOA resolution (and aggregates to authority, county and region) over a period from 2011 to 2051. The current version of NTEM is multi-modal, providing data on trips on foot, by bicycle, motor vehicle (both as a driver and as passenger) by rail and by bus.

7.4.2 Data from NTEM v7.2 were extracted for the East and West Midlands regions for car driver mode for the morning period (07:00 - 09:59), interpeak period (10:00 - 15:59), evening period (16:00 - 18:59) and off-peak period (19:00 - 06:59). The data were extracted using the Trip End Model Presentation programme (TEMPro).

7.4.3 Light goods vehicle (LGV) and heavy goods vehicle (HGV) data are not represented in NTEM. Instead, the Road Traffic Forecasts 2018 (RTF18), derived from the DfT's National Transport Model (NTM) have been interrogated. These provide traffic forecasts by road type, area type and vehicle type in the form of vehicle miles travelled. Data are presented in five-yearly intervals from 2015 to 2050. Scenario 1 of the RTF18 data has been analysed to obtain LGV and HGV growth in the Midlands region.

7.4.4 The MRTM DF4.3 prior demand matrices represent a Base Year of 2015 whilst the CoSTM has a Base Year of 2018. The disaggregated MRTM DF4.3 prior matrices were therefore updated to a 2018 base. As noted in WebTAG Unit M3.1 §8.3.3, matrix estimation should not be used to factor matrices from one year to another.

7.4.5 NTEM v7.2 Car Driver trip end growth was extracted using the TEMPro software for all MSOAs, Local Authorities, Counties and Regions in the Midlands. Growth between 2015 and 2018 for car trip ends in the East and West Midlands is around 1-2%, as shown in Table 4.

Table 4: NTEM v7.2 Car Driver growth (Origin (O) / Destination (D) / Average (Ave)) by Region

Region	AM Period			Interpeak Period			PM Period			Off-Peak Period		
	O	D	Ave	O	D	Ave	O	D	Ave	O	D	Ave
East Midlands	1.0114	1.0114	1.0114	1.0181	1.0181	1.0181	1.0117	1.0117	1.0117	1.0096	1.0096	1.0096
West Midlands	1.0138	1.0138	1.0138	1.0196	1.0196	1.0196	1.0139	1.0139	1.0139	1.0113	1.0113	1.0113

7.4.6 Scenario 1, the central 'reference' scenario, of the NTM RTF18 forecasts was analysed to derive the growth in LGV and HGV traffic miles between 2015 and 2018. Data for the Midlands region were linearly interpolated between 2015 and 2020 to provide numbers for 2018.

7.4.7 Other scenarios exist within the RTF18 forecasts. However, these are used to assess impacts of uncertainty around the key drivers of travel demand (such as GDP) on future traffic growth. Therefore, these scenarios were not used to calculate growth in LGV and HGV traffic.

7.4.8 The interpolation resulted in the following growth between 2015 and 2018 within the Midlands region as presented in Table 5.

Table 5: RTF18 Goods Vehicle Traffic Growth

Region	Vehicle Type	Growth (2015 – 2018)
East Midlands	LGVs	6.37%
	HGVs	-0.07%
West Midlands	LGVs	6.58%
	HGVs	-0.36%

7.4.9 The growth in HGV traffic within the NTM is driven by forecasts of the manufacturing index, produced by the Department for Business, Energy & Industrial Strategy (BEIS), and GDP projections from the Office of Budget Responsibility (OBR). Forecast reductions in productivity has resulted in negative growth in HGV traffic until approximately 2020. Further detail is included in paragraphs 3.24 to 3.26 of the RTF 18 report1.

7.4.10 The DfT's Transport Statistics Great Britain (TSGB) provides summary growth across Great Britain by vehicle type, in the form of vehicle miles travelled.

7.4.11 Table 'TSGB0705 (TRA0104)'2 provides the vehicle miles travelled on all roads by vehicle type in both 2015 and 2018. The growth between 2015 and 2018 is presented in Table 6.

Table 6: Traffic Growth in TSGB0705 (TRA0104)

Vehicle Type	Growth (2015 – 2018)
Cars and Taxis	3%
LGVs	9%
HGVs	2%

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/834773/road-traffic-forecasts-2018.pdf
[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/801188/tra0104.ods

7.4.12 On the basis of the data available from NTEM, RTF18 and TSGB, factors were applied to the disaggregated MRTM DF4.3 prior matrices to uplift to a Base Year of 2018 at the following spatial resolutions:

- For car trips, the average origin and destination trip end growth from NTEM was applied based on growth at a county level for zones within the Midlands region and at a regional level for zones outside of the Midlands; and
- For LGV and HGV trips, the average origin and destination trip end growth from RTF 18 was applied at a regional level.

7.5 Stage 3 - AoDM Demand Factoring

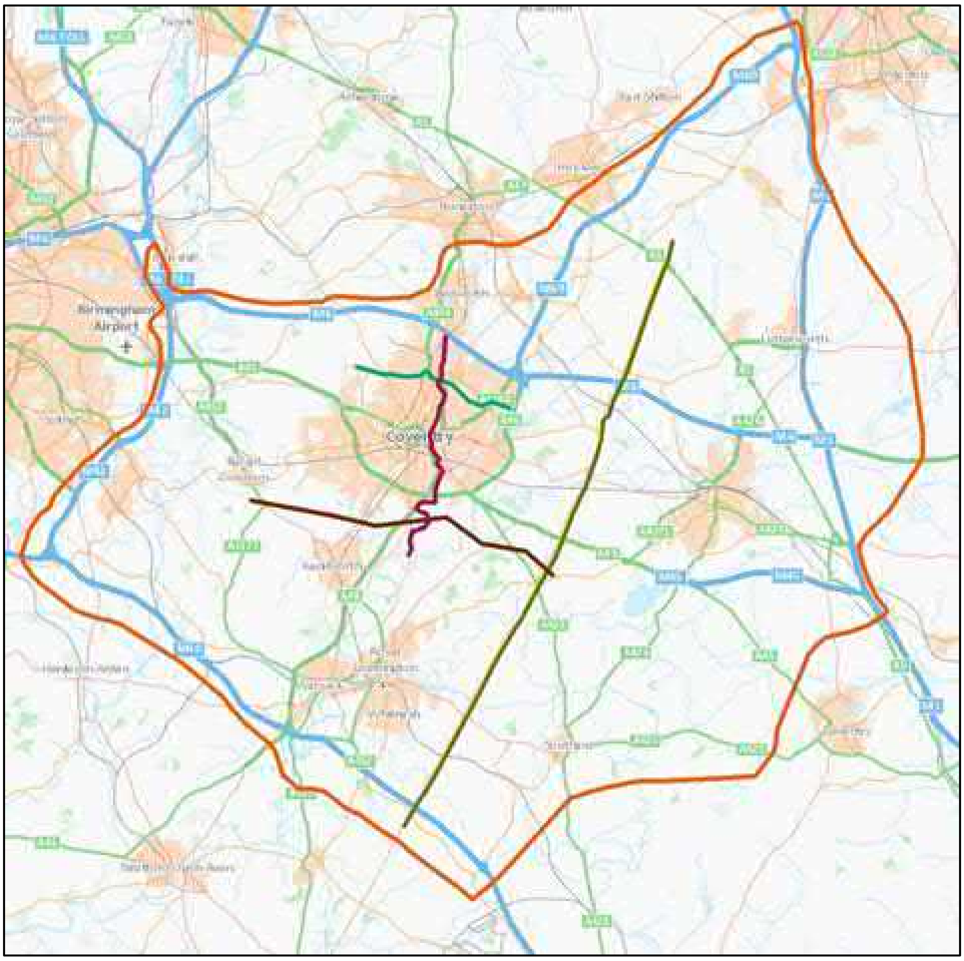
7.5.1 Existing Automatic Traffic Count (ATC) data was obtained from the Highways England web-based Traffic Information System (WebTRIS). Further ATC data was provided by Transport for West Midlands (TfWM), Warwickshire County Council (WCC) and Leicestershire County Council (LCC).

7.5.2 In addition to the existing ATC data, new ATC data was collected within and around Coventry through traffic surveys undertaken by Tracsis (AECOM Technical Note 19: A46 Coventry Junctions – Traffic Data Collection).

7.5.3 In total, there were 272 unique ATC sites for which count data existed for processing covering various months and years. These data were processed to normalise the traffic counts to an average weekday in October 2018.

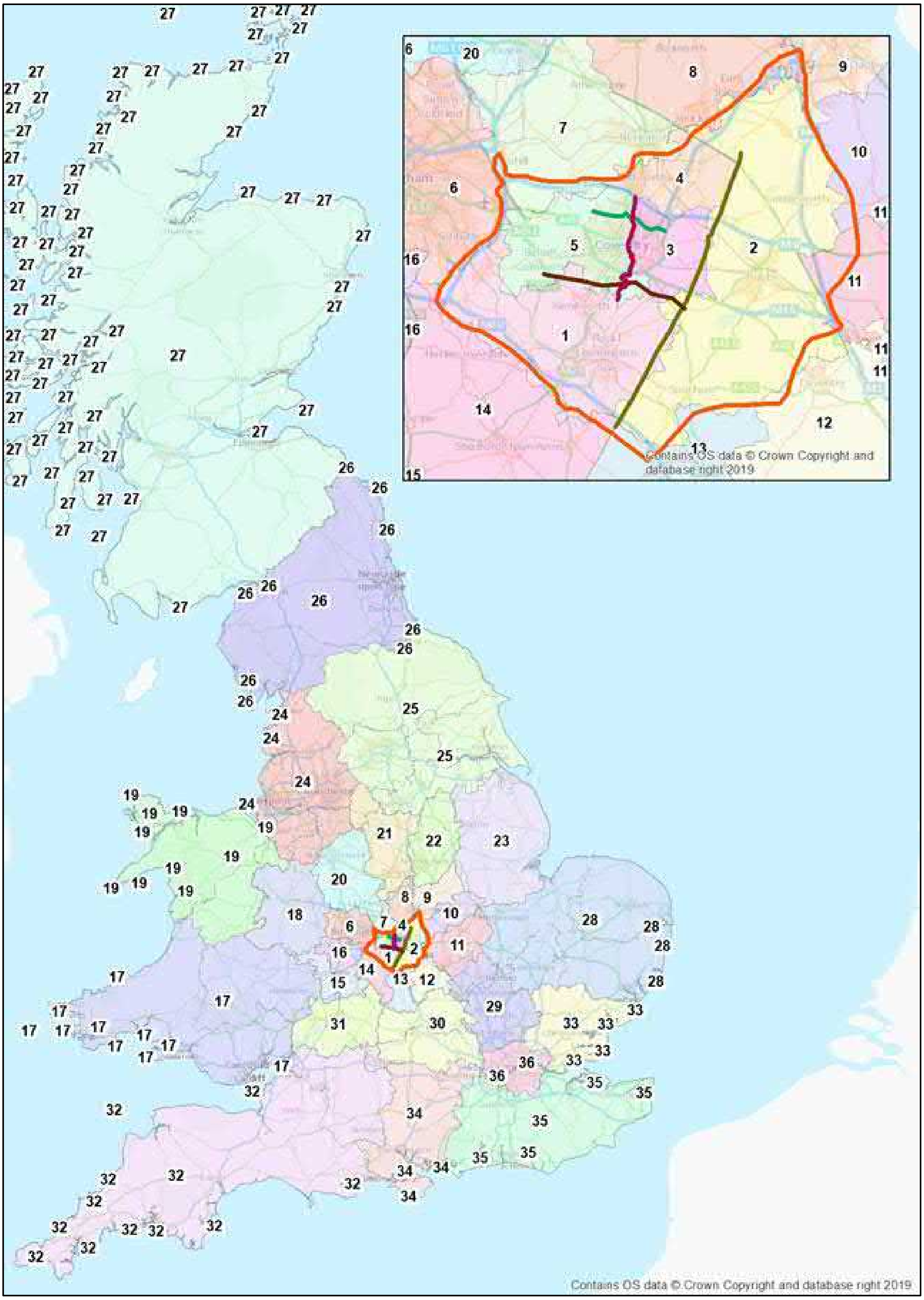
7.5.4 Available ATC data were arranged into four local screenlines and a cordon surrounding the AoDM as presented in Figure 7-1. These match screenlines and cordons used in the calibration of the Base Year CoSTM.

Figure 7-1: AoDM Screenlines



7.5.5 A sector system was defined for the CoSTM based on the location of the screenlines and anticipated routeing through and within the AoDM. This is shown in Figure 7-2.

Figure 7-2: AoDM Screenline Factoring Sectors



7.5.6 The modelled flows were compared to the observed traffic counts on each of the screenlines to generate factors to apply to the demand matrices. These were calculated separately for cars, LGVs and HGVs.

7.5.7 Routeing information was extracted from the traffic assignments and used to identify which screenlines, if any, individual OD movements were crossing. The information on screenline crossings for a movement was used to allocate uplift factors to each OD movement in the matrix as follows:

- Trips within the AoDM and travelling between sectors were uplifted by the factor calculated on the screenline they crossed;
- Trips within the AoDM but within a sector (i.e. not crossing a screenline) were uplifted by a factor calculated across the screenlines which bounded the sector;
- Trips into, out of and travelling through the AoDM were factored by the uplift factor calculated on the cordon surrounding the AoDM; and
- Trips not travelling through the AoDM were not factored.

7.6 Stage 4 - Local Area Update: Screenline Factoring

7.6.1 Existing Automatic Traffic Count (ATC) data was obtained from the Highways England web-based Traffic Information System (WebTRIS). In addition, further ATC data was provided by Transport for West Midlands (TfWM), Warwickshire County Council (WCC) and Leicestershire County Council (LCC).

7.6.2 In addition to the existing ATC data, new ATC data was collected within and around Coventry through traffic surveys undertaken by Tracsis.

7.6.3 In total, there were 272 unique ATC sites for which count data existed for processing covering various months and years. These data were processed to normalise the traffic counts to an average weekday in October 2018.

7.6.4 Available ATC data were arranged into two screenlines as follows:

- A North / South screenline - screenline 1 - shown in mauve in Figure 7-3; and
- An East / West screenline - screenline 2 - shown in green in Figure 7-3.

7.6.5 These screenlines divided Coventry into four sectors - East (1), North East (2), North West (3) and West (4) - and covered travel between these sectors.

7.6.6 Figure 7-3 shows the locations of the screenlines and sectors spatially whilst Table 7 outlines the number of count sites on each screenline (of which all are ATCs). It should be noted that screenline 2 crosses the A4082 where no count site exists in either the existing dataset or newly surveyed data. For the purposes of the screenline update, the factoring of demand has not considered traffic flow on this road.

Figure 7-3: Coventry Screenline Factoring Sectors

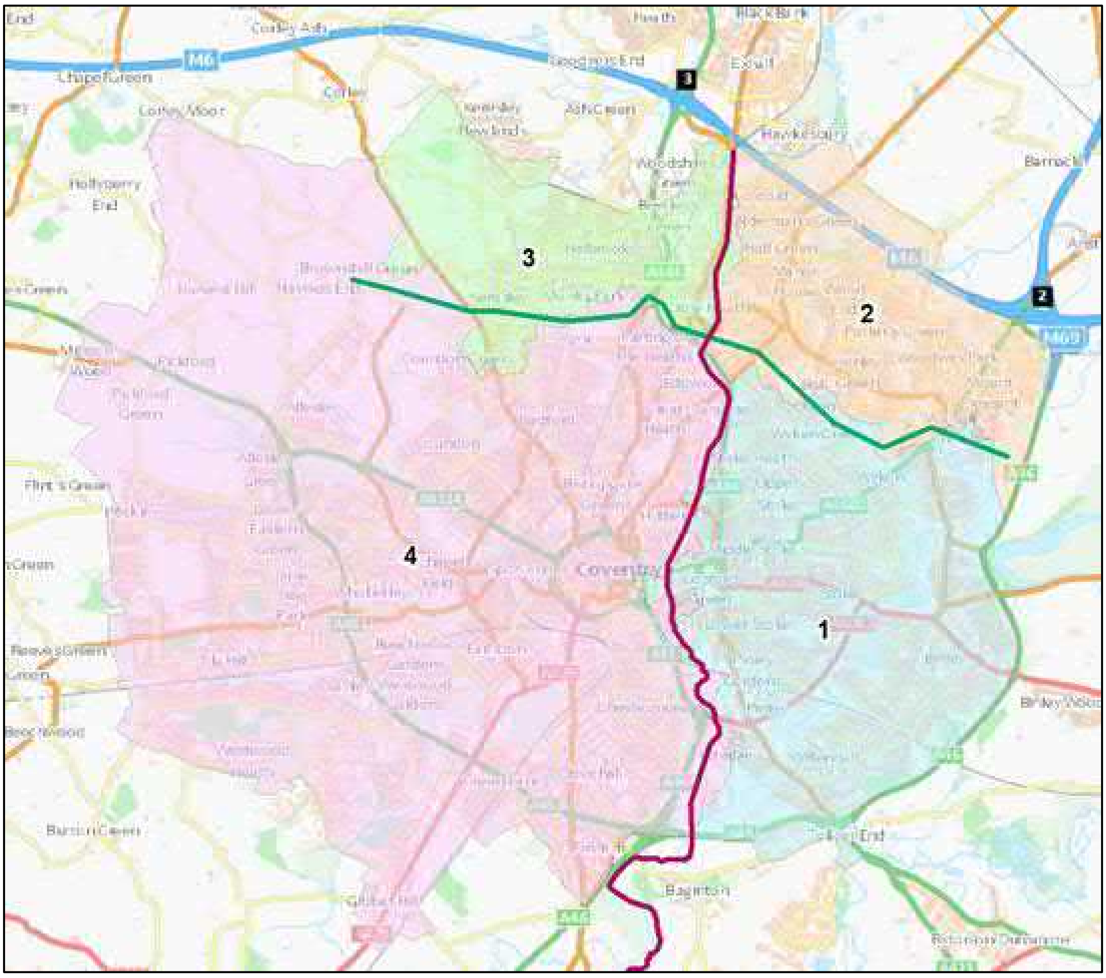


Table 7: ATC Sites per Screenline

Screenline	Number of ATC Sites
1 – North / South (Pink)	16
2 – East / West (Green)	12

7.6.7 The modelled flows were compared to the observed traffic counts on each of the screenlines to derive factors to apply to the demand matrices. These were calculated separately for cars, LGVs and HGVs.

7.6.8 Routeing information was extracted from the traffic assignments and used to identify which screenlines, if any, individual OD movements were crossing. Uplift factors were applied to movements based on the screenlines that they crossed.

7.6.9 The uplift was only applied to trips within Coventry. During development of the MRTM, demand within Coventry was synthesised using a gravity model. The synthetic demand replaced the observed trips in the MPOD data due to the unreliability of recording mobile phone movements across short distances. Therefore, it is only these trips which are considered less reliable in the MRTM prior matrices whilst longer distance trips to, from and through Coventry should be more reliable.

7.7 Stage 5 - Local Area Update: ANPR Factoring

7.7.1 Automatic Number Plate Recognition (ANPR) surveys were conducted by Tracsis on 26 February 2019. ANPR cameras were positioned at the five locations (in both directions of travel) shown in Figure 7-4, creating a watertight cordon around the scheme location.

Figure 7-4: ANPR Survey Sites

7.7.2 The number plate records collected during the survey period were processed into Origin-Destination (OD) trip matrices between ANPR cameras, classified by vehicle class and time of day. The ANPR OD trip matrices were used to refine estimates of travel in the prior trip matrices through the scheme area. These refinements were made to both local and strategic traffic movements.

7.7.3 AM (07:00 to 09:00), Interpeak (09:00 to 16:00) and PM (16:00 to 18:00) average hour ANPR OD matrices were extracted from the processed survey data. Trips were extracted for camera-to-camera movements for cars; LGVs; and HGVs.

7.7.4 The observed camera-to-camera demand was compared to the modelled demand on the same movements. Correction factors, to make the model demand equal the observed, were calculated and applied to the demand matrices resulting from factoring to the screenline counts within Coventry.

7.7.5 The correction factors were only applied to the demand which passed through the ANPR cordon. These trips were identified by examining the routeing within the traffic model to extract OD movements which traversed a link where an ANPR camera was located during the survey period.

7.8 Step 6 - Jaguar Land Rover (JLR) Gaydon Plant Seeding

7.8.1 Analysis of the assignments of the prior trip matrices following the application of ANPR factors revealed an underrepresentation of traffic flow on the M40 between Junctions 12 and 15 compared to observed traffic count data extracted from WebTRIS. Further analysis showed that this was related to traffic entering and leaving the zone representing the Jaguar Land Rover (JLR) factory located in Gaydon.

7.8.2 Investigation of the demand matrices revealed that this was due to an underestimation of demand in the initial MRTM prior matrices.

7.8.3 To derive factors to add additional demand at the JLR Gaydon plant, modelled flows were compared to observed traffic counts. These observed counts were obtained from ATC's via WebTRIS on the M40 J12 on- and off-slips, as well as ATC data collected by Tracsis on the B4100.

7.8.4 Factors were calculated based on observed traffic count data and modelled traffic flows at the three count sites. The factors were calculated separately by time period and direction to reflect the tidal nature of the demand due to the shift patterns in operation at the factory. To uplift the demand at the JLR Gaydon plant zone, various select link analyses (SLAs) were undertaken at the locations of the observed traffic count sites. These SLAs identified the trips in the model passing through the count sites. The correction factors calculated from the count data were applied to the trips identified by the SLAs.

7.9 Summary

7.9.1 The MRTM DF4.3 2015 Base Year prior trip matrices were refined to produce CoSTM 2018 Base Year prior matrices. Six stages of matrix refinement were undertaken as follows:

- Refinement of the zoning system to reflect the updated zones in the CoSTM;

- Uplift of the 2015 demand to a 2018 Base Year using data from NTEM v7.2, RFT18 and TSGB;
- Factoring of trips within the AoDM to ATC data;
- Enhancement of local trips with Coventry, factoring demand to ATC data;
- Enhancement of local trips along the scheme corridor, factoring demand to newly collected ANPR survey data; and
- Improvements to the demand to and from the Jaguar Land Rover plant in Gaydon.

7.9.2 The total demand by user class in the 2015 MRTM prior matrices and the 2018 CoSTM prior matrices are shown in Table 8 and Table 9 respectively. The change in demand between MRTM and CoSTM is summarised in Table 10.

7.9.3 Table 10 shows that the CoSTM prior matrices contain around 5% more trips than the MRTM prior matrices. Car and LGV user classes show increases in trips between the MRTM and CoSTM prior trip matrices, whilst HGV trips exhibit a decrease in line with RTF 18 forecasts.

Table 8: MRTM 2015 Prior Matrix Totals

	User Class Totals					Matrix Total
	UC1 (Car, EB)	UC2 (Car, HBW)	UC3 (Car, Other)	UC4 (LGV)	UC5 (HGV)	
AM	326,048	2,198,865	2,263,074	645,554	303,145	5,736,686
IP	270,245	504,850	3,197,867	594,161	289,944	4,857,067
PM	332,404	1,891,084	3,284,452	582,996	208,535	6,299,471

Table 9: CoSTM 2018 Prior Matrix Totals

	User Class Totals					Matrix Total
	UC1 (Car, EB)	UC2 (Car, HBW)	UC3 (Car, Other)	UC4 (LGV)	UC5 (HGV)	
AM	344,685	2,327,458	2,397,754	694,098	295,112	6,059,107
IP	281,424	527,020	3,337,067	638,659	286,383	5,070,553
PM	348,857	1,984,886	3,449,332	628,648	205,179	6,616,902

Table 10: Percentage Changes Between MRTM and CoSTM Prior Matrix Totals

	Percentage Change					Matrix Total
	UC1 (Car, EB)	UC2 (Car, HBW)	UC3 (Car, Other)	UC4 (LGV)	UC5 (HGV)	
AM	5.72%	5.85%	5.95%	7.52%	-2.65%	5.62%
IP	4.14%	4.39%	4.35%	7.49%	-1.23%	4.40%
PM	4.95%	4.96%	5.02%	7.83%	-1.61%	5.04%

7.9.4 Table 11 shows the performance of the prior matrix traffic assignment against observed count data at a total screenline level.

7.9.5 The ‘initial’ modelled flow is taken from an assignment of prior matrix demand after the first stage of matrix refinement to aggregate and disaggregate trips from the MRTM zones to the CoSTM zones (i.e. only the matrix edits applied in stage 1 as described in section 7.3). This is reflective of the performance of the initial MRTM prior demand in the CoSTM. There are large differences between the modelled and observed flows for all user classes.

7.9.6 The ‘final’ modelled flow is taken from an assignment of the final prior matrix after applying the uplift to demand at the JLR plant in Gaydon (i.e. after applying all matrix updates described in sections 7.4 to 7.8). The modelled flow is now much closer to the observed traffic counts across all time periods showing that the matrix refinements have improved the representation of demand in the CoSTM. Therefore, the updated prior matrix is considered a suitable base for calibration of the trip matrices as described in Chapter 8.

Table 11: Performance of Initial and Final Prior Matrices

		Car				
		Observed Vehicles	**Initial Modelled Vehicles**	**Percentage Difference**	**Final Modelled Vehicles**	**Percentage Difference**
AM	**Calibration SL/cordons**	199,012	145,022	-27%	194,237	-2%
	Validation SL	67,524	48,492	-28%	67,795	0%
IP	**Calibration SL/cordons**	141,736	117,379	-17%	139,999	-1%
	Validation SL	51,054	37,737	-26%	47,894	-6%
PM	**Calibration SL/cordons**	216,029	164,986	-24%	209,225	-3%
	Validation SL	74,323	53,308	-28%	73,623	-1%
		LGV				
		Observed Vehicles	**Initial Modelled Vehicles**	**Percentage Difference**	**Final Modelled Vehicles**	**Percentage Difference**
AM	**Calibration SL/cordons**	30,120	25,395	-16%	28,772	-4%
	Validation SL	9,289	7,282	-22%	8,584	-8%

IP	**Calibration SL/cordons**	27,952	23,618	-16%	27,527	-2%
	Validation SL	9,037	6,719	-26%	8,327	-8%
PM	**Calibration SL/cordons**	25,991	21,406	-18%	25,507	-2%
	Validation SL	7,615	5,981	-21%	7,599	0%
		HGV				
		Observed Vehicles	**Initial Modelled Vehicles**	**Percentage Difference**	**Final Modelled Vehicles**	**Percentage Difference**
AM	**Calibration SL/cordons**	16,241	22,144	36%	18,436	14%
	Validation SL	4,362	5,852	34%	4,845	11%
IP	**Calibration SL/cordons**	19,333	22,183	15%	20,873	8%
	Validation SL	5,152	5,724	11%	5,567	8%
PM	**Calibration SL/cordons**	12,035	15,167	26%	13,592	13%
	Validation SL	2,928	3,746	28%	3,426	17%

8 TRIP MATRIX CALIBRATION

8.1 Introduction

8.1.1 Model calibration is the iterative process of reviewing and adjusting the model's network or trip matrices so that modelled traffic flows, speeds, junction delays and routeings through the network provide a reliable match to observed data.

8.1.2 This Chapter describes the calibration of the trip matrices for CoSTM using Matrix Estimation. This is a process that adjusts the travel pattern for compatibility with the observed traffic counts to produce a matrix which 'best fits' the observed counts.

8.1.3 Matrix Estimation (ME) was undertaken within SATURN, in order to improve the prior matrix using observed traffic counts.

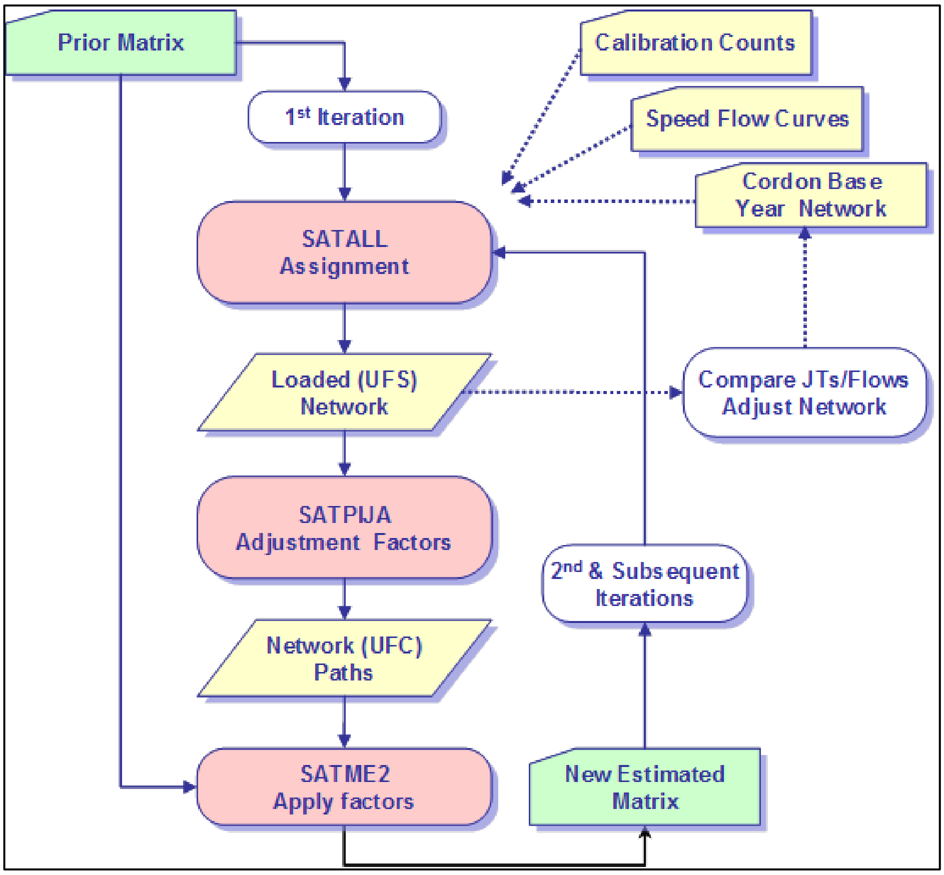
8.1.4 The matrix estimation procedure within SATURN is an iterative process that optimises on the best solution for the calibration counts and network. It uses an objective function, which it seeks to minimise in order to find an optimal solution that improves the goodness of fit between the modelled flows and counts.

8.1.5 The matrix of trips input to matrix estimation is known as the 'prior' matrix and the matrix of trips output from matrix estimation is termed the 'post' matrix. The post matrix will therefore contain a better representation of the individual trip movements on counted links, compared to the prior matrix.

8.2 Matrix Estimation Procedure

8.2.1 The ME process was carried out using the SATPIJA and SATME2 modules of the SATURN modelling software after network checks had been carried out. Trips between Origin/Destination pairs in the prior matrices are adjusted to improve the match between observed and modelled flows. The ME process is shown in the flow chart in Figure 8-1.

Figure 8-1: SATURN's Matrix Estimation Process



8.2.2 The ME procedure is a mathematical process with no behavioural basis and relies on assignments to refine the matrices. TAG guidance on the application of matrix estimation set out in section 8.3 of TAG Unit M3.1 advises that the changes brought about by matrix estimation should not be significant.

8.3 Matrix Estimation Checks

8.3.1 The validity of the matrix estimation process comprises two main checks:

i. An analysis of the changes to the prior matrix resulting from the matrix estimation process

ii. An analysis of the prior and post ME trips totals across the screenlines and cordons used in applying count constraints in the matrix estimation process

8.3.2 The changes between the prior and post ME trip matrices were assessed using the criteria set out in section 8.3.13 of TAG Unit M3.1. This comprises:

- Matrix zonal cell values, prior to and post matrix estimation, with regression statistics (slopes, intercepts and R^2 values);

- Zonal trip ends, prior to and post matrix estimation, with regression statistics (slopes, intercepts and R^2 values);
- Trip length distributions, prior to and post matrix estimation, with means and standard deviations.

8.3.3 The criteria by which the significance of the changes brought about by matrix estimation may be judged as set out in section 8.3.13 of TAG Unit M3.1 are presented in Table 12.

Table 12: TAG criteria for pre and post matrix estimation

Measure	Significance Criteria
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zonal trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%

8.3.4 The pre and post ME matrix totals for the AM, Inter-Peak and PM Peak are presented in Table 13 and Table 14 with the differences between the two matrices presented in Table 15.

Table 13: Prior Matrix Totals (PCUs)

	User Class Totals					Matrix Total
	UC1 (Car, EB)	UC2 (Car, HBW)	UC3 (Car, Other)	UC4 (LGV)	UC5 (HGV)	
AM	344,685	2,327,458	2,397,753	694,098	295,112	6,059,106
IP	281,424	527,020	3,337,067	638,659	286,383	5,070,553
PM	348,857	1,984,886	3,449,332	628,648	205,179	6,616,901

Table 14: Post ME Matrix Totals (PCUs)

	User Class Totals					Matrix Total
	UC1 (Car, EB)	UC2 (Car, HBW)	UC3 (Car, Other)	UC4 (LGV)	UC5 (HGV)	
AM	345,432	2,324,059	2,396,483	694,396	294,591	6,054,961
IP	281,893	527,434	3,337,416	638,937	286,678	5,072,357
PM	349,873	1,984,600	3,448,514	628,625	204,687	6,616,299

Table 15: Percentage Change between Prior and Estimated Matrix Totals

	Percentage Change					Matrix Total
	UC1 (Car, EB)	UC2 (Car, HBW)	UC3 (Car, Other)	UC4 (LGV)	UC5 (HGV)	
AM	0.2%	-0.1%	-0.1%	0.0%	-0.2%	-0.07%
IP	0.2%	0.1%	0.0%	0.0%	0.1%	0.04%
PM	0.3%	0.0%	0.0%	0.0%	-0.2%	-0.01%

8.3.5 Table 15 demonstrates that **Error! Reference source not found.**the matrix totals have not been significantly affected by the Matrix Estimation process. Overall changes are no greater than 0.3% for individual user classes within the AM, IP and PM peak models respectively.

8.3.6 To further demonstrate that the changes to the matrices generated by the ME process are not too severe, the correlation between the values in the prior and estimated matrices has been calculated. The results of this analysis of the change in matrix zonal cell values and zonal trip ends against the TAG stability criteria set out in Table 12 are presented in Table 16 to Table 18.

Table 16: TAG Tests for Change In Matrix Zonal Totals – Full Matrix

	Zonal Cell Values		Zonal Origins		Zonal Destinations	
	Target	Achieved	*Target*	Achieved	Target	Achieved
AM Peak						
Intercept	*Near zero*	-0.001	*Near zero*	-1.014	*Near zero*	-3.939
Slope	*0.98 to 1.02*	1.000	*0.99 to 1.01*	1.000	*0.99 to 1.01*	1.000
R squared	*> 0.95*	1.0000	*> 0.98*	1.0000	*> 0.98*	1.0000
Inter-Peak						
Intercept	*Near zero*	0.000	*Near zero*	0.388	*Near zero*	2.485
Slope	*0.98 to 1.02*	1.000	*0.99 to 1.01*	1.000	*0.99 to 1.01*	1.000
R squared	*> 0.95*	1.0000	*> 0.98*	1.0000	*> 0.98*	1.0000
PM Peak						
Intercept	*Near zero*	0.000	*Near zero*	-0.163	*Near zero*	-0.677
Slope	*0.98 to 1.02*	1.000	*0.99 to 1.01*	1.000	*0.99 to 1.01*	1.000
R squared	*> 0.95*	1.0000	*> 0.98*	1.0000	*> 0.98*	1.0000

Table 17: TAG Tests for Change In Matrix Zonal Totals – FMA

	Zonal Cell Values		Zonal Origins		Zonal Destinations	
	Target	Achieved	*Target*	Achieved	Target	Achieved
AM Peak						
Intercept	*Near zero*	0.000	*Near zero*	1.571	*Near zero*	1.815
Slope	*0.98 to 1.02*	0.996	*0.99 to 1.01*	0.987	*0.99 to 1.01*	0.993
R squared	*> 0.95*	0.9911	*> 0.98*	0.9950	*> 0.98*	0.9928
Inter-Peak						
Intercept	*Near zero*	0.001	*Near zero*	1.578	*Near zero*	6.621
Slope	*0.98 to 1.02*	0.998	*0.99 to 1.01*	0.993	*0.99 to 1.01*	0.994
R squared	*> 0.95*	0.9967	*> 0.98*	0.9970	*> 0.98*	0.9960
PM Peak						
Intercept	*Near zero*	0.000	*Near zero*	1.630	*Near zero*	5.696
Slope	*0.98 to 1.02*	0.997	*0.99 to 1.01*	0.990	*0.99 to 1.01*	0.992
R squared	*> 0.95*	0.9931	*> 0.98*	0.9947	*> 0.98*	0.9945

Table 18: TAG Tests for Change In Matrix Zonal Totals – AoDM

	Zonal Cell Values		Zonal Origins		Zonal Destinations	
	Target	Achieved	*Target*	Achieved	Target	Achieved
AM Peak						
Intercept	*Near zero*	0.009	*Near zero*	3.092	*Near zero*	35.587
Slope	*0.98 to 1.02*	0.934	*0.99 to 1.01*	0.925	*0.99 to 1.01*	0.865
R squared	*> 0.95*	0.8523	*> 0.98*	0.9315	*> 0.98*	0.9420
Inter-Peak						
Intercept	*Near zero*	0.012	*Near zero*	3.165	*Near zero*	15.860
Slope	*0.98 to 1.02*	0.976	*0.99 to 1.01*	0.977	*0.99 to 1.01*	0.977
R squared	*> 0.95*	0.9300	*> 0.98*	0.9650	*> 0.98*	0.9463
PM Peak						
Intercept	*Near zero*	0.006	*Near zero*	4.439	*Near zero*	8.210
Slope	*0.98 to 1.02*	0.973	*0.99 to 1.01*	0.935	*0.99 to 1.01*	0.971
R squared	*> 0.95*	0.8927	*> 0.98*	0.9567	*> 0.98*	0.9302

8.3.7 Table 16 shows that across the entire matrix the TAG criteria have been met or exceeded for all 3 time periods. Table 17 shows that when comparing the effects on trips only between zones in the Fully Modelled Area (FMA) the TAG criteria have been met in almost all respects – the slope value for the AM Peak origins is outside the required range, and the slope value for the PM Peak origins may also be outside the required range (depending on whether it was rounded up or down). The impacts of ME are more significant within the Area of Detailed Modelling (AoDM), Table 18 showing that only the intercept criteria are met (the largest absolute values for the intercepts are less than 1% of the maximum plotted value). The AM and PM Peaks in particular show slope values that deviate significantly from the WebTAG criteria. The results for all three time periods at all scales are also shown in a series of plots in Appendix A.

8.3.8 Throughout the Matrix Estimation the modelled changes to the trip length distribution (TLD) were monitored to check that the characteristics of the prior matrices were not distorted by the ME process.

8.3.9 TLD analysis was undertaken both pre- and post-ME and the resulting distribution for each vehicle group plotted.

8.3.10 Plots showing the TLD analysis for all time periods are presented in Appendix B. These show that in all cases the overall relationships between trip movements and distances travelled post-ME are similar to the pre-ME analysis and within an acceptable level of variation.

8.3.11 The mean distance travelled was also estimated based on the assumption that trips falling between n*5 km and (n+1)*5 km have a mean distance of n*5+2.5 km for 0≤n<40, while trips of over 200km were assumed to have a mean distance of 250km. The resultant data are shown below in Table 19 to Table 21. Consequently, no attempt has been made to calculate the standard deviation of the trip lengths (the impact of the trip length assumptions for over 200km is particularly significant for HGVs, for which this trip band constitutes between 10% and 15% of the total demand in all time periods both pre- and post-ME).

Table 19: Changes in Estimated Mean Trip Length (km) as a result of Calibration by Vehicle Class – AM Peak

	Cars	LGVs	HGVs	All Vehs
Prior Mean Trip Length	47.411	54.217	96.751	51.623
Post Mean Trip Length	47.670	54.330	94.986	51.720
Change	0.5%	0.2%	-1.8%	0.2%

Table 20: Changes in Estimated Mean Trip Length (km) as a result of Calibration by Vehicle Class – Interpeak

	Cars	LGVs	HGVs	All Vehs
Prior Mean Trip Length	46.585	53.896	98.606	47.614
Post Mean Trip Length	46.714	54.033	97.540	47.745
Change	0.3%	0.3%	-1.1%	0.3%

Table 21: Changes in Estimated Mean Trip Length (km) as a result of Calibration by Vehicle Class – PM Peak

	Cars	LGVs	HGVs	All Vehs
Prior Mean Trip Length	46.113	53.025	102.752	46.757
Post Mean Trip Length	46.315	53.171	102.208	46.953
Change	0.4%	0.3%	-0.5%	0.4%

8.3.12 The above changes in the mean trip lengths fall within the 5% as set out in TAG (refer to Table 12) for all vehicle classes and for all time periods.

8.4 Screenline and Count Comparisons

8.4.1 A comparison between modelled and observed flows, following the application of the ME process was carried out for the screenlines and cordons described in section 5.3. These are illustrated in Figure 8-2 that shows all of the screenlines and cordons and Figure 8-3 that shows the detail in and around Coventry.

Figure 8-2: Location of Screenlines

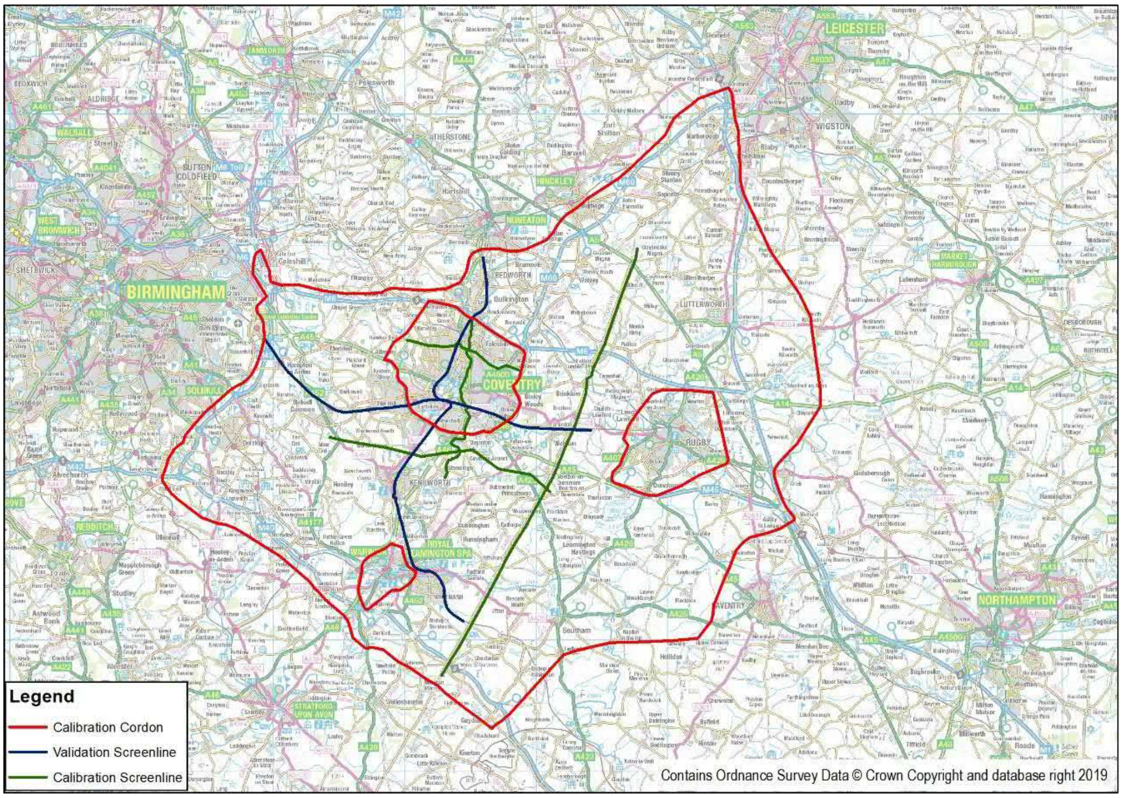
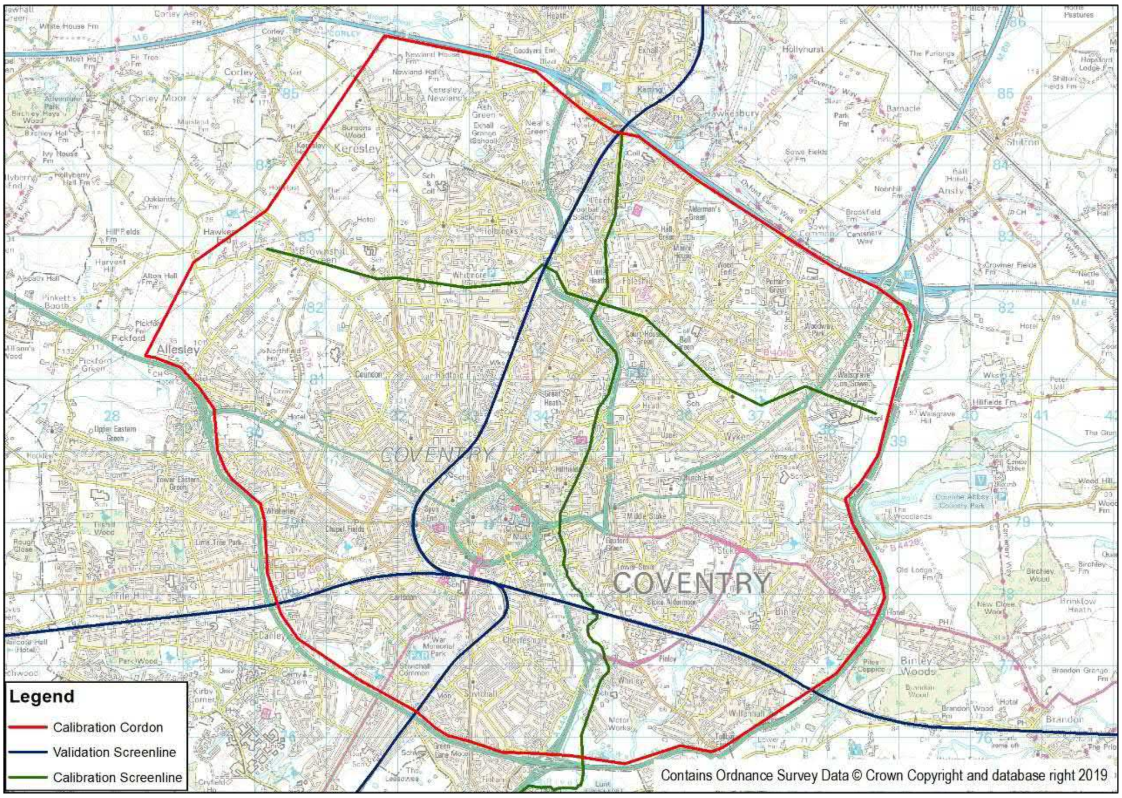


Figure 8-3: Location of Screenlines in the Vicinity of Coventry



8.4.2 The initial intention was for count data from each cordon and four of the six screenlines to be used for the calibration process. Data from the remaining two screenlines would be used for validation i.e. to provide independent count data not used within the calibration process. The screenlines initially intended for validation are shown in Figure 8-2 and Figure 8-3 above.

8.4.3 However, the results from the two validation screenlines failed to meet the TAG validation criteria. This is shown in Table 22 below with the equivalent calibration results shown in Table 23. Both for All Vehicles and for Cars there were no time periods within which more than 70% of the validation counts passed, and the results are significantly below the WebTAG requirements for an 85% pass rate. Validation counts performing to this level casts significant doubt on the overall fitness of the resultant matrices. It was therefore agreed that data from these two screenlines would be used for the model calibration to enhance the overall quality of the matrix.

Table 22: Count Site Validation Results from final ME Run with Validation Screenlines

Time Period	Measure	Number of Counts	Cars		LGVs		HGVs		All Vehicles	
			Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing
AM	Flow	100	61	61%	99	99%	99	99%	61	61%
	GEH	100	54	54%	90	90%	97	97%	54	54%
	Either	100	66	66%	100	100%	99	99%	62	62%
IP	Flow	100	65	65%	98	98%	99	99%	67	67%
	GEH	100	56	56%	94	94%	98	98%	56	56%
	Either	100	68	68%	99	99%	99	99%	68	68%
PM	Flow	100	55	55%	100	100%	99	99%	55	55%
	GEH	100	46	46%	95	95%	96	96%	50	50%
	Either	100	57	57%	100	100%	99	99%	59	59%

Table 23: Count Site Calibration Results from final ME Run with Validation Screenlines

Time Period	Measure	Number of Counts	Cars		LGVs		HGVs		All Vehicles	
			Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing
AM	Flow	287	269	94%	287	100%	287	100%	266	93%
	GEH	287	261	91%	285	99%	284	99%	262	91%
	Either	287	271	94%	287	100%	287	100%	270	94%
IP	Flow	287	282	98%	287	100%	287	100%	282	98%
	GEH	287	273	95%	284	99%	287	100%	274	95%
	Either	287	282	98%	287	100%	287	100%	282	98%
PM	Flow	287	273	95%	287	100%	287	100%	270	94%
	GEH	287	264	92%	282	98%	285	99%	263	92%
	Either	287	274	95%	287	100%	287	100%	272	95%

8.4.4 It is acknowledged that although the absence of independent data for model validation is not ideal, the utilisation of all available count data within the ME process will ultimately result in a more reliable match with observed data thereby ensuring a more robust model.

8.4.5 With reference to Table 1 in section 3.2.5 of TAG Unit M3.1 the TAG acceptability criteria for screenlines and cordons is that the total modelled flows are within 5% of the observed for all or nearly all.

8.4.6 Figure 8-4 to Figure 8-9 show both the pre and post calibration screenline and cordon results for all vehicles combined.

Figure 8-4: AM Screenline / Cordon Calibration All Vehicle Results (Pre ME)

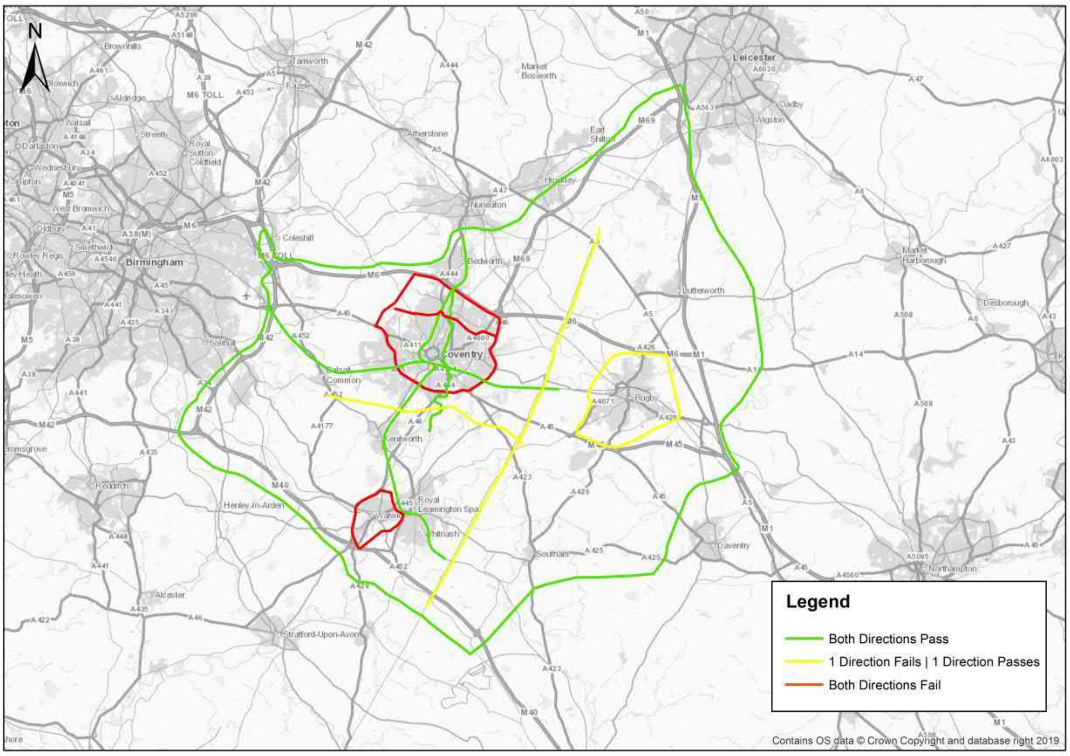


Figure 8-5: AM Screenline / Cordon Calibration All Vehicle Results (Post ME)

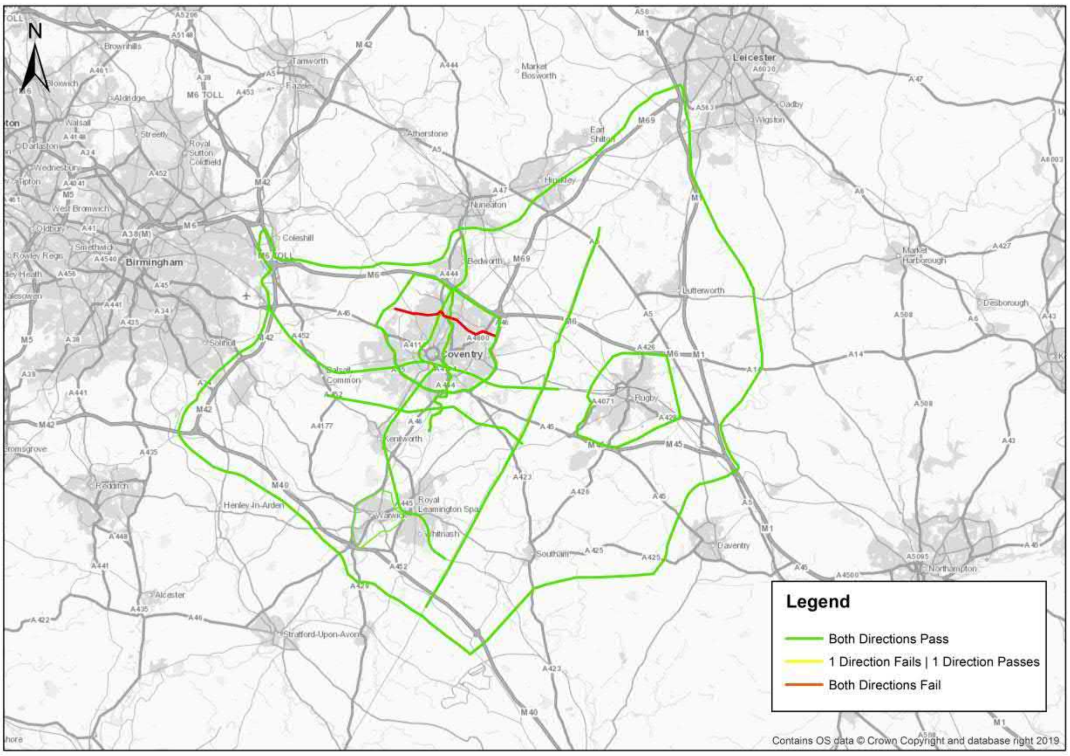


Figure 8-6: IP Screenline / Cordon Calibration All Vehicle Results (Pre ME)

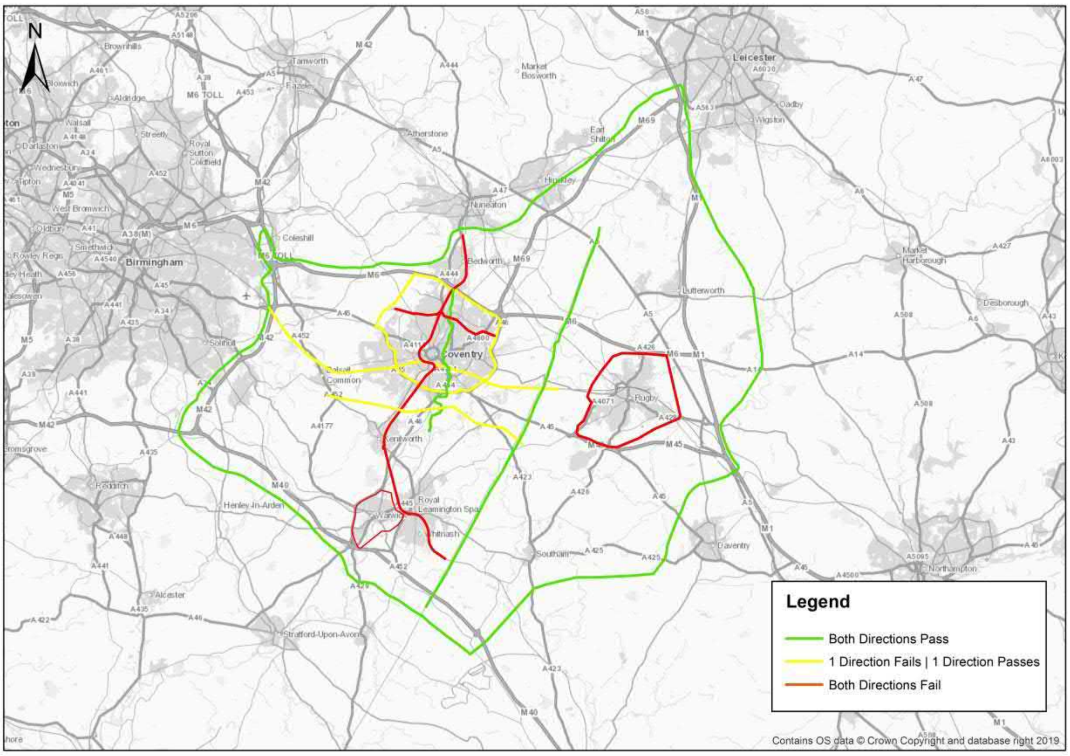


Figure 8-7: IP Screenline / Cordon Calibration All Vehicle Results (Post ME)

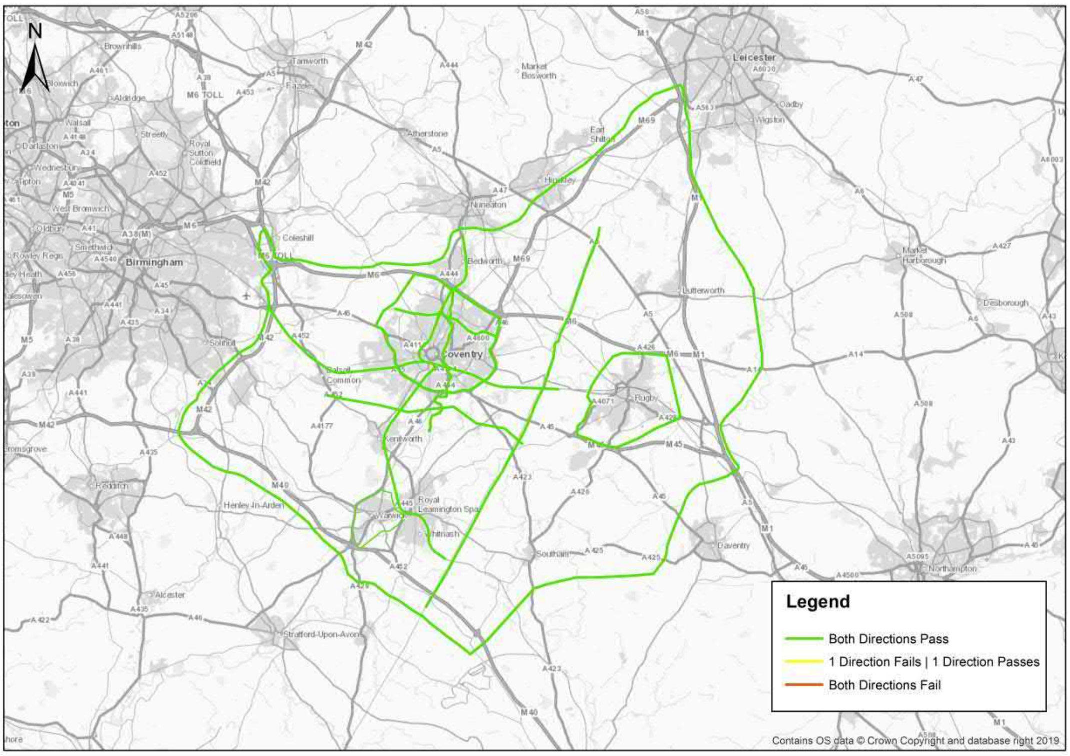


Figure 8-8: PM Screenline / Cordon Calibration All Vehicle Results (Pre ME)

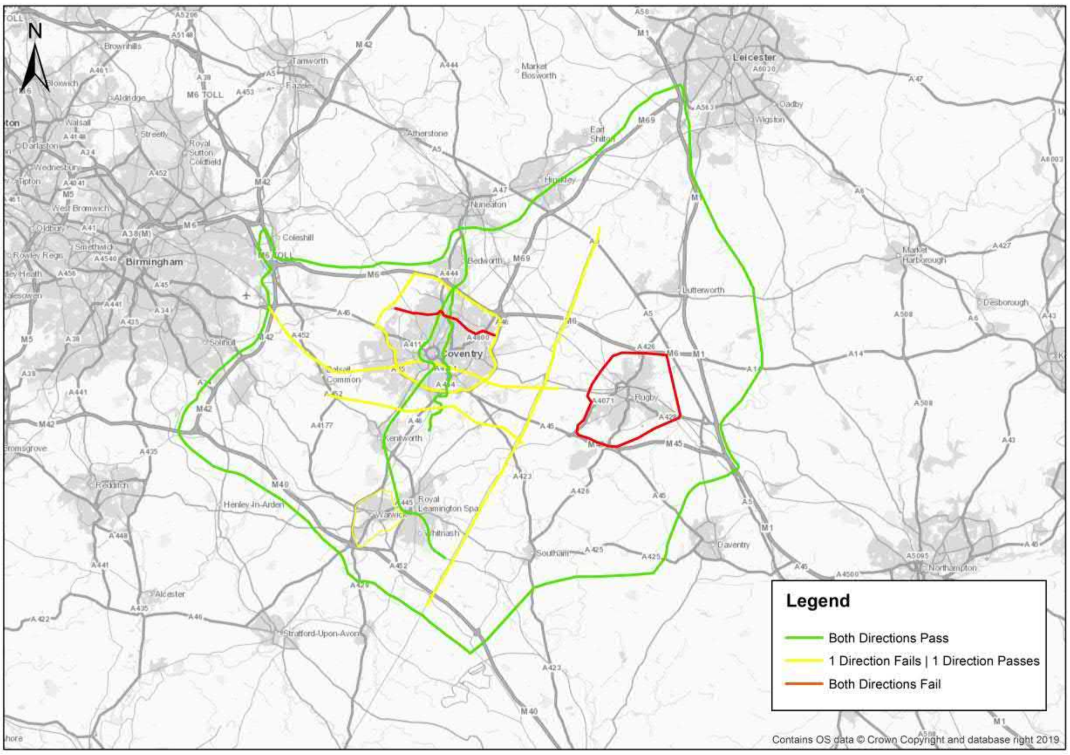


Figure 8-9: PM Screenline / Cordon Calibration All Vehicle Results (Post ME)

8.4.7 Table 24 shows the number of screenlines passing this criterion for the prior matrices i.e. pre-matrix estimation while Table 25 presents the results for the post-ME matrices.

8.4.8 Table 24 and Table 25 show that application of the ME process results in a significant improvement in the match between modelled and observed data. The post-ME results are very good for cars, LGVs and for all vehicles combined. While the HGV's do not meet the validation criteria, it should be noted that for many of the screenines and cordons the expected HGV volumes are low. Screenlines/cordons with low volumes are widely recognised to be very difficult to validate as small differences in flows can result in relatively large percentage differences.

Table 24: Screenline Flow Results for the Prior Matrices

Time Period	Number of Screenlines	Cars		LGVs		HGVs		All Vehicles	
		Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing
AM	20	10	50%	7	35%	1	5%	12	60%
IP	20	8	40%	8	40%	2	10%	9	45%
PM	20	10	50%	7	35%	5	25%	11	55%

Table 25: Screenline Flow Results Post-ME

Time Period	Number of Screenlines	Cars		LGVs		HGVs		All Vehicles	
		Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing
AM	20	19	95%	18	90%	8	40%	18	90%
IP	20	20	100%	20	100%	16	80%	20	100%
PM	20	19	95%	17	85%	14	70%	19	95%

8.4.9 A further validation test was carried out by comparing modelled flows against observed data at individual sites. In addition to the counts on the cordons/screenlines analysed above, four counts on the A46 were obtained. This meant that the calibration process used counts on the A46 in both directions between Walsgrave and Binley, north of Walsgrave and south of Binley.

8.4.10 In total 391 separate counts were used for calibration (11 of which appeared on two separate screenlines/cordons and which were only counted once in the final totals)[3]. The extent to which the post-ME modelled flows conformed to the WebTAG criteria for these sites is presented in Table 26.

[3] The four additional A46 sites were added to the set of counts after the decision had been made to use all counts for calibration, hence they do not appear in either Table 22 or Table 23 above.

Table 26: Count Site Calibration Results

Time Period	Measure	Number of Counts	Cars		LGVs		HGVs		All Vehicles	
			Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing	Number Passing	%age Passing
AM	Flow	391	372	95%	391	100%	391	100%	370	95%
	GEH	391	361	92%	386	99%	389	99%	362	93%
	Either	391	372	95%	391	100%	391	100%	371	95%
IP	Flow	391	387	99%	391	100%	391	100%	387	99%
	GEH	391	376	96%	386	99%	391	100%	377	96%
	Either	391	387	99%	391	100%	391	100%	387	99%
PM	Flow	391	375	96%	391	100%	391	100%	373	95%
	GEH	391	364	93%	387	99%	390	100%	365	93%
	Either	391	377	96%	391	100%	391	100%	375	96%

8.4.11 WebTAG requirements are that at least 85% of counts pass on either the flow measure or the GEH measure. Table 26 demonstrates that across all time periods and all vehicle classes over 90% of counts achieved both the link flow and GEH criteria which demonstrates an excellent match with the observed data.

8.4.12 Figure 8-10 to Figure 8-12 show the count site calibration results for AM, IP and PM. Each site is summarised by one node on the map and indicate where at least one direction fails the All Vehicle criteria following ME.

Figure 8-10: AM Count Site Calibration All Vehicle Results

Figure 8-11: IP Count Site Calibration All Vehicle Results

Figure 8-12: PM Count Site Calibration All Vehicle Results

9 MODEL VALIDATION

9.1 Introduction

9.1.1 The test of a model's 'fitness for purpose' is carried out by examining the extent to which the model reproduces observed conditions. As noted in Section 8.4 above, all traffic count data was used for the model calibration process. Consequently, there was no independent traffic count data for link flow validation. Validation of the CoSTM using independent data was therefore based upon comparisons between observed and modelled journey time data.

9.2 Journey Time Validation

9.2.1 The modelled journey times were compared to observed journey time data extracted from Trafficmaster as detailed in Section 5.4. These constitute a total of 11 routes, in both directions.

9.2.2 The results of the journey time validation are presented in Table 27 to Table 29 for the AM peak, Inter-Peak and PM peak respectively.

9.2.3 Table 27 to Table 29 demonstrate that all of the journey time routes were within the 15% validation criterion for the AM Peak and for the IP. In the PM Peak 20 out of the 22 modelled journey times (or 91%) were within 15% of the observed, the exception being Route 11 in both directions which followed the M40 and M42.

Table 27: Journey Time Route Validation - AM

Route Name	Road Name	Observed				Modelled			%Diff	ABS Diff (s)	Within 15%?
		Distance (m)	Time (s)	Ave+15%	Ave-15%	Distance (m)	Time (s)	Speed (kph)			
Route 1 NB	A46 / M69	36339	1487	1710	1264	36381	1674	78	13%	187	Yes
Route 1 SB	A46 / M69	35991	1744	2006	1483	35986	1721	75	-1%	-23	Yes
Route 2 EB	A45 / M45	24071	903	1039	768	24105	910	95	1%	7	Yes
Route 2 WB	A45 / M45	23716	1099	1264	934	23682	992	86	-10%	-107	Yes
Route 3 EB	M6	36563	1829	2103	1555	36594	1648	80	-10%	-181	Yes
Route 3 WB	M6	36562	1627	1872	1383	36608	1733	76	6%	106	Yes
Route 4 EB	A428	16264	1398	1608	1188	16143	1363	43	-2%	-35	Yes
Route 4 WB	A428	16282	1547	1779	1315	16199	1479	39	-4%	-68	Yes
Route 5 NB	A423 / A444	17290	1606	1847	1365	17198	1426	43	-11%	-180	Yes
Route 5 SB	A423 / A444	17067	1411	1622	1199	17039	1462	42	4%	51	Yes
Route 6 EB	A4114 / A4600	11677	1672	1923	1422	11694	1479	28	-12%	-193	Yes
Route 6 WB	A4114 / A4600	11791	1494	1719	1270	11778	1510	28	1%	16	Yes
Route 7 EB	A4082 / B4082	5312	546	627	464	5247	496	38	-9%	-50	Yes
Route 7 WB	A4082 / B4082	5239	685	788	582	5249	605	31	-12%	-80	Yes
Route 8 NB	B4455	34604	1942	2233	1650	34525	2051	61	6%	109	Yes
Route 8 SB	B4455	34644	2267	2607	1927	34557	1941	64	-14%	-326	Yes
Route 9 EB	A45	18095	1421	1634	1208	18109	1247	52	-12%	-174	Yes
Route 9 WB	A45	18089	1329	1528	1129	18048	1146	57	-14%	-183	Yes
Route 10 NB	A46	19198	883	1016	751	19185	920	75	4%	37	Yes
Route 10 SB	A46	19309	965	1109	820	19306	922	75	-4%	-43	Yes
Route 11 NB	M40 / M42	33427	1224	1408	1041	33256	1198	100	-2%	-26	Yes
Route 11 SB	M40 / M42	33218	1388	1596	1180	33185	1326	90	-4%	-62	Yes
									Overall Pass %		100%

Table 28: Journey Time Route Validation - IP

Route Name	Road Name	Observed				Modelled			%Diff	ABS Diff (s)	Within 15%?
		Distance (m)	Time (s)	Ave+15%	Ave-15%	Distance (m)	Time (s)	Speed (kph)			
Route 1 NB	A46 / M69	36339	1379	1585	1172	36381	1413	78	3%	34	Yes
Route 1 SB	A46 / M69	35991	1298	1493	1104	35986	1378	75	6%	80	Yes
Route 2 EB	A45 / M45	24071	908	1044	772	24105	889	95	-2%	-19	Yes
Route 2 WB	A45 / M45	23716	934	1074	794	23682	904	86	-3%	-30	Yes
Route 3 EB	M6	36563	1528	1757	1299	36594	1563	80	2%	35	Yes
Route 3 WB	M6	36562	1545	1777	1314	36608	1624	76	5%	79	Yes
Route 4 EB	A428	16264	1307	1502	1111	16143	1349	43	3%	42	Yes
Route 4 WB	A428	16282	1340	1541	1139	16199	1392	39	4%	52	Yes
Route 5 NB	A423 / A444	17290	1317	1514	1119	17198	1310	43	-1%	-7	Yes
Route 5 SB	A423 / A444	17067	1245	1431	1058	17039	1296	42	4%	51	Yes
Route 6 EB	A4114 / A4600	11677	1348	1550	1146	11694	1397	28	4%	49	Yes
Route 6 WB	A4114 / A4600	11791	1256	1445	1068	11778	1339	28	7%	83	Yes
Route 7 EB	A4082 / B4082	5312	450	518	383	5247	485	38	8%	35	Yes
Route 7 WB	A4082 / B4082	5239	465	535	395	5249	514	31	11%	49	Yes
Route 8 NB	B4455	34604	1891	2175	1608	34525	1784	61	-6%	-107	Yes
Route 8 SB	B4455	34644	1913	2200	1626	34557	1786	64	-7%	-127	Yes
Route 9 EB	A45	18095	1062	1221	902	18109	1084	52	2%	22	Yes
Route 9 WB	A45	18089	1080	1242	918	18048	1058	57	-2%	-22	Yes
Route 10 NB	A46	19198	741	852	630	19185	757	75	2%	16	Yes
Route 10 SB	A46	19309	751	864	639	19306	742	75	-1%	-9	Yes
Route 11 NB	M40 / M42	33427	1307	1503	1111	33256	1213	100	-7%	-94	Yes
Route 11 SB	M40 / M42	33218	1212	1394	1030	33185	1198	90	-1%	-14	Yes
								Overall Pass %			100%

Table 29: Journey Time Route Validation - PM

Route Name	Road Name	Observed				Modelled			%Diff	ABS Diff (s)	Within 15%?
		Distance (m)	Time (s)	Ave+15%	Ave-15%	Distance (m)	Time (s)	Speed (kph)			
Route 1 NB	A46 / M69	36339	1924	2212	1635	36381	1857	78	-3%	-67	Yes
Route 1 SB	A46 / M69	35991	1480	1702	1258	35986	1484	75	0%	4	Yes
Route 2 EB	A45 / M45	24071	925	1064	786	24105	1006	95	9%	81	Yes
Route 2 WB	A45 / M45	23716	981	1128	834	23682	980	86	0%	-1	Yes
Route 3 EB	M6	36563	1685	1937	1432	36594	1595	80	-5%	-90	Yes
Route 3 WB	M6	36562	1791	2060	1522	36608	1692	76	-6%	-99	Yes
Route 4 EB	A428	16264	1542	1774	1311	16143	1437	43	-7%	-105	Yes
Route 4 WB	A428	16282	1618	1861	1376	16199	1450	39	-10%	-168	Yes
Route 5 NB	A423 / A444	17290	1756	2019	1492	17198	1630	43	-7%	-126	Yes
Route 5 SB	A423 / A444	17067	1527	1756	1298	17039	1325	42	-13%	-202	Yes
Route 6 EB	A4114 / A4600	11677	1707	1963	1451	11694	1603	28	-6%	-104	Yes
Route 6 WB	A4114 / A4600	11791	1596	1835	1357	11778	1566	28	-2%	-30	Yes
Route 7 EB	A4082 / B4082	5312	639	735	543	5247	611	38	-4%	-28	Yes
Route 7 WB	A4082 / B4082	5239	539	620	458	5249	533	31	-1%	-6	Yes
Route 8 NB	B4455	34604	2347	2699	1995	34525	2256	61	-4%	-91	Yes
Route 8 SB	B4455	34644	2021	2324	1718	34557	2142	64	6%	121	Yes
Route 9 EB	A45	18095	1416	1628	1203	18109	1264	52	-11%	-152	Yes
Route 9 WB	A45	18089	1408	1619	1197	18048	1240	57	-12%	-168	Yes
Route 10 NB	A46	19198	948	1091	806	19185	946	75	0%	-2	Yes
Route 10 SB	A46	19309	931	1070	791	19306	869	75	-7%	-62	Yes
Route 11 NB	M40 / M42	33427	1943	2235	1652	33256	1455	100	-25%	-488	No
Route 11 SB	M40 / M42	33218	1715	1972	1458	33185	1342	90	-22%	-373	No
								Overall Pass %			91%

9.2.4 Of these routes, the most important is Route 1, that passes through both Walsgrave and Binley (in both cases N-S along the A46). It is noted that route 1 passes the criteria in all 3 time periods.

9.2.5 Plots showing modelled versus observed times for all routes in all time periods are in APPENDIX C. All six plots for Route 1 show reasonable delay patterns along the route.

9.3 Route Choice Validation

9.3.1 Route choice between selected OD pairs was carried out at various stages of the calibration/validation process. Three sets of OD pairs were chosen for this purpose.

- A set of routes to/from the centre of Coventry and suitable large settlements in the vicinity as well as routes between these where they would be expected to travel through or nearby Coventry. These were intended to test the routing in the wider network surrounding Coventry.
- A set of routes to/from the centre of Coventry and six areas of Coventry surrounding the centre, as well as trips between these areas. These were intended to test the routing within Coventry.
- A set of routes covering local routing in the vicinity of the Binley and/or Walsgrave junctions.

9.3.2 For each set either the zone containing the town/city centre was used or a suitable representative zone in the area was selected. The intention was that the central portion of the routing would be used by the majority of trips between the origin and destination.

9.3.3 For ease of checking the routing for only two user classes Car Other and HGV (UCs 3 and 5 respectively) were extracted. It is expected that the routing for the other three UCs will be similar to one or other of the two UCs being checked for sufficiently long-distance travel.

9.3.4 The set of routes tested have been tabulated below.

Table 30: Route Choice Checks – Set 1 – Wider Network Checks

	Coventry Centre	Birmingham Centre	Warwick	Northampton	Rugby	Nuneaton	Leicester	Tamworth	Lichfield
Coventry Centre		X	X	X	X	X	X	X	X
Birmingham Centre	X			X	X				
Warwick	X					X	X		
Northampton	X	X						X	X
Rugby	X	X				X		X	X
Nuneaton	X		X		X				
Leicester	X		X						
Tamworth	X			X	X				
Lichfield	X			X	X				

Table 31: Route Choice Checks – Set 2 – Coventry Network Checks

	Coventry Centre	Coventry SW	Coventry South	Coventry SE	Coventry East	Coventry NE	Coventry NW
Coventry Centre		X	X	X	X	X	X
Coventry SW	X		X	X	X	X	X
Coventry South	X	X		X	X	X	X
Coventry SE	X	X	X		X	X	X
Coventry East	X	X	X	X		X	X
Coventry NE	X	X	X	X	X		X

Coventry NW	X	X	X	X	X	X	

Table 32: Route Choice Checks – Set 3 – Local Network Checks

	Binley Woods	Brinklow	Coventry SE	Coventry East
Binley Woods			X	X
Brinklow			X	X
Coventry SE	X	X		
Coventry East	X	X		

9.3.5 The guidance in WebTAG Unit M3.1 (paragraph 7.3.2) gives a rule of thumb that the number of OD pairs should be of the order of the fourth root of the number of zones multiplied by the number of user classes. For CoSTM (including the 20 development zones only four of which are currently used) this calculation gives a requirement for 27.4 OD pairs to be checked. The above set of tables gives a set of 42 OD pairs that have been checked. This is just over 50% in excess of the minimum requirement in WebTAG and is believed to adequately mitigate the checking of routing for only two of the five User Classes.

9.3.6 The full set of plots will be issued as part of the supporting data for the Transport Modelling Package along with a Technical Note explaining the naming convention.

9.3.7 A review of these have shown that there is some variation in routing within Set 1, but all these routes appear to be reasonable. Within Set 2 there does appear to be some usage of minor roads in preference to A roads and B roads within Coventry in some time periods. However if there is sufficient congestion on the major roads and sufficient local knowledge then drivers will use the minor roads in such circumstances so this is not unreasonable. The Set 3 routes follow the routing that looks to be most sensible in all time periods.

9.4 Model Convergence

9.4.1 One of the measures used to monitor convergence within the SATURN assignment model is via the parameter %FLOW. This measures the percentage of links on which flows vary by more than a pre-defined percentage between consecutive assignment iterations.

9.4.2 Convergence was improved with the use of the parameters RSTOP, PCNEAR and NISTOP which were set at 99, 1 and 4 respectively. These convergence settings – more stringent than the TAG minima – were originally used for the MRTM and have been adopted for CoSTM. These settings define convergence as being met when link flows on 99% of all links in the network vary by less than 1% for four consecutive iterations.

9.4.3 TAG provides further guidance on model stability in Appendix C of TAG unit M3.1. This suggests that other appropriate measures are the Average Absolute Difference (AAD) in link flows between consecutive iterations and also the Relative Average Absolute Difference (RAAD) in link flows between iterations, with the latter being the preferred measure with a target value of 0.1%.

9.4.4 Table 33 to Table 35 show the convergence statistics for the AM Peak, Interpeak and PM Peak respectively. For the last four assignment iterations, the %GAP statistic is well below the 1% criterion that each modelled time period must achieve, while %FLOW also meets the 99% criterion. The %RAAD is also well below 0.1%, which satisfies the WebTAG criterion on each of the last four iterations. Overall, the three time-period models are fully converged.

Table 33: Summary Convergence Results - AM

Assignment Loop	% GAP	AAD	RAAD	% Flows
1	0.5470			
2	0.1810	38.14	2.39	55.9
3	0.0790	14.05	0.88	65.3
4	0.0570	5.87	0.37	74.0
5	0.0390	3.02	0.19	81.8
6	0.0280	2.46	0.15	83.5
7	0.0220	2.63	0.16	82.5
8	0.0200	2.33	0.15	83.8
9	0.0170	2.03	0.13	85.5
10	0.0150	1.65	0.10	87.9
11	0.0100	1.38	0.09	90.1
12	0.0100	1.35	0.08	90.0
13	0.0092	1.08	0.07	92.0
14	0.0089	1.05	0.07	92.3
15	0.0077	0.75	0.05	94.6
16	0.0081	0.76	0.05	94.4
17	0.0066	0.69	0.04	95.0
18	0.0070	0.74	0.05	94.6
19	0.0052	0.67	0.04	95.1
20	0.0062	0.58	0.04	95.7
21	0.0042	0.68	0.04	95.4
22	0.0048	0.51	0.03	96.4
23	0.0039	0.63	0.04	95.8
24	0.0041	0.44	0.03	96.8
25	0.0034	0.45	0.03	96.8
26	0.0039	0.43	0.03	96.8
27	0.0028	0.42	0.03	97.2
28	0.0036	0.35	0.02	97.4
29	0.0029	0.36	0.02	97.5

Assignment Loop	% GAP	AAD	RAAD	% Flows
30	0.0027	0.25	0.02	98.4
31	0.0027	0.19	0.01	98.7
32	0.0027	0.24	0.01	98.4
33	0.0026	0.24	0.02	98.2
34	0.0025	0.20	0.01	98.7
35	0.0024	0.27	0.02	98.2
36	0.0022	0.19	0.01	98.7
37	0.0025	0.15	0.01	99.0
38	0.0037	0.24	0.01	98.4
39	0.0024	0.36	0.02	97.6
40	0.0023	0.19	0.01	98.9
41	0.0028	0.23	0.01	98.6
42	0.0027	0.30	0.02	98.1
43	0.0027	0.29	0.02	98.1
44	0.0035	0.28	0.02	98.2
45	0.0022	0.33	0.02	97.9
46	0.0017	0.18	0.01	98.9
47	0.0028	0.22	0.01	98.7
48	0.0018	0.18	0.01	99.0
49	0.0019	0.20	0.01	98.9
50	0.0017	0.18	0.01	98.9
51	0.0016	0.11	0.01	99.5
52	0.0016	0.06	0.00	100.0
53	0.0024	0.10	0.01	99.6
54	0.0016	0.08	0.00	99.9

Table 34: Summary Convergence Results - IP

Assignment Loop	% GAP	AAD	RAAD	% Flows
1	0.2210			
2	0.0540	18.64	1.61	60.2
3	0.0360	4.39	0.38	76.3
4	0.0220	1.74	0.15	86.5
5	0.0160	1.96	0.17	84.2
6	0.0140	1.74	0.15	85.6
7	0.0069	0.95	0.08	91.8
8	0.0059	0.95	0.08	91.5
9	0.0048	0.69	0.06	93.7
10	0.0043	0.54	0.05	95.3
11	0.0036	0.44	0.04	96.3
12	0.0031	0.39	0.03	96.7

Assignment Loop	% GAP	AAD	RAAD	% Flows
13	0.0027	0.33	0.03	97.3
14	0.0025	0.27	0.02	97.8
15	0.0021	0.27	0.02	97.8
16	0.0022	0.22	0.02	98.2
17	0.0017	0.20	0.02	98.5
18	0.0021	0.13	0.01	99.1
19	0.0017	0.19	0.02	98.6
20	0.0016	0.17	0.01	98.8
21	0.0014	0.16	0.01	99.0
22	0.0016	0.13	0.01	99.2
23	0.0015	0.18	0.02	98.8
24	0.0013	0.15	0.01	99.0
25	0.0013	0.13	0.01	99.3
26	0.0010	0.07	0.01	99.6
27	0.0009	0.05	0.00	99.8
28	0.0011	0.06	0.00	99.8

Table 35: Summary Convergence Results - PM

Assignment Loop	% GAP	AAD	RAAD	% Flows
1	0.9500			
2	0.3240	40.72	2.60	55.1
3	0.1690	19.00	1.21	64.3
4	0.1510	9.24	0.59	70.4
5	0.0640	6.77	0.43	74.3
6	0.0590	3.27	0.21	82.4
7	0.0530	3.00	0.19	83.3
8	0.0400	2.66	0.17	84.0
9	0.0330	2.34	0.15	85.5
10	0.0280	2.30	0.15	85.8
11	0.0270	1.80	0.12	88.1
12	0.0220	1.68	0.11	88.7
13	0.0170	1.51	0.10	89.7
14	0.0170	1.46	0.09	89.8
15	0.0130	1.32	0.08	90.9
16	0.0130	1.21	0.08	91.2
17	0.0130	1.26	0.08	91.5
18	0.0079	0.97	0.06	93.5
19	0.0082	0.77	0.05	94.5
20	0.0084	0.72	0.05	95.4
21	0.0084	0.69	0.04	95.3
22	0.0093	0.59	0.04	96.1

Assignment Loop	% GAP	AAD	RAAD	% Flows
23	0.0063	0.40	0.03	97.3
24	0.0052	0.50	0.03	96.9
25	0.0061	0.45	0.03	97.1
26	0.0038	0.47	0.03	97.4
27	0.0050	0.32	0.02	97.8
28	0.0035	0.38	0.02	97.7
29	0.0048	0.26	0.02	98.3
30	0.0032	0.36	0.02	97.8
31	0.0047	0.25	0.02	98.4
32	0.0026	0.34	0.02	98.0
33	0.0046	0.20	0.01	98.8
34	0.0024	0.32	0.02	98.1
35	0.0034	0.18	0.01	98.8
36	0.0023	0.26	0.02	98.4
37	0.0033	0.17	0.01	98.9
38	0.0020	0.24	0.02	98.6
39	0.0030	0.16	0.01	99.1
40	0.0020	0.20	0.01	98.8
41	0.0036	0.14	0.01	99.2
42	0.0022	0.22	0.01	98.7
43	0.0020	0.11	0.01	99.4
44	0.0025	0.16	0.01	99.2
45	0.0023	0.17	0.01	99.0
46	0.0017	0.15	0.01	99.1

10 VARIABLE DEMAND MODEL

10.1 Introduction

10.1.1 This Chapter discusses the development, calibration, and validation of the Variable Demand Model (VDM) of the CoSTM.

10.1.2 As noted in TAG Unit M2, there is a presumption that the effect of variable demand on scheme benefits should be estimated quantitatively unless there is a compelling reason not to do so. TAG Unit M2 §2.2 notes that 'it may be acceptable to limit the assessment of a scheme to a fixed demand assessment if the following criteria are satisfied:

- *The scheme is quite modest either spatially or financially and is also quite modest in terms of its effect on travel costs. Schemes with a capital cost of less than £5 million can generally be considered as modest; or the following two points:*
- *There is no congestion or crowding on the network in the forecast year (10 to 15 years after opening), in the absence of the scheme; and*
- *The scheme will have no appreciable effect on travel choices (e.g. mode choice or distribution) in the corridor(s) containing the scheme.*'

10.1.3 Initial cost estimates indicate the Binley and Walsgrave interventions will have capital costs in excess of £5M. Hence the first criteria will not be met.

10.1.4 Current evidence demonstrates congestion and delay exists at Binley and Walsgrave junctions. In the absence of any interventions, it is unlikely that this congestion will be relieved in the future. Therefore, there is no compelling reason not to quantitatively assess the effects of variable demand on the scheme.

10.1.5 The CoSTM VDM has been developed from the standard setup within the MRTM. Calibration of the MRTM VDM was undertaken in parallel across all five RTMs with the resultant calibration parameter values justified at the total RTM level.

10.1.6 The VDM has not been re-calibrated as part of the model refinement to produce the CoSTM. Instead realism testing was undertaken to determine if any material changes from the MRTM calibrated model were noted.

10.1.7 Full details of the development, calibration and validation of the MRTM VDM are presented in the MRTM Model Validation Report.

10.2 Model Form

10.2.1 To ensure consistency between all regional models with respect to the approach to VDM, all RTMs use the DfT's software package DIADEM (Dynamic Integrated Assignment and DEmand Modelling). The VDM approach for CoSTM has retained the use of the DIADEM software.

10.2.2 DIADEM is designed to enable practitioners to set up and run variable demand models. It allows for setting up a multi-stage transport demand model and finding equilibrium between demand and supply, using the SATURN package as the supply model. The process iterates between demand calculations and highway assignments until a converged solution is reached.

10.2.3 DIADEM is compliant with TAG guidance with respect to model form, most notably model hierarchy and incremental nature of the model. The approach makes use of cost changes from relative differences between Base Year and Forecast Year travel costs, operated using a pivot point approach. Thus, the demand model form is incremental rather than absolute, which estimates changes in trip patterns relative to a set of reference demand matrices derived from observed data.

10.2.4 Forecast changes in demand from the reference point are based on relative changes in travel costs and journey times. Changes in demand due to external factors such as population, employment and income, are applied separately to establish the reference matrices from the Base Year demand.

10.2.5 A bespoke software tool, HEIDI (Highways England Integrated Demand Interface), was developed as part of the RTM development programme to:

- Control the application of DIADEM;
- Enable consistent application of DIADEM across all RTM's;
- To simplify file management;
- Organise and implement forecast model runs;
- Assemble trip ends;
- Undertake multiple model runs; and
- Prepare 'template' reporting of VDM runs

10.2.6 HEIDI is a C# based Graphical User Interface which interrogates a SQL database containing model inputs and outputs. This approach simplifies the overall model process, where HEIDI controls DIADEM which in turn controls the SATURN assignments within internal loops of supply / demand calculations until convergence is reached. The VDM approach for CoSTM retained the use of the HEIDI tool to control DIADEM runs.

10.3 Segmentation

10.3.1 Table 36 describes the model segmentation within the CoSTM VDM with respect to modelled time periods and journey purposes and modes.

10.3.2 The model time slices and time period factors have been updated from the standard MRTM setup to reflect the updated CoSTM assignment time slices. All other parameters are unchanged from the MRTM VDM.

Table 36: CoSTM VDM Segmentation Parameters

Parameter	Values	Notes
Modelled Time Slices	AM = 07:00-09:00 IP = 10:00-16:00 PM = 16:00-18:00 OP = 18:00-07:00	AM, IP, and PM travel costs derived from average period hour calibrated assignments. OP travel costs derived from uncalibrated assignment of MPOD data derived OP matrix to IP network to represent freeflow conditions.
Time Period Factors	AM = 2 IP = 7 PM = 2 OP = 13	Simple calculation consistent across all movements and purposes as average period demand is assigned.
Assigned User Classes	From assignment models: - Car Employer's Business - Car Commute - Car Other - Light Goods Vehicles - Heavy Goods Vehicles	
VDM Demand Segments	Demand Segments (DS): 1. Home Based Employer's Business 2. Home Based Work 3. Home Based Other 4. Non-Home Based Employer's Business 5. Non-Home Based Other 6. Fixed Employer's Business 7. Fixed Work 8. Fixed Other 9. Light Goods Vehicles 10. Heavy Goods Vehicles	Fixed elements relate to 'special zones' which include unique travel patterns that are not subject to VDM response. These may be ports or airports where 'Other' (passengers) and Employer's Business may be assumed not to be subject to VDM responses, for example where separate demand modelling has taken place to provide demand inputs.

10.3.3 Home based demand segments are represented as all-day Production-Attraction (PA) demand whilst non-home based demand segments are represented as average hour Origin Destination (OD) demand. All demand segments represent car available travel only.

10.3.4 A representation of Public Transport (PT) is required for the VDM. With the RTMs focusing on inter-urban travel, and the need for a proportionate approach to representing PT, it was deemed that rail travel was the main competitor to inter urban car travel and that bus/coach need not be represented.

10.3.5 Base Year and Forecast Year PT rail demand and travel cost matrices were created as part of the development of the MRTM. These have been retained in the CoSTM VDM with appropriate refinements made to reflect the updated zone system.

10.3.6 Both highway and PT (rail) responses are modelled for the home based and non-home based demand segments. Forecast highway travel costs respond to changes in demand within each demand-supply loop in DIADEM whilst PT costs are fixed. Goods vehicle traffic does not have a demand response, but route choice is modelled within the highway assignment.

10.3.7 The zone system within the demand model is identical to the zone system developed and applied in the Base Year CoSTM highway assignment model.

10.4 Generalised Cost

10.4.1 Generalised costs of travel are calculated using the guidance set out in TAG Unit M2. Within the DIADEM software, generalised costs of travel are represented in units of time, specifically generalised minutes. The formulation of the generalised costs of travel are given below:

$$G_{car} = 60.\left(t + \frac{VOC.d + toll}{VoT}\right)$$

$$G_{PT} = 60.\left(t + \frac{fare}{VoT}\right)$$

Where: G_{car} and G_{PT} are the generalised cost of travel for car and PT respectively

t is the travel time

d is the trip distance

$toll$ and $fare$ represent any monetary costs

VoT is the value of time, varying by purpose

VOC is the vehicle operating cost

10.4.2 The highway travel times, toll costs and trip distances are calculated by skimming the reference and forecast SATURN assignments. This happens automatically during the DIADEM run.

10.4.3 Public transport fare and generalised travel time (with appropriate weightings for walk, wait, in-vehicle, and interchange time) matrices were defined as fixed inputs into the VDM during the development of the MRTM. The CoSTM VDM has retained the same public transport inputs with refinements made to reflect the updates to the zone system and change of Base Year from 2015 to 2018.

10.4.4 Values of time and vehicle operating costs applied to the highway and public transport cost matrices were derived from the May 2019 TAG Databook.

10.5 Cost Damping

10.5.1 Two common approaches to cost damping set out in TAG:

- Varying cost as a function of distance, with common cost damping parameters are set out related to the distance function (TAG Unit M2 §3.3.15); and
- A power function of utility, for which common cost damping assumptions referred (WebTAG Unit M2 §3.3.18), for which a beta value of 0.75 (centre of range) was assumed and a value for mu estimated to set the mean generalised cost.

10.5.2 During the development of the RTMs, outturn elasticities in response to fuel price changes were analysed under different assumptions for fixed and varying values of time, and different methods of cost damping.

10.5.3 This analysis showed that a distance-based deterrence function appeared to result in a more plausible balance between business and non-business fuel price elasticities and therefore this form of cost damping was selected. This cost damping function, with common assumptions as set out in WebTAG, takes the following form:

$$\acute{G} = \max\left(1, \left(\frac{d}{k}\right)^{-\alpha}\right) . G$$

Where: G is the generalised cost of travel

d is the trip distance

k is a distance cut-off, set at 30km

α is set to 0.5

10.5.4 In addition to this, a process was introduced during development of the RTMs to calculate a variable value of time for non-work users with respect to trip distance. This presents a second form of cost damping. The non-work value of time is given by the following expression:

$$VoT = VoT_C . \left(\frac{\max(d, d_C)}{d_0}\right)^{\eta_s}$$

Where: VoT is the value of time in the demand model

VoT_C is the central value of time given in Table A1.3.2 in the WebTAG Databook

d is the minimum length of the trip, defined from an inter-peak Base Year highway network with an allowance for travel distance to access the modelled transport network based on the radius of the zone

d_C, d_0 and η_s are parameters

10.5.5 Parameter values were estimated during development of the MRTM. These have been retained in the CoSTM VDM aside from the initial values of time, which have been updated to reflect the 2018 Base Year of the calibrated highway assignment model. The parameter values are shown in Table 37.

Table 37: Value of time cost damping parameters

Parameter	Employer's Business (Car)	Employer's Business (Rail)	Commute (Car and Rail)	Other (Car and Rail)
d_C (km)	10	10	10	10
d_0 (km)	99.5	99.5	30.5	31.2
η_s	0.387	0.435	0.248	0.315

10.5.6 The CoSTM VDM has maintained the cost damping functionality and parameters as defined in the MRTM. Values of time have not been adjusted as functions of trip length in the highway model; in other respects, the VDM values of time are consistent with those used in the highway assignment.

10.6 Choice Model Equations

10.6.1 The demand model functionality applied in the CoSTM is unchanged from the MRTM.

10.6.2 The CoSTM VDM is a hierarchical logit model operated via an incremental pivot point approach against the calibrated Base Year model. This calculates the likelihood of travellers making one choice over many alternatives based on changes in travel costs. Mode, destination and (macro) time period choices are represented in the demand model.

10.6.3 In line with guidance in TAG Unit M2, sensitivity parameters are applied to composite costs of travel. The values used are the median TAG values, maintained from the development of the MRTM demand model. These functions are applied to all trips.

10.6.4 The time period choice formulation is as follows:

$$T_{t*i*} = T_{**i*} \cdot \frac{\sum_{mj} T^0_{tmij} e^{\theta_t \Delta C_{t*i*}}}{\sum_{tmj} T^0_{tmij} \, e^{\theta_t \Delta C_{t*i*}}}$$

with the change in composite travel cost across all modes calculated as follows:

$$\Delta C_{t*i*} = ln\left(\frac{\sum_{mj} T^0_{tmij} e^{\theta_m \Delta C_{tmi*}}}{\sum_{mj} T^0_{tmij}}\right)$$

10.6.5 The mode choice formulation, for choice between car and public transport, is then given by:

$$T_{tmi*} = T_{t*i*} \cdot \frac{\sum_j T^0_{tmij} e^{\theta_m \Delta C_{tmi*}}}{\sum_j T^0_{tPij} \, e^{\theta_m \Delta C_{tPi*}} + T^0_{tCij} e^{\theta_m \Delta C_{tCi*}}}$$

with the change in composite travel costs by mode calculated as follows:

$$\Delta C_{tmi*} = \ln\left(\frac{\sum_j T^0_{tmij} e^{\lambda_d \Delta C_{tmij}}}{\sum_j T^0_{tmij}}\right)$$

10.6.6 Finally, trip distribution is calculated as a function of the change in generalised cost as follows:

$$T_{tmij} = T_{tmi*} \cdot \frac{T^0_{tmij} e^{\lambda_d \Delta C_{tmij}}}{\sum_j T^0_{tmij} e^{\lambda_d \Delta C_{tmij}}}$$

with the change in generalised cost of travel, ΔC_{tmij}, calculated directly from the highway assignment skims.

10.6.7 In these formulations, the following parameters are used:

T_{tmij} is the output demand

T^0_{tmij} is the input demand

ΔC_{tmij} is the change in composite travel cost

θ_t is the time period choice sensitivity parameter

θ_m is the mode choice sensitivity parameter

i is the production or origin

j is the attraction or destination

t is the time period

m is the mode

$*$ represents aggregation across production, attraction, time period or mode

C is the car mode and P is the public transport mode

10.6.8 In-line with guidance in TAG Unit M2, commuting trips are doubly-constrained to ensure each zone produces and attracts a fixed number of total trip ends. Employer's business and other trips are singly constrained at the production end. This functionality is applied across all modes and time periods and is consistent with the MRTM.

10.7 Convergence

10.7.1 All variable demand models iterate between the demand model and the assignment (or supply) model. This is because the volume of demand affects travel times, which in turn affect the volume of demand and so on.

10.7.2 It is important to monitor the convergence of this iterative process. Poor convergence causes noise in the model outputs, which in turn introduces errors into subsequent analyses such as economic appraisal, noise and air quality.

10.7.3 TAG requirements for VDM convergence are set out in TAG Unit M2 §6.3. This defines the demand/supply gap as the preferred measure of convergence and states that '*Tests indicate that gap values of less than 0.1% can be achieved in many cases, although in more problematic systems this may be nearer to 0.2%. Where the convergence level, as measured by the %GAP, is over 0.2% remedial steps should be taken to improve the convergence, by increasing the assignment accuracy.*'

10.7.4 TAG also states that '*ideally the user benefits, as a percentage of network costs, should be at least 10 times the % Gap achieved in the Without-Scheme and With-Scheme scenarios'*. However, this relates to economic appraisal and forecasting and cannot be applied to Base Year realism testing.

10.7.5 Convergence of the demand model in the MRTM was calculated both over the whole model and across a subset of matrix cells, known as the 'subarea'. This was done to address concerns that the whole-model gap could be dominated by external zones with very high levels of demand, which may give a misleading picture of convergence in the Region of Focus (RoF).

10.7.6 Based on TAG guidance, the stopping criteria in DIADEM in the MRTM were set as:

- Whole-model gap < 0.1%; and
- Subarea gap < 0.2%.

10.7.7 The CoSTM has retained the same convergence criteria as the MRTM but with a refined definition of the subarea. In the MRTM, the subarea was defined as every zone within the RoF. In the CoSTM, only those zones in the AoDM, and therefore within the fully simulated network area, are considered as within the subarea for gap calculation purposes.

10.7.8 The gap values achieved during realism testing, along with the number of demand-assignment loops required, are shown in Table 38.

Table 38: Realism Test Convergence Statistics

Realism Test	Whole-model Gap	Subarea Gap	Number of Loops
Fuel Cost Realism Test	0.05%	0.10%	6
Rail Fare Realism Test	0.06%	0.07%	4

10.8 Generalised Cost Parameters

10.8.1 The generalised cost parameters used in the CoSTM VDM have been derived from the May 2019 TAG Databook. This is the same TAG Databook used to define the Value of Time and Vehicle Operating Cost values in the highway assignment.

10.8.2 Values of time (VoTs) and vehicle operating costs (VOCs) are shown for the 2018 Base Year in Table 39.

Table 39: Generalised cost parameters, 2018 values, 2010 prices

Demand Segment	Highway VoT (pence per hour)	Highway VOC (pence per km)	Rail VoT (pence per hour)
Home based employer's business	1879.43	11.84	2698.09
Home based work	1248.76	5.80	1095.23
Home based other	895.09	5.80	499.90
Non-home based employer's business	1879.43	11.84	2698.09
Non-home based other	895.09	5.80	499.90

10.9 Choice Model Sensitivity Parameters

10.9.1 Mode, destination and (macro) time period choices are represented in the demand model. The assumed logit choice parameters have been drawn from median illustrative values as set out in TAG unit M2 and summarised in Table 40. The destination parameters give the sensitivities per minute of generalised car time; the mode and time parameters define the sensitivity of these choices relative to destination choice. These parameters imply that mode and (macro) time period choices are equally sensitive to changes in generalised car time.

Table 40: Destination and Mode sensitivity parameters

Purpose	Car		Rail	
	Destination	Mode	Destination	Mode
Home Based Employer’s Business	-0.067	0.45	-0.036	0.45
Home Based Work	-0.065	0.68	-0.033	0.68
Home Based Other	-0.090	0.53	-0.036	0.53
Non-home Based Employer’s Business	-0.081	0.73	-0.042	0.73
Non-home Based Other	-0.077	0.81	-0.033	0.81

10.9.2 Demand for non-car available segments is not represented in the variable demand model. Demand from air passengers travelling to/from airports, freight and from selected developments is modelled separately and held fixed within the CoSTM.

10.10 Calibration

10.10.1 The CoSTM VDM has been developed from the standard setup within the MRTM. Calibration of the MRTM VDM was undertaken in parallel across all five RTMs with the resultant calibration parameter values justified at the total RTM level.

10.10.2 The VDM has not been re-calibrated as part of the model refinement to produce the CoSTM. Instead realism testing has been undertaken to determine if any material changes from the MRTM calibrated model were noted.

10.10.3 Full details of the development, calibration and validation of the MRTM VDM are presented in the MRTM Model Validation Report (Midlands Regional Traffic Model: Model Validation Report – DF2 v3.6 22/03/2017)

10.11 Realism Test Results

10.11.1 Realism testing has been undertaken for the CoSTM following the guidance set out in TAG Unit M2 §6.4. Outturn demand elasticities have been calculated using the formula specified in the guidance:

$$e = \frac{\log(T^1) - \log(T^0)}{\log(C^1) - \log(C^0)}$$

Where: T^1 and T^0 indicate values of demand in the test and base runs

C^1 and C^0 indicate levels of cost in the test and base runs

10.11.2 The realism of both fuel cost kilometrage elasticities and public transport fare elasticities have been assessed for the CoSTM. This provided a direct comparison to the outturn elasiticities achieved in the MRTM to determine if any material changes from the calibrated model were noted.

10.12 Fuel Cost Elasticities

10.12.1 The fuel price realism test analysed the impact on car vehicle kilometres with respect to a 10% increase in car fuel costs.

10.12.2 The guidance on fuel cost elasticities in TAG Unit M2 §6.4 states that the overall annual fuel cost elasticity across purposes should lie in the range -0.25 to -0.35. Guidance around expected purpose variation is also provided as follows:

- values for business travel expected to be in the region of -0.1;
- values for commuting and education expected to be in the region of the -0.3 average; and
- values for discretionary travel expected to be closer to -0.4.

10.12.3 The fuel cost elasticities for the MRTM are reported for trips originating in the MRTM RoF in Table 41.

Table 41: MRTM fuel cost elasticities, by purpose and time period

Time Period	Employer's Business	Home Based Work	Other	All Purpose
AM	-0.24	-0.19	-0.46	-0.29
IP	-0.25	-0.20	-0.43	-0.35
PM	-0.20	-0.19	-0.44	-0.30
OP	-0.26	-0.24	-0.50	-0.41
All-day	-0.24	-0.20	-0.45	-0.33

10.12.4 The fuel cost elasticities for the CoSTM are reported for trips originating in the CoSTM Area of Detailed Modelling (AoDM) are shown in Table 42.

Table 42: CoSTM fuel cost elasticities, by purpose and time period

Time Period	Employer's Business	Home Based Work	Other	All Purpose
AM	-0.24	-0.18	-0.37	-0.26
IP	-0.22	-0.20	-0.36	-0.31
PM	-0.15	-0.14	-0.33	-0.22

OP	-0.23	-0.25	-0.49	-0.39
All-day	-0.21	-0.18	-0.38	-0.29

10.12.5 The overall outturn elasticity from the CoSTM is within the range mandated by TAG and shows only limited change from the reported MRTM elasticity. As would be expected reflecting values of time assumed for the RTMs, the business and commuting elasticities are substantially lower than the other purpose. There are slightly lower elasticities in the peak periods reflecting the constraining effects of network congestion.

10.13 Public Transport Fare Elasticities

10.13.1 The public transport fare realism test analysed the impact on public transport trips in response to a 10% increase in public transport fares.

10.13.2 TAG Unit M2 quotes a public transport fare elasticity range of -0.2 to -0.9, i.e. a relatively wide range of values, based on 2004 TRL (Transport Research Laboratory) work.

10.13.3 The public transport fare elasticities for the MRTM are reported for trips originating in the RoF in Table 43.

Table 43: MRTM rail fare elasticities, by purpose and time period

Time Period	Employer's Business	Home Based Work	Other	All Purpose
AM	-0.12	-0.12	-0.64	-0.20
IP	-0.16	-0.12	-0.67	-0.44
PM	-0.15	-0.12	-0.70	-0.23
OP	-0.13	-0.12	-0.70	-0.26
All-day	-0.14	-0.12	-0.68	-0.26

10.13.4 The public transport fare elasticities for the CoSTM are reported for trips originating in the AoDM in Table 44.

Table 44: CoSTM rail fare elasticities, by purpose and time period

Time Period	Employer's Business	Home Based Work	Other	All Purpose
AM	-0.15	-0.18	-0.76	-0.26
IP	-0.19	-0.20	-0.83	-0.56
PM	-0.21	-0.24	-0.90	-0.37
OP	-0.18	-0.20	-0.90	-0.37

All-day	-0.18	-0.20	-0.84	-0.36

10.13.5 The overall public transport fare outturn elasticity from the CoSTM is within the range mandated by TAG. The difference between the CoSTM and MRTM elasticities is greater than shown in the fuel cost realism test although these do not represent a material change from the MRTM results.

11 SUMMARY AND CONCLUSIONS

11.1 Model Development

11.1.1 This report has described how the Coventry Strategic Traffic Model (CoSTM) traffic model was developed and validated to a 2018 base year.

11.1.2 The purpose of the validation was to assess the accuracy of the traffic model and to demonstrate its suitability as a forecasting and appraisal tool for the A46 Scheme at Binley and Walsgrave.

11.1.3 CoSTM was developed from the Midlands Regional Transport Model (MRTM). The MRTM is one of the five regional models commissioned by HE covering England. It utilised Mobile Phone Network Data (MND) for development of the car matrices and was validated to a March 2015 Base Year. The MRTM provided the building block for the development of a detailed local model that focussed on the area likely to be impacted by the scheme at Binley and Walsgrave.

11.1.4 The model has applied coding standards from the RTM Network Coding manual. The network has been reviewed and refined in the area between the M6 and A5 to the north and M40 to the south, and between the M42 to the west and M1 to the east.

11.1.5 The MRTM Design Freeze 4.3 (DF4.3) "prior" highway assignment trip matrices were used as the starting point for the development of the CoSTM Base Year prior trip matrices. This ensured that the effects of any matrix estimation undertaken by the MRTM development team were excluded.

11.1.6 The MRTM DF4.3 trip matrices were primarily defined from mobile phone origin-destination (MPOD). A zone system refinement was undertaken followed by a base year uplift to Autumn 2018. Freight demand was adjusted using RTF18 factors. A series of sector factoring processes were undertaken to further refine the short distance trips in the Fully Modelled Area.

11.1.7 Traffic data was collected to build and refine the CoSTM model. Existing traffic data from local authorities and highways agencies were gathered alongside new traffic data collection sites (counts and ANPR data) to complement the existing data. TrafficMaster journey time data was collected in order to perform journey time validation. Traffic signal data was obtained from local authorities and highways agencies in order to refine the highway network.

11.2 Standards Achieved

11.2.1 The performance of the calibration counts for the highway assignment model is good. Post Matrix Estimation, the pass rate for flow or GEH criteria for all vehicle types across the 391 sites that make up the calibration screenlines and cordons are as follows:

- AM peak; 371 sites; 95%
- Inter peak; 387 sites; 99%
- PM peak; 375 sites; 96%

11.2.2 These meet the requirements for 85% or more of links to pass this validation flow test.

11.2.3 Utilisation of all count data in the calibration meant that there was no independent count data available for the link flow validation. However, the decision to adopt a ‘calibration’ only approach was justified due to the improved quality of the base year matrix.

11.2.4 The model was validated against the journey time data, which was independent and has not been used for the development of matrices or assignments. The journey time validation showed an excellent match with observed journey times across the 22 routes, the journey time pass rate is as follows:

- AM peak; 22 routes; 100%
- Inter peak; 22 routes; 100%
- PM peak; 20 routes; 91%

11.2.5 The highway model convergence statistics are summarised in the table below. These indicate that the model is converged well in all three time periods and meets WebTAG acceptability criteria.

Table 45: Model Convergence Statistics

Model Hour	% GAP	AAD	RAAD	% Flows
AM	0.0016	0.08	0.00	99.9
IP	0.0011	0.06	0.00	99.8
PM	0.0017	0.15	0.01	99.1

11.3 Demand Model Realism Testing

11.3.1 The DIADEM demand model has been calibrated. Two realism tests were undertaken and confirm that the demand elasticities are appropriate (in terms of meeting TAG guidance), for the assumed scenarios including a 10% change of the car fuel cost and rail fares.

11.4 Model Suitability

11.4.1 This report has demonstrated that the Coventry Strategic Traffic Model (CoSTM) is sufficiently robust to be taken forward and would provide a reliable basis for forecasting, economic evaluation and other dependant assessments.

11.4.2 The report has shown that the model replicates traffic volumes and journey times to a good standard of accuracy. It has also shown that the level of detailed network coverage is sufficient such that it encompasses the impacts arising from construction of the A46 Binley and Walsgrave junctions upgrade scheme.

12 GLOSSARY

Acronym	Description
AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekday (Monday to Friday) Traffic
ACO	Appraisal Certifying Officer
ALR	All Lanes Running
AoI	Area of Influence
ANPR	Automatic Number Plate Recognition
AoDM	Area of Detailed Modelling
AQMA	Air Quality Management Area
ASR	Appraisal Specification Report
AST	Appraisal Summary Table
ATC	Automatic Traffic Counts
BRES	Business Register and Employment Survey
BY	Base Year
BYFM	Base Year Freight Matrices
CASM	Coventry Area Strategic Model
CAPRI	Computer Analysis of Passenger Revenue Information
CHEM	Chief Highways Engineer Memo
CAA	Civil Aviation Authority
COBA	Cost and Benefit Analysis
COSTM	Coventry Strategic Traffic Model

DCO	Development Consent Order
DF	Design Freeze
DfT	Department for Transport
DHS	Dynamic Hard Shoulder
DIADEM	Dynamic Integrated Assignment and DEmand Modelling
DM	Do Minimum' (Without Scheme)
DMRB	Design Manual for Roads and Bridges (HA)
DS	Do Something' (With Scheme)
DTDV	Day To Day Variability
EAR	Economic Assessment Report
EG	Environment Group
FMA	Fully Modelled Area
GDP	Gross Domestic Product
GEH	Geoffrey E. Havers statistic (see section 3.2.4)
GIS	Geographic Information System
GPS	Global Positioning System
HATRIS	Highways England's Traffic Information System
HDV	Heavy Duty Vehicle – vehicle > 3.5 tonnes gross (i.e. COBA classes OGV1+OGV2+PSV)
HEIDI	Highways England Integrated Demand Interface

HGV	Heavy Goods Vehicle – goods vehicle > 3.5 tonnes
HS2	High Speed 2
HSR	Hard Shoulder Running
IDC	Investment Decision Committee
INCA	INcident Cost-benefit Assessment
JLR	Jaguar Land Rover
JT	Journey Time
JTS	Journey Time Survey
LAD	Local Authority District
LCC	Leicestershire County Council
LGV	Light Goods Vehicle
LRoI	Likely Region of Impact
LSOA	Lower Super Output Area
MAC	Managing Agents Contract
MCC	Manual Classified Counts
ME	Matrix Estimation
MIDAS	Motorway Incident Detection and Automatic Signalling
MM	Managed Motorway
MND	Mobile Phone Network Data
MOIRA	Software which models the demand and revenue changes to rail timetables
MPOD	Mobile Phone Origin-Destination data
MRTM	Midlands Regional Transport Model
MSA	Motorway Service Area
MSOA	Middle Super Output Areas

MyRIAD	Motorway Reliability Incidents and Delays
MVR	Model Validation Report
NAPALM	National Air Passenger Allocation Model
NATA	New Approach to Transport Appraisal
NetServ	Network Services
NRTS	National Rail Travel Survey
NTEM	National Trip End Model
NTM	National Transport Model
NTS	National Travel Survey
OA	Output Area
OBR	Office of Budget Responsibility
OD	Origin and Destination
OGV	Other Goods Vehicle
PA	Production and Attraction
PCF	Project Control Framework
PCU	Passenger Car Unit
PDFH	Passenger Demand Forecasting Handbook
PIA	Personal Injury Accident
PPK	Pence Per Kilometre
PPM	Pence Per Minute
PSF	Project Support Framework
PT	Public Transport

QUADRO	QUeues And Delays at ROadworks
RC	Reference Case
RCB	Rigid Concrete Barrier
RIS	Road Investment Strategy
RoF	Region of Focus
RP	Road Period
RSI	Roadside Interview
RFT	Road Traffic Forecast
RTM	Road Traffic Model
SATURN	Simulation & Assignment of Traffic in Urban Road Networks
SFC	Speed-flow Curve
SLA	Select Link Analyses
SDI	Social and Distributional Impact
SMP	Smart Motorway Programme
TAG	Transport Analysis Guidance
TAME	Traffic Appraisal Modelling and Economics
TCG	Technical Consistency Group
TEE	Transport Economic Efficiency
TEMPRO	Trip End Model Presentation Program
TfWM	Transport for West Midlands
TM	Traffic Master

TMP	Transport Model Package
TLD	Trip Length Distribution
TRADS	Traffic Flow Data System
TRL	Transport Research Laboratory
TSGB	Transport Statistics Great Britain
TUBA	Transport User Benefit Appraisal
VDM	Variable Demand Model
VISUM	Transport modelling software
VOC	Vehicle Operating Cost
VoT	Value of Time
VSL	Variable Speed Limit
WCC	Warwickshire County Council
WebTRIS	Web Traffic Information System
WZ	Workplace Zone

APPENDIX A

Figure A-1: AM Matrix Changes due to ME – Individual Cell Values – Full Matrix

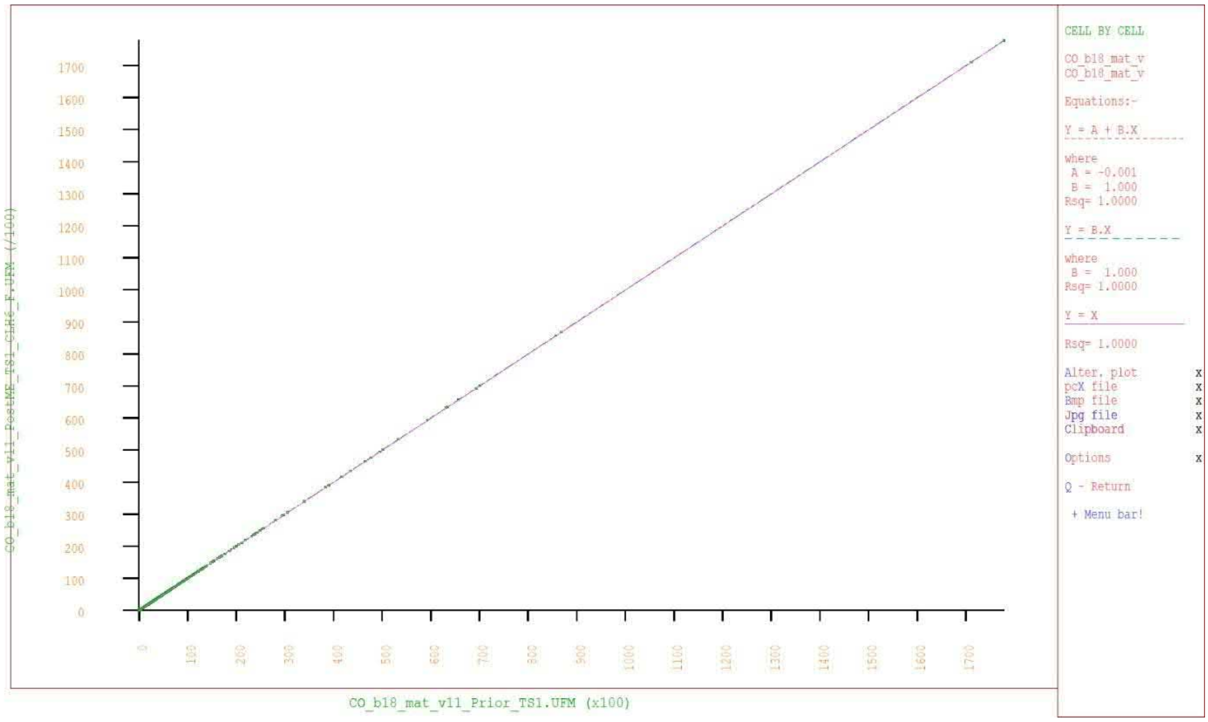


Figure A-2: AM Matrix Changes due to ME – Origin Totals – Full Matrix

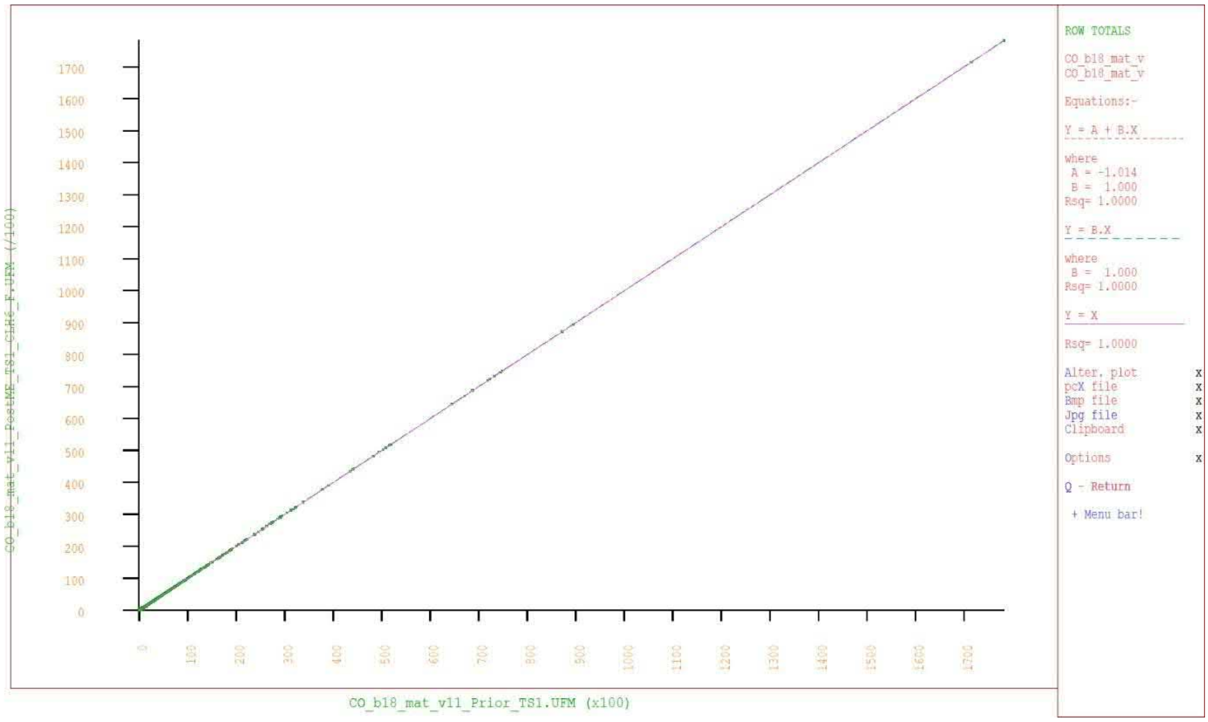


Figure A-3: AM Matrix Changes due to ME – Destination Totals – Full Matrix

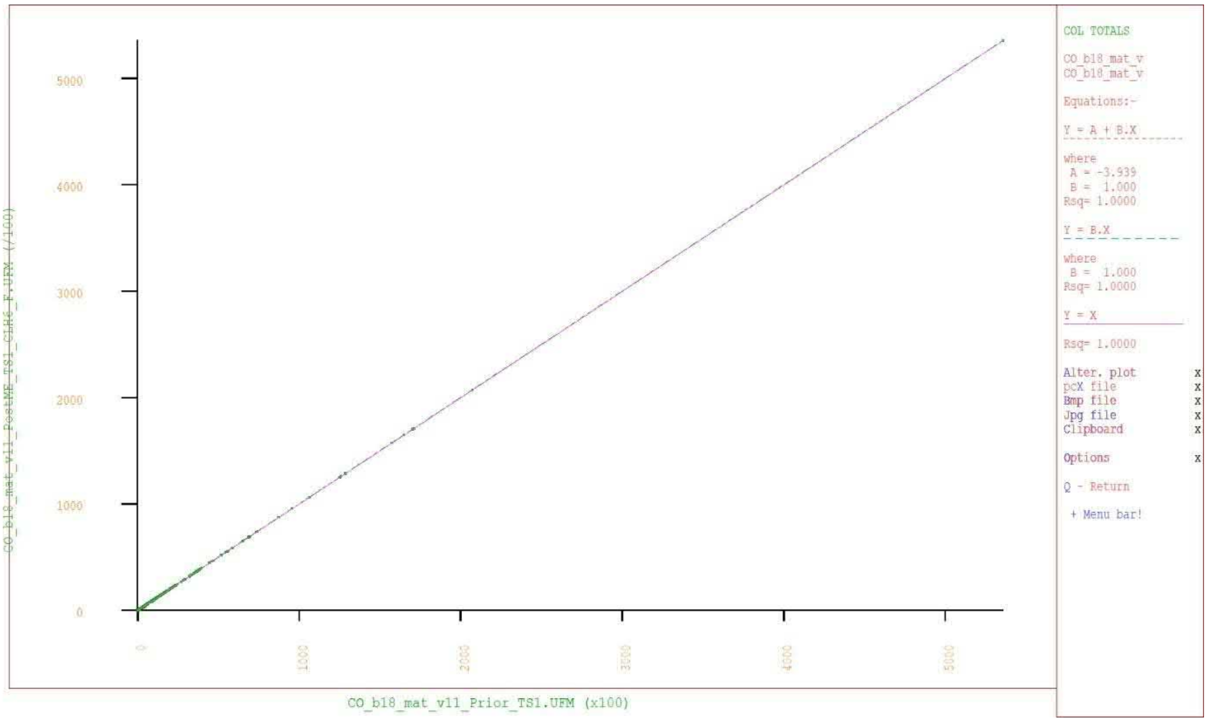


Figure A-4: IP Matrix Changes due to ME – Individual Cell Values – Full Matrix

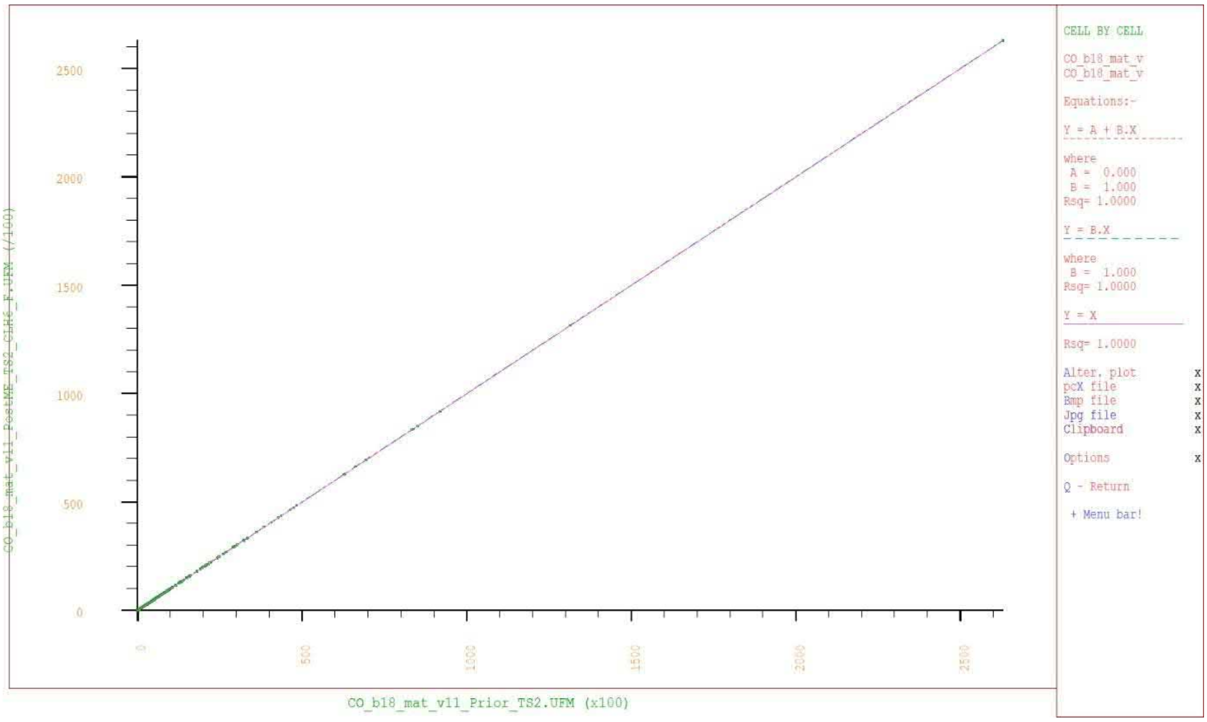


Figure A-5: IP Matrix Changes due to ME – Origin Totals – Full Matrix

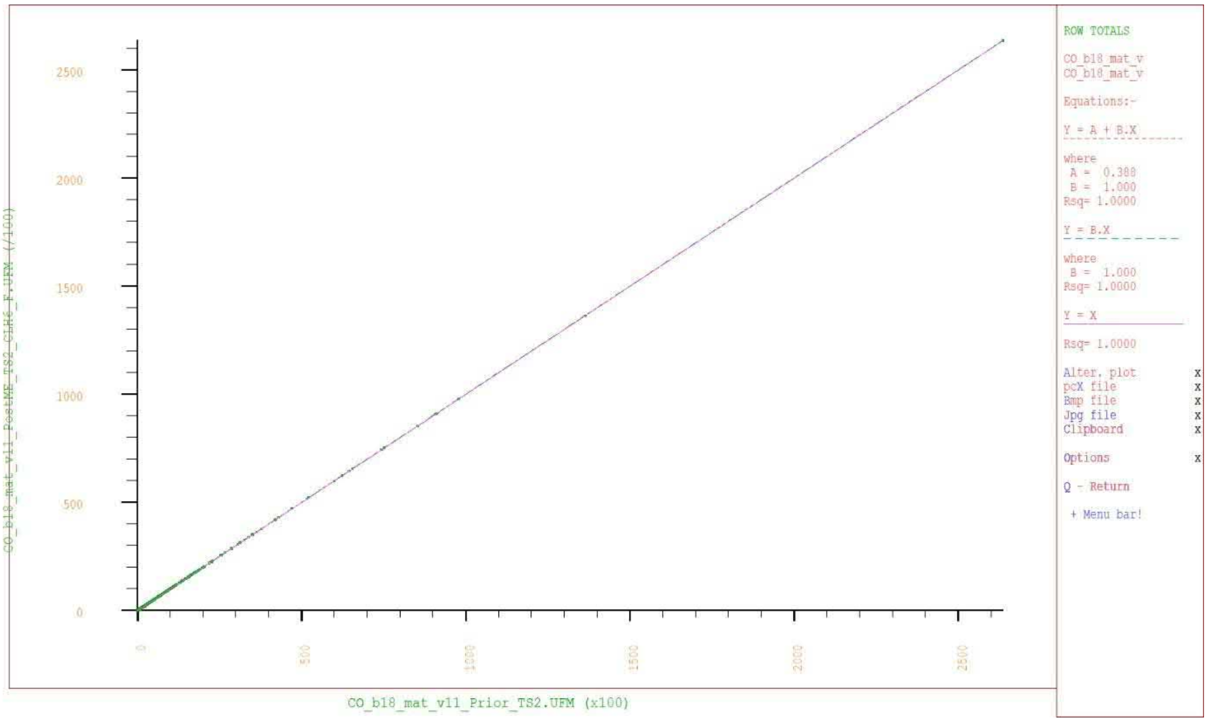


Figure A-6: IP Matrix Changes due to ME – Destination Totals – Full Matrix

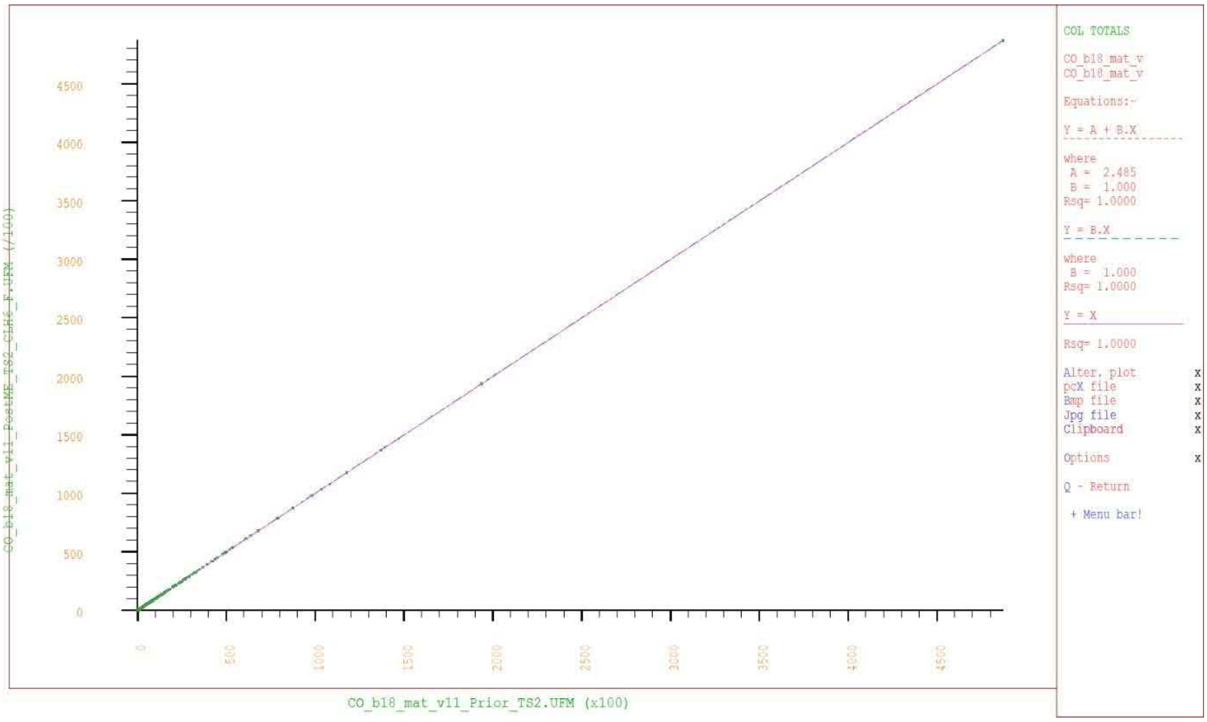


Figure A-7: PM Matrix Changes due to ME – Individual Cell Values – Full Matrix

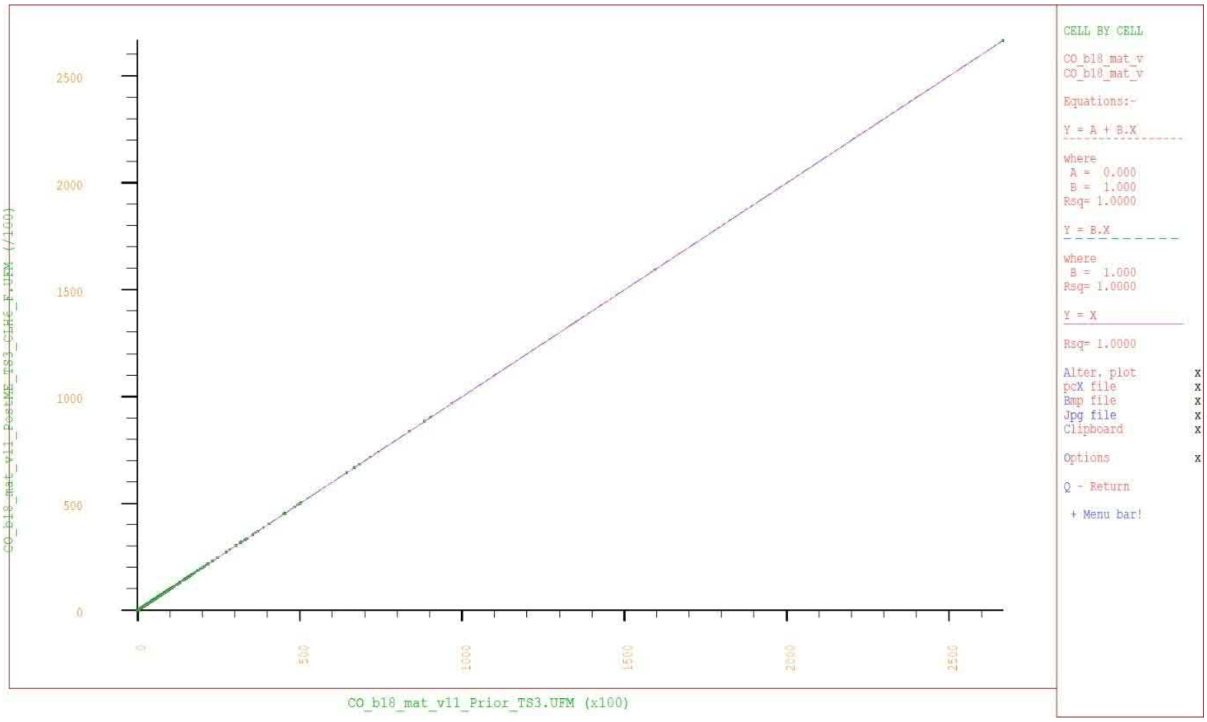


Figure A-8: PM Matrix Changes due to ME – Origin Totals – Full Matrix

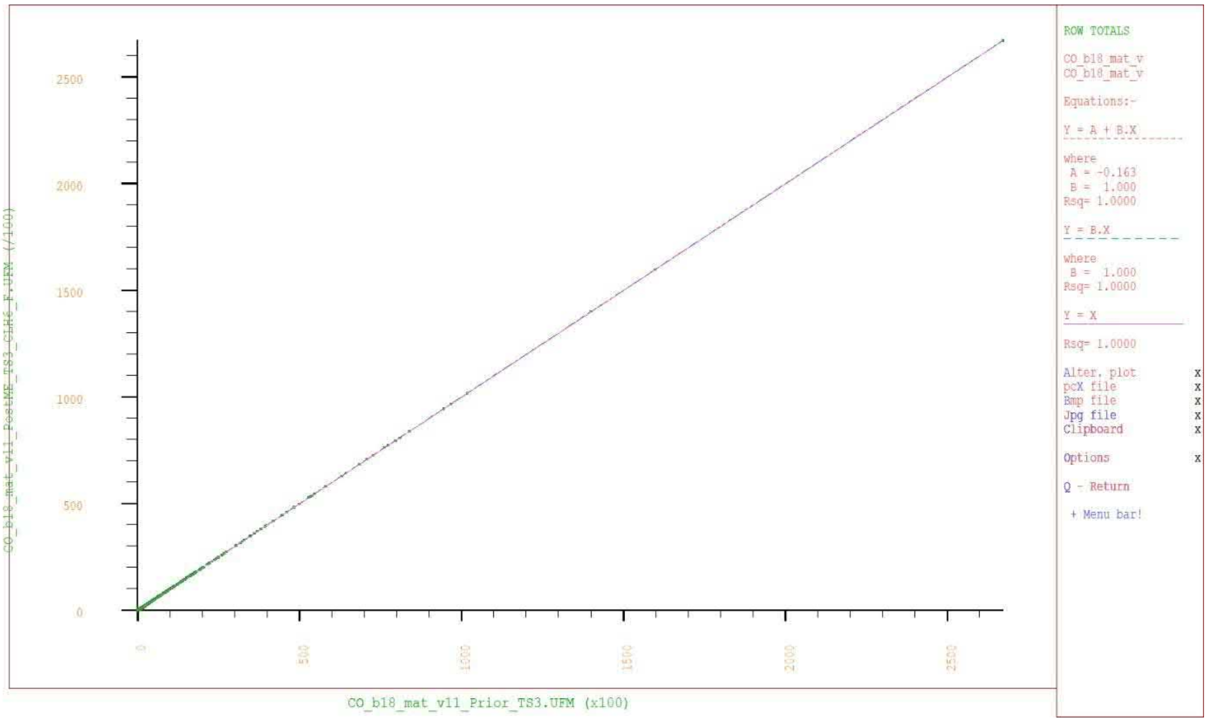


Figure A-9: PM Matrix Changes due to ME – Destination Totals – Full Matrix

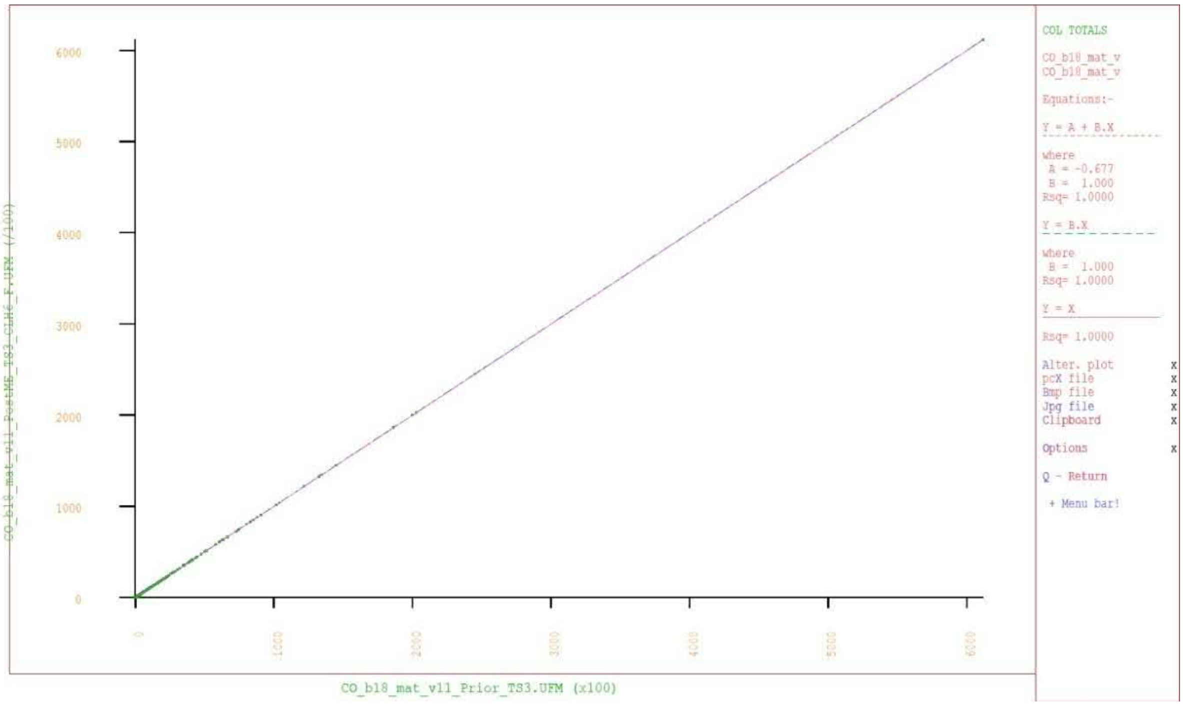


Figure A-10: AM Matrix Changes due to ME – Individual Cell Values – FMA

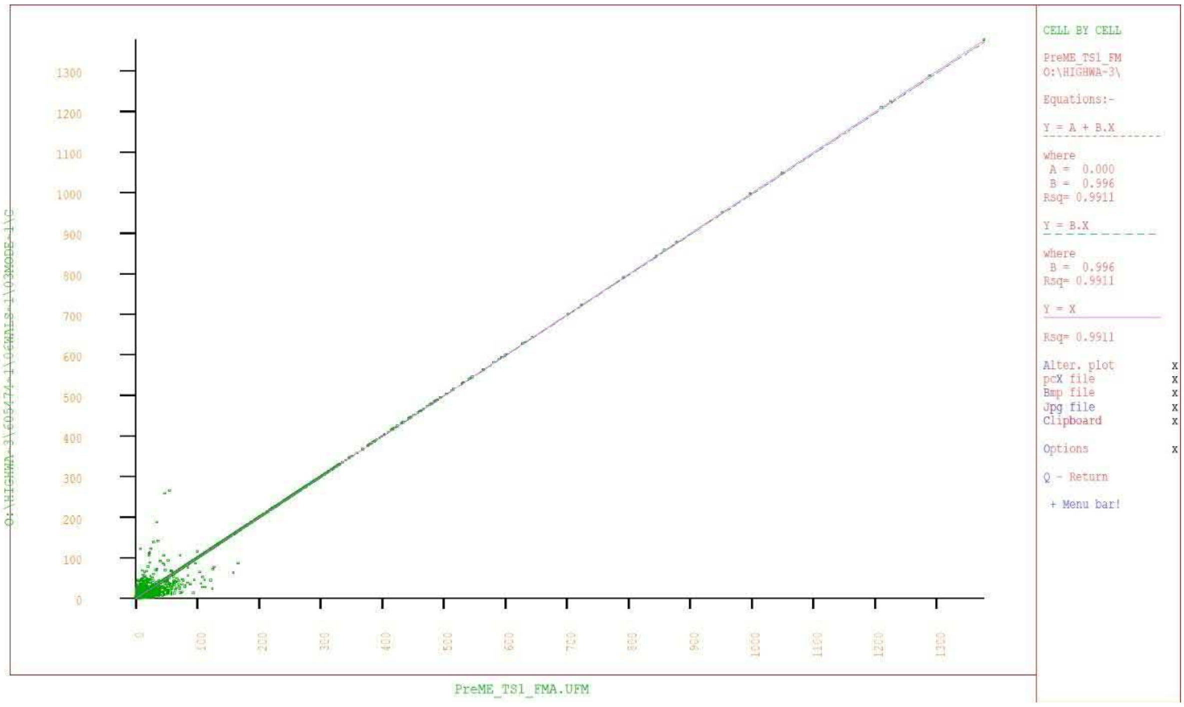


Figure A-11: AM Matrix Changes due to ME – Origin Totals – FMA

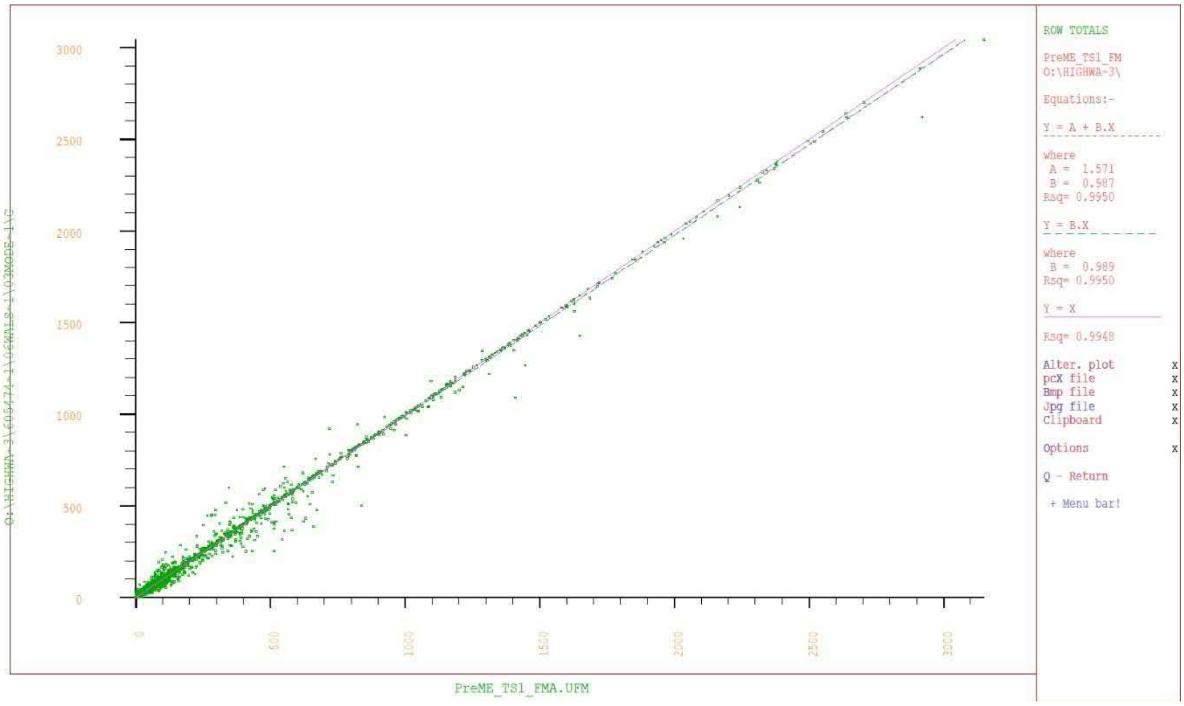


Figure A-12: AM Matrix Changes due to ME – Destination Totals – FMA

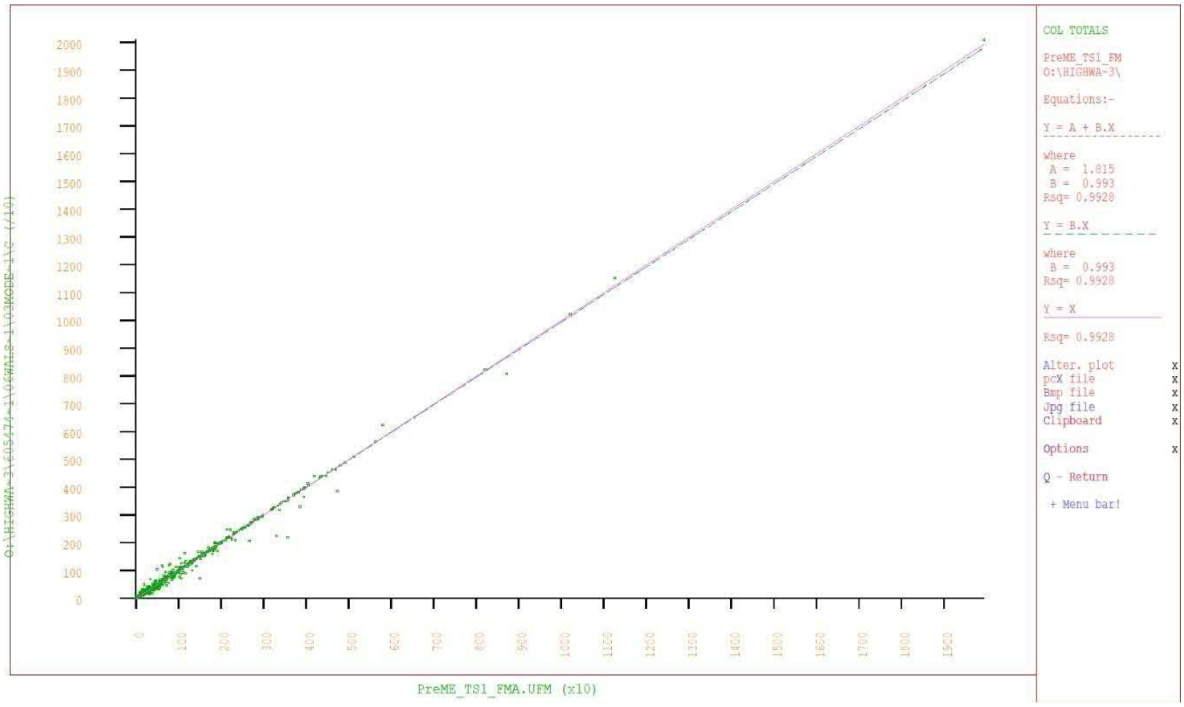


Figure A-13: IP Matrix Changes due to ME – Individual Cell Values – FMA

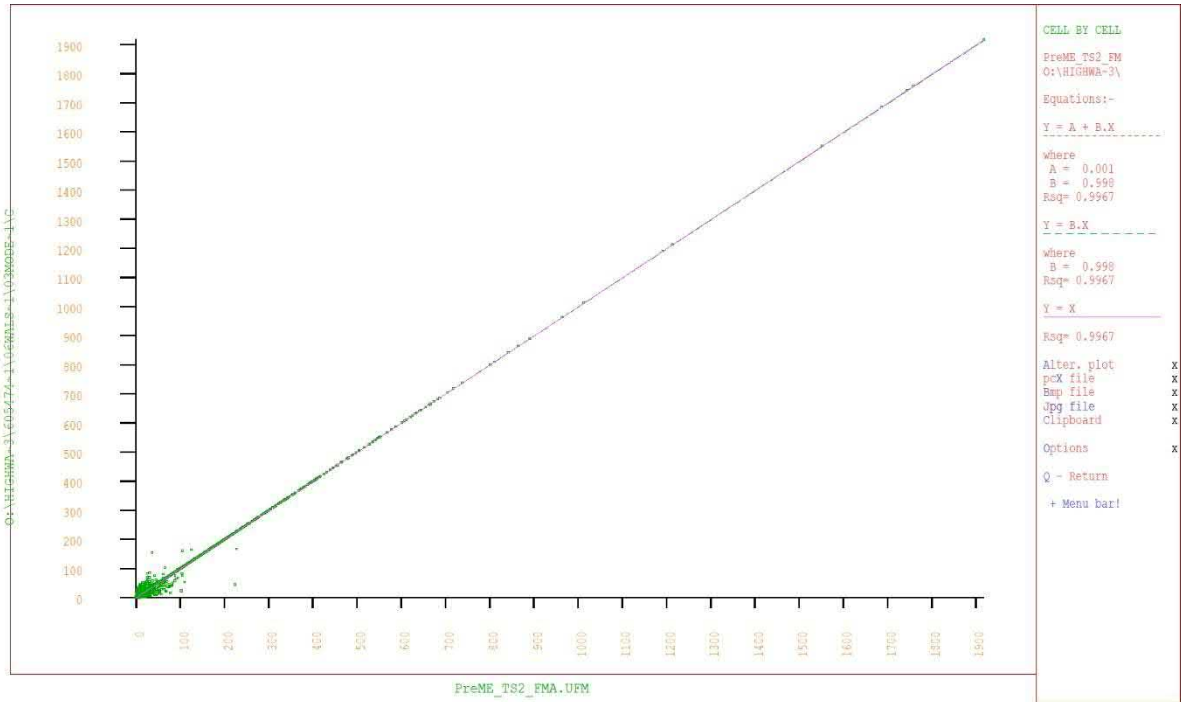


Figure A-14: IP Matrix Changes due to ME – Origin Totals – FMA

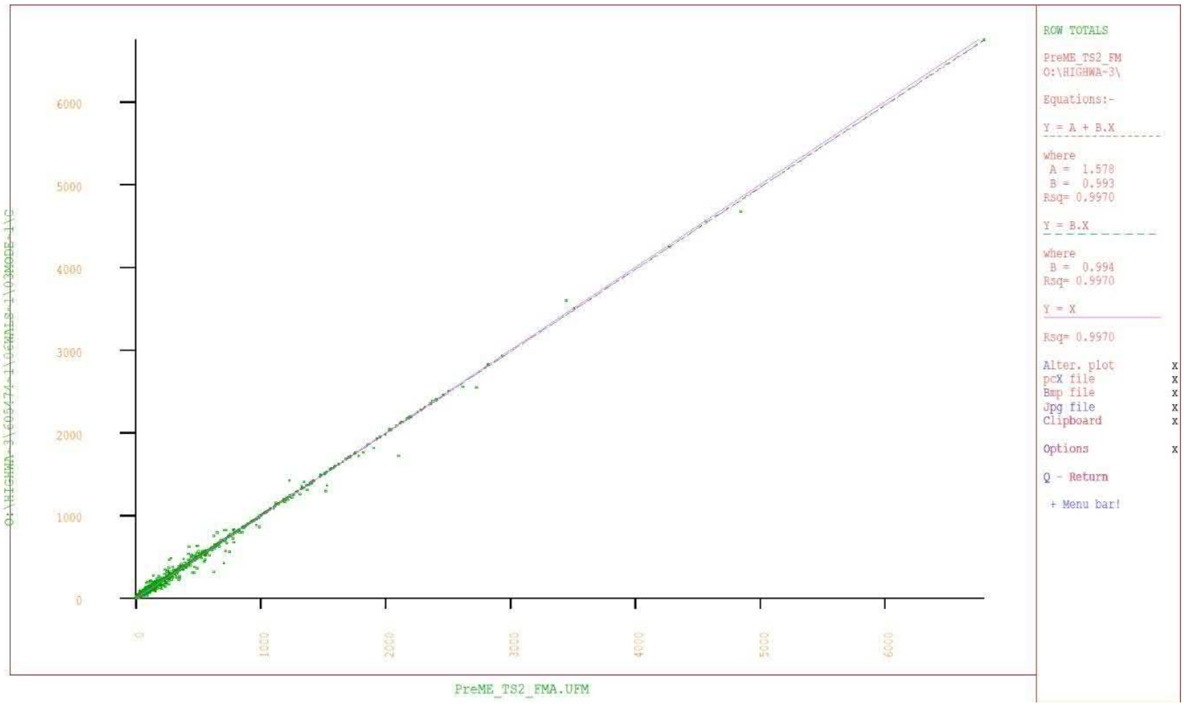


Figure A-15: IP Matrix Changes due to ME – Destination Totals – FMA

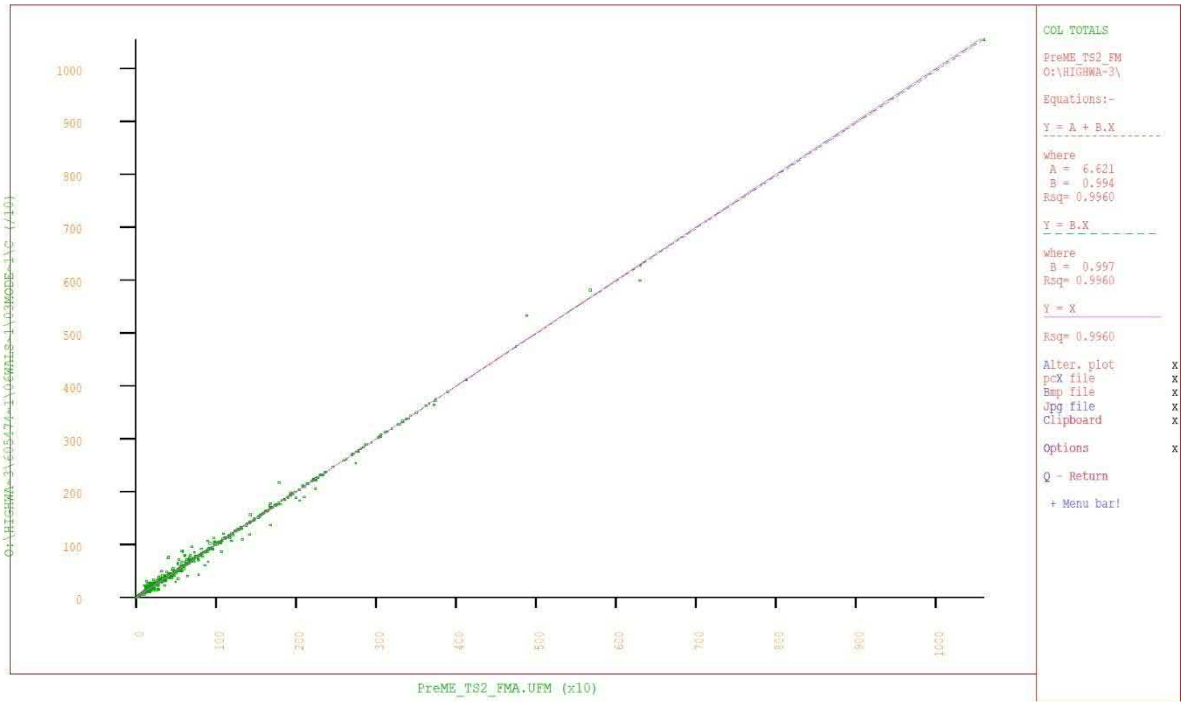


Figure A-16: PM Matrix Changes due to ME – Individual Cell Values – FMA

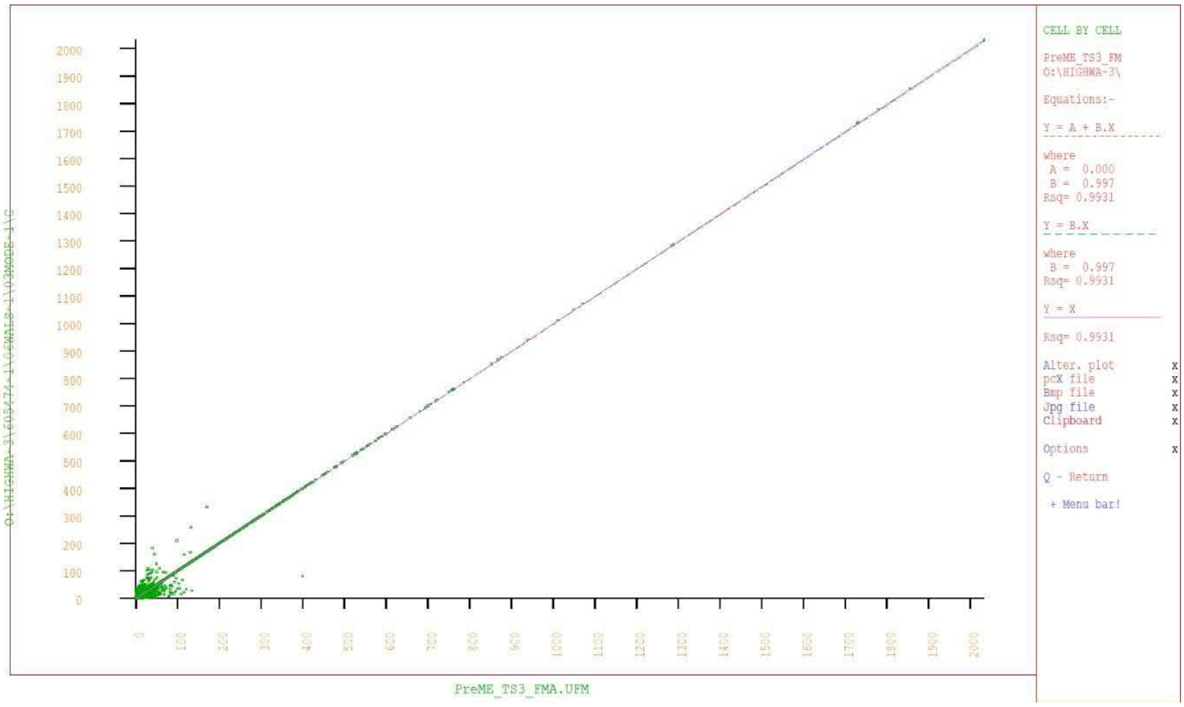


Figure A-17: PM Matrix Changes due to ME – Origin Totals – FMA

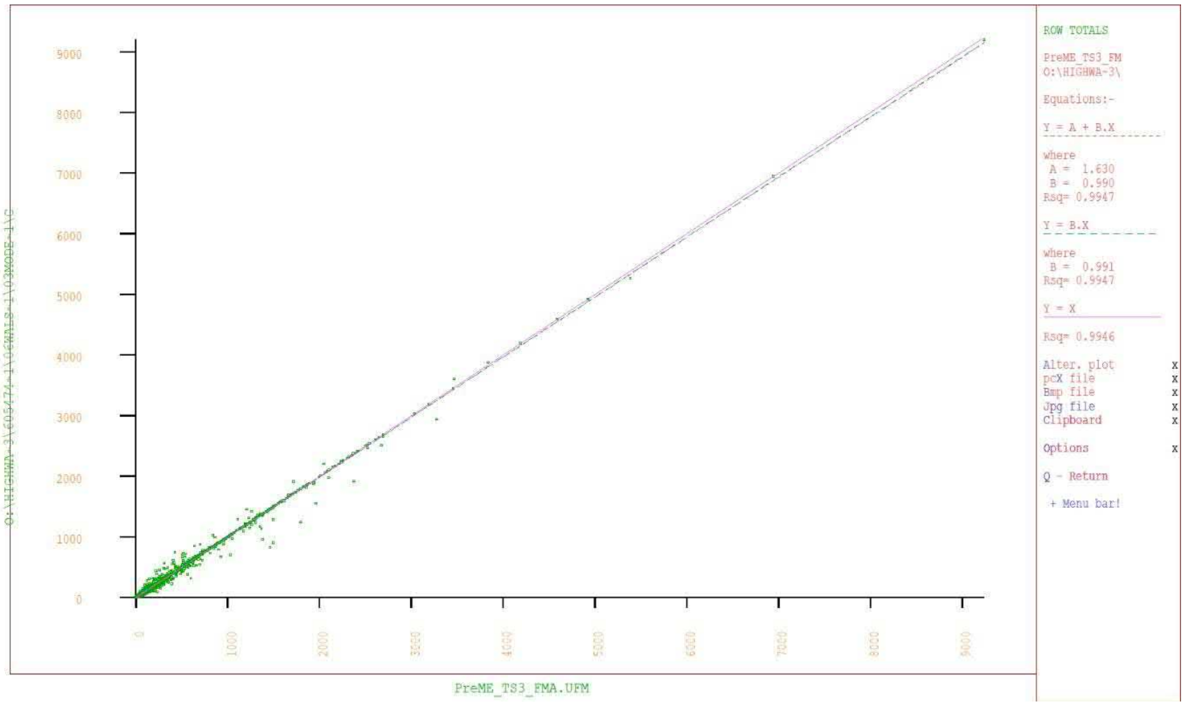


Figure A-18: PM Matrix Changes due to ME – Destination Totals – FMA

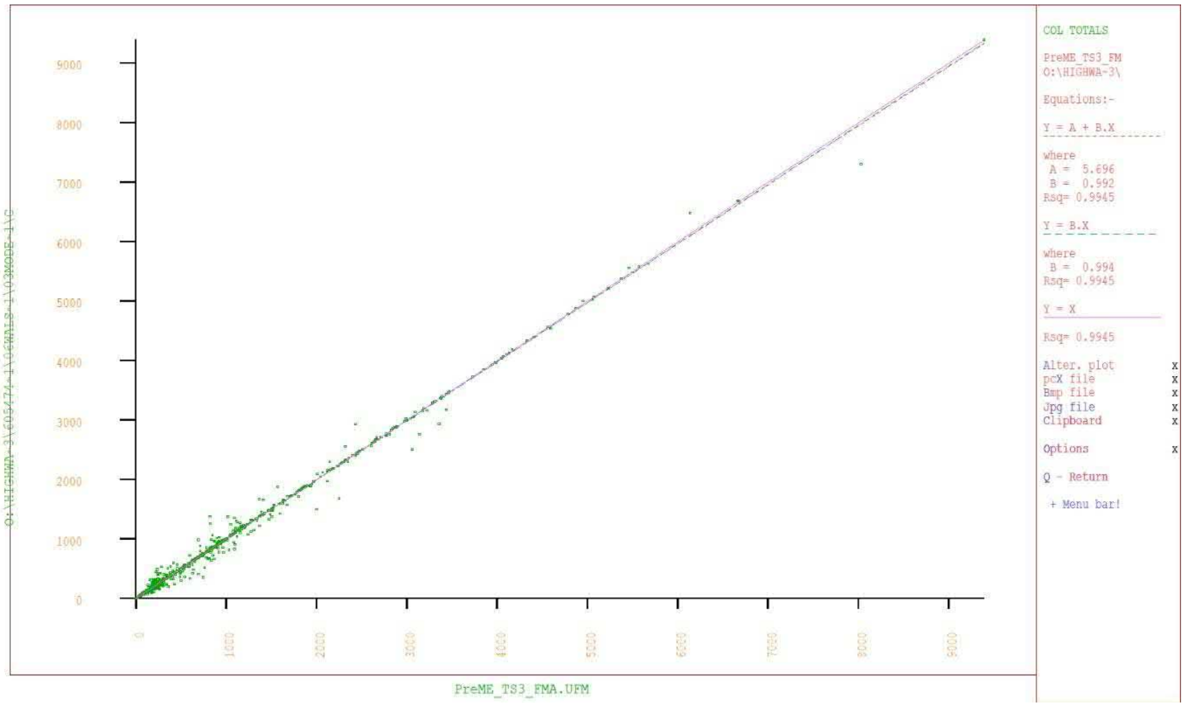


Figure A-19: AM Matrix Changes due to ME – Individual Cell Values – AoDM

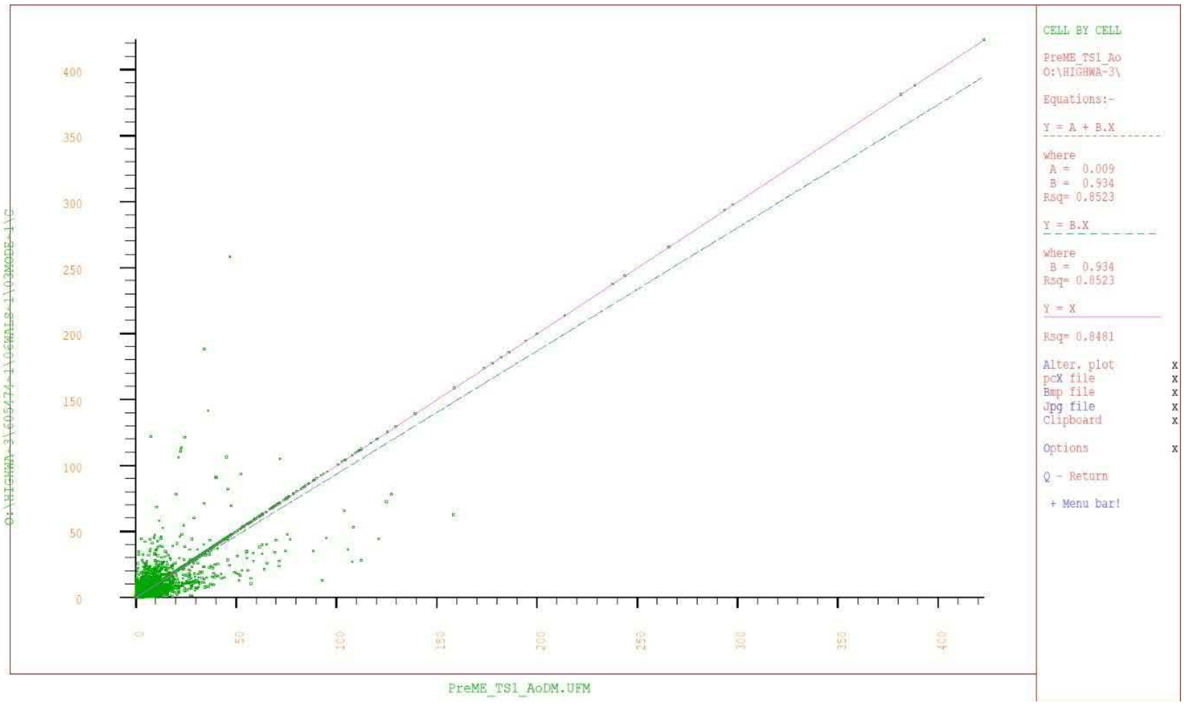


Figure A-20: AM Matrix Changes due to ME – Origin Totals – AoDM

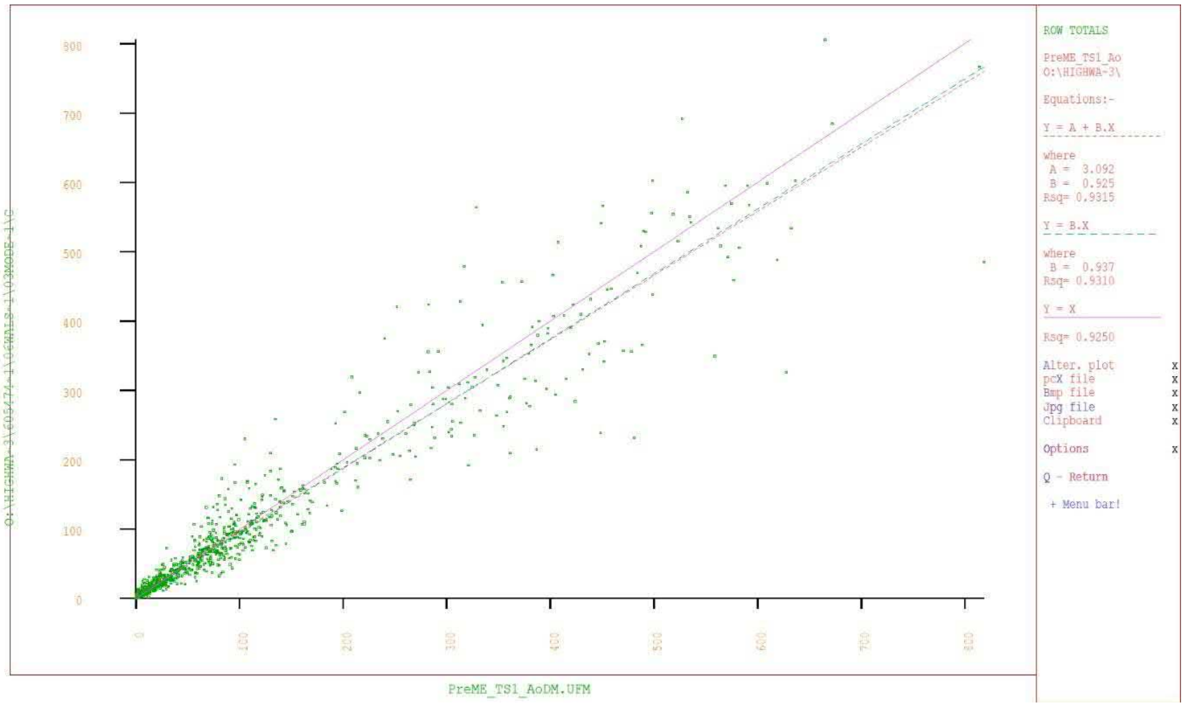


Figure A-21: AM Matrix Changes due to ME – Destination Totals – AoDM

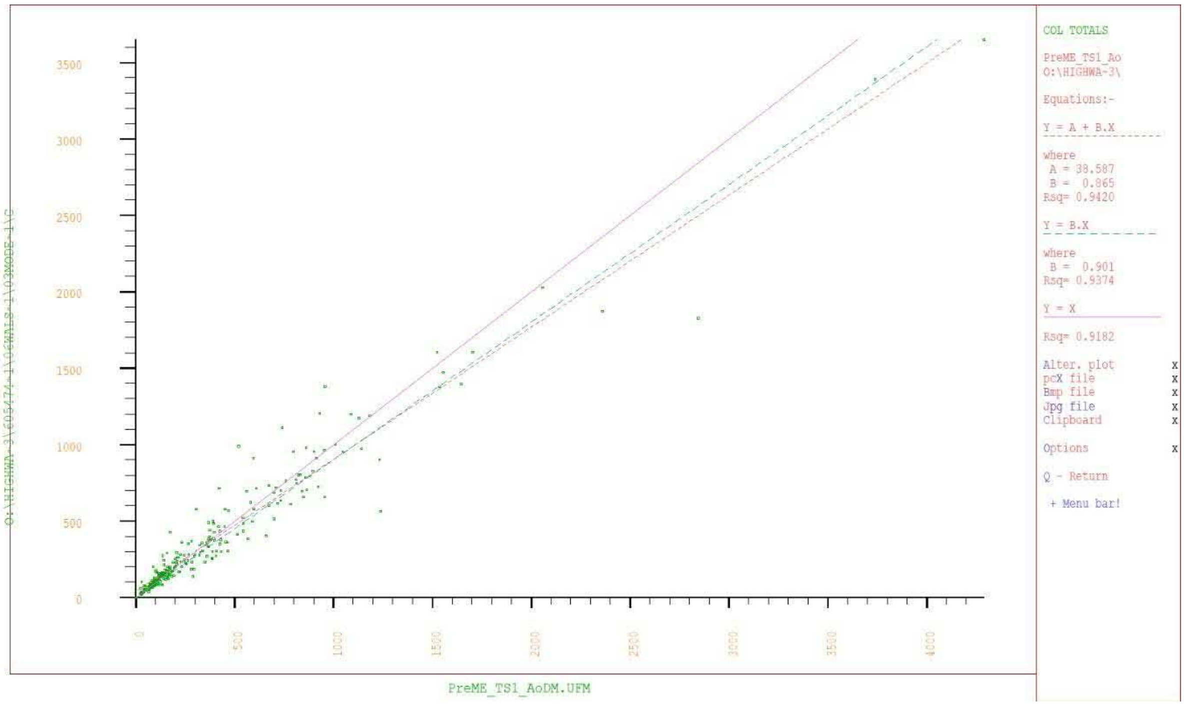


Figure A-22: IP Matrix Changes due to ME – Individual Cell Values – AoDM

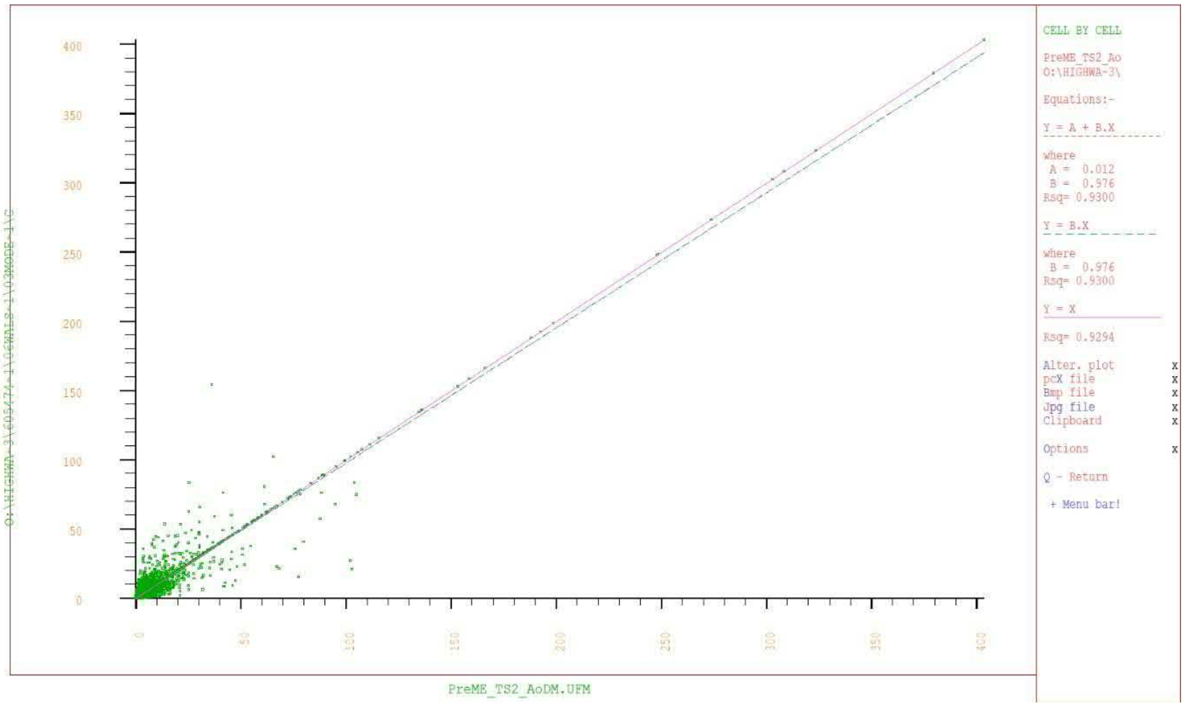


Figure A-23: IP Matrix Changes due to ME – Origin Totals – AoDM

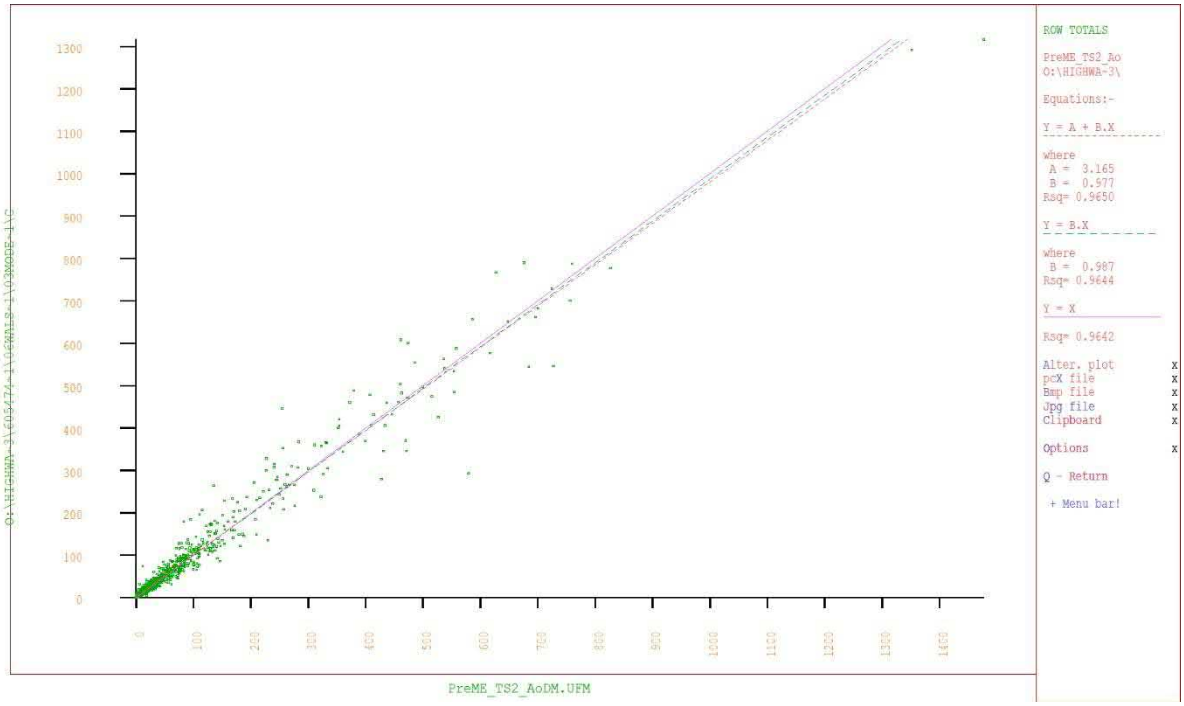


Figure A-24: IP Matrix Changes due to ME – Destination Totals – AoDM

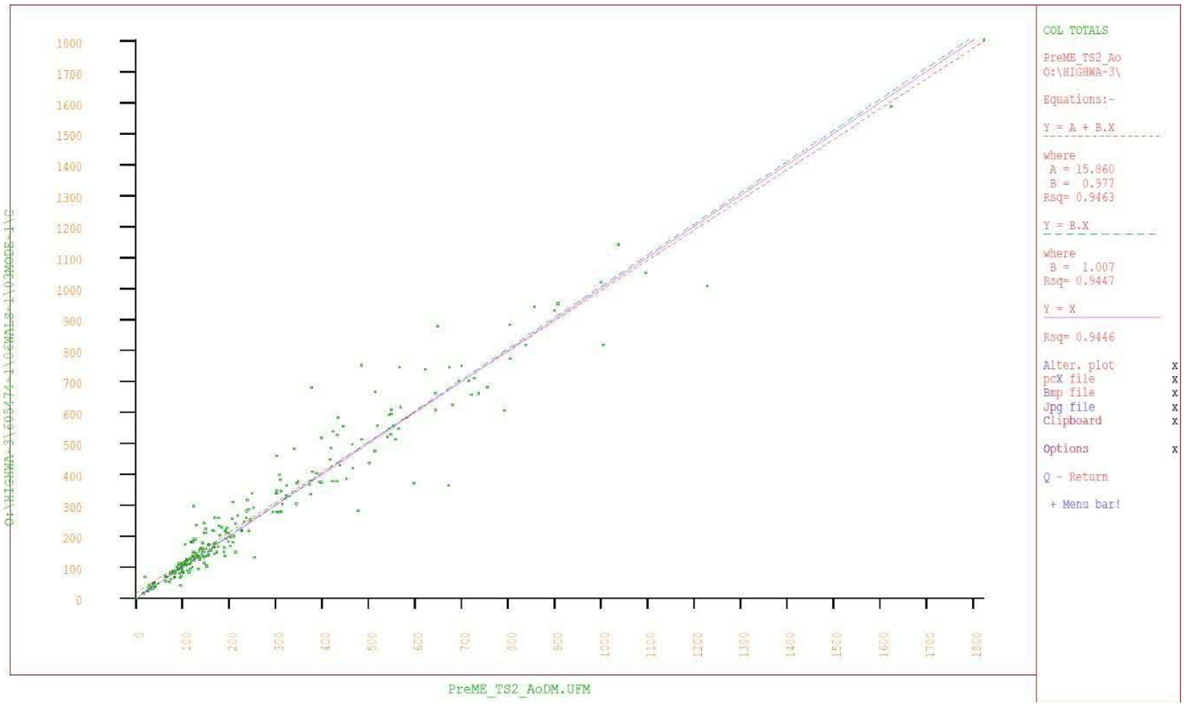


Figure A-25: PM Matrix Changes due to ME – Individual Cell Values – AoDM

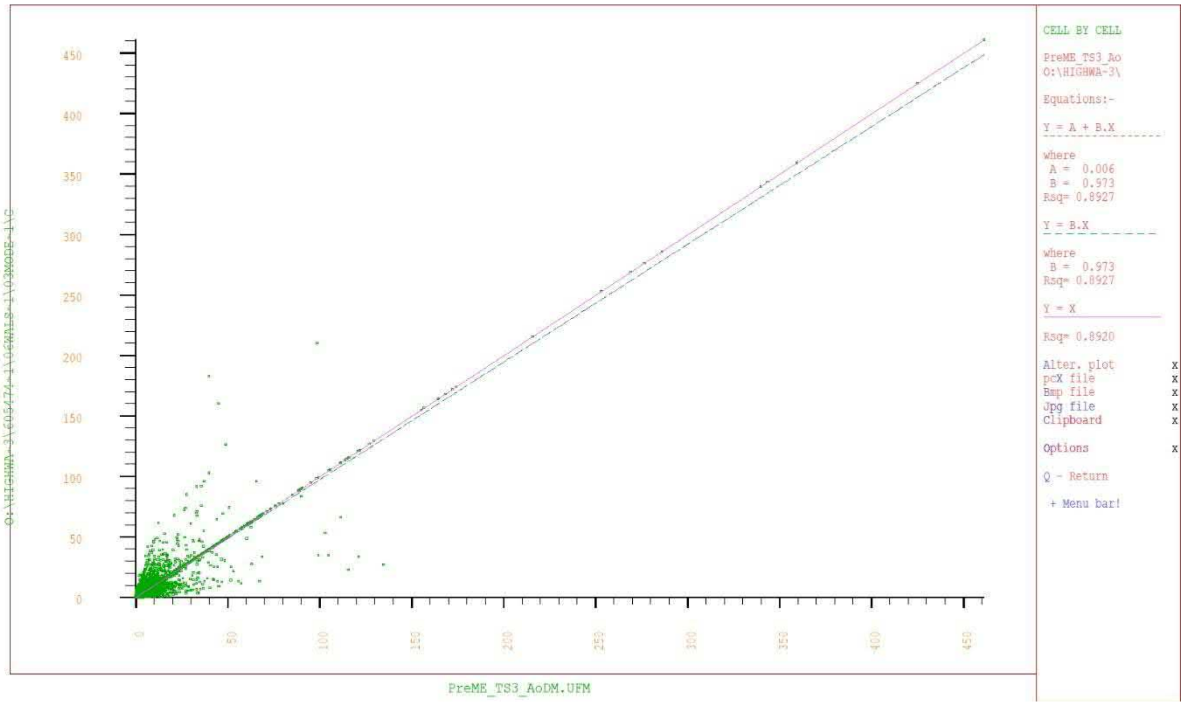


Figure A-26: PM Matrix Changes due to ME – Origin Totals – AoDM

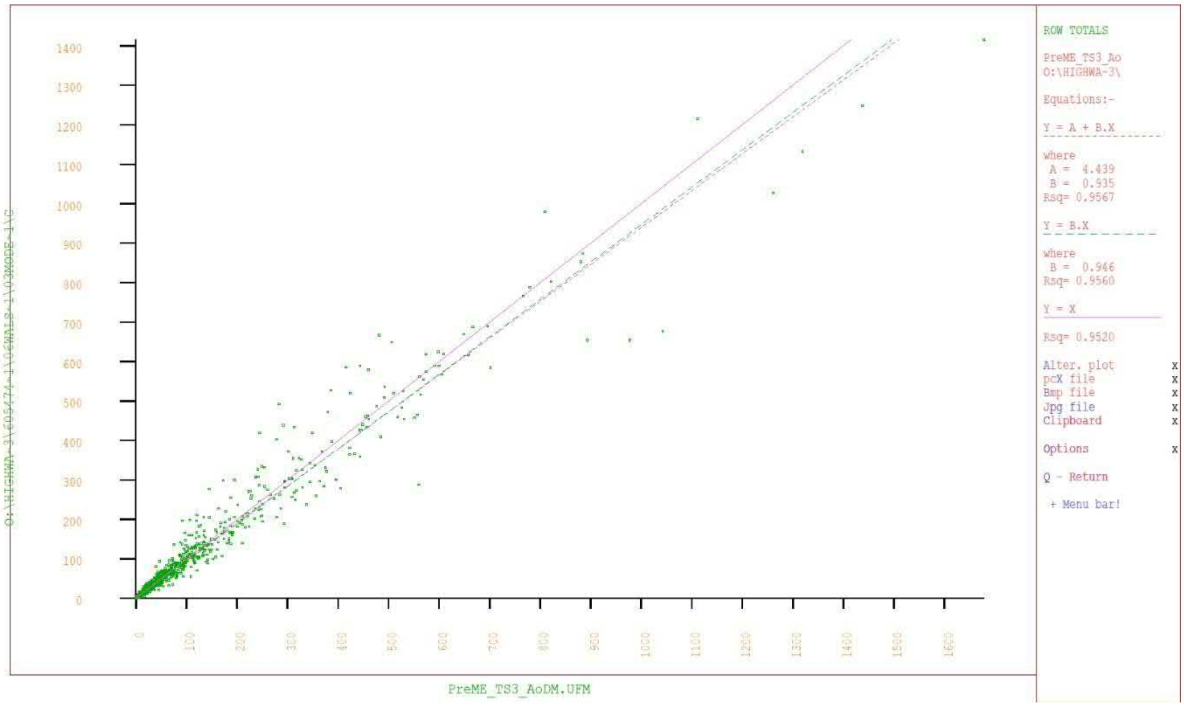
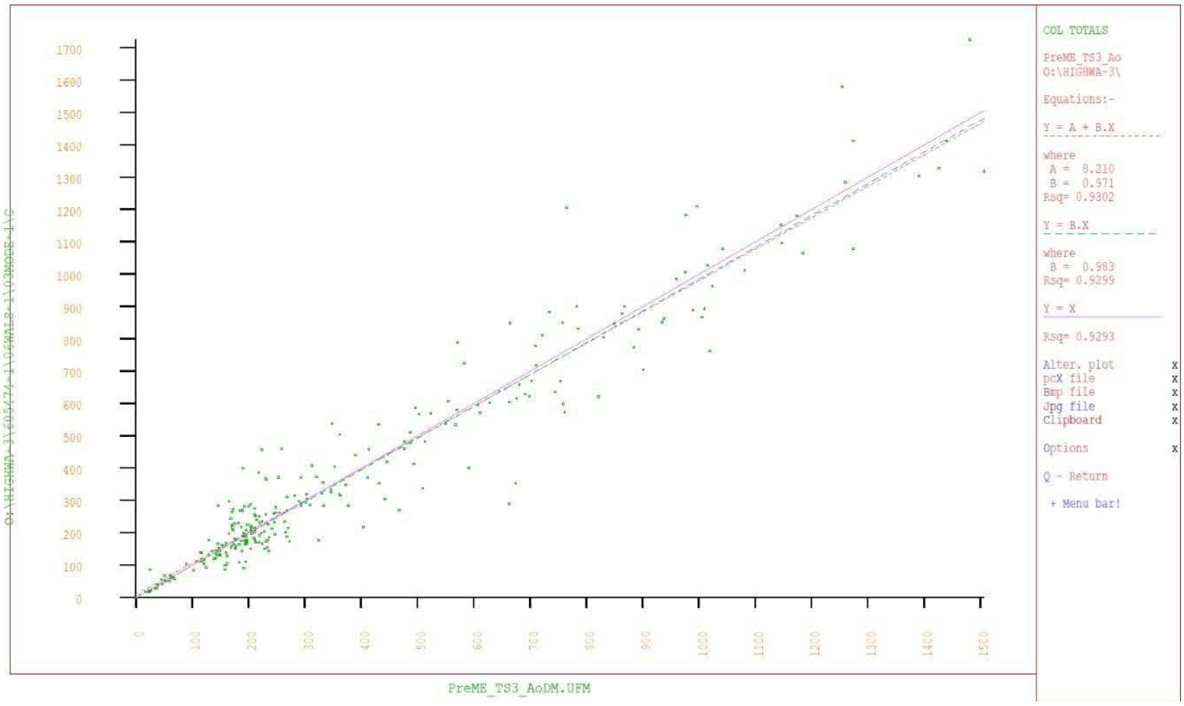


Figure A-27: PM Matrix Changes due to ME – Destination Totals – AoDM



APPENDIX B

Figure B-1: AM Trip Length Distribution – Cars

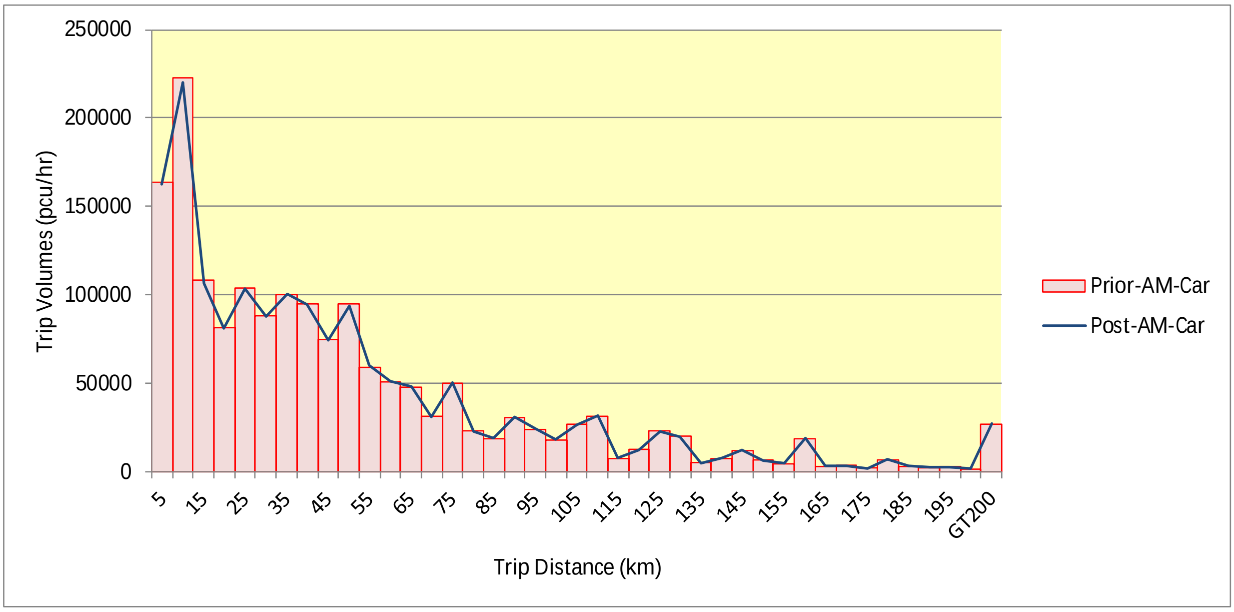


Figure B-2: AM Trip Length Distribution – LGVs

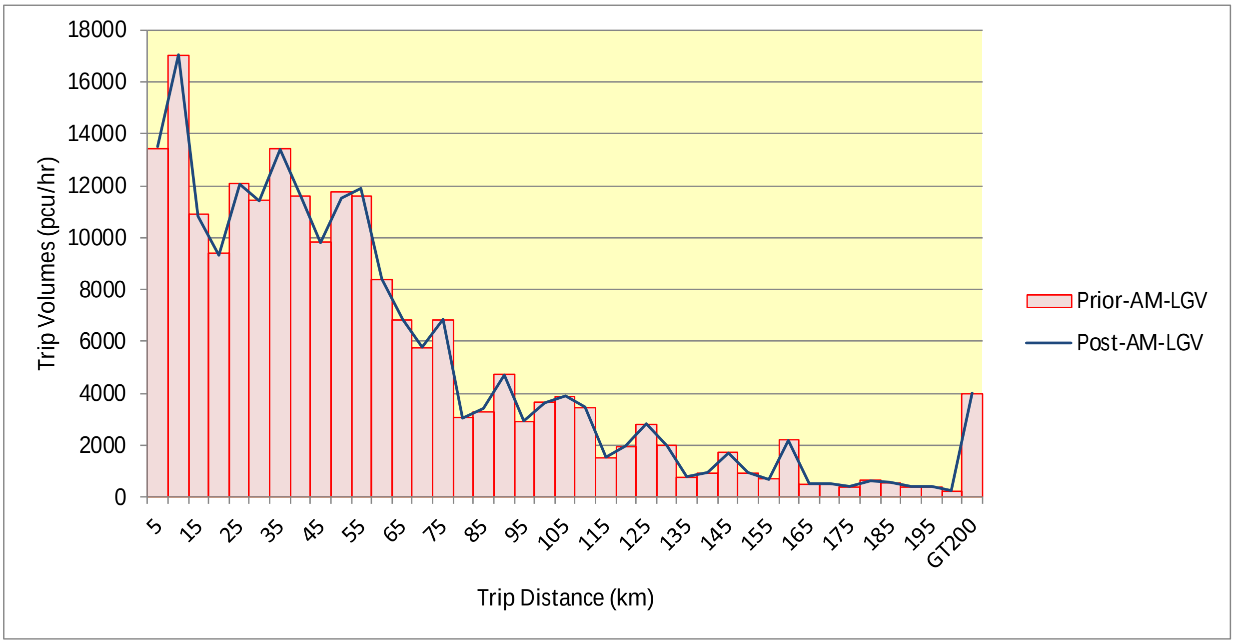


Figure B-3: AM Trip Length Distribution – HGVs

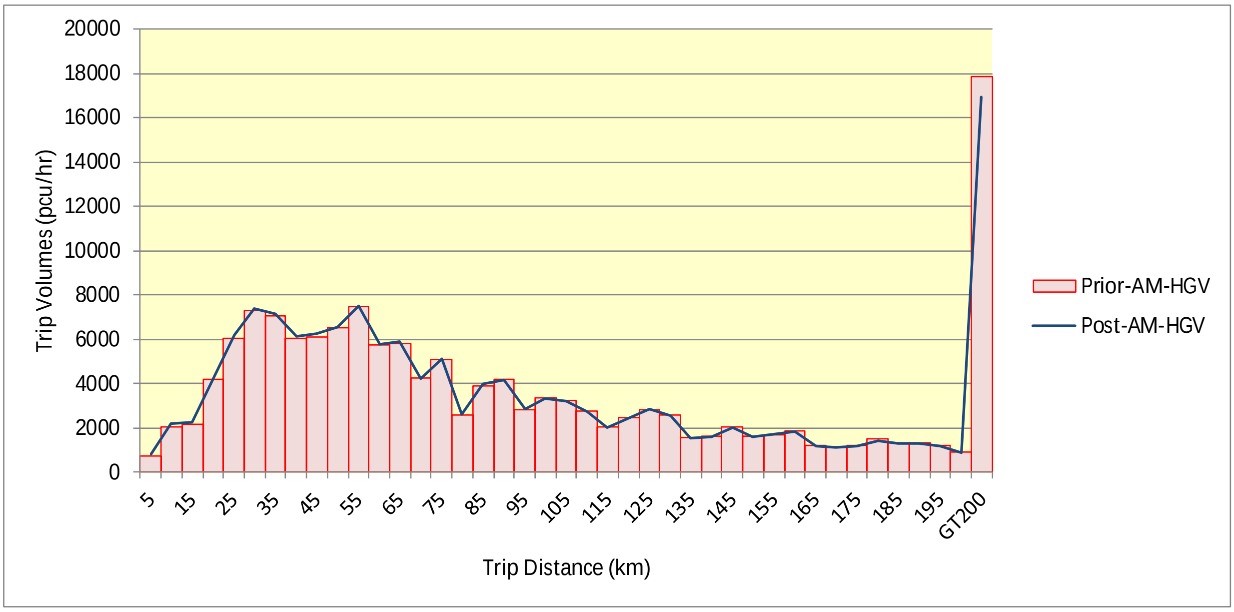


Figure B-4: IP Trip Length Distribution – Cars

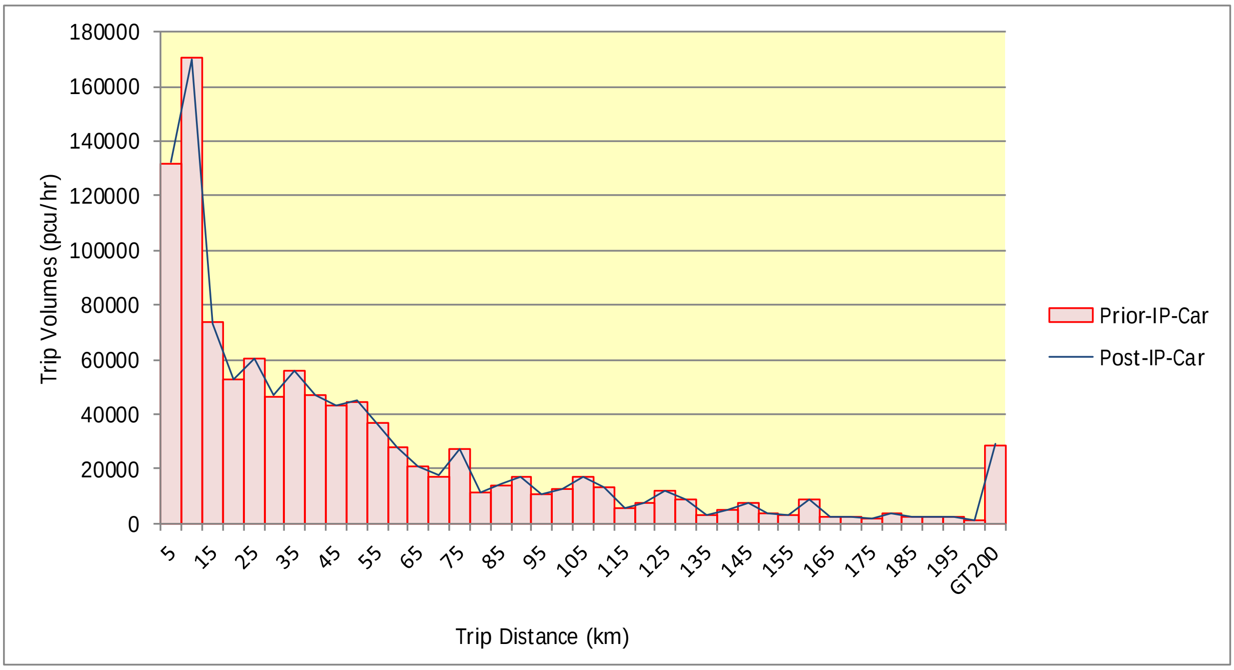


Figure B-5: IP Trip Length Distribution – LGVs

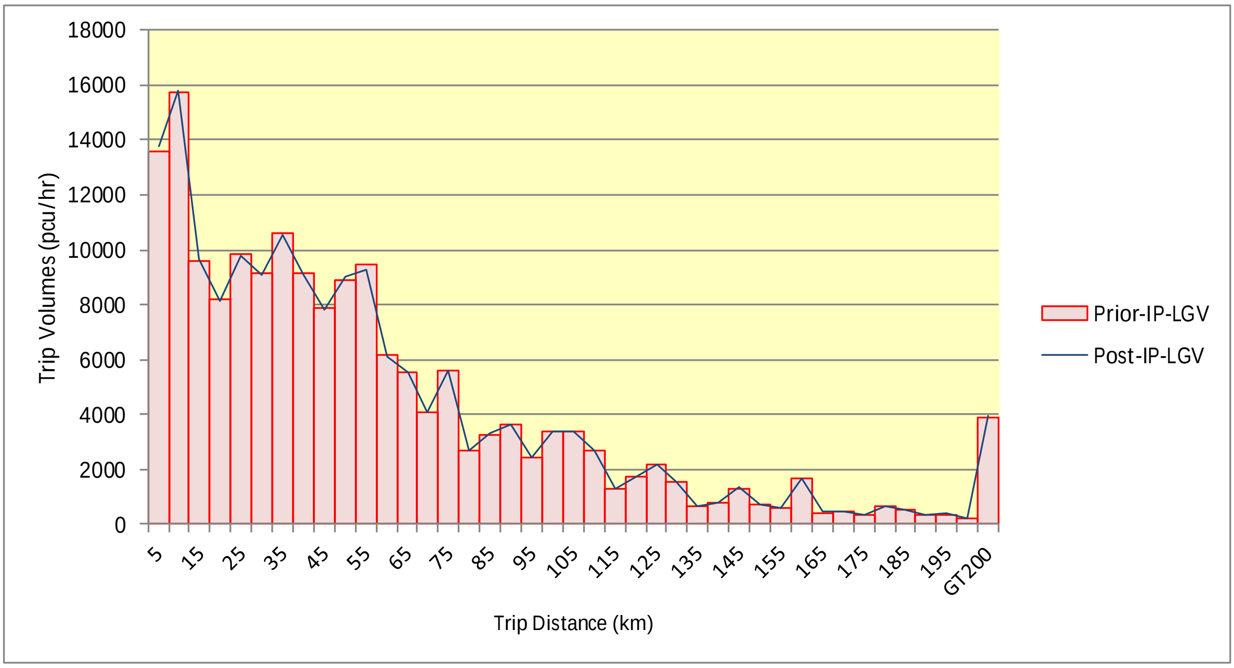


Figure B-6: IP Trip Length Distribution – HGVs

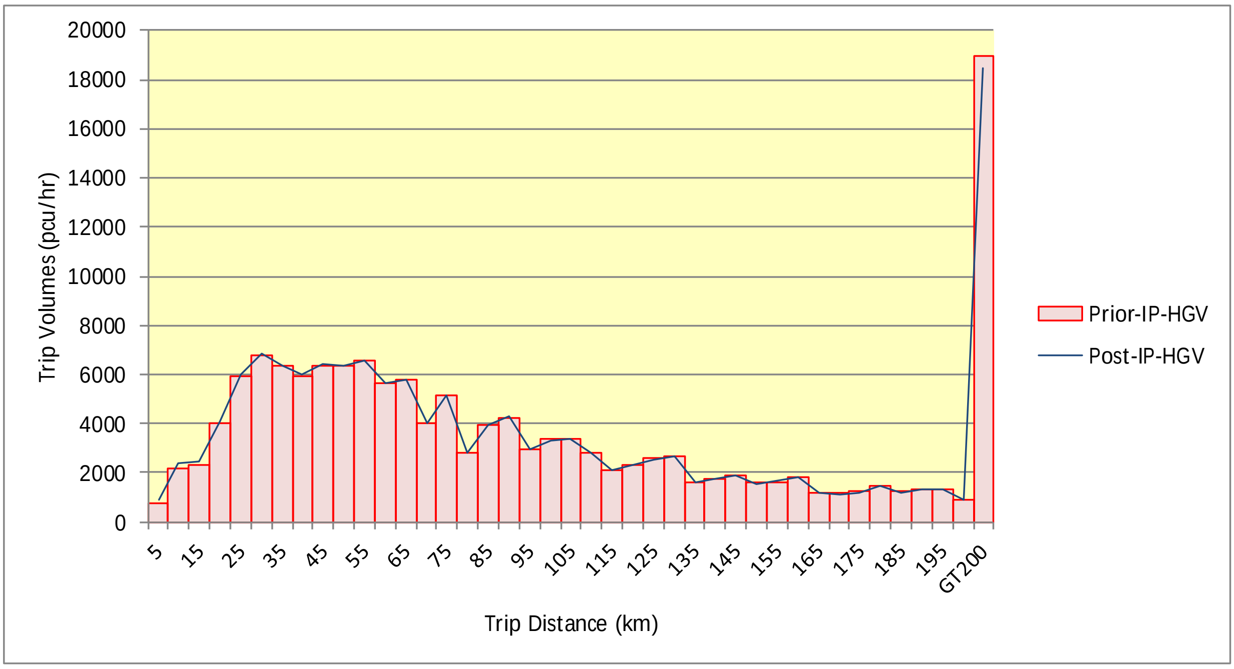


Figure B-7: PM Trip Length Distribution – Cars

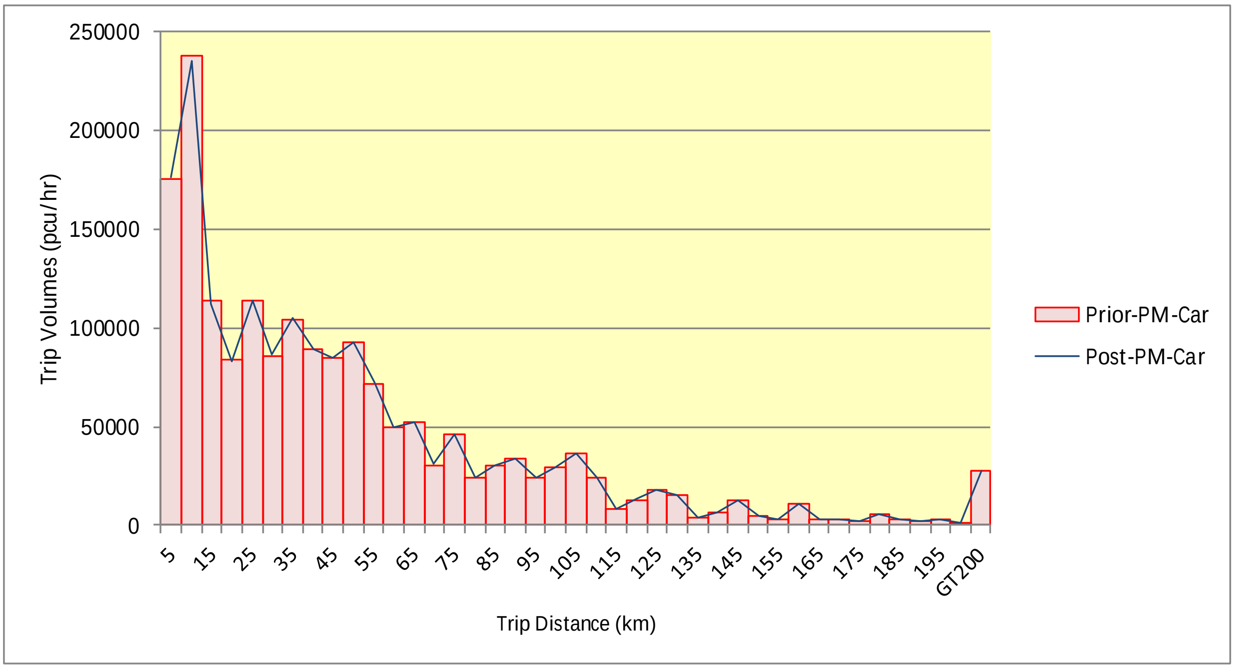


Figure B-8: PM Trip Length Distribution – LGVs

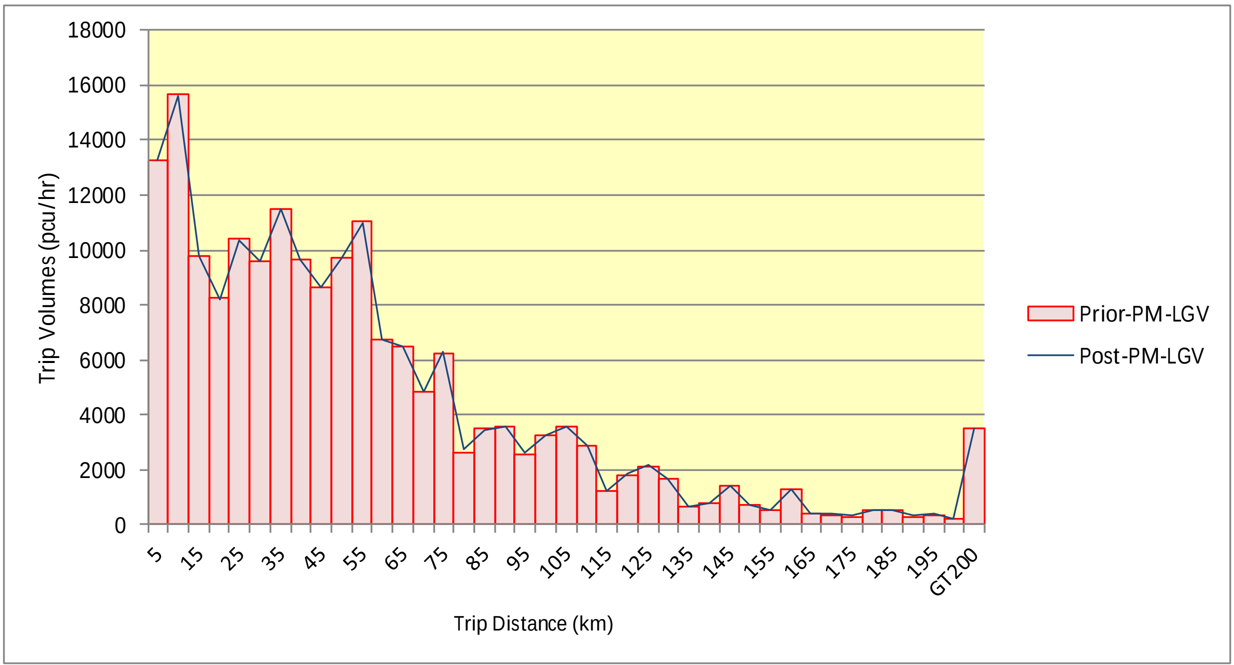
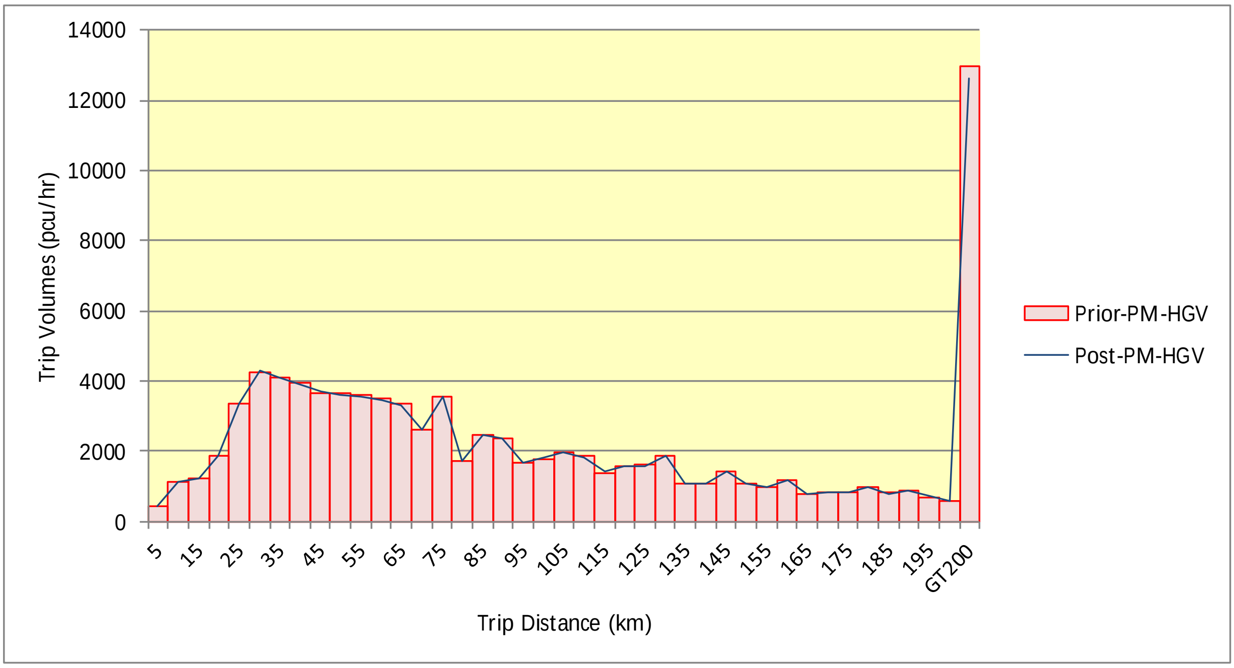


Figure B-9: PM Trip Length Distribution – HGVs



APPENDIX C

Figure C-1: Journey Time Route 1 NB – Modelled Times vs Observed - AM

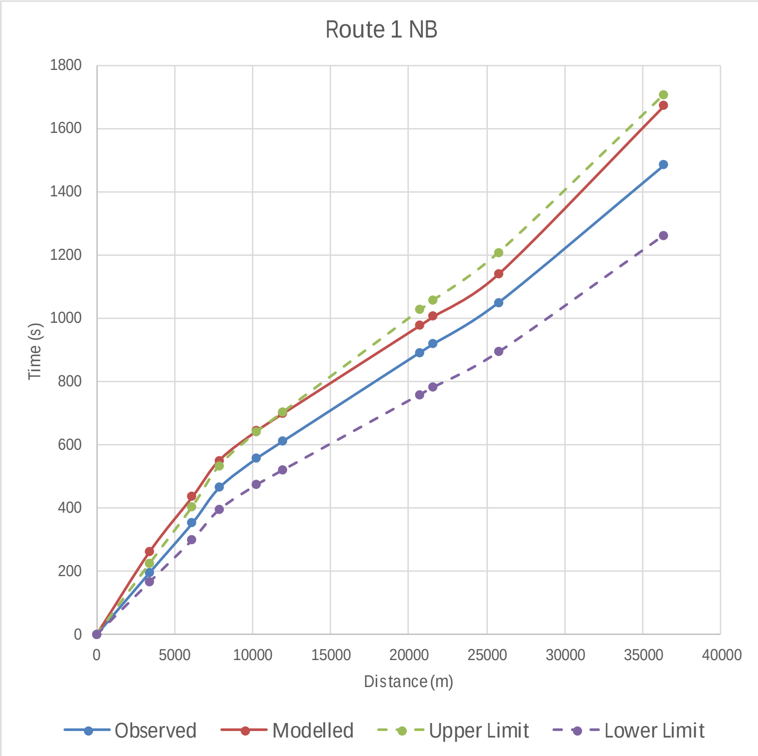


Figure C-2: Journey Time Route 1 SB – Modelled Times vs Observed - AM

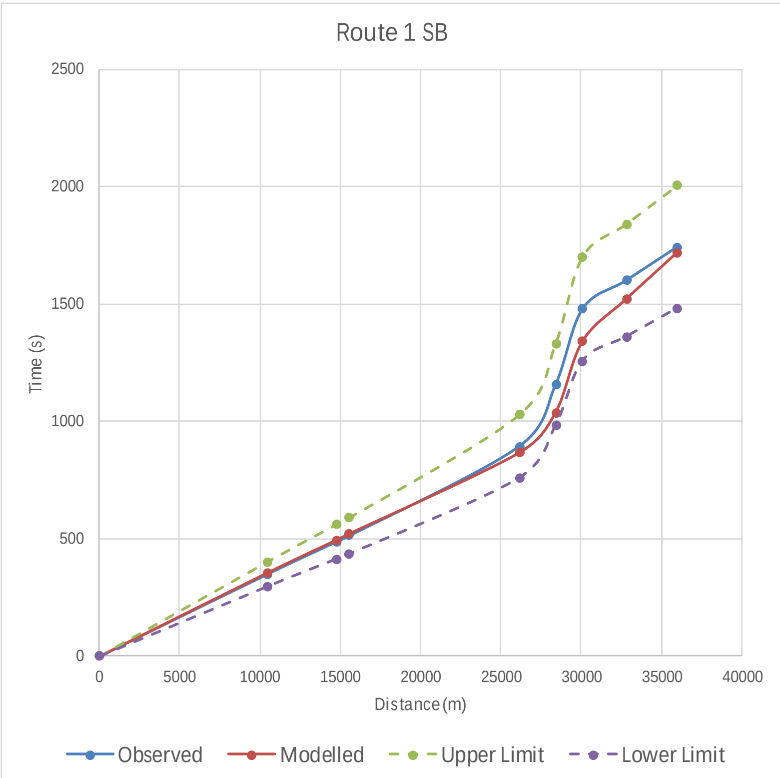


Figure C-3: Journey Time Route 2 EB – Modelled Times vs Observed - AM

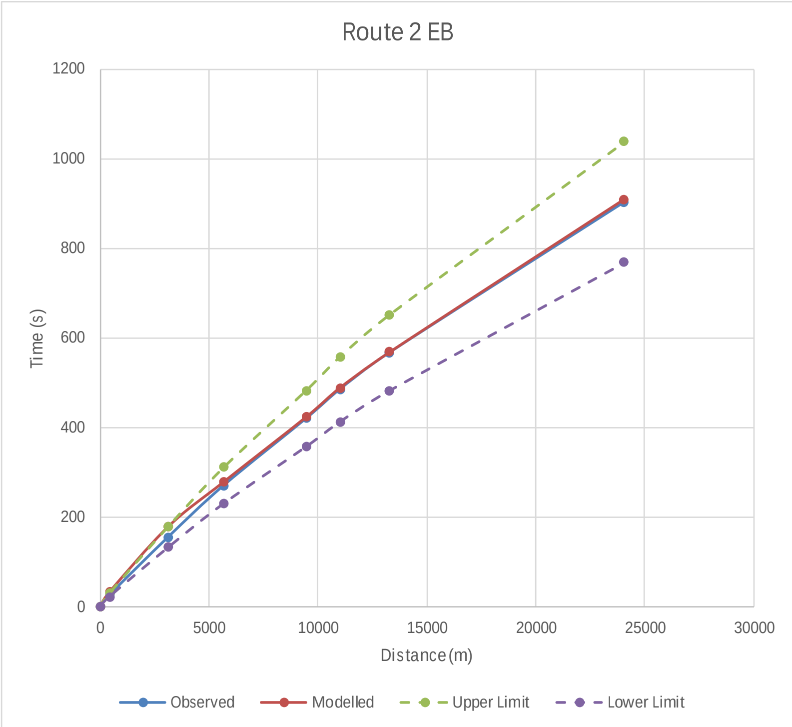


Figure C-4: Journey Time Route 2 WB – Modelled Times vs Observed - AM

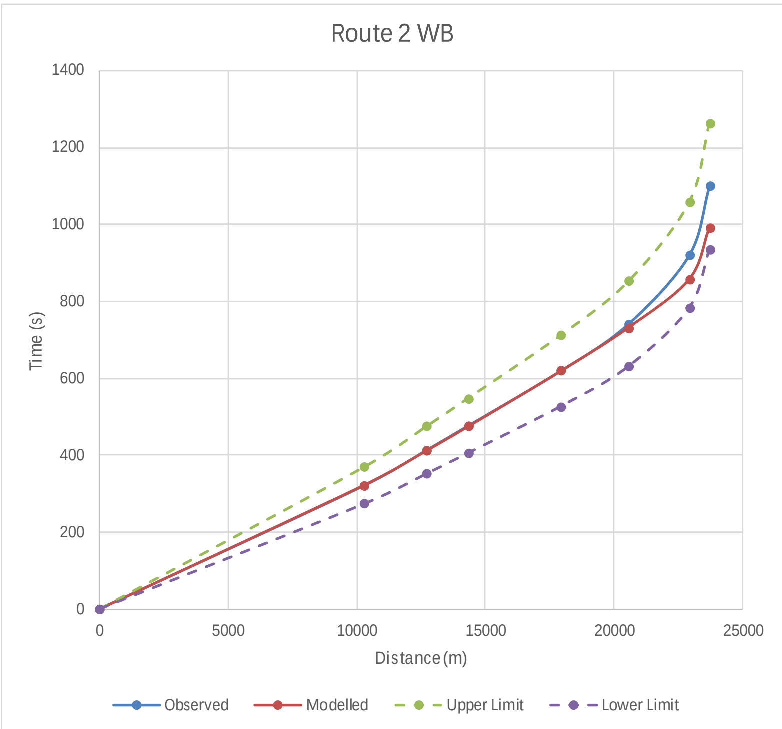


Figure C-5: Journey Time Route 3 EB – Modelled Times vs Observed - AM

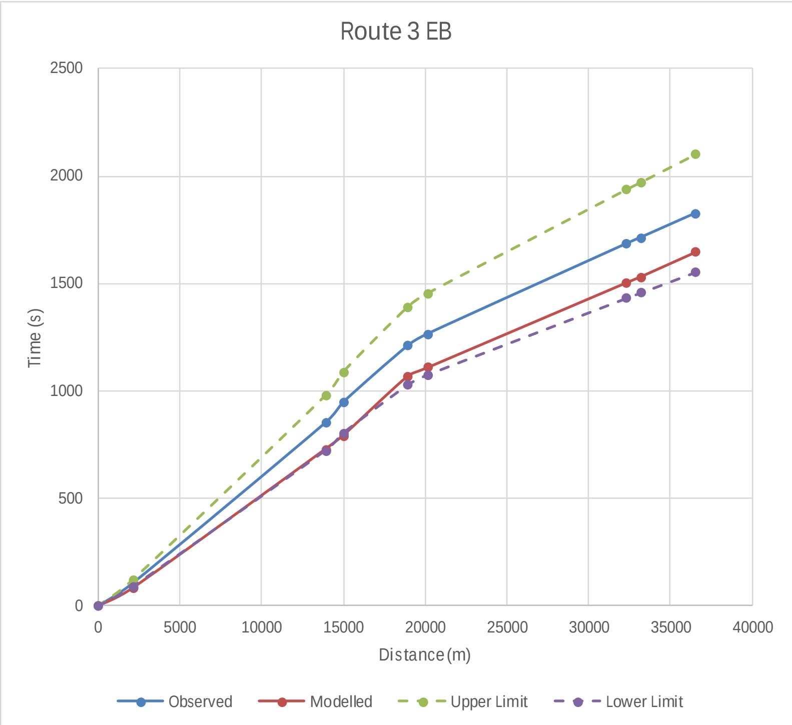


Figure C-6: Journey Time Route 3 WB – Modelled Times vs Observed - AM

Figure C-7: Journey Time Route 4 EB – Modelled Times vs Observed - AM

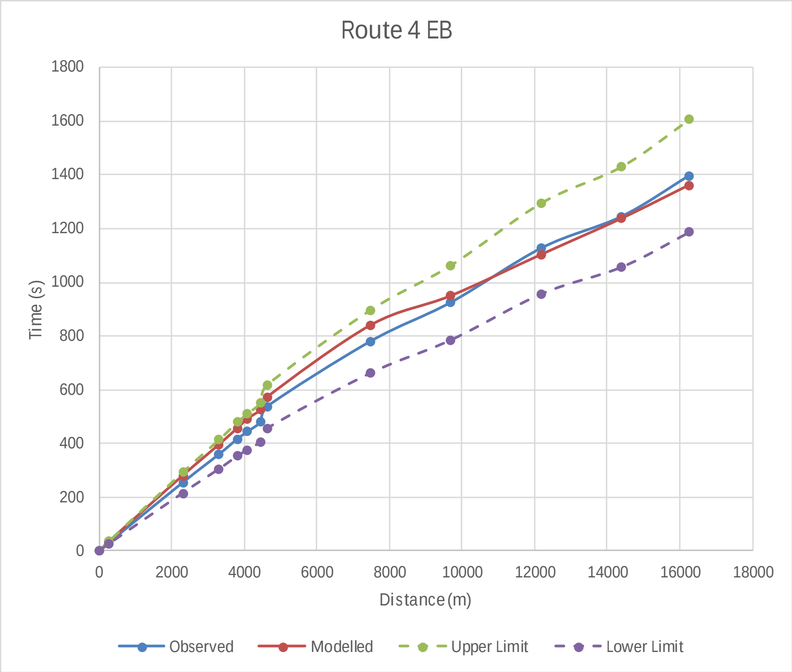


Figure C-8: Journey Time Route 4 WB – Modelled Times vs Observed - AM

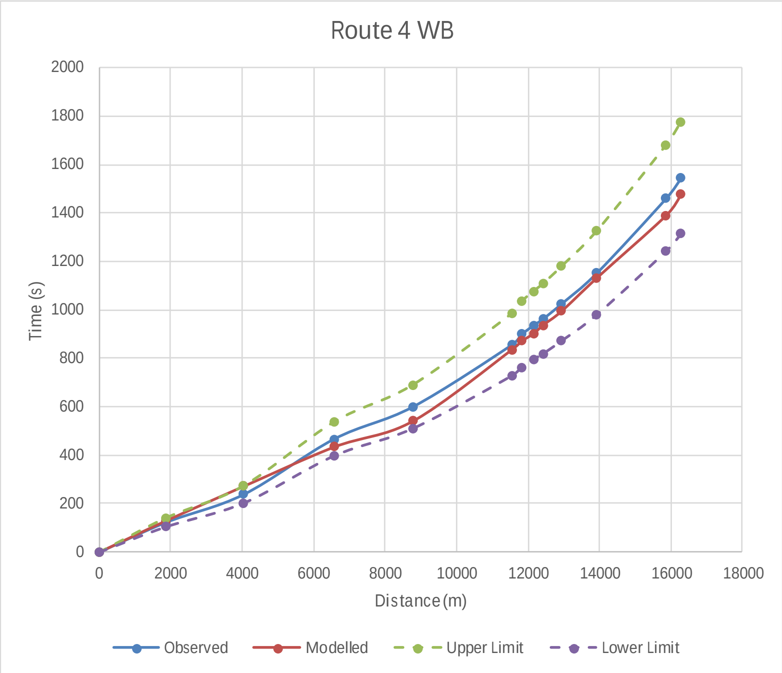


Figure C-9: Journey Time Route 5 NB – Modelled Times vs Observed - AM

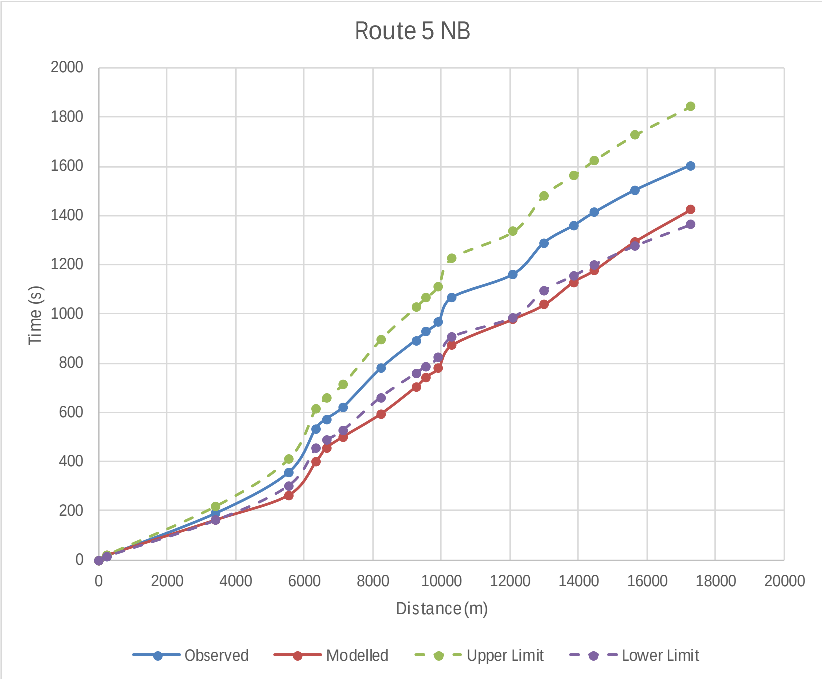


Figure C-10: Journey Time Route 5 SB – Modelled Times vs Observed - AM

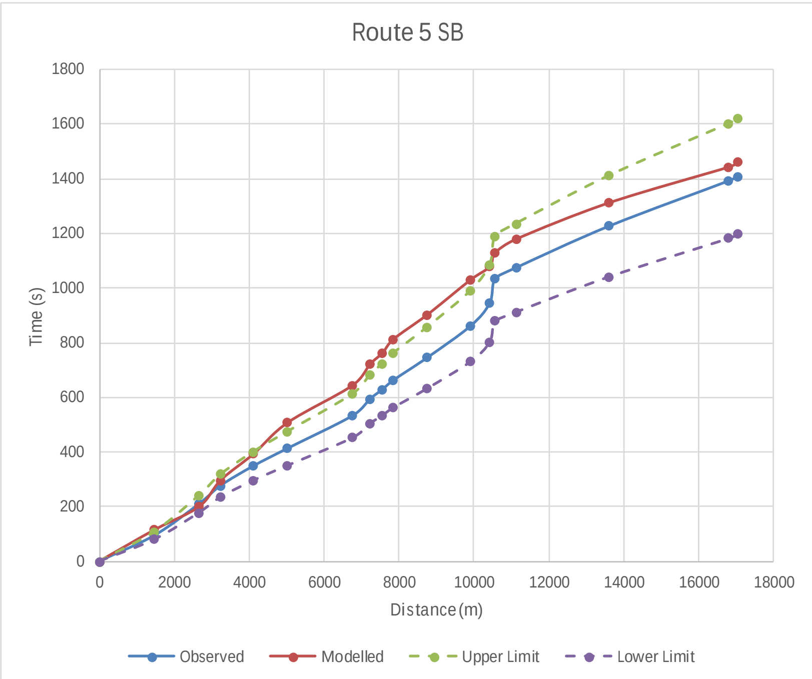


Figure C-11: Journey Time Route 6 EB – Modelled Times vs Observed - AM

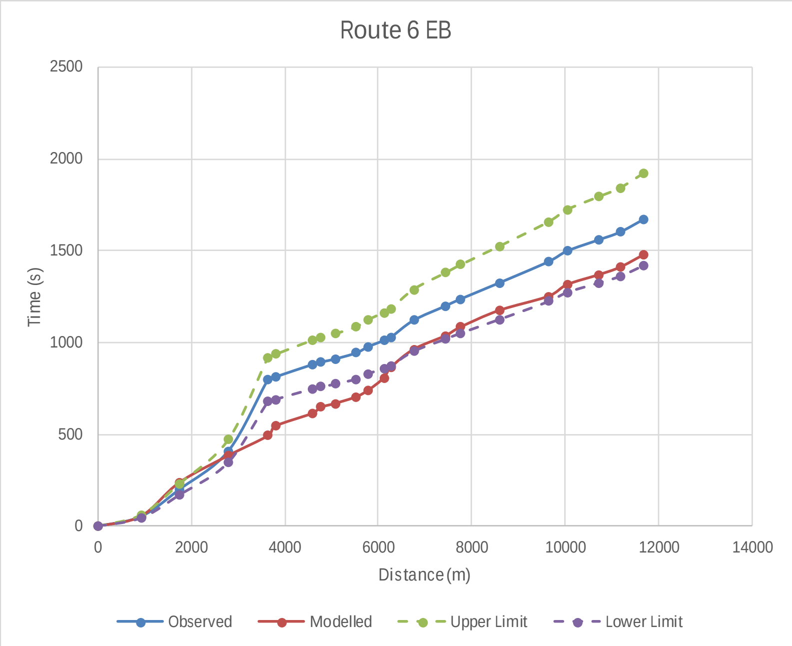


Figure C-12: Journey Time Route 6 WB – Modelled Times vs Observed - AM

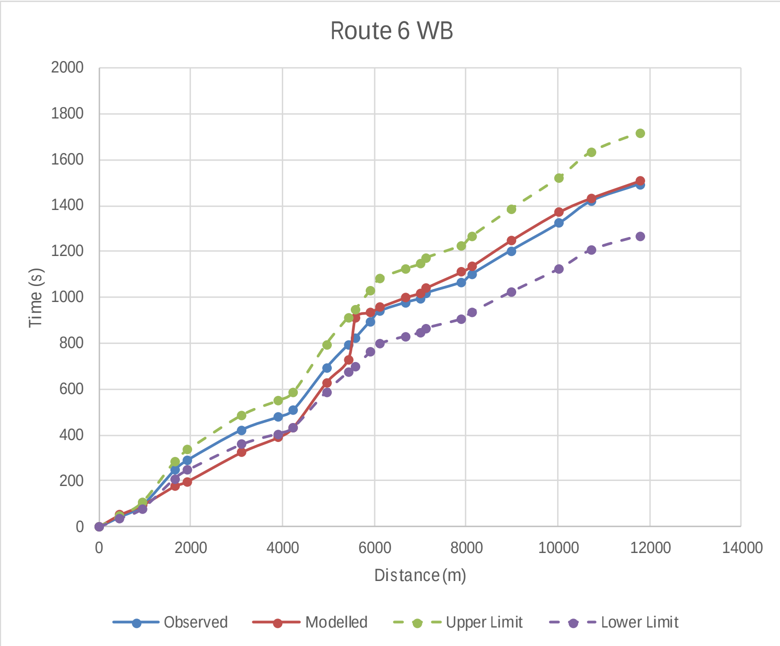


Figure C-13: Journey Time Route 7 EB – Modelled Times vs Observed - AM

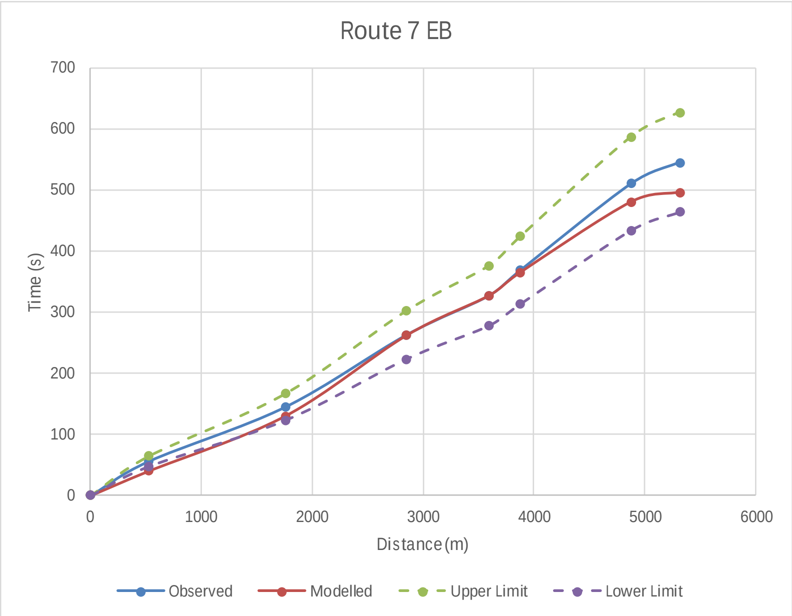


Figure C-14: Journey Time Route 7 WB – Modelled Times vs Observed - AM

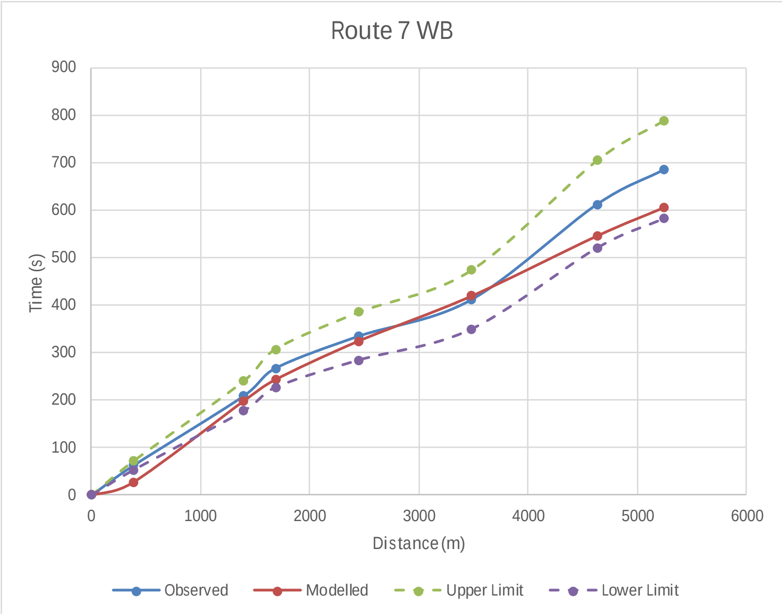


Figure C-15: Journey Time Route 8 NB – Modelled Times vs Observed - AM

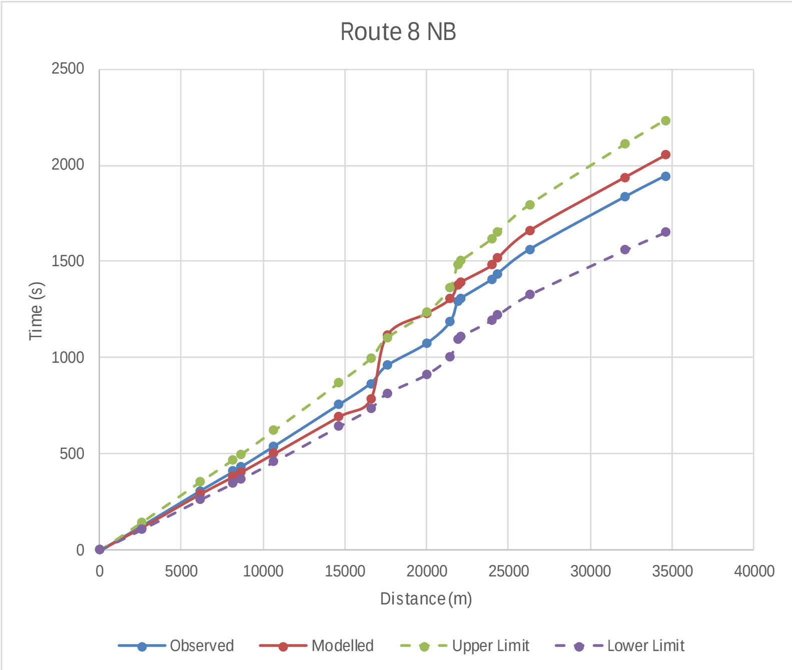


Figure C-16: Journey Time Route 8 SB – Modelled Times vs Observed - AM

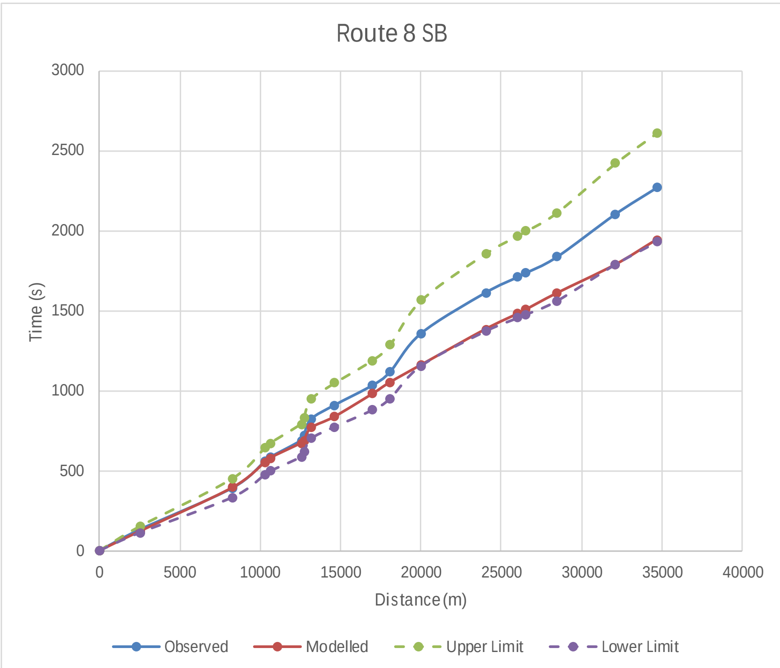


Figure C-17: Journey Time Route 9 EB – Modelled Times vs Observed - AM

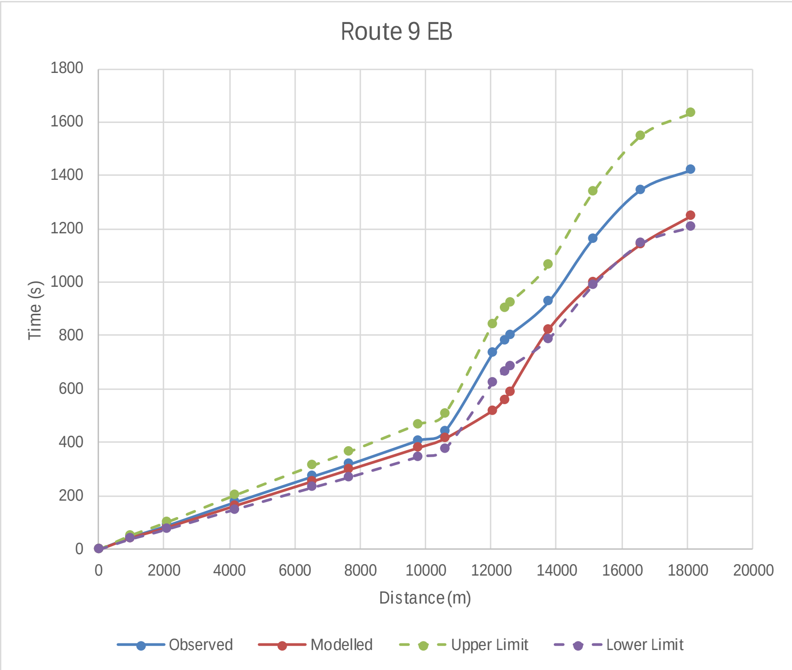


Figure C-18: Journey Time Route 9 WB – Modelled Times vs Observed - AM

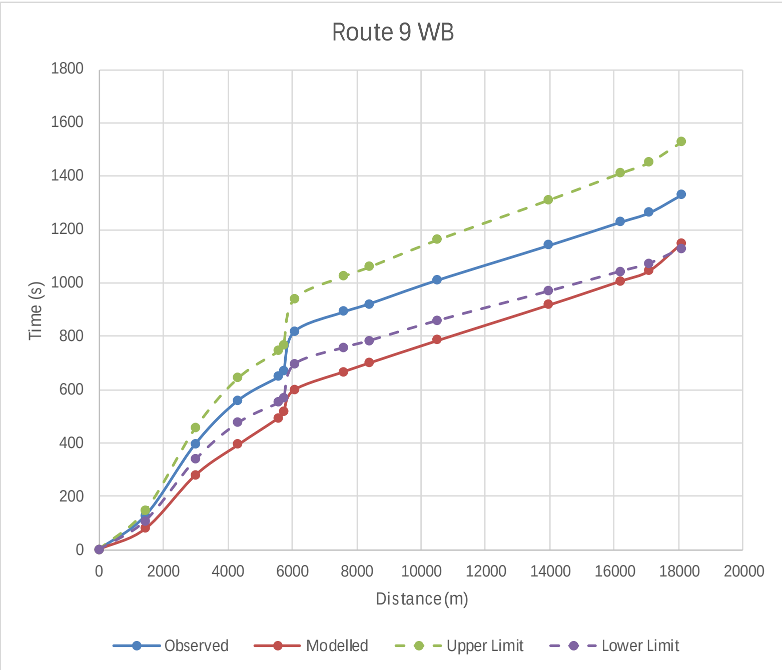


Figure C-19: Journey Time Route 10 NB – Modelled Times vs Observed - AM

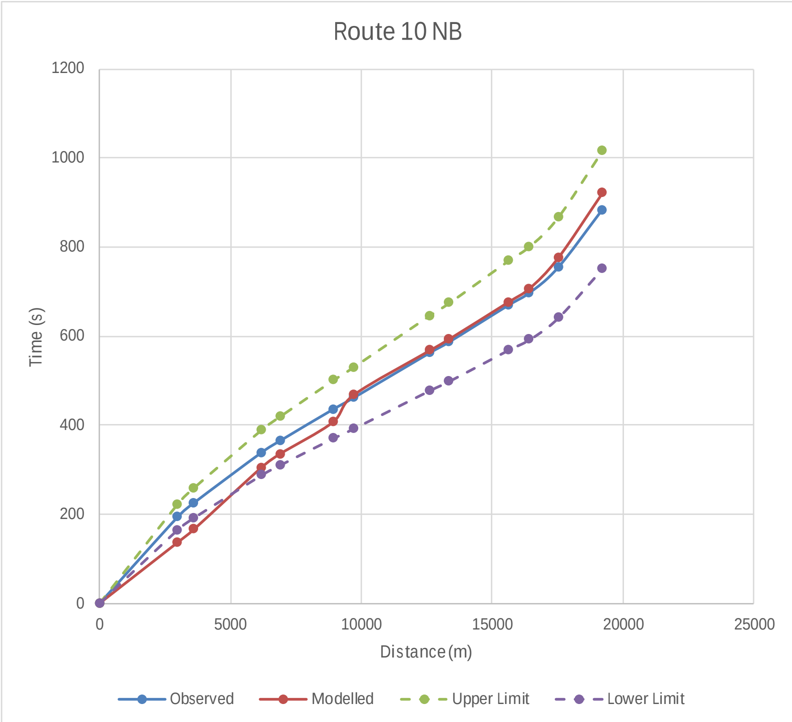


Figure C-20: Journey Time Route 10 SB – Modelled Times vs Observed - AM

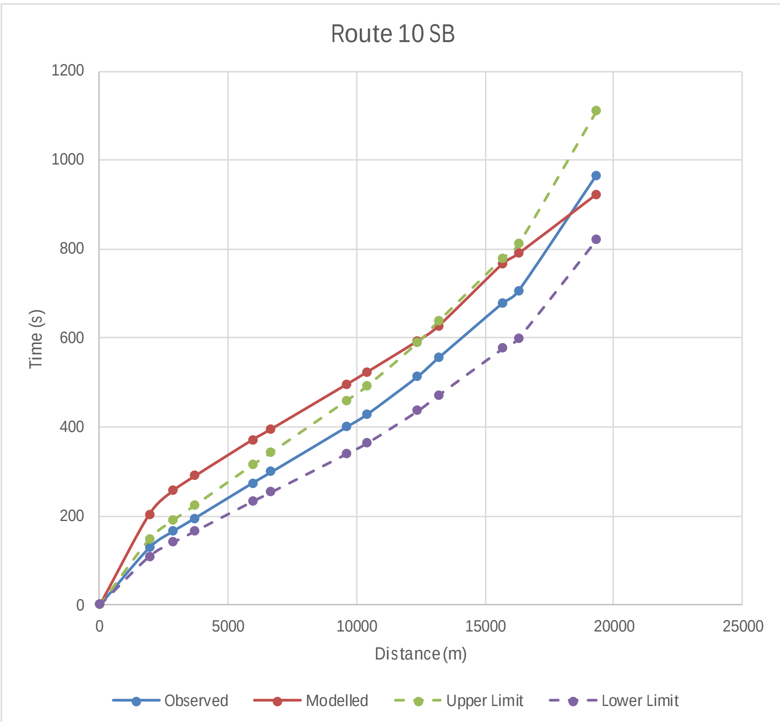


Figure C-21: Journey Time Route 11 NB – Modelled Times vs Observed - AM

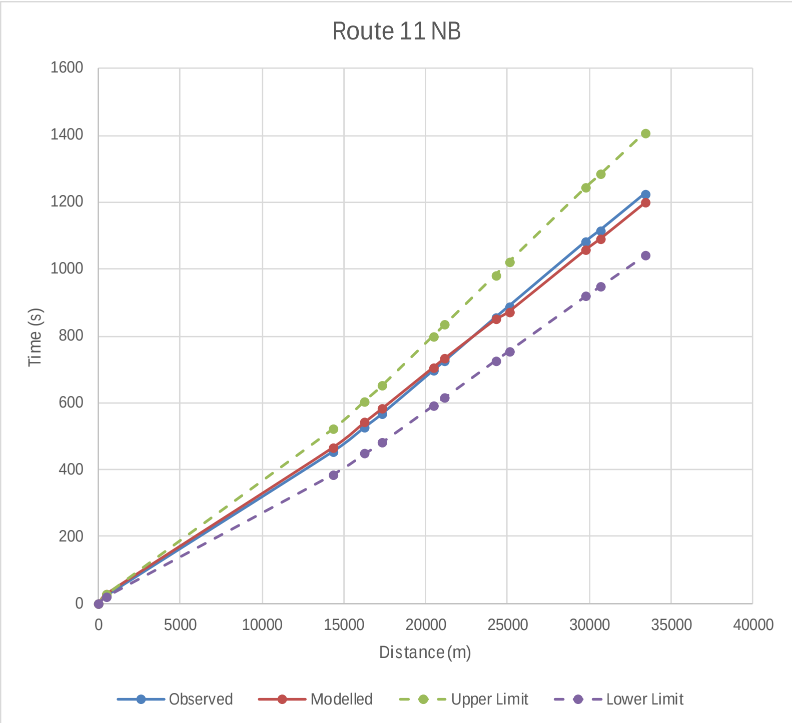
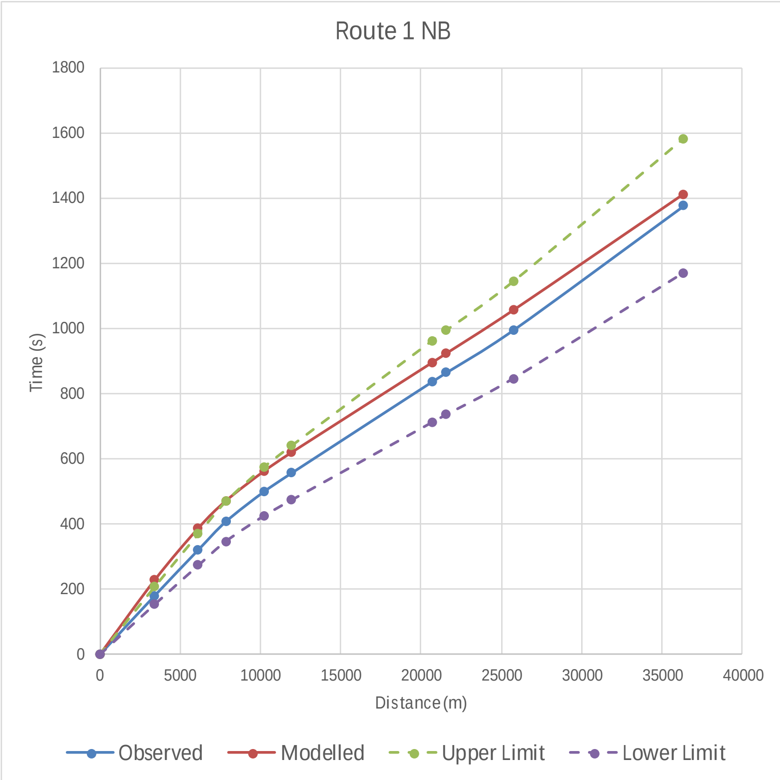


Figure C-22: Journey Time Route 11 SB – Modelled Times vs Observed - AM

Figure C-23: Journey Time Route 1 NB – Modelled Times vs Observed - IP



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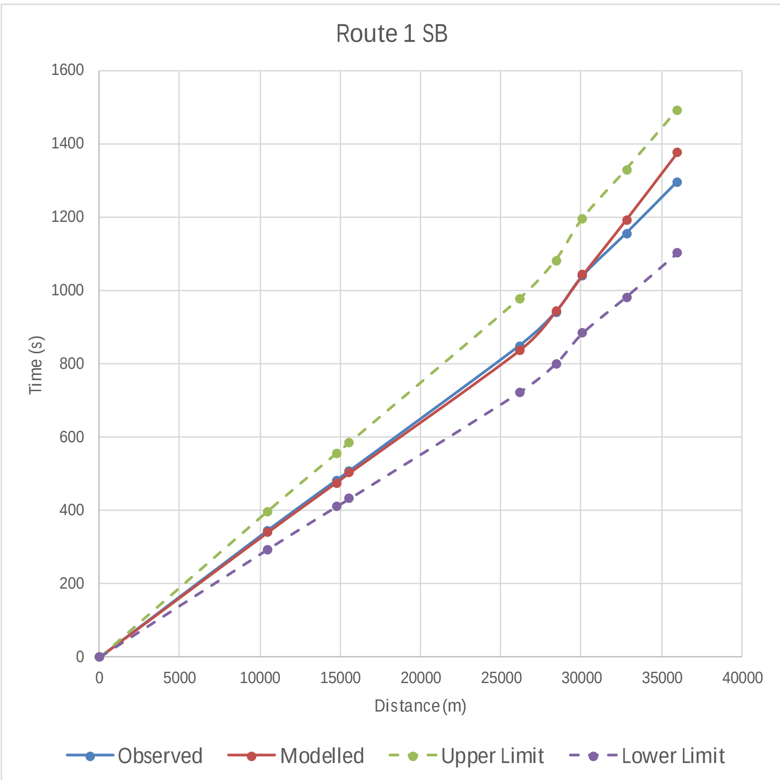


Figure C-25: Journey Time Route 2 EB – Modelled Times vs Observed - IP

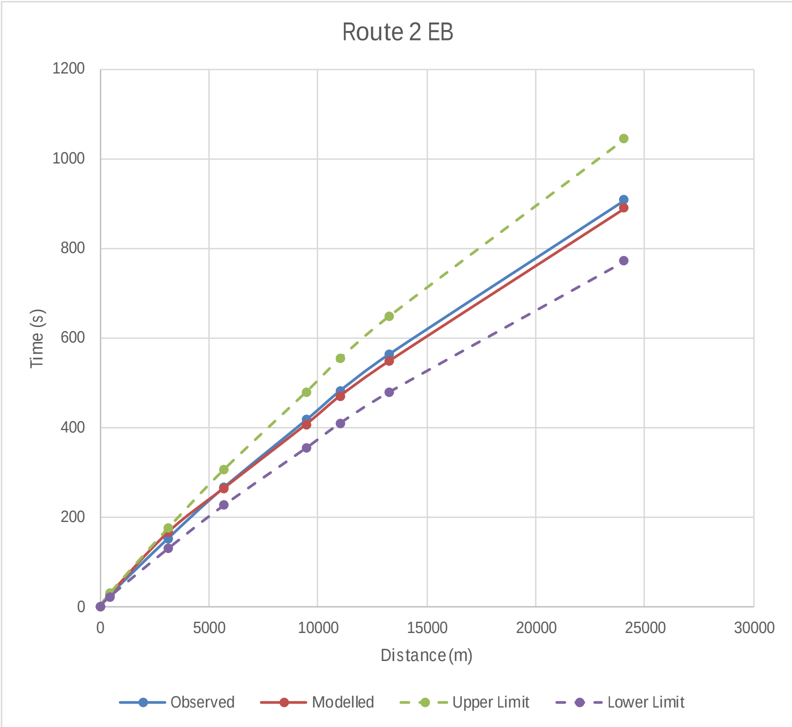
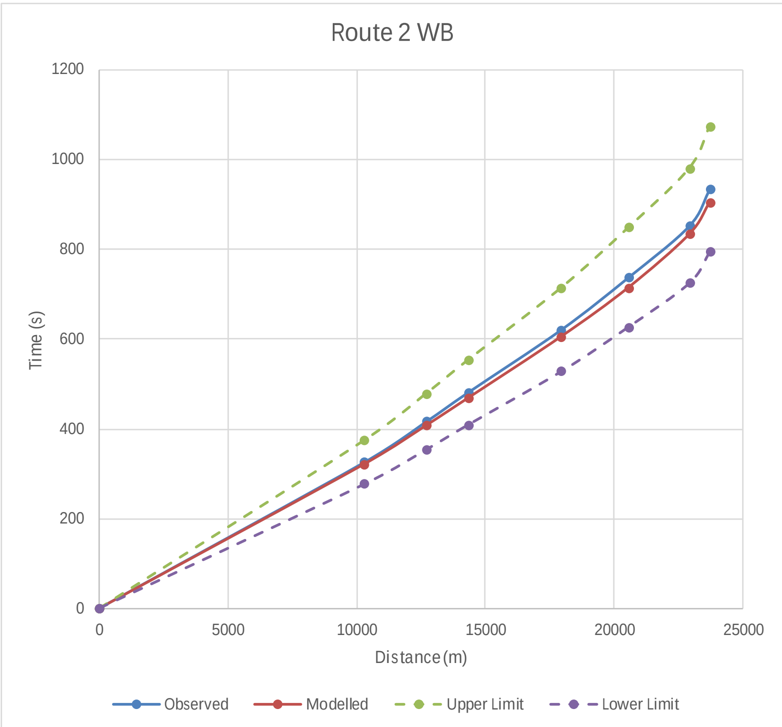


Figure C-26: Journey Time Route 2 WB – Modelled Times vs Observed - IP



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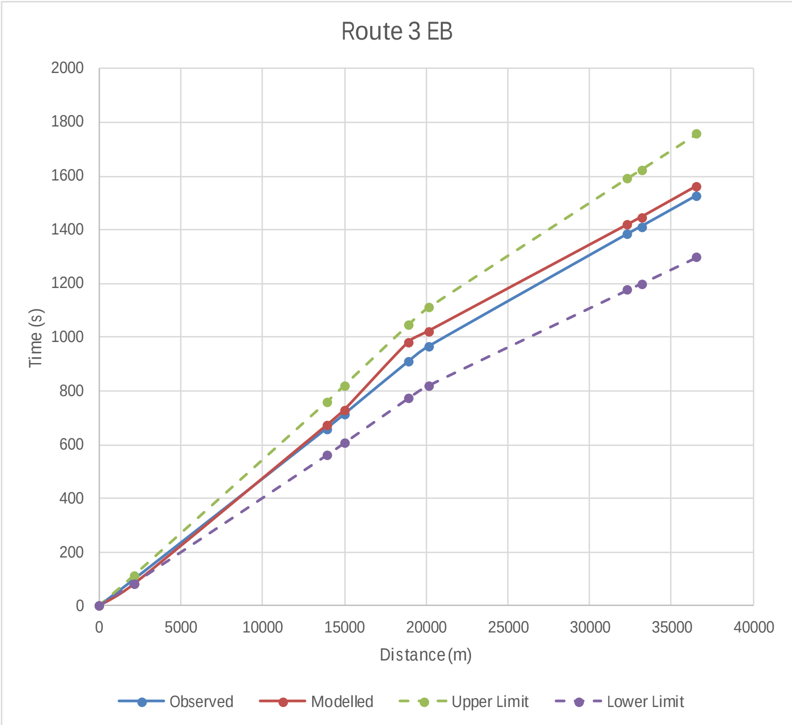
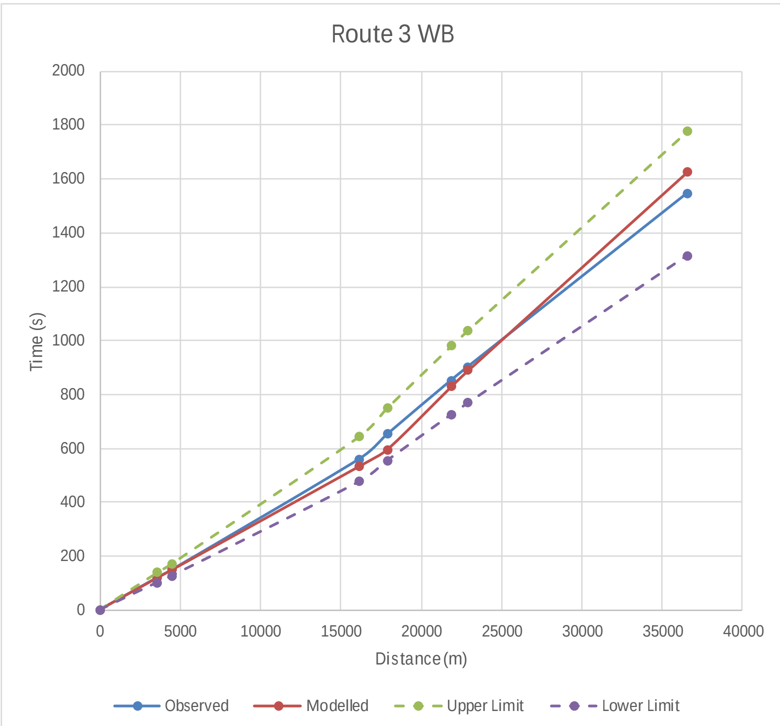


Figure C-28: Journey Time Route 3 WB – Modelled Times vs Observed - IP



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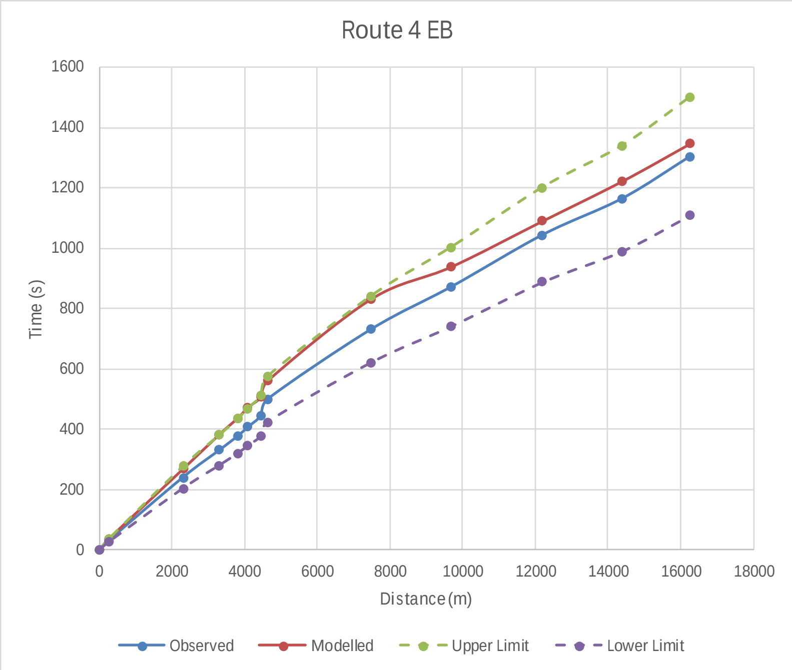

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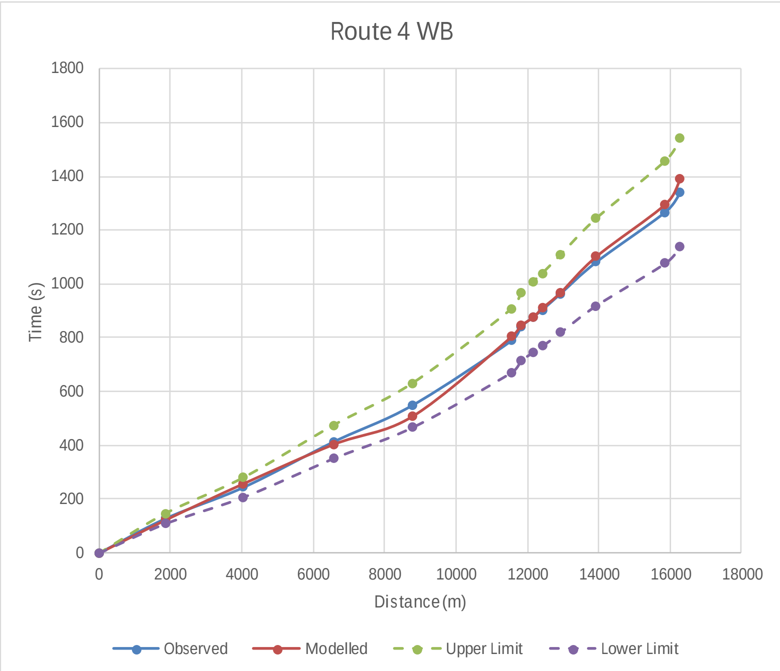

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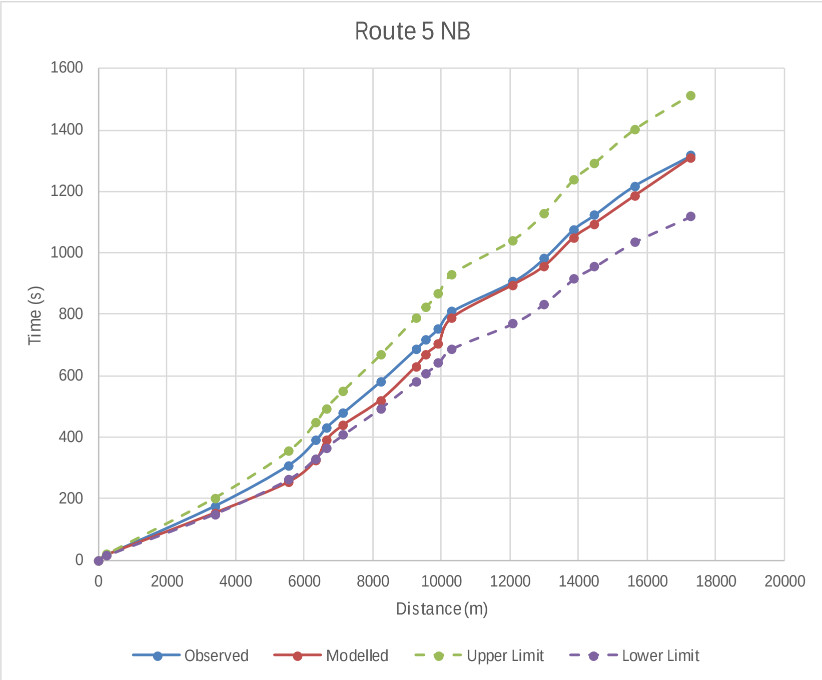

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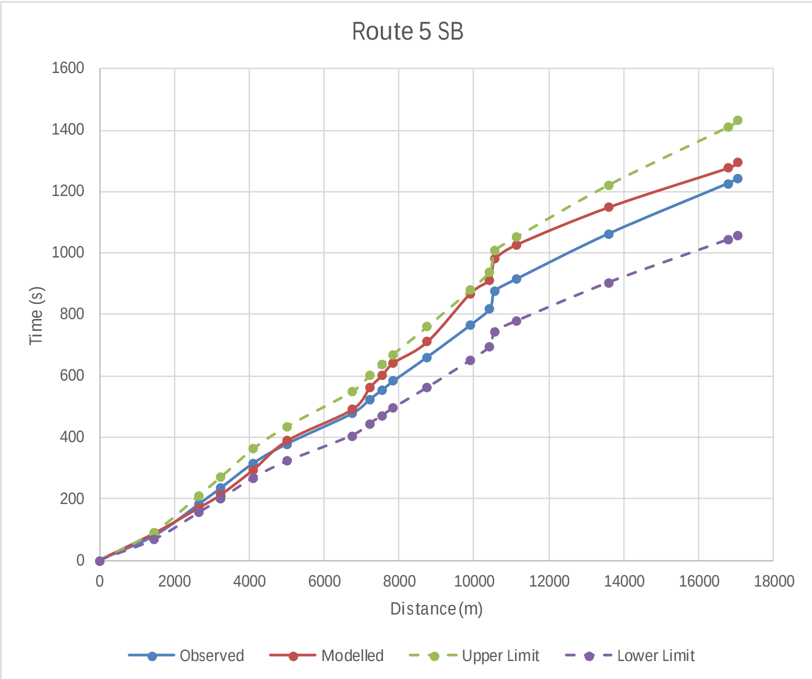

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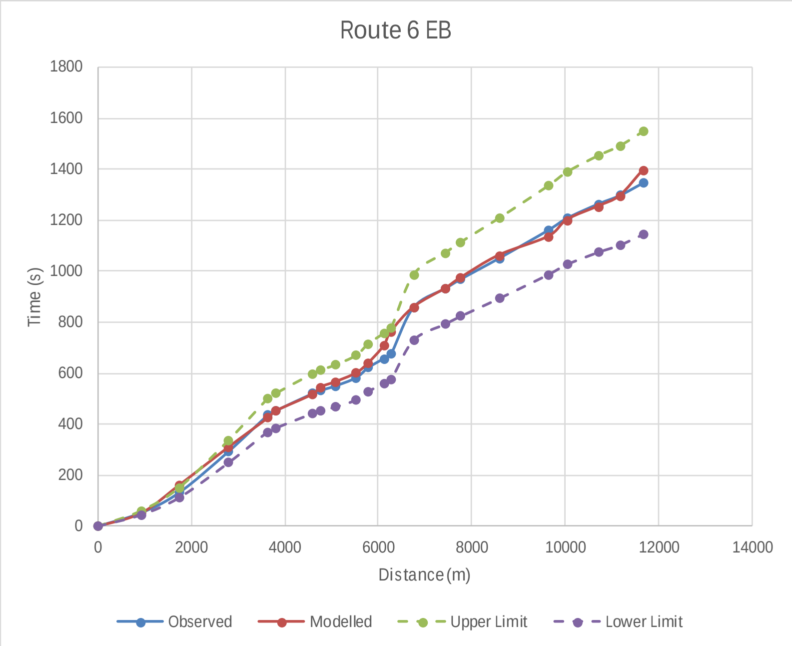

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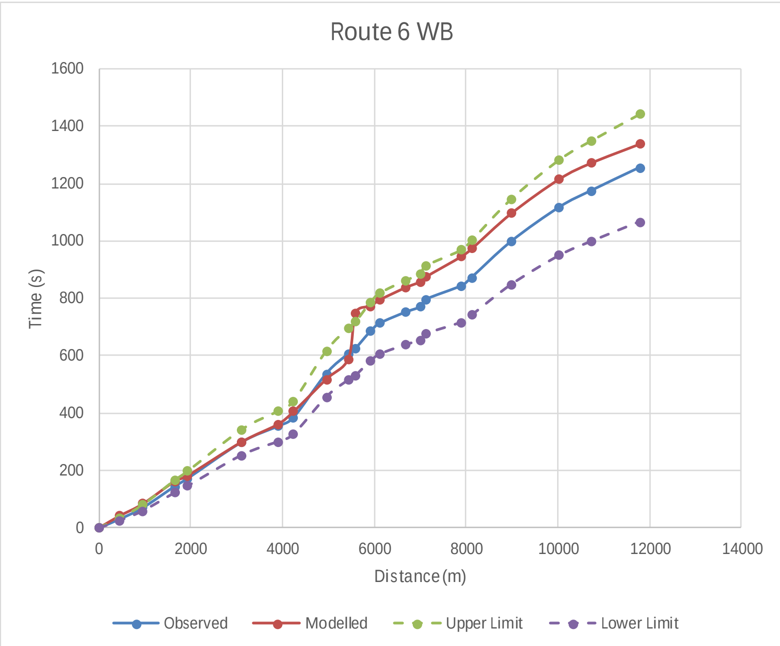


Figure C-35: Journey Time Route 7 EB – Modelled Times vs Observed - IP

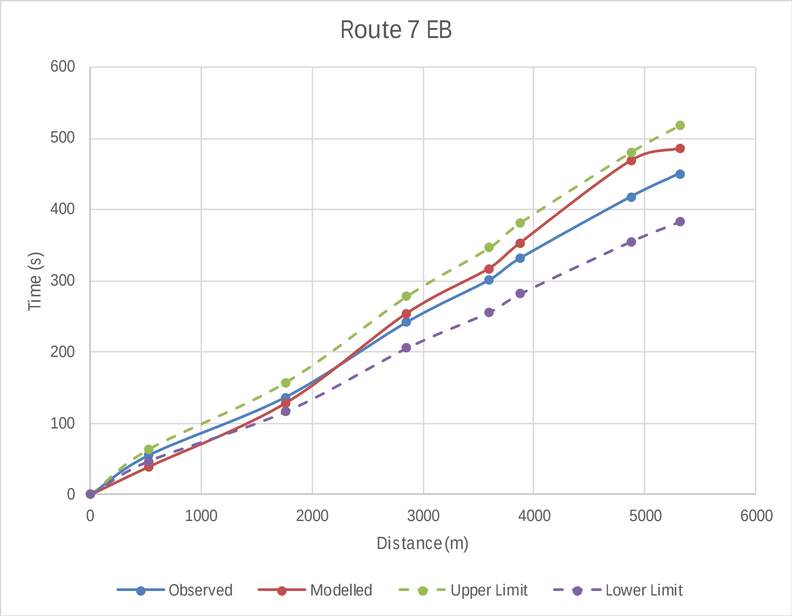


Figure C-36: Journey Time Route 7 WB – Modelled Times vs Observed - IP

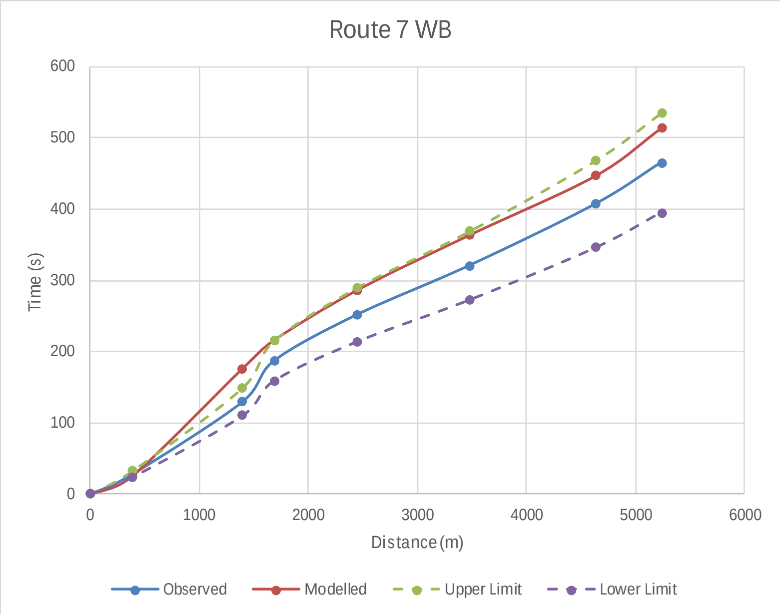


Figure C-37: Journey Time Route 8 NB – Modelled Times vs Observed - IP

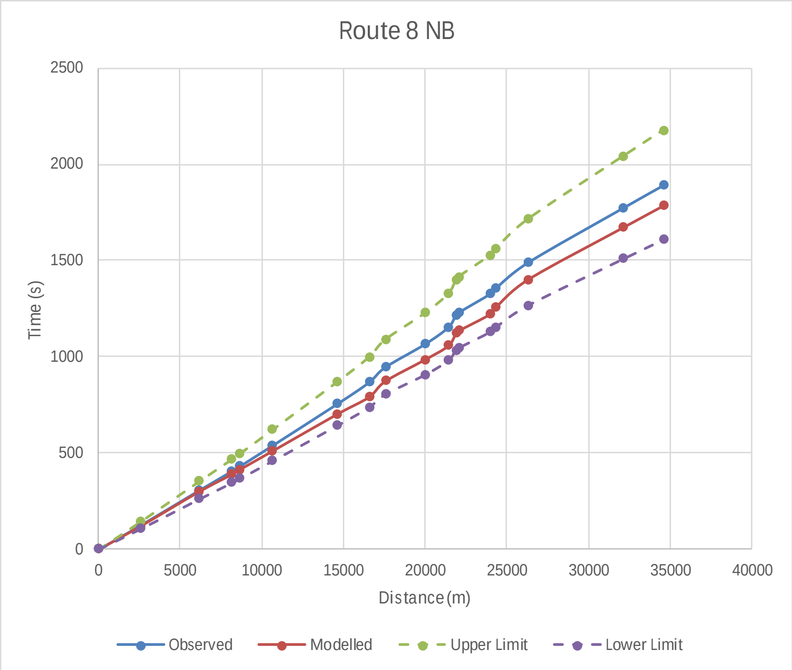


Figure C-38: Journey Time Route 8 SB – Modelled Times vs Observed - IP

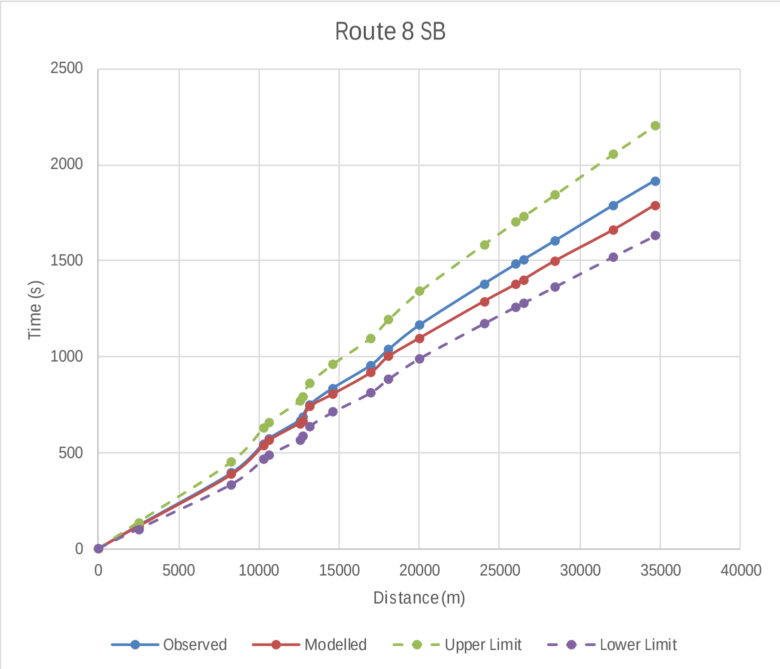
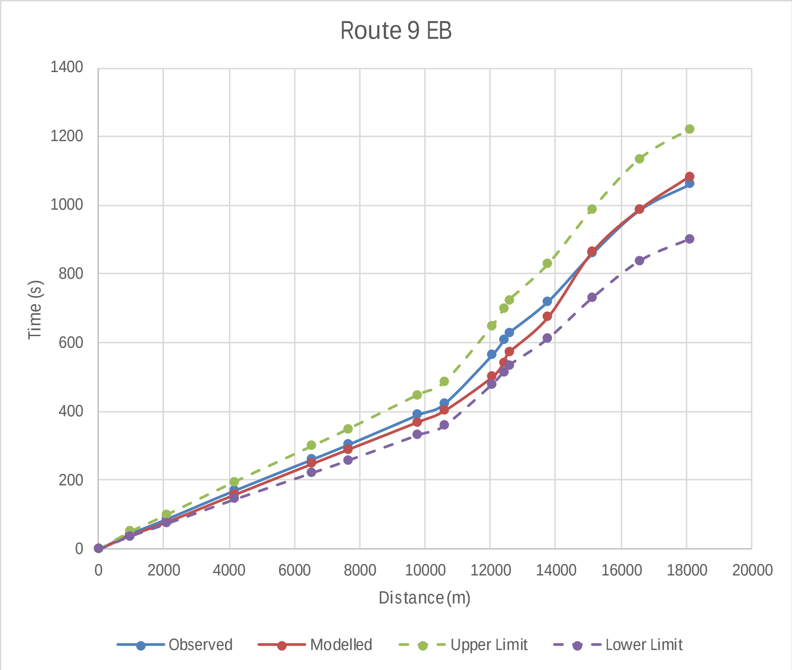


Figure C-39: Journey Time Route 9 EB – Modelled Times vs Observed - IP



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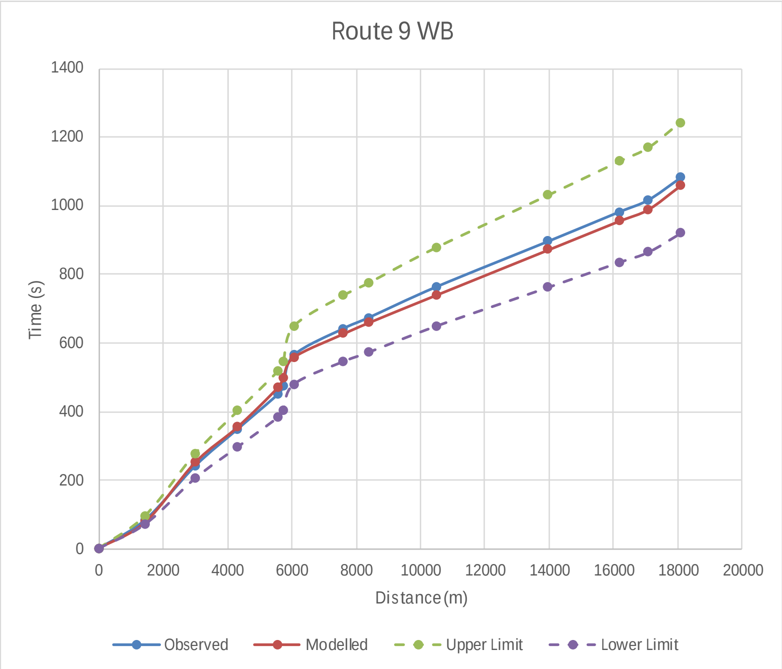
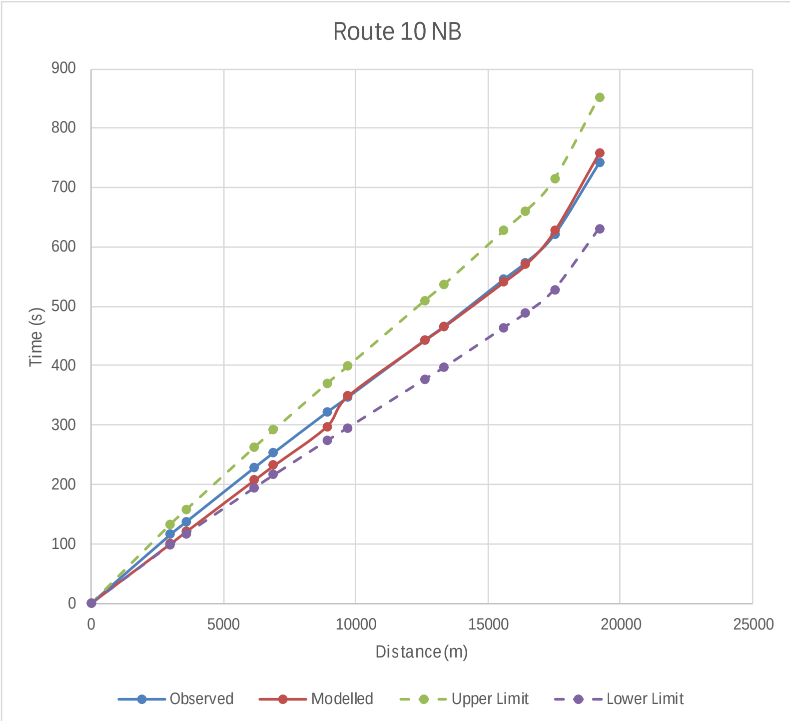


Figure C-41: Journey Time Route 10 NB – Modelled Times vs Observed - IP



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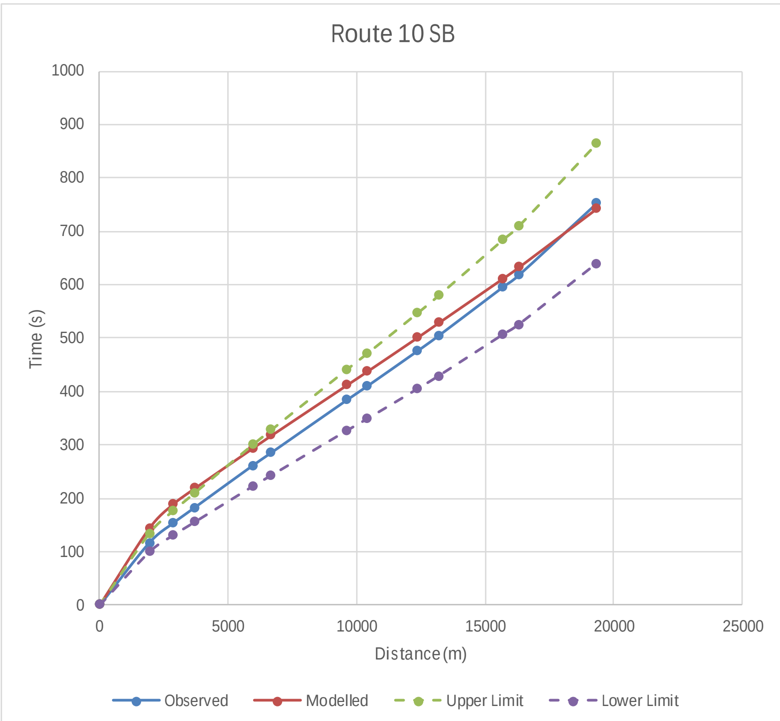
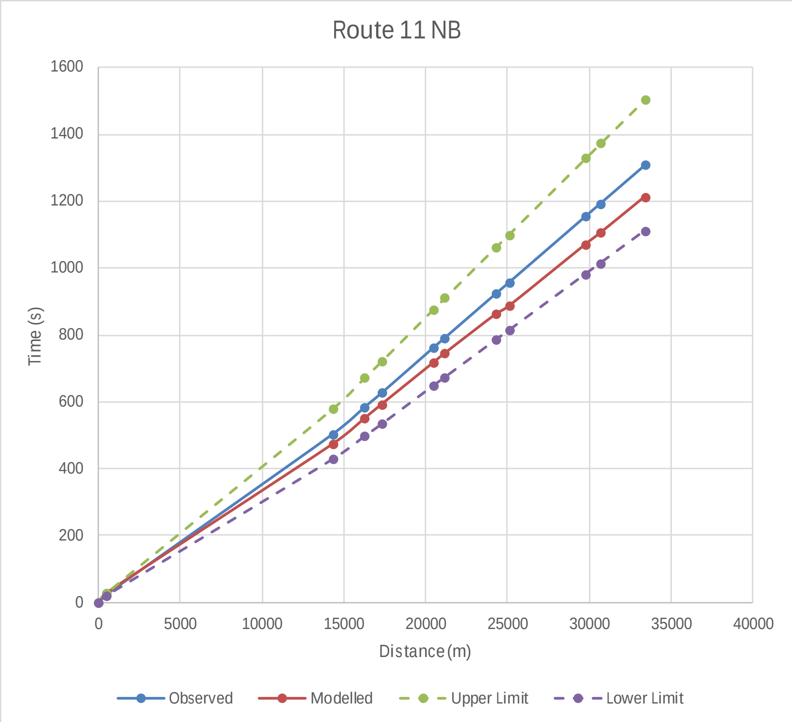


Figure C-43: Journey Time Route 11 NB – Modelled Times vs Observed - IP



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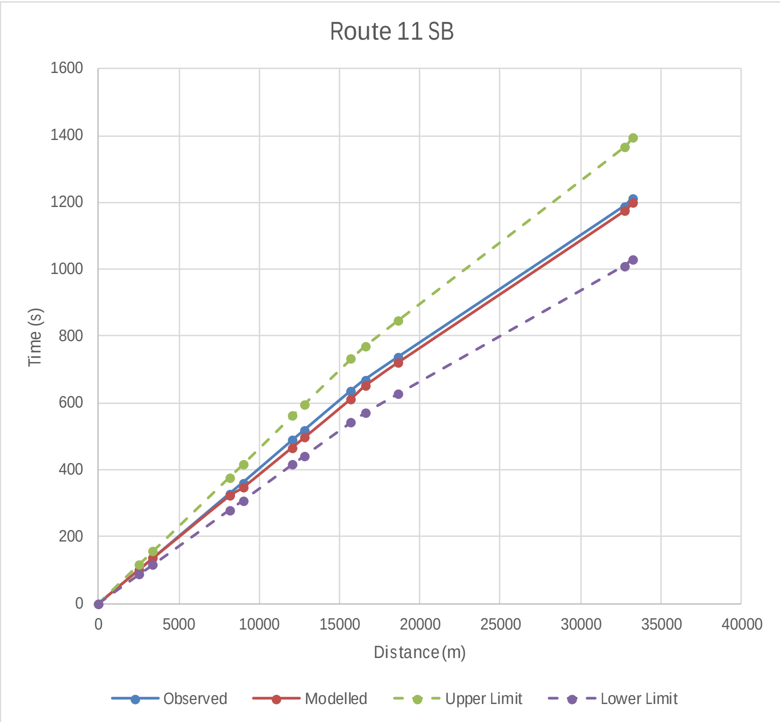


Figure C-45: Journey Time Route 1 NB – Modelled Times vs Observed - PM

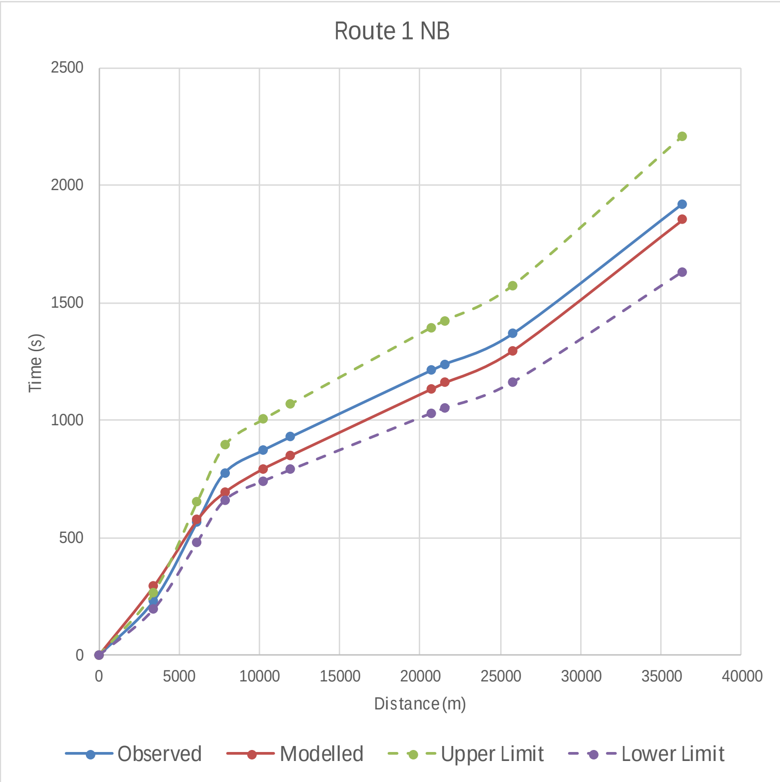


Figure C-46: Journey Time Route 1 SB – Modelled Times vs Observed - PM

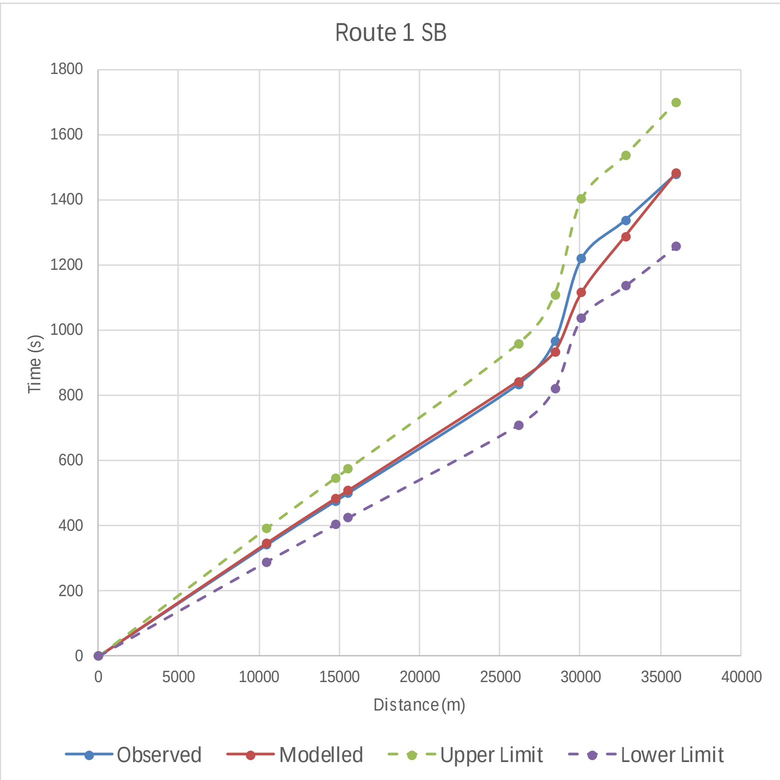


Figure C-47: Journey Time Route 2 EB – Modelled Times vs Observed - PM

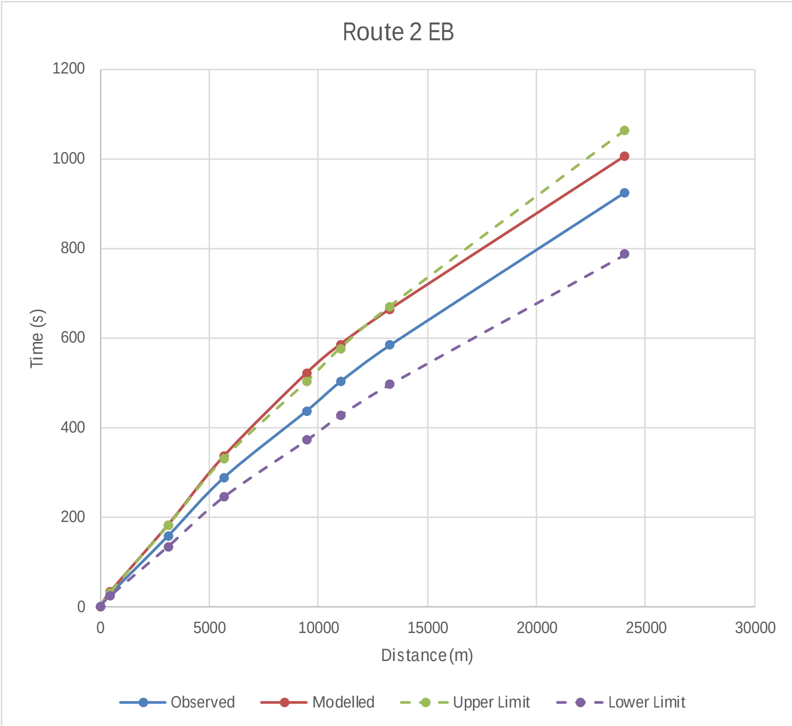


Figure C-48: Journey Time Route 2 WB – Modelled Times vs Observed - AM

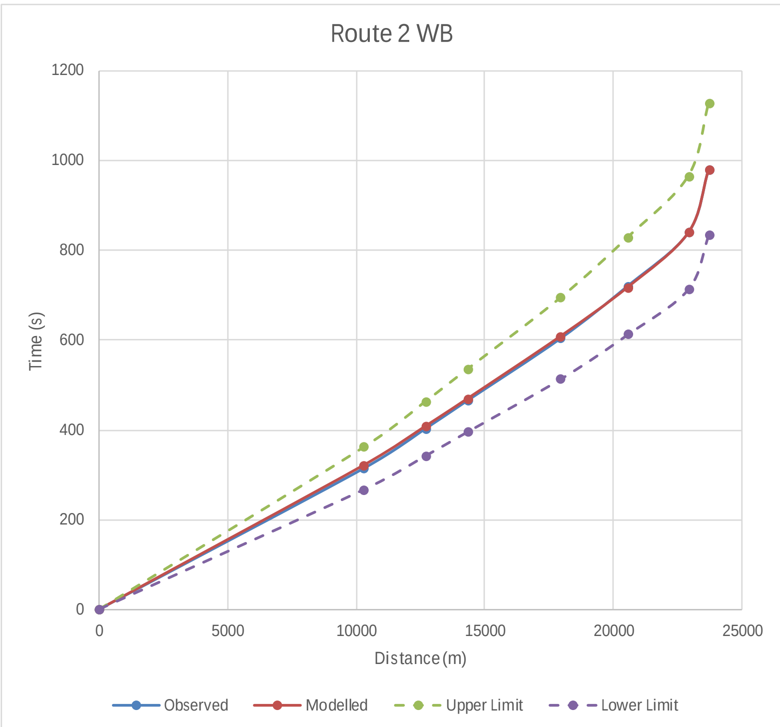


Figure C-49: Journey Time Route 3 EB – Modelled Times vs Observed - PM

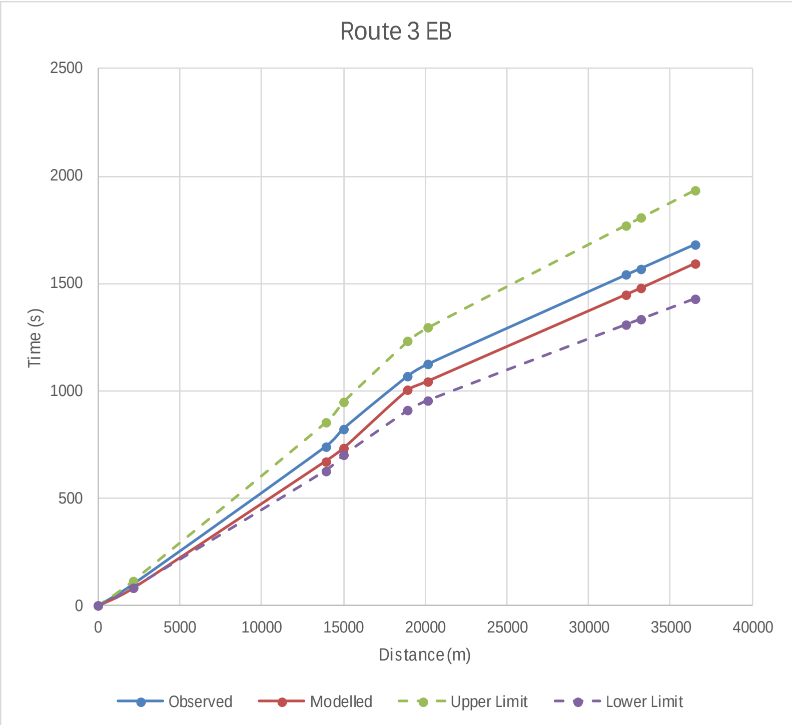


Figure C-50: Journey Time Route 3 WB – Modelled Times vs Observed - PM

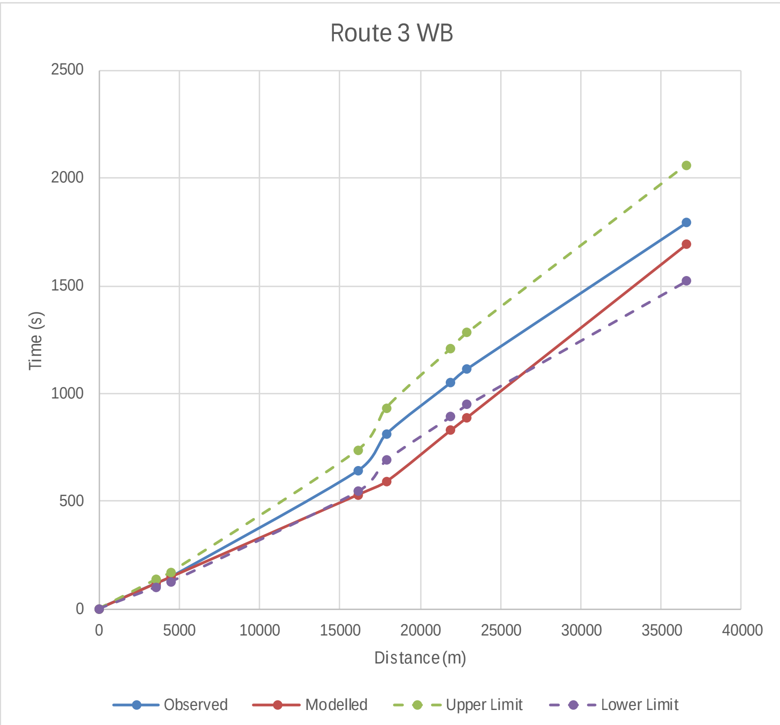


Figure C-51: Journey Time Route 4 EB – Modelled Times vs Observed - PM

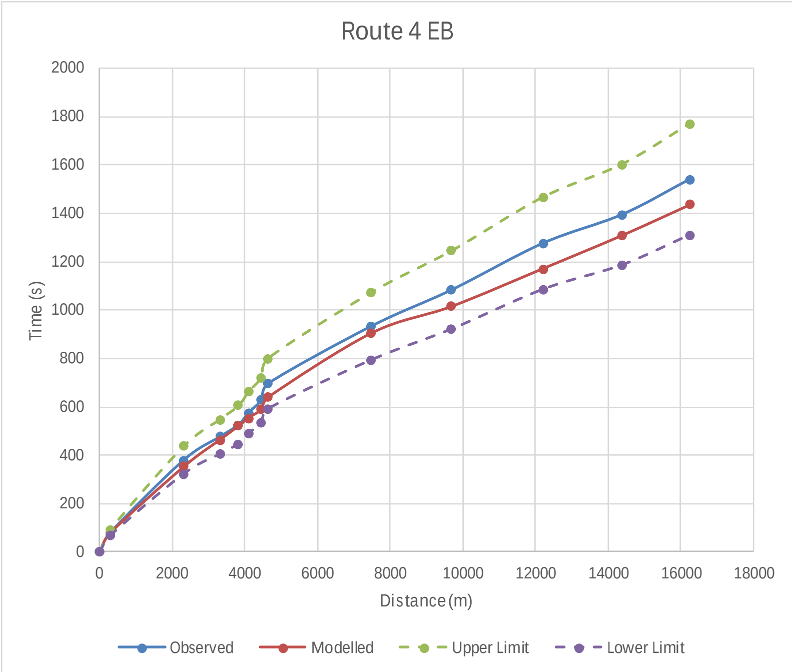


Figure C-52: Journey Time Route 4 WB – Modelled Times vs Observed - PM

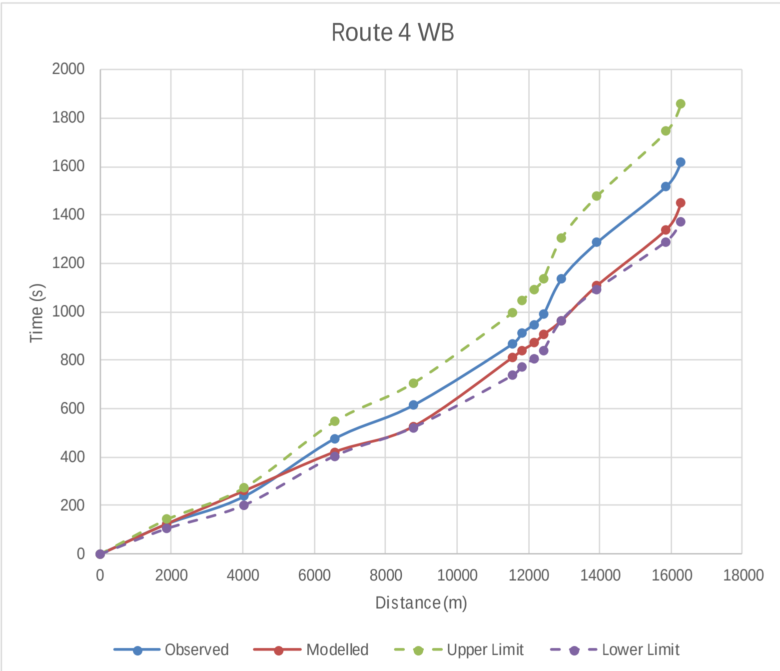


Figure C-53: Journey Time Route 5 NB – Modelled Times vs Observed - PM

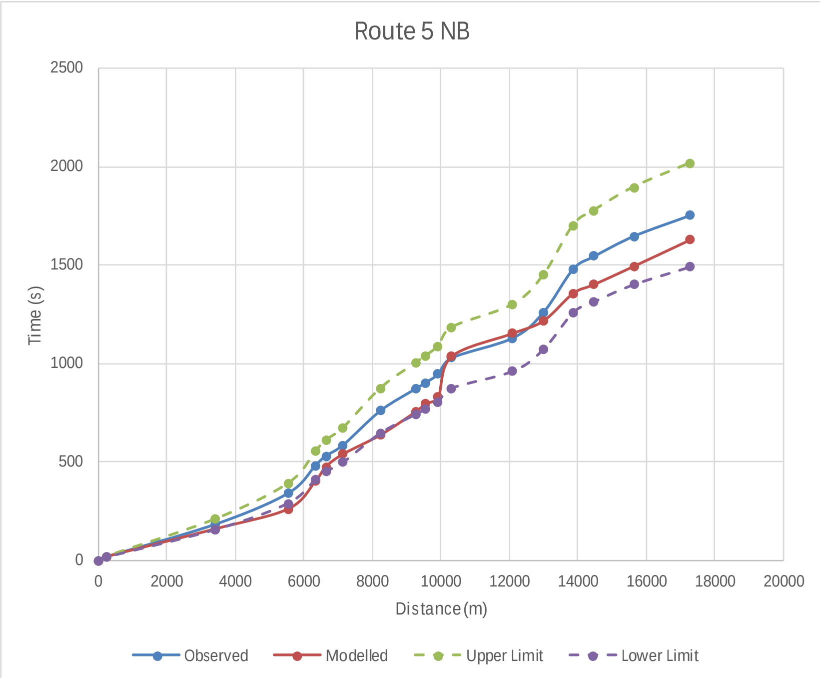


Figure C-54: Journey Time Route 5 SB – Modelled Times vs Observed - PM

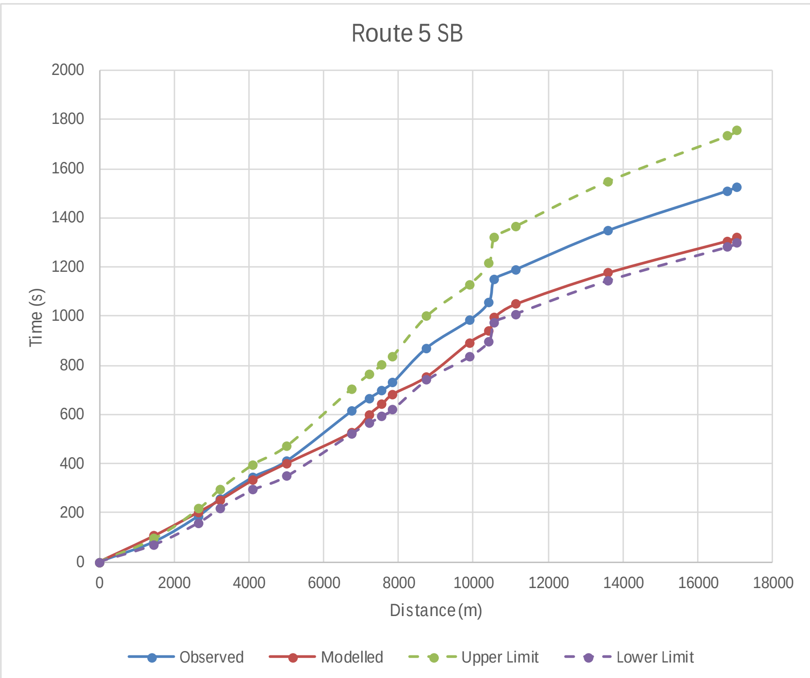


Figure C-55: Journey Time Route 6 EB – Modelled Times vs Observed - PM

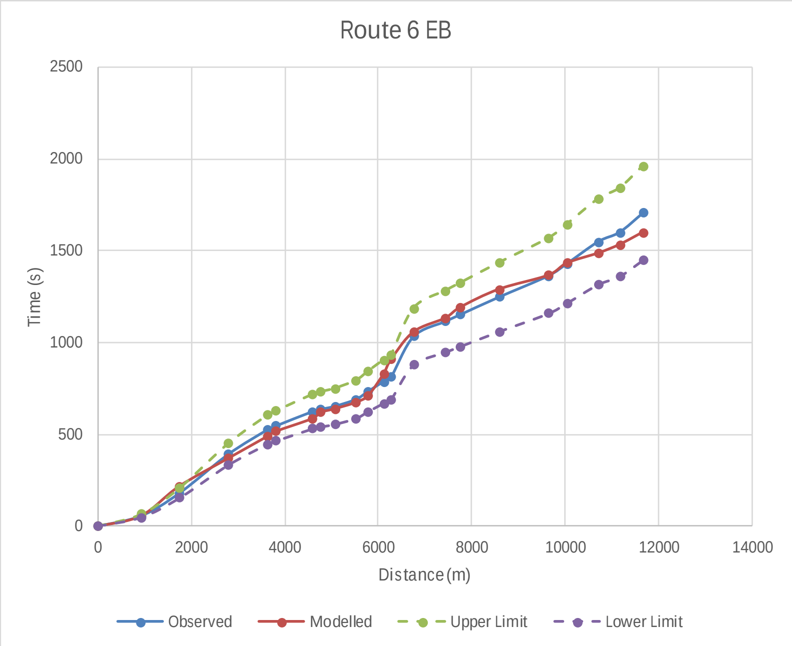


Figure C-56: Journey Time Route 6 WB – Modelled Times vs Observed - PM

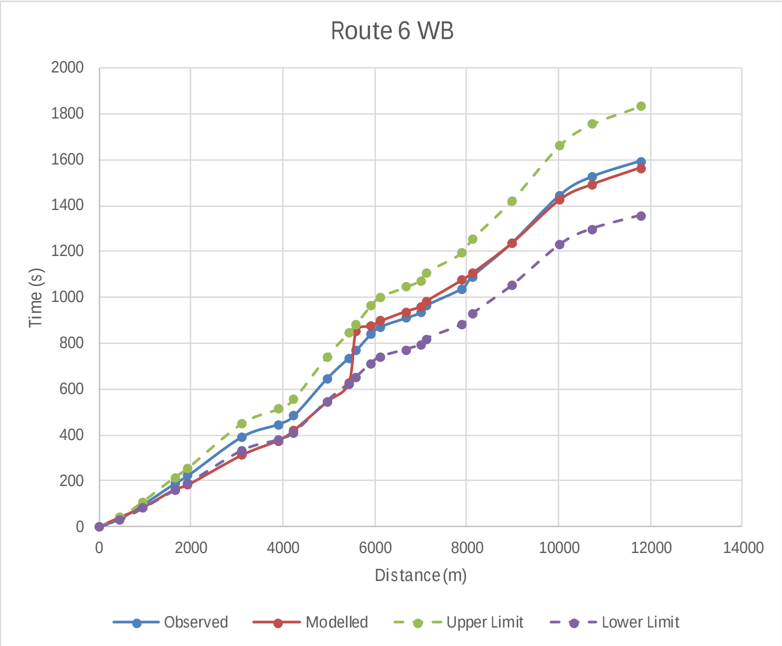
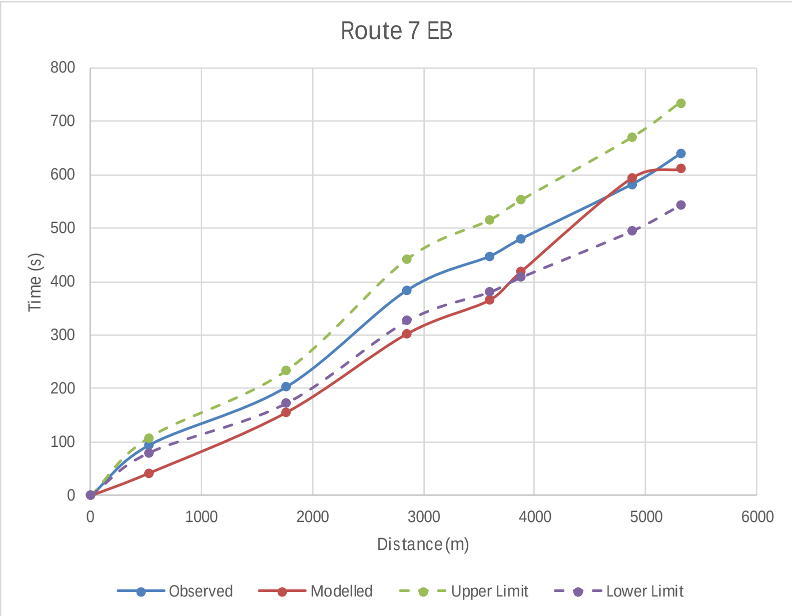


Figure C-57:Journey Time Route 7 EB – Modelled Times vs Observed - PM



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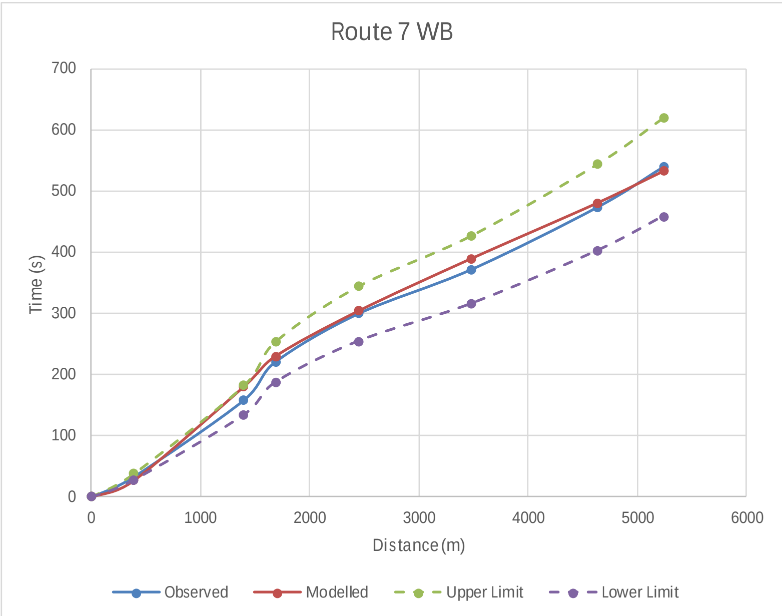


Figure C-59: Journey Time Route 8 NB – Modelled Times vs Observed - PM

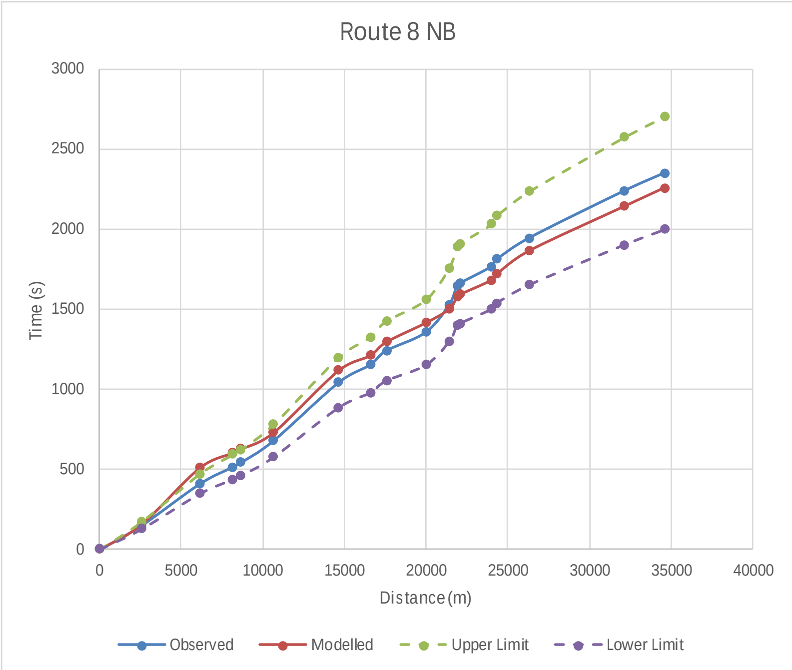


Figure C-60: Journey Time Route 8 SB – Modelled Times vs Observed - PM

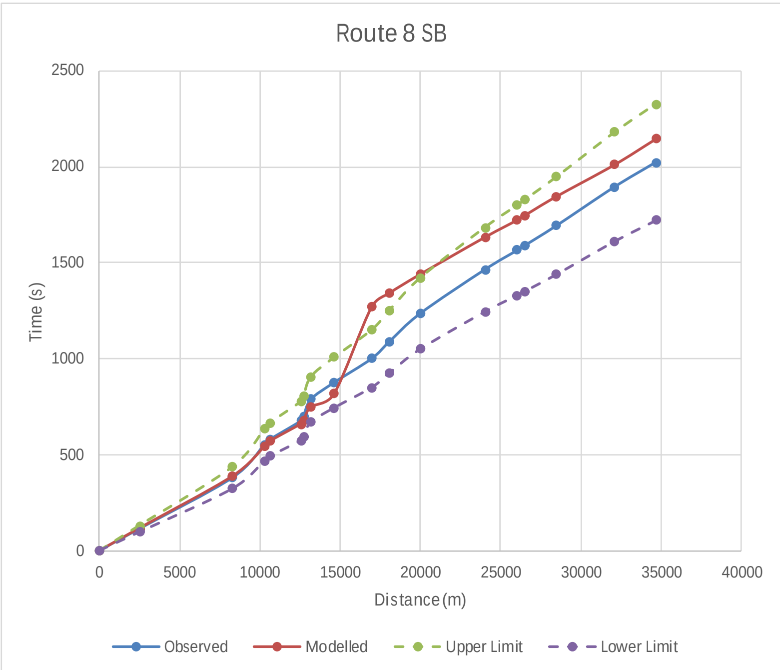


Figure C-61: Journey Time Route 9 EB – Modelled Times vs Observed - PM

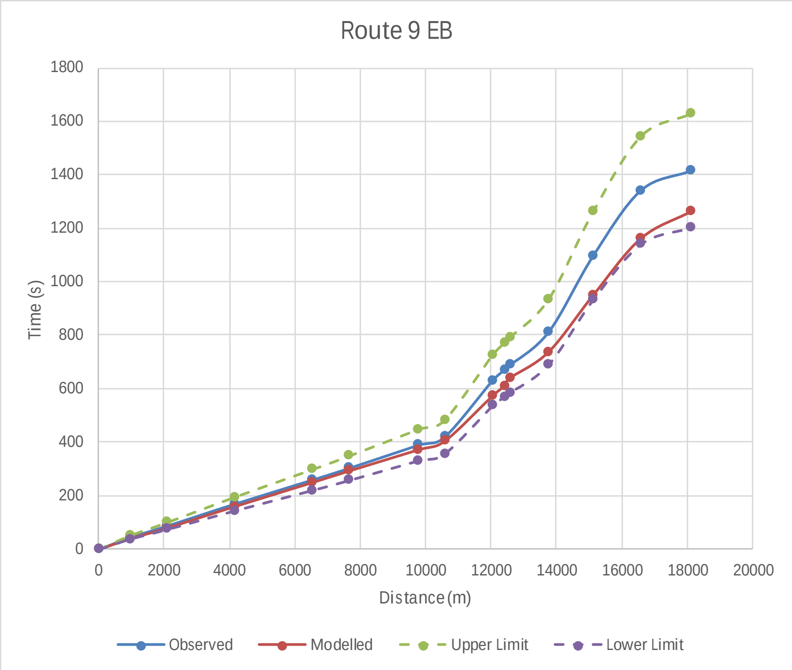


Figure C-62: Journey Time Route 9 WB – Modelled Times vs Observed - PM

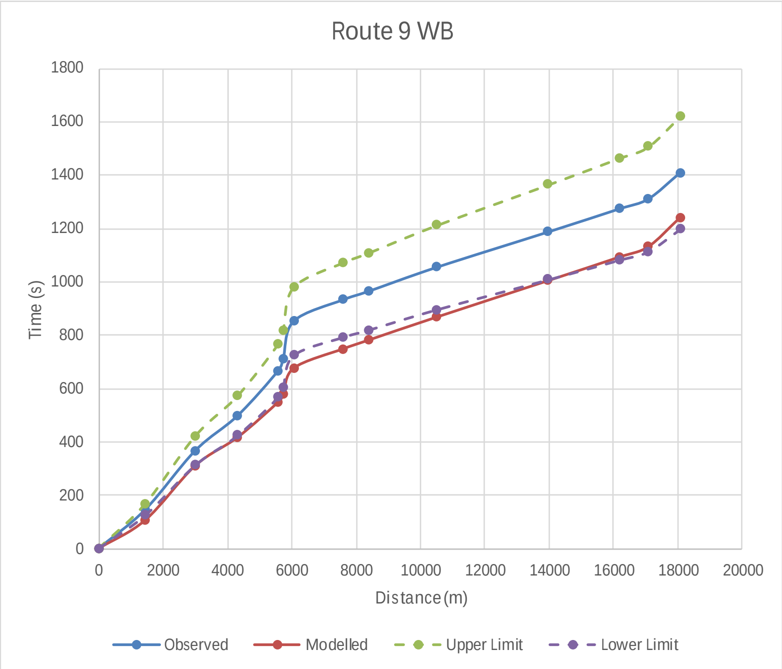


Figure C-63: Journey Time Route 10 NB – Modelled Times vs Observed - PM

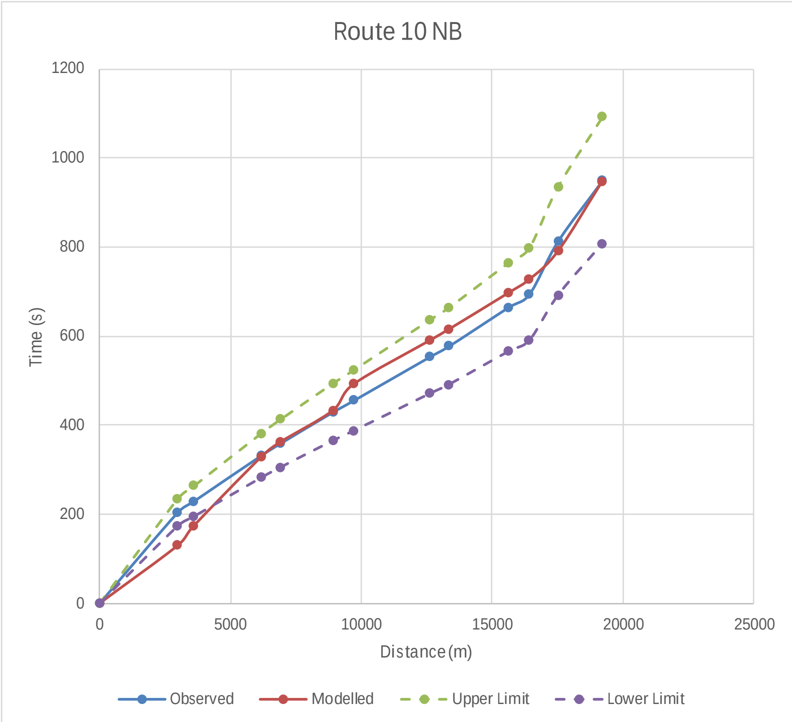


Figure C-64: Journey Time Route 10 SB – Modelled Times vs Observed - PM

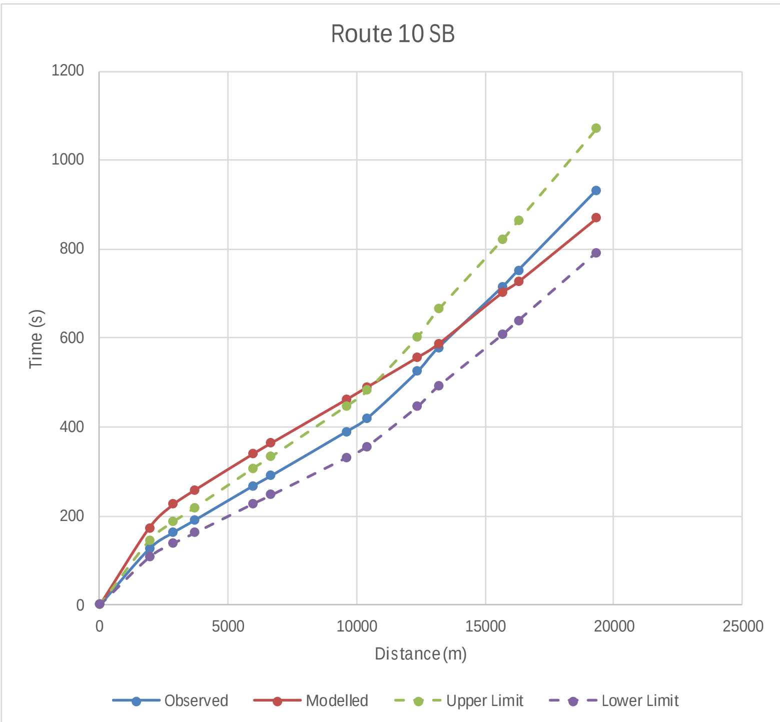


Figure C-65: Journey Time Route 11 NB – Modelled Times vs Observed - PM

Figure C-66: Journey Time Route 11 SB – Modelled Times vs Observed - PM

Appendix 1 I.04: HIGHWAYS ENGLAND DELIVERY PLAN 2015-2020

Highways England
Delivery Plan
2015-2020

Contents

Foreword

Highways England is a new company with a big brief. As a result, while we are operating and improving the country's roads, we will grow our own capability – investing in our people and working with our strongest suppliers.

Every customer wants less congested roads to enable swift, safe, comfortable and informed travel. This means increasing road capacity while modernising the motorway network and our major A roads.

This will require England's largest road investment programme for a generation. And, we need to reduce congestion and disruption at the same time.

Responsibility for that transformation lies in the hands of Highways England. We are a public service company operating a public network. Everything we do is determined by the public interest, from supporting local authorities with their development plans to reducing the environmental impact of the road network.

The specific requirements, along with a 25 year strategic vision, for the strategic road network were presented by the Government in its Road Investment Strategy. This Delivery Plan has been created to explain how we will meet them and the context within which we will work. It is the first to be published by Highways England and covers our first five years of operation to 2020.

The road to successful implementation will not be straightforward, but we understand that our job is to deliver results and satisfy the people we serve. We will define success as the efficient, effective and safe implementation of this plan, resulting in a better road network for our customers and our neighbouring communities.

Colin Matthews
Chairman

Graham Dalton
CEO

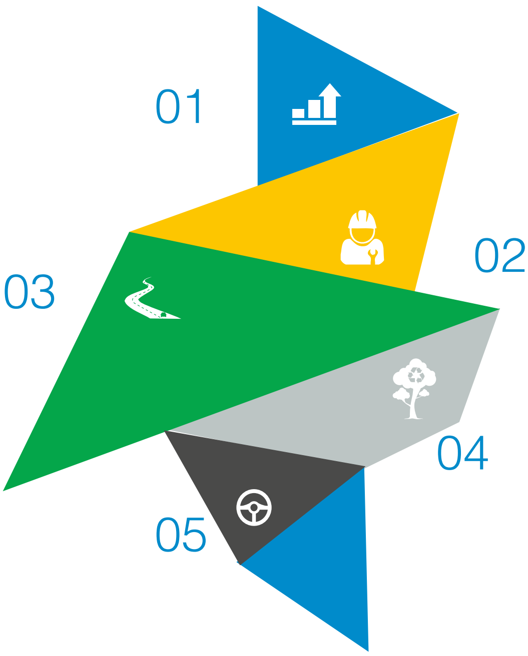
1. Executive Summary

Highways England's role is to operate, maintain, and modernise the strategic road network in the interests of customers.

Our Strategic Business Plan (SBP)[1] published in response to the Government's Road Investment Strategy RIS[2] sets out Highways England's main activities, strategic outcomes and describes how we will go about delivering the Investment Plan and meeting of our Performance Specification[3].

Delivering our strategic outcomes

The Delivery Plan builds on the SBP, setting out in detail how we will deliver our strategic outcomes, how we will measure our success, and how we will identify future goals and plans to keep improving our customers' and neighbours' experience of the strategic road network. Over the course of this road period we will maintain and endeavour to improve on a 90% customer satisfaction rating.



01 Supporting Economic Growth

In order to relieve congestion and minimise delay, we will deliver 112 individual schemes generating £4 in long term economic benefit[4] for every £1 invested. Between 2015/16 and 2019/20 (Road Period or RP1), we will start work on 15 Smart motorways projects as identified in Spending Round 2013 (SR13), with eight of these to be completed by the end of RP1. This means starting work on 480 lane miles by the end of the Road Period and completing 286.

We will also complete all junction improvement, road widening and bypass projects identified in Spending Review 2010 (SR10), and complete four of the ten projects identified in SR13, while beginning work on the remainder.

Additionally, wider investments will be used to cycle proof the network and we will use resources like the Innovation Fund and the Growth and Housing Fund to boost economic growth. We will publish a long term Strategic Economic Growth Plan by the end of 2016.

02 A Safe and Serviceable Network

Our target is to reduce the number of people killed or seriously injured on the network to no more than 1,393 in year by the end of 2020, a 40% reduction from 2010. We will set out exactly how we plan to achieve this in our five-year plan, Driving Forward Safety, which we will publish in autumn 2015.

By the end of RP1, we will invest £3.658bn in renewing the strategic road network. We will maintain the road pavement in good condition, to ensure it does not fall below the 95% target.

[1] https://www.gov.uk/government/publications/highways-england-strategic-business-plan-2015-to-2020
[2] https://www.gov.uk/government/collections/road-investment-strategy
[3] https://www.gov.uk/government/publications/road-investment-strategy-performance-specification
[4] https://www.gov.uk/government/collections/road-investment-strategy

We will develop an overall asset management system and capability that is consistent with ISO55000 industry standards. The framework and guiding principles for this will be detailed in our Asset Management policy, which we intend to update and issue in August 2015. This will be followed by our Asset Management Strategy in April 2016.

Through the investment and wholesale modernisation of the network we will ensure that by the end of 2020 more that 90% of travel on the strategic road network is on roads with a safety rating of EuroRAP 3* (or equivalent). We will also ensure that the majority of those roads with 1* and 2* safety rating have improved to 3*.

We will work with our partners to address issues that impair safe driving, as well as raising awareness of the inherent potential dangers of using the network. We will work closely with police and other emergency services to open roads more quickly after incidents, and work with the Driver and Vehicle Standards Agency and other agencies to reduce the number of poorly-maintained vehicles on the network.

03 A More Free-Flowing Network

We will ensure that lane availability does not fall below 97% in any one rolling year, and clear at least 85% of all motorway incidents within one hour, in line with Government requirements. To this end, we will publish our Operational Strategy by December 2015, setting out how we will manage demand and increase availability of the network. Over RP1, we will invest over £11bn which will contribute to a more free-flowing network.

04 Improved Environment

We are committing to mitigate at least 1,150 Noise Important Areas over RP1, and publish a Biodiversity Action Plan by June 2015, reporting annually on how we are halting net biodiversity loss. In addition, we will invest £300m over RP1 through the designated Environment and Air Quality Funds to deliver specific environmental enhancements on or around the network with regard to water and flooding, carbon emissions, landscape and cultural heritage. Our full plans will be set out in our Environment Strategy, which we will publish by March 2016.

05 An Accessible and Integrated Network

We will upgrade and increase the number of safe crossings on the network in the interests of the safety and convenience of more vulnerable customers; and ensure we integrate with other networks including local roads, existing and emerging rail links, ports and airports. We will work with key stakeholders and partners to develop a package of integration measures during 2015-16 and develop an Accessibility and Inclusion Strategy by March 2016. Overall, we will invest £100m from the Cycling, Safety and Integration Designated Fund to deliver an Accessible and Integrated Network.

Making the most of our key enablers:

To deliver our five strategic outcomes we will use four key enablers:

01 Delivering Performance and Efficiency

We allocate funding based on an assessment of what is of most value to our customers. To monitor our performance, we will publish information on a number of key performance indicators for each of the five strategic outcomes. We have also committed to making capital efficiency savings of £1.212bn by 2020 (in nominal terms). Our exact approach to measuring, recording and monitoring efficiencies will be set out in an Efficiency and Inflation Monitoring Manual, to be published in September 2015, having been agreed with the Department for Transport and the Highways Monitor.

02 Managing Risk and Uncertainty

There is inevitably some uncertainty about our estimates of customer demand for the network and of the cost of enhancements and renewals, as well as assumptions about the weather and other external events. Whilst we will manage those risks that are within our control, we will work with others to mitigate the impact on our operations, maintenance and modernisation of the network to deliver the RIS. We have also commented on the key sources of additional uncertainty under the RP1 settlement.

03 People and Company

We recently set-out our new people strategy which is underpinned by four pillars: Accountable Leadership; Capable Employees; Customer-Focused Delivery and Rewarding Performance. We will use this as a platform to anticipate future needs and deploy the right people, with the right skills, at the right time, across the business.

04 Collaborative Relationships

To ensure our customer needs are being met, Highways England will set up a customer panel to help clarify customer needs and ensure customer satisfaction.

We are also engaging in two new key relationships with the Highways Monitor and Transport Focus. The Highways Monitor will monitor how well we are delivering against the Performance Specification, Investment Plan and aspects of its Licence, while Transport Focus, will have the role of watchdog.

The launch of Highways England is an opportunity to strengthen relationships with existing stakeholders and to work with new ones. We will review and improve our approach to stakeholder engagement to promote better and more frequent liaison with our key stakeholders, and publish an updated account of how we engage with them in the summer this year.

We will also seek to deepen our relationships with our supply chain to deliver the outcomes more effectively. We will work closely with the emergency services and roadside assistance organisations which play a key part in supporting our delivery. Other key relationships including freight organisations, local authorities, technology and innovation partners, sustainability and environmental bodies and motorway service operators.

2. Introduction

Our role
Highways England's role is to operate, maintain and modernise the strategic road network in line with the RIS, reflecting public interest and to provide effective stewardship of the network's long term operation and integrity.

2.1 Context

2.1.1 Our network

England's strategic road network consists of more than 4,300 miles of motorway and major A roads, including a highly complex asset base of more than 16,000 structures, 21,870 miles of pavement, and 110,000 technology assets.

2.1.2 Our legal status and responsibilities

Highways England Company Limited (Highways England) is a corporate body established on 8 December 2014 as a company limited by shares, and wholly owned by the Secretary of State for Transport. It was appointed as a strategic highways company by way of an Order made by the Secretary of State pursuant to section 1 of the Infrastructure Act 2015[5].

2.1.3 Our functions and obligations

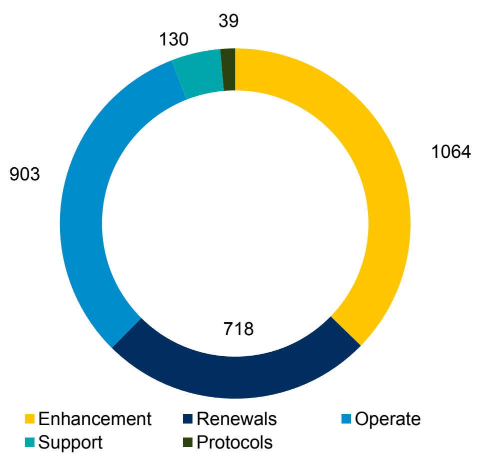
Highways England is tasked by the Act with delivering the RIS set by the Secretary of State, and to prepare and publish route strategies as directed by the Secretary of State. Highways England carries out its functions in accordance with directions and guidance given by the Secretary of State. These are set out in our Licence[6] from Government.

2.1.4 Our funding

Highways England is funded from the public purse by grants-in-aid from the Department for Transport. Our five year funding allocation set out in the RIS Statement of Funds Available (SOFA) totals[7] £11.351bn of capital expenditure across the RP1.

This total five-year fixed capital settlement from the Government includes all funds that we will use to enhance and renew our network; resource funds required to operate our network are set out in the Government's Resource Delegated Expenditure Limit (RDEL). A single year resource settlement of £1.072bn has been agreed for 2015/16. A breakdown of the funding for 2015/16 is shown below with additional detail set out in Annex C.

Figure 1: 2015/16 funding Settlement



Key: Figures = £ millions

[5] http://www.legislation.gov.uk/ukpga/2015/7/contents/enacted
[6] https://www.gov.uk/government/publications/road-investment-strategy-performance-specification
[7] https://www.gov.uk/government/publications/road-investment-strategy-investment-plan

2.2 Document purpose

This Delivery Plan shows how we will achieve Government's objectives and long term vision for the strategic road network, as set out in the RIS. It sets out exactly what we deliver during RP1 covering 2015-20, including how we will:

- Use our budget allocation
- Effectively manage this critical national asset
- Deliver outcomes for our customers
- Transform our organisation and be more effective
- Measure our success

The Delivery Plan builds on Highways England's recently published Strategic Business Plan (SBP), which was our response to the Government's RIS. The RIS sets out the performance requirements for the network and our company and a five year investment plan.

These investment plans take account of the Government's policy[8], not to introduce national road pricing to manage demand on the Strategic Road Network. Therefore, Highways England are not doing any work in this area.

In turn, this plan sets out exactly what we will deliver and by when, in order to achieve our five key strategic outcomes. These are:

Supporting Economic Growth – through a modern and reliable network that reduces delays, thereby creating jobs, helping businesses and opening up new areas for development.

A Safe and Serviceable Network – where no one should be harmed when travelling or working.

A More Free-Flowing Network – where routine delays are less frequent and journeys are safer and more reliable.

An Improved Environment – where our activities ensure a long term and sustainable benefit to the environment.

A More Accessible and Integrated Network – where we will work with local authorities and other transport hubs to facilitate other modes of transport and enable safe movement across and alongside our network.

[8]National Policy Statement – National Networks

This is Highways England's first Delivery Plan, which we have developed to coincide with the launch of the company. These plans range from short-term activity delivering near term goals to longer term programmes delivering benefits that will be realised towards the end of this Road Period (RP) and beyond. As we progress through RP1 our plans will be further refined in key strategy documents.

The early years of RP1 will not only define the latter years, but also set in place foundations for delivery well into the next RP covering 2020 to 2025 and beyond.

This Plan will demonstrate how we will maintain efficient and effective working practices, managing risk and uncertainty whilst remaining true to our vision and values.

2.3 Our vision and ambition

2.3.1 Vision

Highways England will be a confident, energetic, agile and connected organisation, fully realising our people and our partners' potential to benefit our customers.

Our ambitious plans to deliver government's aspirations for the strategic road network will be far from easy. To deliver the investment over this Road Period, and continued investment in future Road Period's will require a step-change in performance. We don't underestimate the challenge that lies before us.

2.3.2 Transformational Journey

Our organisation is moving towards a bold future, focussing on performance based delivery. How successful we are at delivering a performance step-change in this new landscape will be down to how we transform our organisation. We recognise this new territory will be challenging, and therefore we must be better at:

- Planning for the future
- Growing our capability
- Building stronger relationships
- Efficient and effective delivery
- Improving customer service

2.4 What we will deliver

We will focus on the issues that matter most to our customers and stakeholders. These are woven into the fabric of our Delivery Plan:

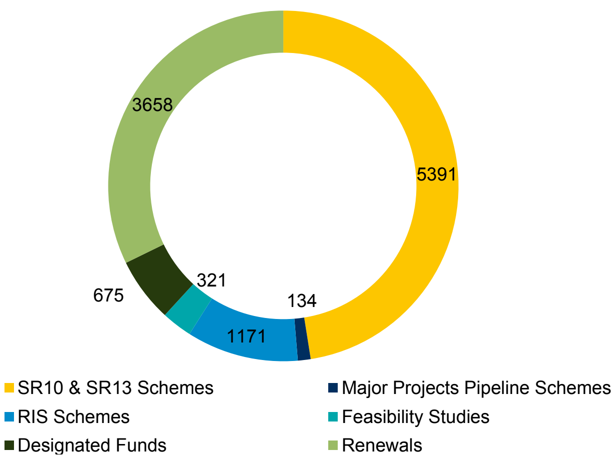
- Improving the safety of all our customers, partners and Highways England staff members
- Increasing road capacity to meet the nation's future needs
- Reaching milestones on time and to budget
- Delivering value for money and demonstrating real efficiency
- Significantly improving the environment for national health and wellbeing
- Collaborating and engaging to deliver better outcomes
- Utilising designated funds to; improve air quality, improve the environment, stimulate economic growth and housing, make the network safer and more accessible for cyclists and vulnerable users, and stimulate new innovative ideas to support in-vehicle systems and improvements to technology on the network.

To focus on the issues that matter most, we will deliver outputs and interventions to operate, maintain and modernise the strategic road network.

2.4.1 Capital Expenditure

Highways England will invest £11.351bn in the modernisation of the network and maintenance of existing assets. This capital expenditure for RP1 is shown in figure 2 below.

Figure 2: Total capital expenditure – RP1

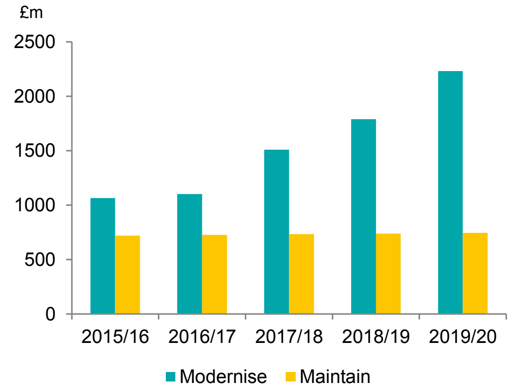


Key: Figures = £ millions

As shown in figure 3, investment in the enhancement of our network will increase across RP1, while capital expenditure on renewals will remain fairly stable. It is this stability and certainty in the maintenance funding that will enable Highways England to take a longer-term approach to asset management; ensuring we maintain the network in a safe and serviceable condition, while minimising delays to our customers.

As investment increases so too will our delivery output right across the network. This in turn will generate rapid efficiency growth in the final years of this Road Period, as further elaborated in Section 8.

Figure 3: Capital split by theme and year



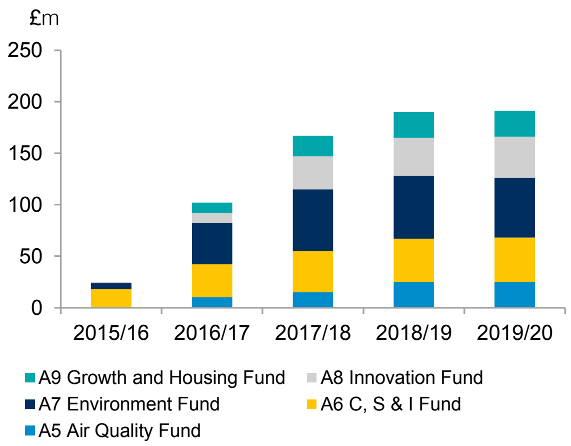
2. Introduction

Our enhancement programme will upgrade some of the most important major routes to provide more capacity and better connections, and maintain the network safely and efficiently with minimal impact on drivers and communities.

2.4.2 Designated funds

The Government has created a series of designated funds, to address a range of issues over and above the traditional focus of road investment. The funds are worth £900m over a six year spending period covering 2015 – 2021. This document sets out Highways England's five year investment plan for these funds, totalling £675m. These funds allow for actions beyond business as usual and will help Highways England to invest in retrofitting measures to improve the existing road network as well as maximising the opportunities offered by new road schemes to deliver additional improvements at the same time. The figure 4 below shows how we plan to spend the designated funds over RP1.

Figure 4: Designated funding split by year



2.5 What does this mean?

We will deliver better value for money; improve customer satisfaction, providing more capacity and a better quality of service to the millions who use or rely on our roads every day.

2.5.1 What this means for customers

With journeys totalling up to 85 billion miles per year, our customer base is vast:

- Four million users every day
- Millions of neighbours who live near the network
- Numerous logistic and freight companies
- Industries from all corners of the country
- Thousands of walkers, cyclists and equestrians
- Many local communities connected by the road network.

Engaging with all our customers to ensure the network meets their longer-term needs is central to all our plans set out in this document.

Our greatest challenge will be balancing our customers' competing priorities while maintaining or improving customer satisfaction. This plan sets out how we will listen to customers, and act upon their feedback. Highways England is confident of achieving all it has been asked to deliver, while forging an ambitious new future for the strategic road network.

We will strive to improve user satisfaction over this Road Period. Our performance in this area will be measured against the Key Performance Indicator (KPI) from the Performance Specification set out below:

Government key performance indicator
User satisfaction

KPI — The percentage of NRUSS Respondents who are Very or Fairly satisfied

Target — Achieve a score of 90% by 31 March 2017 and then maintain or improve it

The move towards longer term funding certainty, away from stop-start decision making and towards greater commercial flexibility will enable us to respond more positively to customer demands and speed up delivery. We want to ensure that every journey is safe and our customers are well-informed so they can predict and react to changing network conditions.

2.5.2 What this means for stakeholders and partners

Our partners and stakeholders expect us to live up to our vision and values at all times. We will:

- Be more mature, open, flexible and collaborative in our working relationships
- Understand each other's priorities and objectives, and always put the customer first
- Share high-quality information
- Maintain high performance and effective delivery
- Work to build a more sustainable business

2.6 Delivering measurable success

In preparing our first Delivery Plan we have set out a number of:

- Deliverables, interventions and outputs
- Core strategy documents
- Action plans and reports
- Programmes of work
- Key milestones

These all form a plan of how we will deliver Government's Performance Specification, Investment Plan, longer term Strategic Vision, along with Highways England's plans for the strategic road network.

2.6.1 Delivery Plan success

Progress against this Delivery Plan will be reported through a Key Performance Indicator. This indicator will measure progress against a number of key strategic outputs and interventions set-out within this document, and subsequent updates of the Delivery Plan.

Government key performance indicator
Efficiency

KPI: Progress of work, relative to forecasts set out in the Delivery Plan, and annual updates to that Plan, and expectations at the start of RP1

Target: Meet or exceed forecasts

We will develop a performance dashboard by July 2015 to track progress of these interventions and provide an overall rating of achievement against the plan. This information will be updated on a quarterly basis, and reported back to our Shareholder and the Highways Monitor. We anticipate this dashboard will cover areas such as; strategies delivered, new programmes defined, environmental delivery, programme updates for major projects and renewals, and progress updates on development of new performance measures and indicators.

This indicator is part of a suite of KPIs that seek to focus our activities on; meeting the needs of all our customers and the country as a whole, maintaining a reliable and effective strategic road network that supports the economy while also contributing to wider environmental and social aims.

Within this document each of the KPIs from the Performance Specification has been aligned to our strategic outcomes, or core enabling activities. The two exceptions are progress against the Delivery Plan as referenced above, and delivering improved customer satisfaction. Highways England views customer satisfaction as an overarching indicator of our performance.

These KPIs are supported by Performance Indicators (PIs) to give additional information on our performance. Some PIs are identified in the Performance Specification, while others have been identified and developed by Highways England. Those PIs from the Performance Specification and our associated activity are referenced throughout the Delivery Plan.

For ease of reference, Annex B clearly sets out what activities contribute to each of the Government's performance requirements.

2.6.2 Operational Metrics Manual

Alongside our Delivery Plan we have published our Operational Metrics Manual (OMM) which details the mechanics behind how each of these indicators function. The OMM defines, for each KPI and PI, how the data is collected, transformed and reported. The manual details ownership of Requirements contained in the Performance Specification. The OMM also explains Highways England's expectations of our organisation as we move to a performance based culture. It also sets out the contributions others' are expected to make to deliver performance.

We will evolve the manual over time, as reporting processes change. The OMM details a change control process to facilitate this.

The manual is owned by Highways England, and has been produced in collaboration with the Department for Transport, and the Highways Monitor.

The OMM will be used to ensure all performance measures, associated methodologies and success factors are clearly understood. The manual will be used by the Monitor to gain further details and understanding of the metrics to enable more robust monitoring of performance within the agreed parameters, performance measures and definitions as set out in the document's technical notes.

Further information about Highways England can be found on our website **www.highways.gov.uk**

3. Supporting Economic Growth

At the heart of Highways England's plans for delivering the RIS for RP1 is a drive to support and encourage economic growth across England and the wider United Kingdom. We will do this by modernising the network to relieve congestion and reduce delays, helping businesses to grow, encouraging investment, creating jobs and opening up new areas for development.

Investment into the strategic road network across England has progressively grown over the past few years. Investment in major improvements has grown from around £450m in 2012/13 to more than £750m this year as we head toward investing around £3bn on major improvements in 2020.

Delivery over the last four years has outperformed expectation. We planned to start investment on the ground on 22[9] schemes. We have started construction on 24 schemes, completed seven, delivered around £2.7bn of investment and expect to have achieved over £1bn of savings against previously approved estimates.

When this programme completes at the end of RP1, we will have delivered more than 300 miles of additional lanes, including junction, road widening and 286 lane miles of Smart motorways – providing much needed capacity to heavily congested routes and unlocking potential for developments to support further economic growth. This investment is expected to enable £4 of benefit to the economy for every £1 spent. To deliver this benefit we will be working closely with our key suppliers in the construction sector; to support the five goals set by Government in Construction 2025, the industrial strategy for construction.

Benefits are not just felt as a result of this investment but also through its delivery. Each scheme now takes an opportunity to support industry and grow skills as well as provide jobs that support their local community. Through this we have delivered more than 37,000 training events that not only help to train the workforce but provide employment opportunities.

The Government has asked us to focus on reducing average delay times, and the various ways we will do this are set out within this section. (our performance in this area will be measured against the Key Performance Indicator (KPI) from the Performance Specification set out below). Many factors influence average delay, some of which are not within our control, so although we have not set a target for this measure, we will be seeking to reduce delays as far as possible and report annually on Average Delays.

Government key performance indicator
Economic growth

KPI — Average Delay (time lost per vehicle per mile)

Target — No target set

Supporting economic growth is a broad goal, and in addition to other measures discussed in this section, it is woven into the Delivery Plan as a whole. The OMM has set out a suite of PIs to illustrate the impact of our activities, and other external factors on traffic flow. This includes a measure of the reliability of journey times. The central challenge will be reducing average delay times and keeping the network as available as possible to customers in the short term, while delivering an investment programme that will modernise the network to ensure shorter journey

[9] When adjusting for combining the three schemes around Manchester in a single project and excluding A30 Temple to Carblake – being delivered by Cornwall County Council.

times and maximum availability in the long term. In line with the Government requirement we will annually report on average delay across our network.

3.1 What we will deliver

We have an agreed programme of major improvements that we are taking forward over the next five years that totals around £7bn of capital expenditure and comprises 112 individual schemes and the development of a further 15 schemes for Road Investment Strategy 2 (RIS 2).

We are organising these into programmes of work to help make future steps in efficiency improvements and will measure progress of schemes after PCF stage 5 during the construction phase through cost and schedule performance[10] measures.

Set in this section is a summary of what we are planning to do where and when over the next five years. These plans assume that the associated schemes continue to demonstrate value for public money and achieve necessary statutory approvals. We have set out in the following sections programmes of work to prepare for delivery of 112 schemes.

Annex A provides a set of maps that set out the major improvements planned to be delivered across the network.

3.1.1 Types of solution

There are a number of solutions that we consider when seeking to tackle the different issues faced by customers and neighbouring communities.

Smart motorways

Smart motorways use active traffic management techniques such as variable speed limits and hard shoulder running in order to increase capacity and smooth the flow of traffic. This allows for more reliable journey times as well as fewer accidents, less noise and pollution.

Our long term goal is a Smart motorway spine linking London, Birmingham, Manchester and Leeds. During RP1 we are committed to starting 480 lane miles of Smart motorways and will complete 286 lane miles of Smart motorways from existing SR10 schemes and new SR13 schemes. The balance will be completed by 2022/23.

Junction improvements, road widening and bypasses

In addition to the innovative Smart motorway product, we will complete a number of more conventional improvements. These include junction improvements at some of the worst pinch-point locations, widening certain sections of the road network and upgrading poorer quality single carriageway trunk roads to dual carriageway standard.

3.1.2 Schemes already in construction

Around £1bn of investment is associated with 16 schemes already in construction. These schemes are primarily those announced following the SR10 and also those announced in the Autumn Statements in 2011 and 2012.

Below we set out a summary by region of these investments and set out what will be delivered and the benefits we plan on delivering.

North East and Yorkshire

Four schemes currently in construction will:

- Provide an additional 28 lane miles of capacity on the A1 between Leeming and Barton to relieve congestion, and improve the section between Coal House and the Metro centre to support the creation of 18,900 jobs and 21,900 homes in the Newcastle and Gateshead area
- Increase capacity on the M1 by delivering a four lane Smart motorway which will improve connection from Rotherham to Sheffield and Wakefield to Leeds. Together these schemes will add a further 41 lane miles to the network.

[10] Cost Performance Index (CPI) and Schedule Performance Index (SPI)

North West

Two schemes currently in construction will:

- Add capacity on the M60 and M62 motorways around Manchester through the delivery of a further 9 lane miles using Smart motorways
- Improve the A556 Knutsford to Bowdon, which will make journeys more reliable along this key transport corridor linking Birmingham and the South of England with Manchester, Manchester Airport and the North of England.

Midlands

Six schemes currently in construction will:

- Enhance capacity on the M1 between Derby and Nottingham, reducing congestion and aiding economic growth in the region
- Improve the interchange of the M1 with the M6 and A14 near Rugby. Removing a key bottleneck and reducing significantly the number of accidents
- Tackle delays on the A453 near Nottingham by replacing rural sections with dual carriageway and widening urban sections to two lanes, which will also improve access to the railway station and East Midlands airport
- Improve capacity on the M6 by providing an additional 19 lane miles to relieve congestion in Staffordshire
- Carry out widening of the A14 near Kettering to allow for increased traffic flow on one of the key strategic routes linking the Midlands to the Haven Ports
- Improve the A45/A46 junction south of Coventry facilitating plans for housing and employment in the surrounding areas.

East

One scheme currently in construction will:

- Improve the A505 at Dunstable by providing a new dual carriageway linking the A5 to a new junction on the M1, supporting local development plans to increase housing and employment opportunities in the area.

South East

Two schemes currently in construction will:

- Add capacity on the M3 from the M25 to Farnborough, supporting economic growth and development along the M3 corridor and the Thames Valley by adding a further 27 lane miles to the network
- Carry out significant junction improvements on the M25 at J30 to improve access to wider UK markets for the Thurrock area and the users of the Ports of Tilbury and London Gateway.

South West

One scheme being delivered by Cornwall Council will tackle the current congestion and journey delays on the A30 in Cornwall and remove a major constraint that hinders economic sustainability and future growth in Cornwall.

The table 1 below sets out when we expect to bring the new investments into operation i.e. opening up the new routes or improvements to traffic. For each scheme we identify the quarter period within the year that we expect operations to begin.

Table 1: New routes or improvement to traffic

Scheme	Open for Traffic		
	2015/16	2016/17	2017/18
A14 Kettering Bypass Widening	Q1		
A453 Widening	Q2		
M6 J10a-13 (SM)	Q3		
M1 J39-42 (SM)	Q3		
M1 J28-31 (SM)	Q4		
A1 Coal House to Metro Centre		Q1	
A45-A46 Tollbar End		Q3	
M1 J19 improvement		Q3	
A30 Temple to Carblake[11]		Q3	
A556 Knutsford to Bowdon		Q4	
M1 J32-35A (SM)		Q4	
A1 Leeming to Barton			Q1
M3 J2-4A			Q1[12]
M25 J30			Q1
A5/M1 J11a Link			Q1
M60 J8 to M62 J20 (SM)			Q2
Completions in year	5	6	5

These timescales may change, particularly if we see opportunities to combine other local improvements or undertake renewal of adjacent infrastructure.

3.1.3 Schemes announced in June 2013

Around £5bn of investment is associated with schemes that are being developed or nearing construction. Following their announcement in the SR13, these schemes have now completed background work to inform the plans on how we will take them forward. We expect to start work on all 26 of these schemes within this Road Period, with nearly half expected to complete within the period.

Below we set out a summary by region of these investments, what we plan to deliver and the benefits we anticipate they will create.

North East and Yorkshire

Four schemes to start construction will:

- Improve junctions on the A19 in Tyne and Wear, supporting regeneration at the Port of Tyne, Newcastle Airport and further development at Cobalt Business Park. This will also complement improvements to the local network, notably an additional Tyne crossing
- Make improvements along the A63 in Hull, supporting existing businesses, attracting new businesses and promoting local development
- Early stages of construction are underway to improve the junction between the A160 and A180 near Immingham plus a full dual carriageway link from the A180 to the Port of Immingham, improving journey time reliability and supporting economic growth in the area.

North West

Five schemes to start construction, supporting the Northern Powerhouse, will:

- Improve the M6 between Stoke and Knutsford and also between Warrington and Wigan by upgrading to Smart motorway, adding 56 lane miles of capacity to relieve congestion

[11] Highways England is contributing toward the cost of this scheme which is being delivered by Cornwall County Council
[12] When including for the extensive maintenance and asset renewals works thats has recent been identified

- Upgrade further sections of the M60 and M62 near Manchester to improve journey time reliability by providing an additional 32 lane miles of capacity
- Upgrade to Smart motorway the M56 from Manchester Airport to the A556, increasing capacity and improving access to the airport by adding eight lane miles to the network.

Midlands

Seven schemes to start construction will:

- Upgrade further sections of the M6 to Smart motorway around Coventry, and from Stafford to Stoke. This will increase capacity by adding 58 lane miles to the network
- Upgrade the M5 between Bromsgrove and Worcester. Adding another 17 lane miles of increased capacity
- Further upgrades to Smart motorways on the M1 from Milton Keynes up to the M6/A14 interchange and also at East Midlands Airport to the Nottingham/Derby junction which will relieve congestion and add 84 lane miles
- Replace the roundabouts on the A38 in Derby with grade separate junctions to reduce high levels of congestion and improve safety
- Provide a new link road connecting the M54 and M6 and the M6 Toll road which will improve journey time reliability and reduce high levels of congestion in the area.

East

One significant scheme to start construction will:

- Improve the A14 by providing a new bypass to the south of Huntingdon and the widening of some of the existing carriageway near Cambridge
- In total this will add a further 44 lane miles to the network and support development of the new Alconbury Enterprise Zone and the potential of up to 100,000 new homes and many more highly skilled jobs.

South East

Nine schemes to start construction will:

- Enhance capacity on the M3 between Winchester and Southampton and on the M27 from Southampton to Fareham to support growth aspirations for the area by adding a further 49 lane miles to the network
- Upgrade the M20 near Maidstone to a Smart motorway, adding 11 lane miles to the network and improving traffic flow in the area
- Upgrade the M4 between the M25 and Reading, adding more than 60 lane miles to the network and providing a significant increase in capacity along the M4 corridor
- Early stages of construction are underway to tackle a heavily congested section of the A21 between Tonbridge and Pembury by providing dual carriageway which will also improve safety and accessibility
- Carry out upgrades on the A27 at Chichester through junction improvements and a bypass, removing congestion from the local villages
- Provide junction improvements on the A2 in Kent to support the level of growth proposed for Kent Thameside including Ebbsfleet Garden City, supporting potential development of 50,000 homes and 20,000 jobs in the area.

Table 2 below sets out when we plan to start work on site for each of these 26 schemes, it also identifies when we expect to bring the new infrastructure into operation – for example, opening up the new route to traffic.

These timescales assume certain types of solution and impact. As solutions are developed, particularly in response to consultation and environmental impact, and the programme is developed to make a more efficient flow of work that reduces disruption some of these timeframes may alter.

For the first year of the Road Period we have greater certainty around timing and have also included the quarter period within that year for the planned start work on site.

Table 2: Timescales for delivering schemes announced in June 2013

	Anticipated Start of Works Year					Anticipated Open for Traffic Year						
	RIS 1					RIS 1				RIS 2		
	2015/16	2016/17	2017/18	2018/19	2019/20	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
A160/A180 Immingham	Q1					√						
A21 Tonbridge to Pembury	Q1					√						
M5 J4a-6	Q3						√					
M6 J16-19	Q3							√				
M1 J13-19	Q3										√	
M1 J24-25		√					√					
A19 Coast Road		√						√				
A63 Castle Street		√								√		
A14 Cambridge to Huntingdon		√								√		
M4 J3-12		√									√	
M20 J10a			√					√				
M6 J2-4			√						√			
M20 J3-5			√						√			
M23 J8-10			√						√			
M27 J4-11			√							√		
M6 J13-15			√								√	
M6 J21a-26				√					√			
M60 J24-27 & J1-4				√					√			
A19 Testos				√						√		
A27 Chichester Bypass				√						√		
M54 to M6 / M6 toll				√							√	
M56 J6-8					√						√	
M3 J9-14					√						√	
M62 J10-12					√							√
A38 Derby Junctions					√							√
A2 Bean & Ebbsfleet					√							√
Totals in year	5	5	6	5	5	2	2	3	5	5	6	3

3.1.4 Schemes announced in December 2014

This funding will also enable the company to take forward the new schemes that were announced last December.

Exact timings are yet to be confirmed but we plan to start construction within the period on all 49 projects which will deliver around £1bn of investment by the end of 2019/20.

Below we set out a summary by region of these investments, what we plan to start over the course of RP1 and the benefits we anticipate they will create.

North East and Yorkshire

Seven schemes to start construction will:

- Improve connections to Sunderland, Teesside and Newcastle along the A19 to support economic growth
- Improve connection to Leeds and road safety along the M621 and M1, enabling planned developments to go ahead and that will create around 13,500 new jobs
- Tackling the severe delays experienced by commuters travelling between Leeds and Bradford on the M62 and M606
- Making further capacity improvements along the M62 – completing a four lane Smart motorway that connects Leeds and Manchester.

North West

Six schemes to start construction will:

- Improve connections on the M6 to help support Liverpool's economic aspirations and provide improved access along the M6 corridor of Cheshire and Manchester. This will assist in the development of 67,000 new houses in Manchester and the creation of 120,000 new jobs, which includes the Airport City Enterprise Zone
- Increase capacity on the M53 by providing an additional 13 lane miles to relieve congestion around Ellesmere Port

- Improve road safety and add capacity to facilitate growth at the Port of Liverpool
- Enhance the A585 near Blackpool to improve accessibility to local services
- Relieve congestion on the M56 corridor by improving accessibility of proposed development / growth sites and improving access to Daresbury, Mersey Multi-Modal Gateway and the wider corridor.

Midlands

Thirteen schemes to start construction will:

- Increase capacity on the M1 by extending the Smart motorway planned between East Midlands Airport and the Nottingham junction
- Improve connections on the M5 between Droitwich and Worcester to facilitate housing and economic growth
- Improve connections on the A14 near Kettering to support the delivery of the Kettering East Sustainable Urban Extension
- Provide access along the A46 to further residential developments and key employment sites near Binley and Walsgrove.
- Improve traffic flow along the A43 and A5 near Northampton supporting development of 23,000 houses and creation of 32,000 jobs
- Widening the A5 near Hinckley to dual carriageway, supporting proposed development of 23,000 homes and releasing the potential to access 580 hectares of employment space
- Carry out improvements on the M6 near Walsall to increase access to the motorway and to the Darlaston Enterprise Zone
- Introduce Smart motorways around the M42/ M40 interchange to provide better access to the A45, Birmingham Airport, and the new High Speed 2 railway station
- Deliver a package of measures to improve junctions along the A52 near Nottingham to assist with the development of the Nottingham Enterprise Zone adjacent to the M52.

East

Six schemes to start construction will:

- Increase capacity on the A1(M) providing an additional 14 lane miles to relieve congestion in Hertfordshire, including Stevenage and Welwyn Garden City
- Upgrade technology at junctions on the M11 from Stansted Airport to Cambridge which will improve safety, relieve congestion and support plans for additional housing
- Provide technology along the A12 from the M25 to Ipswich and widening the stretch between Chelmsford and Colchester to three lanes, adding 30 miles of additional lane capacity, improving safety, reducing congestion and supporting economic growth

- Provide a new 13 mile stretch of dual carriageway on the A428 between western Cambridgeshire and the north east of Bedfordshire, relieving congestion, improving safety and supporting significant levels of planned economic growth in the area.

South East

Fourteen schemes to start construction will:

- Improve the A34 between the M4 at Chieveley and the M40 at Wendlebury to ease congestion, improve safety and incident management
- Increase capacity on the M2 to improve flows between Sittingbourne and Maidstone and the east/west link across Kent
- Deliver improvements on several junctions of the M3, enabling developments that will create up to 17,200 new jobs in the region, and around 11,000 new homes in Winchester
- Make improvements along the M27 and M271 around Southampton, supporting employment, housing and access to the port
- Tackle delays on the A31 at Ringwood, supporting growth plans, employment opportunities and housing
- Improve access from the M25 to the A12 and A3 trunk roads, and upgrade the M25 to a five lane Smart motorway between the M40 and Chertsey.

South West

Three schemes to start construction will:

- Provide a new junction on the M49 at Avonmouth, releasing the potential for a further 8,000 jobs in the Severnside and Avonmouth area and act as a catalyst for future growth
- Improve the M5 at Bridgwater where there are proposals to develop around 5,000 new homes and create more than 4,400 new jobs. This will also improve access to the new power station planned at Hinckley Point
- Provide more than eight miles of new dual carriageway on the A30 in Cornwall, facilitating the planned increase of over 22,000 homes and more than 11,000 jobs.

Given the early stage of these schemes, we are not yet in a position to commit to the timescales for the start of construction work. However, we set out in the table 3A the nature of work we plan to do next, along with their anticipated timescales. These are stated in the quarter period of 2015/16 when we expect to start this work.

Table 3A: Next Steps for Schemes Announced in December 2014

Project	Key next step in year 1	
	Starting	Activity
Projects where a project specific plan is already forming		
M5 Junctions 5, 6 and 7 Upgrades	Q1	Developing the more detailed options at Junction 6 and undertaking further surveys to inform the final design, this element of the scheme will be included as part of the M5 Junction 4a-6 Smart Motorway scheme which is planned to start construction in 2015. We also expect to start construction at junctions 5 and 7 in 2015.
A19 Down Hill Lane Junction Improvement	Q1	Developing options and undertaking surveys to inform initial designs ahead of consultation with stakeholders. Proposals are also being developed to package this scheme with the previously announced A19 Testos scheme, due to start work on site in 2018. Taking this approach will enable greater efficiency and reduce the impact of delivery to customers.
A1 & A19 Technology Enhancements	Q1	Feasibility and initial design work has completed. During 2015 we will be undertaking more detailed design work and anticipate starting construction in 2016.
A30 Chiverton to Carland Cross	Q1	Public engagement meetings have already been run jointly with Cornwall County Council, which have helped to inform development of the options. During 2015 we will be appointing designers to prepare the scheme for wider public consultation which is planned for 2016. We plan to start construction in 2020.
M42 Junction 6	Q1	We will be developing the options in more detail and preparing the scheme for public consultation in 2016, this will take into account planned station developments linked to High Speed 2. We anticipate being able to recommend a preferred route in early 2017. We are planning to start construction in 2020.
A45/A6 Chowns Mill Junction Improvement	Q1	Site survey works ongoing, which will inform develop of the options to take forward in discussion with stakeholders with an expectation to start detailed design in 2016 and construction in 2019.
M5 Bridgwater Junctions	Q1	Discussions with Somerset County Council and EDF, to better understand the impacts with Hinkley Point Nuclear Power Station, have started and will start preparing design options. We expect to complete the design in 2015 and are looking to start construction in 2016.
M2 Junction 5 Improvements	Q1	Traffic and environmental surveys will commence. We will also engage with key stakeholders to help develop design options. During 2015 and 2016 we will widen the engagement and further develop and assess the options, leading to a public consultation in 2017. We are aiming to start construction on these improvements in 2019.
M6 Junction 10 Improvement	Q2	Work with Walsall Council, which is undertaking and promoting development of a package of solutions across the local road linking up to junction 10 on the M6. This will include the development of initial designs and site surveys. We expect to start consultation in 2015 and to have prepared the scheme to take through the planning process in 2016. We expect to start construction in 2020.
M621 Junctions 1-7 Improvements	Q2	During 2015 we will be developing options and engaging with stakeholders, including Leeds City Council, with a view to finalising proposals and starting design in 2016. Construction of the scheme is expected by 2020.
A5036 Princess Way – acc. Port of Liverpool M6 Junction 19 Improvements	Q2	Appointing designers to undertake environmental and traffic surveys to inform initial designs for a range of options. Following engagement with stakeholders, we anticipate this leading to a public consultation in 2016. We plan to start construction on the A5036 scheme in 2019, with the remainder following on in 2020.
A585 Windy Harbour – Skippool		
M62/M606 Chain Bar		
M49 Avonmouth Junction	Q2	Topographical surveys of possible locations for new junction will be completed, until then we will be uncertain over the planning route required for this scheme. However, we will start engaging with stakeholders on the options through 2015. We are looking to target start of construction for this scheme in 2017, assuming planning consent is not required.
M1 Junction 45 Improvement	Q3	More detailed plans will be developed around a number of options and early engagement will take place between key stakeholders and local authorities in 2015. We are targeting to start construction on site in 2017.
A43 Abthorpe Junction	Q3	Site surveys completed, during 2015 we will be undertaking public engagement to seek wider views to inform detailed design to commence early 2016. We are looking to target the start of construction works later in 2016.

Table 3B: Next steps for schemes announced in December 2014

Key next step in year 1				
Project	Starting	Project	Starting	Activity
Projects at an earlier stage where more generic initial activities are planned				
M56 new Junction 11A	Q2	M25 Junction 25 Improvement	Q2	Identifying options and initiating surveys to inform the more detailed development, including engagement with wider stakeholders. Typically we would expect this stage to take a year to 18 months to complete. Following which we will prepare the schemes for consultation ahead of progressing with detailed design.
A5 Dodwells to Longshoot Widening	Q2	M25 Junction 28 Improvement	Q2	
A14 Junction 10a	Q2	M25 Junction 10/A3 Wisley Interchange	Q2	
A428 Black Cat to Caxton Gibbet	Q2	M271/A35 Redbridge Roundabout Upgrade	Q2	
M11 J8 to 14 Technology Upgrade	Q2	M3 Junction 9 Improvement	Q2	
A12 Chelmsford to A120 Widening	Q2	A31 Ringwood	Q2	
A12 Whole-route Technology Upgrade	Q2	M3 Junction 10-11 Improved Slip Roads	Q3	
A1(M) Junctions 6-8 Smart Motorway	Q2	M3 Junctions 12-14 Improved Slip Roads	Q3	
M11 Junction 7 Junction Upgrade	Q2	M27 Southampton Junctions	Q3	
A34 Oxford Junctions	Q2	A5 Towcester Relief Road	Q3	
A34 Technology Enhancements	Q2			
A19 Norton to Wynyard	Q1	M40/M42 Interchange Smart Motorways	Q1	Initiate procurement for design consultants, needed to work up and assess a range of options. This stage will typically take six to nine months to complete, following which we will be in a position to start engaging stakeholders in the development and assessment of the options.
M62 Junctions 20-25	Q1	M4 Heathrow Slip Road	Q1	
M53 Junctions 5-11	Q1	M25 Junctions 10-16	Q1	
A500 Etruria Widening	Q1	M6 Junction 22 Upgrade	Q3	
M1 Junctions 23A-24	Q1	A52 Nottingham Junctions	Q3	
A46 Coventry Junction Upgrades	Q1			

3.1.5 Progressing the outcomes from the six Feasibility Studies

In addition to the investments previously outlined, we will take forward and develop solutions to the issues investigated last year as part of a range of feasibility studies.

These studies examined some of the most notorious and long-standing congestion hot-spots in the country, and sought to identify ways in which these could be tackled.

Below we set out a summary for each of the studies and what schemes we will develop:

- Around Newcastle and Gateshead – taking forward a programme of work that will add seven miles of additional capacity to the A1, relieving heavy congestion and providing much improved access to the Tees Valley employment zone
- North of Newcastle – plans to upgrade 13 miles of the A1 to dual carriageway standard linking the Morpeth and Alnwick bypasses, providing additional capacity and improved accessibility to sites across the region including Newcastle Airport
- Trans-Pennine Routes – a package of schemes between Manchester and Sheffield which will improve journey times between these two key cities in the north of England. These schemes will also address a number of safety concerns on the route and alleviate the impact of traffic in Mottram
- A47/A12 Corridor – a package of six schemes across a 115 mile section of the A47 between Peterborough and Great Yarmouth. This will include converting almost eight miles of single carriageway to dual carriageway and making improvements to three junctions, relieving congestion and increasing journey time reliability
- A27 Corridor – taking forward two schemes that will provide a total of six miles of dual carriageway across the A27, helping to relieve congestion at Arundel, 225 Worthing, Lancing and East of Lewes
- A303/A30/A358 Corridor – potentially creating up to 35 miles of dual carriageway between Amesbury in Wiltshire and Honiton in Devon which will improve the connectivity, journey time reliability and road safety.

These investments are at an early stage in their development, however, we set out in table 4 the nature of work we plan to do next and provide indicative timescales for key milestones that we expect to flow from this.

Table 4: Next Steps for Feasibility Schemes

Feasibility Study	Activity	Year
A1 North of Newcastle	■ Commence further development and appraisal work on a range of options to inform consultation with key stakeholders. ■ Initiate traffic and environmental surveys.	2015
	■ Hold public exhibitions and consult on the proposals.	2016
	■ Make recommendations on the preferred route for the A1 Morpeth to Ellingham dualling scheme.	2017
	■ Start construction on the A1 North of Ellingham enhancements in advance of the dualling scheme.	2018
A1 Newcastle-Gateshead Western Bypass	■ Develop the options for the A1 Birtley to Coalhouse scheme ■ Engage early with Network Rail as the scheme includes proposals to replace Allerdene Bridge which crosses the East Coast mainline rail link ■ Undertake environmental assessments of the potential impacts for both the A1 Birtley to Coalhouse and A1 Scotswood to North Brunton schemes.	2015
	■ Consult with the public on the proposals.	2016
A27 Corridor	■ Develop and assess a range of options to inform consultation with key stakeholders. ■ Engage more widely with local stakeholders on the A27 bypasses at Arundel and Worthing / Lancing. ■ For improvements east of Lewes, we will work with local enterprise partnerships and authorities to review long term growth plans and model future traffic demands in order to inform potential options.	2015
	■ Further develop proposals and assess traffic and environmental impacts.	2016
	■ Further and more detailed consultation on proposals for Arundel and Worthing / Lancing. ■ Make recommendations on the preferred routes for these two schemes.	2017
Trans-Pennine Routes	■ Develop design options in preparation for wider engagement, including initial assessments on environmental, traffic and economic impacts.	2015
	■ Carry out environmental surveys and complete assessments.	2016
	■ Present the higher performing options to the public through a consultation.	2017
A47/A12 Corridor	■ Undertake more detailed development of the options, upgrade the eastern regional traffic model and start surveys to inform initial designs. ■ Prepare the seven schemes into a single programme for consultation with stakeholders.	2015
	■ Consult widely with the public on proposals. ■ Subsequently, to make a recommendation on the preferred route.	2016
	■ Start construction on this programme of improvements.	2020
A303/A30/ A358 Corridor	■ Investigate and assess a range of options to understand traffic, environmental and economic impacts. ■ Engage with key stakeholders throughout, including with English Heritage and National Trust. Widening out discussions with stakeholder in the second half of the year.	2015
	■ Start public consultation on the A30 and A358 schemes.	2016
	■ Aiming to make a recommendation on the preferred routes for the A30 and A358 schemes. ■ For the A303, we expect to start a wider and public consultation on the scheme	2017

3.1.6 The Innovation Fund programme

The designated Innovation Fund will support the modernisation of the network by developing innovative services to support expressways, Smart motorways, information provision and data collection, as well as the safe, efficient and sustainable movement of people and goods.

This £120m Fund will stimulate new ideas and ways of working, enabling partnerships with key organisations such as Innovate UK[13], allowing Highways England to take advantage of different ways of procuring innovative solutions and sponsoring research. It will also enable us to learn from and share best practice with other sectors.

With this Fund we will develop a variety of technologies to support performance specification goals. As well as plans to support the testing and introduction of intelligent vehicles on the network, we will use the Fund to deliver, off-road trials of Wireless Power Transfer technologies during 2016/17, install an acoustic tunnel incident detection system at Hindhead and install Wi-Fi technology in the South East.

We will develop our Innovation, Technology and Research Strategy by March 2016, setting out our longer term plans for driving forward innovation and technology to deliver a smarter network, including how we will make effective use of the designated Innovation Fund to support this Strategy. The delivery plan for the Innovation Fund programme will be reviewed on an annual basis to ensure that this reflects how new technologies have emerged or developed successfully.

3.1.7 The Growth and Housing Fund programme

The strategic road network has an important role in enabling the planning and delivery of new housing. We will work in a targeted way with developers to ensure that housing growth means better journeys and no longer tailbacks. This means upgrading junctions making improvements around towns and cities, and enabling works for potential Garden Cities.

This type of investment will be supported by a £80m fund, committed to unlocking housing and growth projects.

We will use the Growth and Housing Fund to unlock development sites in partnership with a broad range of stakeholders. This will accelerate the pace of development sites that have secured planning consent, but have not yet been implemented, and those emerging through the Local Plans and already contained within the Strategic Economic Plans of Local Enterprise Partnerships.

3.1.8 Road Investment Strategy 2 schemes

During RP1, we will prepare 15 new schemes for delivery in the next Road Period. The following sets out a summary by region of these future planned investments:

North East and Yorkshire

Five schemes identified for development and for delivery in the next Road Period:

- A64 with the York outer ring road – the route is significantly constrained at junctions with the local network and improvements are needed to both alleviate these constraints and support planned developments
- M1/M62 Lofthouse Interchange – increasing capacity to ease traffic flows and support wider growth in employment and housing
- A1 between Redhouse to Darrington and A1(M) around Doncaster. We will be undertaking a feasibility study in 2015 to identify potential solutions to be taken forward to improve congestion and safety and provide resilience on the North-South corridor in Yorkshire
- M1 between Rotherham and Wakefield – easing congestion by upgrading to Smart motorways and providing an additional 27 lane miles of capacity.

North West

One scheme identified for development and for delivery in the next Road Period:

- Simister Island interchange between the M62, M60 and M66 - introducing more free-flowing movements to substantially improve one of the busiest junctions to the north east of Manchester.

[13] https://www.gov.uk/government/organisations/innovate-uk

Midlands

Four schemes identified for development and for delivery in the next Road Period:

- A46/A616/A617 and A46/A1 junctions – improvements to create smooth running of the Newark bypass and to support planned growth in the region. Options will include use of technology to provide better information and promote greater network resilience
- M1 in the Midlands – upgrading the remaining sections to Smart motorway, a continuous Smart motorway link from London to Yorkshire. This is likely to include upgrades to junction 21, to improve links from the M1 to the M69
- M42/M5 interchange (M5 J4a) to M42 J3 – upgrading to provide a continuous section of four-lane Smart motorway
- A45 between Stanwick and Thrapston – upgrading the last single carriageway link between the A14 and M1, helping growth, including housing, in Northampton and reducing traffic pressure on Kettering.

East

Two schemes identified for development and for delivery in the next Road Period:

- A12 between junctions 25 and 29 - widening to three lanes and improving junction layouts to relieve congestion and improve access between London and Ipswich
- A12 carriageway between the M25 and the Chelmsford bypass – Widening to three lanes and providing technology to provide greater traffic information and potentially ramp metering at junctions.

South East

Two schemes identified for development and for delivery in the next Road Period:

- A3 in Guildford between the A31 Farnham Road and the A3/A320 Stoke Road - widening of the existing carriageway to provide additional capacity and safety improvements
- Lower Thames crossing – developing plans for an additional crossing to alleviate congestion and support the significant growth plans for the area, including proposals to create tens of thousands of new homes and jobs through a major new development around the high speed rail station in Ebbsfleet in Kent.

South West

One scheme identified for development and for delivery in the next Road Period. A417 near Birdlip in Gloucestershire – connection of the two dual carriageway sections, taking account of both the environmental sensitivity of the site and the importance of the route to the local economy.

3.1.9 Contributing to investment with local authorities

We will also be providing funds and working with local authorities to deliver some specific improvements.

In the North West we will be working with both Lancashire County Council and Rochdale Council to deliver a new junction to the M55 and to provide a new access road from Junction 19 of the M62 to Heywood.

The new junction on the M55 will improve access to the Warton site of the Lancashire Enterprise Zone, the Springfields nuclear fuel facility at Salwick and enable the comprehensive development of the North West Preston strategic housing location which will accommodate more than 4,000 new homes. Ground investigations are taking place together with environmental surveys, to enable detailed designs to be produced. Work on site is planned to start in 2018/19.

The new road from the M62 will provide a link between existing employment sites, including Heywood Distribution Park and Hareshill Business Park. In the coming months the council will be working on a business case to finalise the funding and preparing a planning application for submission later in 2015.

In the Midlands we will be working with Staffordshire County Council to provide improvements on the A50 around Uttoxeter providing improved access to a new housing and employment site to the south of the A50 and the existing and new JCB factories to the north of the A50. Proposals, for first phase of the project, have been approved and works are expected to start on site in 2015. Options are being developed for the second phase of the project, which will be subject to an extensive public consultation exercise later in the year.

In the South West we have been working with Cornwall County Council on plans to dual the last section of single carriageway on the A30 between Temple and Higher Carblake which will improve opportunities for economic growth in Cornwall by removing a constraint to the capacity of the A30 route, which will improve safety and relieve congestion and delay. The start of construction on site is imminent with completion expected in 2016/17.

3.2 Route Strategies and the Strategic Economic Growth Plan

Underpinning the way in which we plan and coordinate future interventions on the network, from an operational, maintenance and modernisation perspective, is our route strategies. Working closely with Local Enterprise Partnerships and other local partners and stakeholders, we use route strategies to identify current and future constraints to economic growth that the performance of the strategic road network potentially causes, and identify how future delivery and investment plans might address them.

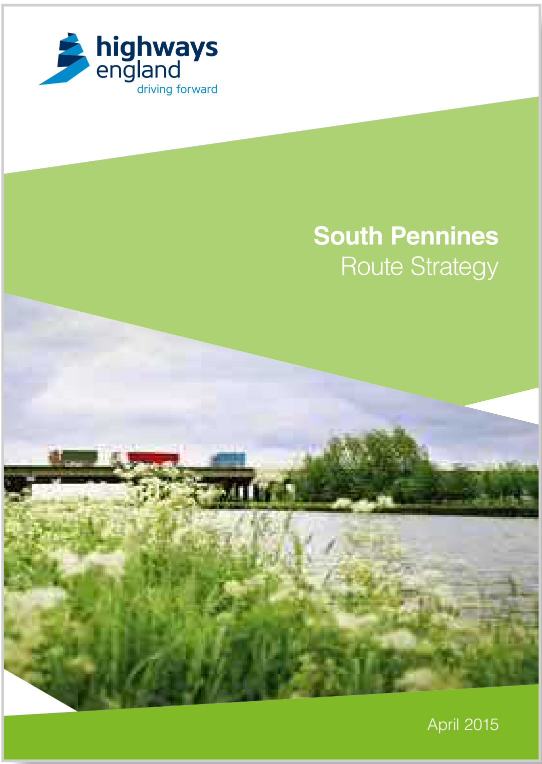
We have now completed our first set of route strategies. Looking forward to Road Period 2 (RP2) we will begin to develop our next iteration of the strategies and will publish them at the end of 2016/17 in order to inform our strategic road network Initial Report and the RIS 2.

Alongside this we are committed to doing more to ensure that the strategic road network does take account of local, regional and wider national economic growth. By the end of 2016 we will publish our joint Strategic Economic Growth Plan with our public and private partners (including Local Enterprise partnerships, developers, local authorities and the Combined Authorities.)

The plan will enable us to develop a better understanding of how investment contributes to economic growth, where it will deliver best value in the future and how we can collaborate and pool funding to unlock the greatest benefits. It will also form an important input to our future route strategies. Following evidence gathering and consultation in year one, we expect to publish the plan and begin implementation in year two.

Throughout this Road Period, we will evaluate what activities have been undertaken to support the economy. As a minimum we will include the following metrics:

- Being an active and responsive part of the planning system, by responding to 99% of all formal planning applications within 21 days
- Supporting businesses, and the freight and logistics sector
- Helping Government support Small and Medium sized Enterprises, by meeting Government target of 25% (SME) direct and indirect spend.



4. A safe and serviceable network

England's strategic road network is currently one of the safest in the world. The Highways Agency always put safety at the core of its work, and as Highways England we will build on this legacy, working towards the goal of bringing the number of people killed or injured on the network as close as possible to zero by 2040.

One of the most important factors in providing a safe strategic road network is well-maintained and well-serviced road surfaces and associated infrastructure. Consequently, over RP1, we plan to use the increased certainty of funding to transform the way we maintain and modernise our assets – see 4.2.

4.1 Safety first

Both the Government and we are resolved that no one should be harmed when travelling or working on the strategic road network.

As a first step towards this goal, the Government has set a challenging target that we are determined to reach.

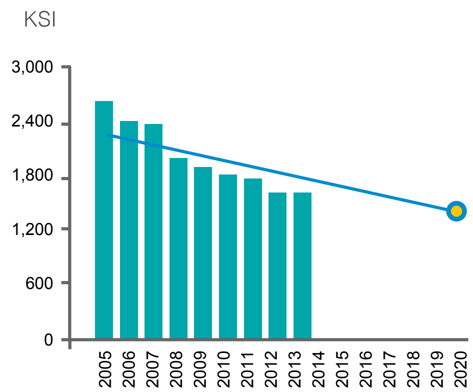
Government key performance indicator
Road Safety

KPI The number of KSIs on the SRN

Target Ongoing reduction in Network KSI's to support a decrease of at least 40% by the end of 2020 against the 2005-09 average baselines

Whilst the number of people Killed or Seriously Injured (KSI) on UK roads has generally been declining since 2005, over the last few years the number of fatalities has remained fairly consistent with a small increase in KSIs in 2013. We recognise that we must continue to improve safety by investing in our road network, both to prevent incidents from occurring and to reduce the severity of those that do. By end of 2020, we aim to have reached a target of no more than 1,393 KSIs across our network in a year. This will be achieved by a year on year reduction in those harmed across the network – see figure 5.

Figure 5: No. of KSIs on the network



We will set out exactly how we plan to achieve this in our five year plan, Driving Forward Safety, which we will publish in the autumn of 2015. Through these plans and the active support of our partners and their enforcement powers we will delivery safer roads, safer vehicles, and safer people.

4.1.1 Safer Roads

Over the course of RP1 we will invest over £11bn to modernise and maintain the network, this will also include a range of safety measures that will result in noticeable improvements for our customers and will contribute significantly to achieving the 40% reduction in KSIs.

The measures that we will implement include:-

- Upgrades to junctions and removing some of the worst bottlenecks
- Developing higher standard A roads, to be known as 'Expressways'
- Upgrading central barriers
- Providing safer verges with improved run off protection
- Improved road signing and markings
- Upgrading lay-bys
- Developing and deploying technology to prevent, detect and monitor incidents.
- Using designated safety funding to deliver targeted safety improvements.

Through the investment and wholesale modernisation of the network we will ensure that by the end of 2020 more that 90% of travel on the strategic road is on roads with a safety rating of EuroRAP 3* (or equivalent). We will also ensure that the majority of those roads with 1* and 2* safety rating have improved to 3*.

Alongside this we will work closely with the International Road Assessment Programme[14], the Road Safety Foundation[15] and the Department for Transport to inform the development of a new comprehensive star rating system.

Understanding causation factors behind incidents and improved intelligence in respect of road safety will allow us to target investment more efficiently. As a result we are committed to develop road safety intelligence profiles on each of the strategic routes by the end of September 2015.

[14] http://www.irap.net/en/
[15] http://www.roadsafetyfoundation.org/

We will also conduct annual progress reviews on scheme delivery to ensure we are making progress towards our safety KPI.

Where there are gaps in our current understanding and knowledge we will address this over the Road Period. We will commission road safety research projects to improve our understanding of the causes of fatalities in collisions on the network, current state of roadworthiness of vehicles and the impact of road works on driver stress for completion by the end of April 2016. We will also develop an improved monitoring capability to ensure incidents on the All Purpose Trunk Road (APTR) are captured by the end of April 2018.

As required by Government as we improve our safety intelligence we will gather data on a range of performance indicators and report annually to the Department for Transport, the Highways Monitor and Transport Focus. These include:

- Incident numbers and contributory factors for motorways
- Incident numbers and contributory factors for APTR
- Number of vulnerable user casualties across the network (cyclists, pedestrians, motorcyclist and equestrians.

4.1.2 Safer vehicles

Where faulty vehicles account for incidents on the network, we know that the majority of them are down to poor car maintenance.

To tackle this we will work with industry bodies, motoring organisations and enforcement agencies to improve vehicle maintenance. In the first instance we will develop a series of campaigns focused on the improvement of vehicle maintenance.

We will also expand our engagement with car manufactures and other organisations to develop technologies that improve safety, including collision-avoidance technology and autonomous vehicles, which mitigate against key contributory factors in incidents.

4.1.3 Safer people

Customers

Driver behaviour and human error remain the most likely cause of incidents on our roads today. As the steward of the network we are reliant on drivers complying with the Highways Code and the support of enforcement authorities when they do not.

To achieve our 40% reduction target we will need a higher level of commitment not just from ourselves but also from our partners who have a huge part to play. We will work closely with them to develop targeted enforcement and education interventions to address a wide range of non-compliance issues which impair driving, such as fatigue, distraction, alcohol and drugs.

We will target improvements in safety for vulnerable customer groups such as cyclists, pedestrians, the young and elderly drivers.

Our people and supply chain

We have a well-established approach to safety for our people and our supply chain. However, we will embed a more mature safety culture while focussing on measures to reducing risk that have the biggest impact.

To develop and evolve our safety leadership and culture approach, we will:-

- Implement a safety leadership and cultural change programme across the Road Period which recognises that change is as much about personal responsibility as it is corporate action
- Manage risks through the development of a single health and safety management system to address both customer and workforce risks. This system will include, rationalised company procedures and processes to create systems of work that are pragmatic and risk based
- Measure performance through the development of enhanced lead indicators
- Raise standards for safety employed by our supply chain, wider industry and our own company over the Road Period

- Eliminate crossings of live carriageways by road worker.

As required by Government we will report annually on the following performance indicators related to our company and supply chain.

- The Accident Frequency Rate for construction and maintenance workers our supply chain
- The Accident Frequency Rate for Customer Operations (the Traffic Officer Service and office-based staff).

4.2 A serviceable network

The Government has asked us to keep the network in a good condition, therefore in our SBP we committed to ensure a more dependable and durable network that requires less time and money to maintain.

We will do this, and in turn enhance the long term safety of the network, by moving to a longer term, more efficient approach to planning our maintenance of the network and improving our asset management capability. We will also improve the way we work with our maintenance supply chain.

4.2.1 Planning the long term maintenance of the network

Over the next five years, we will invest more than £3.65bn in maintaining the strategic road network in order to meet the Government's requirement to keep the network in good condition. This will include an ambitious resurfacing programme covering a significant proportion of the network.

Government key performance indicator
Network Condition

KPI: The percentage of pavement asset that does not require further investigation for possible maintenance

Target: Percentage to be maintained at 95% or above

In 2015/16 we will invest a total of £718m in renewing our road surfaces, structures and technology assets. We will deliver:

- 1,200 linear miles of new road surface
- 178,000 linear metres of vehicular barriers
- 230,000 linear metres of drainage
- 375 technology renewals and upgrades.

The renewals outputs that we will deliver in the first year of RP1 are set out in table 5 below[16].

Table 5: 2015/16 renewals outputs

Renewals Type	Deliverables	Total Quantity
Renewal of Roads (RoR) Pavement	Pavement	1,200 (Lane miles)
Renewal of Roads (RoR) Pavement	Road markings	2,304,000 (lin m)
	Kerbs	13,000
	Vehicle Restraint System – Concrete	59,000 (lin m)
	Vehicle Restraint System – Non Concrete	119,000 (lin m)
	Drainage	231,000 (lin m)
	Drainage – Other	1,435 (no.)
	Geotech	46,000 (linm)
	Traffic Sign (non-electric)	1,525 (no.)
	Guardrail	1,000 (lin m)
	Boundary Fencing	58,000 (lin m)
	Footway	13,000 (lin m)
	Lighting	3,649 (no.)
	Roads - Other	0 (no.)
	Soft Estate	7 (no.)
Renewal of Structures	Bridge Joint	222 (no.)
	Bridge Bearing	214 (no.)
	Parapet	1, 000 (lin m)
	Waterproofing	20,000 (sq. mtrs)
	Vehicle Restraint System – Non Concrete	0 (lin m)
	Drainage	0 (lin m)
	Structures – Edge protection	0 (no.)
	Structures – Other	58 (no.)
Renewal of Technology (RoT)	Motorway coms equipment	100 (no.)
	Technology renewals & improvements	375 (no.)
	Technology Projects – Economy	0 (no.)
	Technology Projects – Safety	0 (no.)

[16] Outputs based on current asset knowledge and assumptions for RP1 and subject to change control procedures outlined in Section 9

This work will be done in a way that minimises disruption to customers and neighbouring communities, and will include low-noise surfacing of the network. This will contribute significantly to the achieving the target to mitigate at least 1150 noise important areas over RP1.

We will measure our overall performance through annual inspections of the road pavement to ensure that we meet our KPI requirement.

We will embark upon a significant departure from the way we have traditionally planned asset renewal works based on an annual cycle of funding. This often resulted in planning work in the spring and summer before carrying it out in the autumn and winter when the weather is poor. A longer-term and more integrated view of maintenance and modernisation, based on better asset knowledge, will offer huge benefits in terms of minimising disruption to our customers and ensuring best value whole-life cost from the asset.

By December 2015, we will define our programme for renewal and small scale enhancement for 2016/17. At the same time, we will develop a methodology for getting inputs for regional delivery plans that will adopt a longer term view, the outputs of which will be updated throughout RP1. The development of our plans will be controlled by Regional Programme Boards and coordinated through an integrated portfolio management approach that packages together all our renewals, major schemes, and routine maintenance activities for both now and in the future.

This will mean we can carry out all necessary works in one go, with an aspiration to not return back to the same location to carry out further work on any given part of the network for at least five years. Naturally, it will also contribute to our KPI target of ensuring lane availability does not fall below 97% in any given year.

We will also ensure the most critical and vulnerable parts of the network are prioritised for enhanced resilience and contingency measures. This includes implementing our Metal Theft Strategy to prevent the theft of cables, which causes significant disruption.

4.2.2 Improving our asset management system and capability

Building on our existing asset management capability, by the end of RP1 we will have in place an asset management system that is consistent with ISO55000 industry standards.

Our asset management guiding principles will be outlined in our Asset Management Policy, which we will issue in August 2015. This will be followed by our Asset Management Strategy in April 2016. This Strategy will outline how we will deliver our asset management approach outlined in the Asset Management Policy. Our organisation's asset management capability will be measured through a series of asset management maturity assessments carried out across RP1.

A critical element to any successful asset management system is a good knowledge of the condition and performance of the existing asset base. As such one of the key enablers of our new approach will be a comprehensive asset data information system (the Integrated Asset Management Information System, or IAMIS). This will be introduced in stages over the next five years, adding one asset type after another as we gather improved data and the associated sub-systems come online.

To meet our commitment to keeping the network in good condition we will submit an implementation plan in March 2016 to demonstrate how we are improving asset information quality. The plan will be aligned to our Asset Management Policy and Strategy and will provide confidence that we are progressing towards our objective of improving our asset management capability. Additionally, as we introduce IAMIS, we will work to develop and complete validation of new condition indicators for:

- Pavements and Structures for agreement by March 2017 and complete validation for these by March 2019
- Technology, Drainage and Geotechnical Works for agreement by March 2018 and complete validation for these by March 2019.

4.2.3 A new operating model for maintenance

A key element in our journey to improving our overall asset management capability will be significant change in our operating model for maintenance

Starting in the East Midlands at the point of contract renewal in July 2016, the new model will see us directly manage both routine maintenance and the coordination and planning of capital renewal schemes.

To drive improvements in efficiency and the quality of services delivered to customers we will increase our direct knowledge of the asset and the factors which generate waste and inefficiency. Working more closely with the suppliers who undertake these activities on the ground will open opportunities for us to collaborate more effectively with them to identify innovations in planning and scheduling and the methods employed to improve the quality and value for money of these services.

In this new model the works which were previously undertaken by the maintenance contractor will be split into three principle packages. These include a design package, a term maintenance package, and a management and direction of operations package. The direction and management of operations elements will be insourced and the other two packages let to suppliers. We will also contract directly with a range of specialist providers who had previously worked to the direction of the maintenance contractor.

By increasing our direct exposure to works we will better placed to ensure that the quality of work undertaken is optimised. Quality of workmanship also has a major impact on the durability of asset renewals generating assets which need less future maintenance. Reducing the need for work in the future represents better long term value for money, reduces future disruption to road users and reduces safety risks for road workers.

This change in approach will require a different internal capability to reflect the different role that we will be being adopting.

A key objective of this approach is to build our internal knowledge of the asset and build commercial insight, particularly the causes of waste. We will then utilise our increased asset and commercial insight to drive improved performance across the traditionally contracted maintenance operations in other parts of the country.

To support this transfer of practice we will also be enhancing our central areas of expertise who will work closely with the East Midlands team and other areas.

There are many examples of good practice which have been generated by maintenance contractors across the network and the sharing of best practice in the new arrangements will very much be two way, but with increased Highways England capability to ensure that improvements generated in one area or on one scheme are embedded more widely.

5. More free flowing network

Highways England in line with the RIS, aims to provide a much more free-flowing strategic road network, where all journeys are easier, safer and more reliable, and delays are less likely. In responding to the RIS and listening to our customers we know they currently see the management of roadworks and resulting journey times as one of the least satisfactory aspects of the network we service.

Improvement in this area will have a positive effect not only on the experience of our customers, but also on the wider communities the network serves and ultimately on the national economy. For this reason, the government has rightly set Highways England a challenging target for Network Availability.

Government key performance indicator
Traffic Flow – Network Availability

KPI: The percentage of the SRN available to traffic

Target: Maximise lane availability so that it does not fall below 97% in any one rolling year

5.1 What we will do

We will set out the principles of how we will support the smooth flow of traffic in a Concept of Operations, which we will publish by July 2015. Our full plans to strengthen the company's network management function, maximise network availability and reduce the impact of incidents and recurrent congestion will be published in a new Operational Strategy by the end of December 2015.

The work will change the operating model for our on-road service, providing greater coverage of the network, greater flexibility to respond to variations in demand an increased safety both on our network and for our customers and neighbouring communities. This is one of the key tools to ensure lane availability does not fall below 97% in any one rolling year. We expect to pilot this new operating model in one region by the end of 2016.

There are seven key areas we are working on to deliver a more free-flowing network:

5.11 Operational capability and response to congestion

Operational capability determines how Highways England tackles predictable congestion. This includes cyclical increases in demand around peak times of the day, or holiday periods throughout the year. We commit to providing more effective information well in advance in order to influence travel patterns, and real-time data in a useful format while customers travel on the network.

We will strengthen our response to congestion through preventative measures like communicating alternative routes and additional roadside technology to facilitate these measures, such as customer information signs. Over the four year period from 2016/17 we will use the designated Innovation Fund to deliver incident detection technology on the network.

Over RP1 we will continue to upgrade our regional control centres systems through joint strategic initiatives that embed new control systems such as CHARM, a joint initiative between Highways England and the Dutch road authority, Rijkswaterstaat. These will interlink all key command and control systems into a single more efficient operating system, enabling remote operation and response from any control centre. This will improve our effectiveness, resilience and our ability to flex operational capability at particularly busy times or during emergency incidents.

We will be introducing a new system for managing traffic into one of our control centres by the end of March 2017 and will continue to roll out thereafter.

While we are implementing these initiatives, we will be reviewing our operational approach to delivering information, operating the network and utilisation of on-road Traffic Officers to realise greater value from continued investment in these service. We will complete this review process by the end of December 2015.

5.1.2 Dealing with incidents, including extreme weather events

When incidents do occur we commit to responding more promptly, and deploying the right level of response to resolve the issue and prevent any further escalation. We will coordinate Traffic Officers, our asset maintenance and vehicle clearance contractors in a timely manner to clear the incident and reopen the affected lanes or road to traffic.

Government key performance indicator
Traffic Flow – Incident Management

KPI — Percentage of motorway incidents cleared within one hour

Target — At least 85% of all motorway incidents should be cleared within one hour

We will also develop new incident detection technology to identify and respond to incidents more quickly; for example trialling an acoustic tunnel incident detection system in the first three years of RP1. These systems utilise the latest technology to detect incidents within a tunnel through abnormal sounds; in turn notifying our control rooms, where if required action can be taken to halt tunnel access and activate other emergency measures.

We will continue to work with our partners to refine and improve strategic development of the initiatives and protocols aligned to the CLEAR initiative (Collision, Lead, Evaluate, Act, Re-open) and the Joint Emergency Services Interoperability Programme (JESIP). This includes close liaison with other roads responders, such as emergency services or other government vehicle enforcement agencies to reopen the network quickly after major incidents.

Strengthening collaborative partner relationships like these will also assist us to operate the strategic and local road networks more effectively around planned events.

We will also work alongside industry bodies, motoring organisations and enforcement agencies to improve driver behaviour and vehicle maintenance in order to reduce the number of incidents, and maximise lane availability.

Congestion and road closures caused by extreme weather events are more unpredictable. While such events are out of Highway England's control, we can control how effective our preventative forward planning initiatives and reactive response measures are. We therefore commit to delivering and maintaining an enhanced, Integrated Severe Weather Information Service, to support effective decision making and management of our response to severe weather.

To improve monitoring of incidents and our response to them, we will develop a new incident management measure in 2015, which will initially run alongside the existing measure while we assess and develop its efficiency before implementing it fully from 2020 onwards.

Our on and off-road Traffic Officers and control room staff play an important role in keeping traffic moving. This is especially true in the operation of Smart motorways. With the expansion of further 286 lane miles over the next five years, we will rely heavily upon them to effectively operate the motorway network, help our customers in the event of breakdown or collision and clear debris from the live lane before returning the road to use. During the early years of RP1 we will analyse and capture lessons learnt from the operation of Smart all lane running motorways to better understand and improve future schemes.

5.1.3 Planning and managing roadworks

Another crucial factor in achieving free-flowing roads and maximum lane availability is how effectively we plan and manage roadworks. Given that we are also committed to maintain and modernise the network, this makes RP1 a particularly challenging period.

We will continue to carry out works at times of minimal inconvenience to our customers and neighbours. When this is not possible, we will explore new methods to optimise our occupancy of the network, such as ‘fence-to-fence’ working. In this example combining improvements and renewal works at a location to limit disruption. On completion of such works, we do not expect to return to the location for major roadworks for a minimum period of five years thereafter. We will also utilise the Traffic Officer Service to play a role in network stewardship, monitoring how works are effecting traffic flow and noting visible asset defects while out on the network.

Through improving the quality of information that we provide to our customers about the most disruptive roadworks, and ensuring that planned roadworks are communicated more effectively our customers will be able to expect a better service in this area. We will also develop a delay in roadworks performance indicator during the first year of RP1. We will then report annually to the Government, the Highways Monitor and Transport focus on this and the activities that we have undertaken to minimise inconvenience to our customers in the previous year.

5.1.4 Improving our traffic information

As well as improving how we operate the network and manage roadworks, effective communication of our planned activity and up-to-date network condition information are critical to achieving a more free-flowing network. By December 2015, we will develop and publish Highways England’s Traffic Information Strategy. This Strategy will set-out how we will engage with local highway authorities to integrate journey planning across our networks and improve communication to our customers. Providing our customers with better information on network conditions will allow them to plan their journeys effectively, and avoid incident-related congestion or works.

To support this Strategy we will continue to promote Traffic England, developing the website further so it is recognised as a trusted source of information making Highways England accountable for our customers' journeys. We will also explore using and sharing data and traffic information from the National Traffic Operations Centre to make a step change in the quality and accessibility of information to our customers.

In preparation for a more modernised and technologically advanced network, we will be trialling wireless internet in the south-east region between 2016-18. If this is successful we will investigate the benefits and case for targeted use at other key locations. Integration of the network and mobile technology will undoubtedly be crucial to providing our customers with real-time interactive travel data in the future. We will further explore the possibilities in the second Road Period.

5.1.5 Improving the services we offer our customers

By December 2015, we will develop and publish our Customer Service Strategy setting how we will deal with their needs, as well as taking into account their views and feedback. To develop and broaden our range of services, and to reflect the diversity of our customers and their preferences for contacting us, we will provide multiple channels of communication; for example, expanding social media and web chat contact with our customers.

The plan is to route customer and business contacts through a new centralised customer team within the National Traffic Operations Centre. By basing the team in our operations centre, we can not only answer their general enquiries, but also provide current network condition and traffic information. We expect this to have a positive effect on our customer satisfaction rating.

We will work with Transport Focus to help shape the new customer satisfaction measure they are developing, which will initially run in parallel to our existing Road User Satisfaction Survey. During the first two years of RP1, we will also develop new performance indicators for dealing with customer correspondence and telephone enquiries. Ultimately success will mean we are acknowledged externally for the quality of customer service we provide. We will gain greater customer insight by valuing their feedback and complaints, learning from our customers and responding in an appropriate manner.

Finally, we will also improve how we engage with our stakeholders, using an account management approach to obtain the best value from reciprocal, mutually beneficial relationships with key stakeholders.

5.1.6 Adding capacity, including Smart motorways

As described in Section 3, Supporting Economic Growth, the capital investment of more than £7bn will contribute significantly to increase capacity and remove bottlenecks to facilitate our ambition for a free-flowing strategic road network. The investment will also allow us to address the environmental impact on people and improve access to and from the strategic and local road networks.

5.1.7 Expressways

An expressway will provide a high-standard route normally associated with our modern Smart motorways on the APTR network. It will transform those busy all-purpose roads by creating a free-flowing route where currently there are frequent junctions and local turnings causing congestion.

An early example of how expressways will transform the strategic road network is being taken forward in our planning for the A14. We will be starting work on A14 Cambridge to Huntington project during this Road Period. This will make journeys more reliable through increased capacity, improved technology, better connected junctions and reduced congestion on this key arterial route linking the east coast ports with the Midlands and north of England. We will continue to develop the standards for the expressways concept with the aim of proposing and constructing a number of schemes in this Road Period and the next.

6. Improved Environment

Government has made a strong commitment to an ongoing improvement in environmental outcomes through the operation, maintenance and modernisation of the strategic road network. We are committed to ensuring that all activity on the network is delivered in a manner that does not harm the environment; but instead delivers long term benefits to the natural and built environment, creating a sustainable future for all.

The network has an effect in a variety of ways on the environment. We have set out below what we will do in RP1. Government has set specific targets in the areas of noise and biodiversity.

In recent years we have made significant progress on reducing the impacts of our network. As a result of quiet surfacing, early relocation of affected species, and more intelligent design and landscaping, our performance has improved and surrounding communities have been less effected. However, there is much still to be done. With the increase level of investment during this Road Period we will improve our environmental approach across all design and construction activities.

To meet our ambitions for the environment, we will set out our plans in an Environment Strategy which we will publish in March 2016.

We have substantial investment to start tackling some long standing environmental issues. These include:

- Further design and development making progress towards building a twin bore tunnel on the A303 at Stonehenge, to take traffic away from the surface and reunite the World Heritage Site, and consideration of some small scale work in the Blackdown Hills Area of Outstanding Natural Beauty (AONB), which will take account of the environmental sensitivity of the area.
- Making progress on the outputs from the Trans-Pennine study, including plans for two overtaking lanes on the A628 Woodhead Bridge, and Salter's Brook Bridge, in the Peak District National Park. We will work closely with the National Park Authority to ensure improvements are in keeping with the Park's protected landscape
- A bypass and junction improvements on the A27, whilst also developing sustainable transport measures at Arundel, Worthing, Lancing and East of Lewes.

We will also invest £225m over RP1 through a dedicated Environment Fund to deliver specific environmental enhancements on or around the network. In addition, the £75m from the designated Air Quality Fund is aimed at making real reductions in air pollution.

Measuring Environmental Performance

At this stage, there is no single metric to indicate the overall condition of the environment with respect to the strategic road network. Highways England will therefore develop a broader range of new measures that reflect our environmental performance, and this work will be completed by end of RP1 for use in the next Road Period. These new metrics will allow Highways England to demonstrate clearly what activities have been undertaken, and how effective they have been in improving environmental outcomes.

6.1 Specific areas of environmental action

There is scope for different interventions to deliver integrated solutions where there are opportunities for synergies across topics and geographical areas. For example, one intervention may secure outcomes ranging from biodiversity to water and landscape improvements. There may also be opportunities to lever contributions from other sources to achieve wider improvements.

We will work with statutory environmental bodies and other stakeholders in developing specific action plans and criteria for prioritising expenditure from the fund. We will commence consultation with stakeholders on the initial statement of prioritisation for the fund in summer 2015.

6.1.1 Noise

Concerns about noise represent the highest number of environmental complaints from customers. The design of new schemes includes mitigation to manage noise, but problems remain, particularly on the older parts of the network.

Government key performance indicator
Environment – Noise

Number of Noise Important Areas mitigated;

Mitigate at least 1,150 Noise Important Areas over RP1.

The Government has challenged Highways England to mitigate noise in at least 1,150 Noise Important Areas over RP1. The programme consists of:

- Approximately 45% of the sites will be delivered through our network modernisation programme
- Approximately, a further 45% will receive noise mitigation through the planned quiet noise resurfacing programme
- The remaining 10% of noise sites will be delivered by stand-alone measures such as noise barriers or insulation
- A feasibility assessment of low-noise surfaces and if successful, a trial of Two Layer Porous Asphalt on one or more sections of urban motorway. The feasibility assessment will be completed by 2016 and if successful trial site locations identified by 2017.

We will publish our programme of measures to tackle the 1150 noise important areas for 2016 and beyond in our updates of the Delivery Plan.

6.1.2 Air quality

To support wider Government initiatives targeted at improving air quality, Highways England is committed to invest £75m in a range of projects to reduce pollution and ensure the air around the network is clean and healthy for our customers and neighbours.

We expect to undertake up to six air quality pilots in 2015/16 and a further four in 2016/17. Each of which will take approximately 12 months to complete. The locations for these studies will be identified by working with the Department for Transport and Department for Environment Food and Rural Affairs[17]. We will then identify further locations that would benefit from physical works to improve air quality throughout the remaining years of RP1 and beyond.

We will continue to meet and consult with scientific experts, local and national government, wider stakeholder groups and our delivery partners to discuss how best to achieve better air quality taking into account current legislation. We will build a clear picture of where pollution exists and the impact of our mitigation, support others in developing new approaches to reducing pollution, mitigate and design out pollution from new schemes we build, and actively reduce pollution through effective management of the network.

In the first year of RP1, we will:

- Set up the Air Pollution Strategy Board to govern activity and investment
- Develop an air quality action plan setting out our activities for the next five years
- Produce an update report on trials and research that have been commissioned by March 2016
- Publish a report highlighting lessons learnt and tools which have been successful in addressing the air quality challenge by June 2016.

We will provide further information on our future programme to develop a new performance indicator for air quality.

[17] https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs

6.1.3 Carbon emissions

Road transport is one of the main sources of greenhouse gas emissions, commonly referred to as carbon emissions, which contribute to climate change. We will play our part in reducing the UK's carbon emissions.

We are committed to maintaining our focus on reducing Highways England's carbon footprint, and working closely with our suppliers to reduce emissions from network related activity, and to move from carbon measurement to the challenge of carbon management. We will set out our plans for a low carbon future as part of Highways England's new Sustainable Development Strategy by March 2016.

The key areas of focus over RP1 will include:

- Assessing the feasibility of introducing a mixed fleet of ultra-low emission vehicles (ULEVs) for the Traffic Officer Service, comprising diesel, electric or hybrid vehicles. Our plans will be set-out with our Operational Strategy by December 2015
- Investigate feasibility of solar panel provision on the surplus land estate, and facilitating the generation of renewable energy adjacent to the network estate and delivered to the national grid. Identification of initial programme of interventions by March 2016, and updated annually thereafter
- Developing a programme to support uptake of ULEVs by installing rapid electric charging points along the strategic road network, with a future ambition to ensure 95% of the network has a charging point at least every 20 miles.

During this Road Period we will be measuring carbon dioxide and other greenhouse gas emissions originating from Highways England's or our supply chain's activity on the network. We will also develop a new indicator to determine what vehicle emission levels are from our customers' use of the strategic road network. We will develop the appropriate methodology and complete this work by March 2016.

6.1.4 Biodiversity

Government key performance indicator
Environment – biodiversity

KPI: Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan

Target: The Company should publish its Biodiversity Action Plan by 30 June 2015 and report annually on how it has delivered against the Plan to reduce net biodiversity loss on an ongoing annual basis

There are opportunities to improve the biodiversity of the existing network. Where roads have been constructed in deep cutting through areas of significant environmental value, there is scope to restore biodiversity by reconnecting severed landscapes. Highways England will identify works to fix deep-seated environmental problems and halt net biodiversity loss to contribute to Biodiversity 2020 outcomes. This work will also help meet the Government's commitments within the Natural Environment White Paper[18] and the National Pollinators Strategy[19].

We will set out our plans to halt the loss to biodiversity and the longer term ambition of no net loss in RP2, in our Biodiversity Action Plan by June 2015. Key priorities currently identified for action in RP1 are:

- Reviewing opportunities for specific measures to contribute to a coherent and resilient ecological network by enabling species to move between core areas
- Reviewing opportunities for contributing to restoration areas such as Nature Improvement Areas (NIAs), where strategies are put in place to create high value areas, restoring ecological functions and wildlife. We will continue work on two pilot schemes at the Humberhead Levels, and the Morecombe Bay Limestones and Wetlands NIAs.

[18] https://www.gov.uk/government/publications/natural-environment-white-paper-implementation-updates
[19] https://www.gov.uk/government/publications/national-pollinator-strategy-for-bees-and-other-pollinators-in-england

Further work on the network has the potential to contribute to other NIAs. We will assess what interventions can be undertaken at these sites and publish our draft programme of locations and potential interventions alongside our biodiversity action plan in June 2015

- Reviewing opportunities for contributing to Sites of Special Scientific Interest (SSSI) or core area of high nature conservation value which contain rare or important habitats or ecosystem services. Highways England owns the entirety of two SSSIs.

We will develop a metric to measure and report on progress in this area. The timetable for this will be set out in our Biodiversity Acton Plan.

6.1.5 Landscape

Highways England will invest £29m during RP1 to improve the look of our network, and both protect and enhance the character and quality of the built and natural landscape. Our key areas of focus over the next five years are:

- Addressing existing environmental problems, and specifically reducing visual intrusion to our neighbours. We will do this by reviewing and, where appropriate, revising our existing landscape mitigation to take account of changes in local priorities and land use
- Amending the design of our roads where appropriate, to better address national, regional and local priorities
- Promoting schemes that are better integrated with the surrounding environment at a landscape scale, which also deliver associated ecosystem service benefits. We will do this in-line with National Character Area profiles.

Highways England will continue to develop a programme of interventions to reduce visual impacts. We will further assess, design and appraise around 180 locations during 2015/16. By April 2016 we will have identified the future programme of interventions.

6.1.6 Water quality and flooding

Highways England will invest £78m over the next five years to address flooding and pollution from highway runoff through measures to attenuate and improve flood resilience on the strategic road network and to improve water quality. This investment will also help meet the Government's commitments within the Floods and Water Management Act 2010[20] and the EU Water Framework Directive[21].

We will focus our attention in the following areas:

- Improving resilience to flooding and reducing flood risk to communities adjacent to the network. Activity will focus on addressing all identified high priority flood risk locations recorded in our Drainage Data Management System
- Improving water quality through better environmental protection and specifically improving surface and groundwater quality by addressing priority locations of known pollution
- Working with the Environment Agency[22] to identify opportunities for delivering wider environmental benefits in partnership with other land-owners, and communities.

Highways England is currently developing a programme of interventions for implementation across the strategic road network. This is focusing on identified need from our existing priority outfall, soak away, culvert and flood hotspot registers. A draft of this programme will be available in summer 2015 for those locations where detailed design can be advanced during 2015/16. This programme will be subject to review and interventions will be based on on-going characterisation of the assets. Further plans will be developed by April 2016. We will also introduce additional performance indicators for water quality and flooding.

[20] http://www.legislation.gov.uk/ukpga/2010/29/contents
[21] http://ec.europa.eu/environment/water/water-framework/index_en.html
[22] https://www.gov.uk/government/organisations/environment-agency

6.1.7 Cultural heritage

Highways England will be utilising the Environment Fund to enhance the condition of cultural heritage sites and historic features either in our ownership or in proximity to the network. Key areas of focus will be:

- Reviewing and confirming the 'at risk' and 'unvalidated' condition status for assets identified in the Department for Transport's Historic Buildings Annual report, and identifying a future programme of interventions along with associated costs by March 2016
- Enacting conservation measures at those identified heritage assets most at risk by end of this Road Period
- Reviewing the influence of the network on the setting and condition of the historic environment close to the network, identifying and delivering enhancement opportunities

By delivering on these commitments we will also meet and comply with the requirements of the 'Protocol for the Care of the Government Historic Estate'[23] .

6.1.8 Design Panel

The Government has also asked Highways England to establish a Design Review Panel to encourage design excellence in the landscape, engineering and built environment aspects of our construction projects. The Panel will review development proposals and examine how their designs contribute positively to making better places for people by striking a better balance between aesthetics and the functional and maintenance attributes of schemes.

We will hold the first meeting of the Panel by the end of June 2015, at which point it will agree, refine and finalise its terms of reference.

6.1.9 Other environmental initiatives

Litter and vegetation

Highways England will deliver its duties under the Environmental Protection Act by removing litter from our motorway network. We will further improve our performance in this area by developing and delivering educational campaigns to inform people of the safety and environmental risks of discarding rubbish. We will continue to work with local authorities to reduce litter on the APTR.

We will target over grown vegetation to improve the visual aspects of the network, and reduce the impact that vegetation can have on our neighbours and physical asset.

Legacy initiative

Moreover, under our 'Legacy' initiative, as part of the delivery of any given highway project; we now aim to bring environmental benefits that deliver facilities and design features that go beyond what would be expected from routine assessment and design practices. Such features would be focused on supporting quality of life and, or promoting the distinctiveness and character of a place. Highways England will invest up to £7m on such efforts over the course of RP1. As part of the planning process, we will work with local communities, key stakeholders and the newly formed Design Review Panel. It is envisaged that Legacy initiatives and funded activities will be realised primarily through our programme of major projects, but we will set out an updated position on this by March 2016.

[23] http://www.doeni.gov.uk/niea/built-home/information/protocol_for_the_care_of_the_government_historic_estate.htm

7. Accessible and integrated network

Highways England and the Government have a shared ambition that people should be able to travel across and alongside our network. To this end, the Government has asked us to work to improve provision for walkers, cyclists and other users and report on the number of new and upgraded safe crossings of the network.

Government key performance indicator
Cyclists, walkers and other vulnerable users

KPI — The number of new and upgraded crossings

Target — No target set

At a strategic level, effective transportation of people and goods is not about any single form or mode; it is about integrated end-to-end journeys that benefit our customers, businesses and the wider communities located on or near the network. As operator of the strategic road network, Highways England will ensure we integrate with other networks, including local roads, existing and emerging rail links and ports and airports.

To continue on a path of integrating the strategic road network, the Government has set aside more than £100m in the Cycling, Safety and Integration designated fund for Highways England to deliver targeted infrastructure measures over the course of RP1.

This chapter sets out our RP1 delivery plans, first for integration and accessibility in general and then for cycling in particular.

7.1 Integration and accessibility

Integration includes accessibility and inclusion. In these terms, we recognise that the strategic road network has a significant effect on its surroundings and it is important that we minimise the negative effect of roads dividing communities.

We intend to be more ambitious in improving accessibility and inclusion. Instead of small scale improvements that deliver the minimum that's needed, we will deliver more comprehensive improvements that work more effectively with local authority roads and routes for cyclists, pedestrians and other users. To support this level of ambition we have a programme that will invest in the region of £25m targeting specific interventions in this area.

We are developing an analytical tool that uses demographic, social, population and economic information on a scheme-by-scheme basis to identify where accessibility and inclusion efforts should be focused for the greatest benefit to communities. This tool will be trialled and rolled-out across the business by March 2016.

Alongside this tool we have been developing a means for capturing details of accessibility and inclusion work that is delivered as part of wider schemes that Highways England deliver. We have recently started to build a portfolio of good practice case studies which our project managers will use to better understand what good looks like in this area. It will enable accessibility and inclusion measures to be built into both the design and the delivery of the scheme. This activity contributes to delivering our commitments under the Public Sector Equality Duty[24].

[24] https://www.gov.uk/government/groups/review-of-public-sector-equality-duty-steering-group

We will work with key stakeholders and partners to further develop a package of integration measures during 2015/16. Examples of the work we will undertake, includes:

- Working with Local Communities – through the Place-Making approach, we will listen to local people to identify how to improve the physical or environmental quality of a place, or the economic or social well-being of a community
- We will support the delivery of Park and Ride facilities to better link the strategic road network with local public transport
- Existing and emerging rail links – M42 junction 6, first High Speed 2 station outside of London
- We will support ports by improving the A160/ A180 access to the ports of Immingham and Grimsby; upgrading links to Felixstowe through the various schemes planned for A14
- Airports – We will work with the Government of the day to examine the Airports Commission findings and take forward any recommendations
- Removing Barriers – delivering three crossing improvements on the A64 at Ganton, and East and West Heslerton.

Our focus for 2015/16 will be developing an Accessibility and Inclusion Strategy by March 2016.

7.2 Cycling

Although cycling is prohibited on our motorways and incompatible with major parts of our network, Highways England will play a key role in ensuring that the ambition set for growth in cycling through Cycle Ambition Bids, Local Transport Funds and the Department for Transport's recently published, Cycling Delivery Plan[25] is fully supported by a dedicated programme of work to improve cycle facilities on or near our network. These facilities will be designed to provide safe, direct and attractive routes, linking with wider cycle networks where appropriate, to address the barriers to cycling presented by the network. The development and delivery of these improvements will require close working with local stakeholders and partners, who understand local cycle travel needs and can help to identify locations which require improvement.

[25] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/364791/141015_Cycling_Delivery_Plan.pdf

The objectives of our cycling proposal are to:

- Facilitate cycling on or near the trunk road network for all types of cyclist and make cycling on and over our network safer and easier; and
- Reduce the impact of our network as a barrier to cycling journeys.

The recently published RIS and SBP outlined a commitment to invest £100m between 2015/16 and 2020/21, £78m of that total during this Road Period to improve provision for cyclists on the APTR. This funding will be targeted to provide safe and direct routes that encourage cycling on and over our network as an alternative and sustainable form of transport.

Highways England have worked with key cycling stakeholders including Sustrans[26], Cyclists' Touring Club (CTC)[27], British Cycling[28] and The Times "Cities Fit for Cycling" [29]campaign, to identify and prioritise a comprehensive list of locations based on an assessment of safety, connectivity and accessibility for cyclists. Following further consultation with local stakeholders these locations will be assessed for feasibility to deliver improvement schemes funded through the £100m investment. An example of a successful intervention we have already made using this approach is improvement work along the A63 corridor in Hull, including the creation of a shared pedestrian and cycle path.

We will further expand on our cycling objectives, and set out Highways England's future identified programme of cycling schemes in our first Cycling Strategy by December 2015.

We currently have a package of more than 40 schemes in design and development where we are aiming to complete construction during 2015/16.This includes the provision of dedicated cycling lane facilities, improved crossing points and cycling safety measures. These will be delivered at specific network locations and as part of wider comprehensive corridor treatments. Our programme for 2015/16 is shown in table 6 overleaf.

[26] http://www.sustrans.org.uk/
[27]http://www.ctc.org.uk/
[28]http://www.britishcycling.org.uk/
[29]http://www.thetimes.co.uk/tto/public/cyclesafety/

Table 6: Cycling programmes 2015-16 – RP1

Region	Area	Scheme Name/Description
East	6	Bentley Drive/Foxburrow Hill Roundabout (Lowestoft)
	6	Bentley Drive/Foxburrow Hill Roundabout South arm (Lowestoft)
	6	Foxburrow Hill (lowestoft)
	6	High Street/Old Nelson Street (Lowestoft)
	6	Amold Street (Lowestoft)
	6	Gunton Church Lane to Hollingsworth Road (Lowestoft)
	6	Station Road to Gunton St. Peters Avenue (Lowestoft)
	6	Gunton Hall Pinch Point (Lowestoft)
	6	Katwijk Way/St Peters Road (Lowestoft)
	6	Jubillee Way (Lowestoft)
	6	Camden Street/High Street (Lowestoft)
	6	A12 Witham to Marks Tey
	6	A120 Parkeston Roundabout
	6	A12 Harfreys Roundabout, Great Yarmouth
	6	A47 Hockering to North Tuddenham
	8	A5 Dunstable North
	8	A5 Chalk Hill
	8	A421/A6 Interchange Bedford
Midlands	7	M1 - A609 Nottingham Canal subway, Trowell, N, Of J25 (Sandiacre)
	9	A49 - North of Holmer Road by Church
	9	A38 - Branston Underpass
	9	A5/A452 Roundabout (Cyclist Collision Site)
	7	A50 - Swarkstone
	9	M40 - J15 Longbridge Overbridge
SouthEast	4	A27 Continuation of cycling improvements between Lewes and Polegate
North West	13	A590 Brettargh Holt to Levens
	13	A590 East of Newby Bridge Services
	13	A590 Newby Bridge to Ayside
	13	A590 West of Barrowbanks
	13	A590 Gilpin Bridge Cycleway
	13	A590 Lindale Hill to Low Newton
	13	A595 Egremont to Iron Bridge
	13	A66 Great Clifton to A595 Papcastle via Brighton (Chapel Brow to Fitz)
	13	A66 Chapel Brow roundabout
	10	A663 Cycleway link
	10	M53 junction 2, Moreton Spur & flyover
	10	M53 junction 4 - near Bebington on the Wirral
	10	M57 Jct 2/A58 Prescot
	10	M58 junction 4
	10	M58 junction 1
	10	M58 overbridge close to j4 (footbridge)
	10	M6 Junction 29, Walton Summit
	10	M60 J1-J27 Stockport town centre (phase 2)
	10	M62/M57, Tarbock Island, junction 6 og M62

We will continue to develop an annual rolling programme of cycling schemes during 2015/16 and each year of the Road Period thereafter. This programme will ultimately deliver no fewer than 200 cycling facilities and crossing points on or around the strategic road network by 2021. We will deliver at least 150 of these by the end of RP1.

We will cycle proof all our investments by building in specific cycling facilities where appropriate, as well as supporting activities of local authorities surrounding our network. To ensure schemes deliver high quality cycling facilities we are updating design standards so that schemes are designed which reflect the most up to date and ambitious thinking. We are designing an e-learning training package for highway designers of schemes on our roads and for local authorities to support cycling provision being embedded into designers' thinking. This will also support local authority scheme designers who use our standards in developing their schemes.

To further inform what interventions we will make, and to ensure we evaluate their success appropriately, we will continue to engage and consult with relevant cyclist representation organisations. We will also look to improve our understanding of the nature of cyclist usage of the strategic road network.

Highways England will develop new metrics and indicators for future Road Period's; to help demonstrate that we are supporting the Government's aspiration for improving provision for cyclists, walkers, and other vulnerable users on and around the strategic road network. During this Road Period we will transparently report on an annual basis our progress to deliver new or upgraded network crossings.

8. Delivering performance and efficiency

As part of the RIS we agreed with the Government that we would deliver at least £1.212 billion in efficiencies over RP1 to reinvest in the network, and Government set a target that we meet or exceed the expectations set out in this Delivery Plan.

Government key performance indicator
Efficiency

KPI: Cost savings: savings on capital expenditure

Target: At least £1.212 bn over RP1

Highways England is committed to giving the public value for money, which we define in terms of economy and effectiveness.

This section explains what we intend to achieve, how we plan to deliver and how we will measure our performance. We will be transparent in our reporting of performance and support the Highways Monitor in their monitoring and review of our progress.

To monitor our performance, we will publish information on all the KPIs, PIs and requirements in the RIS, information about all these aspects are indicated below[30]. We will publish an annual report about how we are doing against this Delivery Plan.

8.1 What do we mean by effectiveness?

Our SBP sets out five strategic outcomes for the next five years linking back to the Performance Specification and our effectiveness will be assessed by the extent to which these outcomes are achieved with the funding available as measured against the KPIs, targets, requirements and outputs in the RIS.

We will work closely with the Highways Monitor and Transport Focus to develop the methods for reflecting the effectiveness of what we achieve. A key part will be to further develop our understanding of the views of our customers and to ensure that the outcomes for the strategic road network and the decisions that we make are aligned with customers' values and priorities.

8.1.1 To become more effective we are:

- Focusing on making the strategic road network more accessible and better integrated for everyone, especially more vulnerable road users.
- Implementing a number of customer-driven initiatives to help get the most out of the network's capacity, minimise the number and impact of incidents and improve the provision of information about network conditions and journey times

[30] Our methodology for calculating these KPIs and the supporting performance indicators (PIs) to be monitored will be outlined in our Operational Metrics Manual.

- Using long term funding certainty will allow us to balance the short-term robustness of the network with the need for long term sustainability. We intend to produce and update an asset management strategy and long term assessment management plans, which will develop the asset management capability of our staff.

8.2 What do we mean by efficiency and economy?

The new flexibility over day-to-day operations, procurement and contract management will allow us to change the way we plan, procure and deliver schemes and will facilitate greater productivity savings in the future, allowing Highways England to deliver a greater number of projects and a better quality of service with its allocation of funding than would otherwise be the case.

The funding certainty allows smarter procurement which can both drive down unit cost but more significantly, eliminate waste.

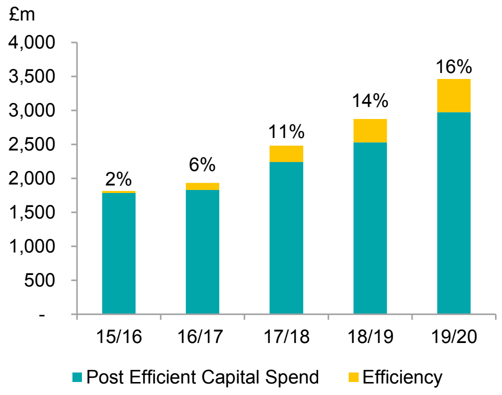
As outlined in the RIS, Highways England has committed to making capital efficiency savings of £1.212bn by 2020 (in nominal terms). These savings are consistent with our commitment to deliver total efficiency savings of £2.6bn over the next ten years and achievement requires a step-change in the way we run our business in RP1.

8.3 How will we become more efficient?

- We will introduce new contractual models (including the Collaborative Delivery Framework) to incentivise suppliers to deliver efficiencies. These will also encourage a more flexible approach to resourcing and greater collaboration with Highways England's supply chain
- We are committed to improving our commercial capabilities to ensure we undertake and procure operational activities and projects effectively. This will include better data gathering and analysis to enable improved commercial decision making. We will also develop our ability to benchmark costs and performance across our business, and to share best practice across the organisation
- Better risk management by analysing and understanding risks and placing the management of those risks with the most appropriate part of our supply chain.
- Category management of key products (e.g., gantries) to ensure we maximise our procurement power
- We are introducing Regional Programme Boards and Integrated Portfolio Office functions to improve resource allocation across regions, to coordinate bulk purchasing arrangements and save on costs by conducting fewer tendering exercises
- We will improve planning and integration of schemes to increase cost efficiency and reduce disruption for users
- Implement a Lean deployment strategy that will build a culture for continuous improvement throughout Highways England and its supply chain to deliver increased customer value and efficiency savings in support of the SBP
- We will continue to develop a portfolio of research, technology and innovation projects (collectively called the 'Innovation Programme'). Over the next five years, Highways England will introduce changes to our business as usual operation and realise benefits that stem from previous innovation work. We will set out the key principles in our Innovation, Technology and Research Strategy and more detailed plans.

These steps will enable us to meet the challenging efficiency targets as set out in figure 6.

Figure 6: Efficiency against Capital Spend



We will record efficiency cost savings on projects and programmes as they progress through the development to construction phases. These efficiencies will be recognised when the projects and programmes enter the construction phase, at which point sufficiently robust outputs and costs will enable monitoring. We will engage with the Highways Monitor on its proposed approach to monitoring which it is currently consulting on.

8.4 Measuring success

The efficiency monitoring regime and five-year funding settlement that will apply over RP1 are new features of our governance framework and we will need to adapt accordingly. In particular we recognise that companies operating under mature monitoring regimes have a better understanding of the link between costs and outputs and we will therefore improve this area.

We will develop this knowledge in the early years of RP1 with assistance from the Highways Monitor. We will produce an improvement plan that will outline the types of information we will need to collect and the processes that we will put in place to monitor our performance, as well as the steps that we will take to ensure that we have these processes in place as soon as possible.

Our exact approach to measuring, recording and monitoring efficiency cost savings will be set out in an Efficiency and Inflation Monitoring Manual, to be published in September 2015. This approach will be developed and agreed with the Department for Transport and the Highways Monitor. This will be based on the principles of transparency and proportionality, with emphasis placed on the activities our customers' value the most and those that involve the largest amount of spend.

9. Managing risk and Uncertainty

In this section we set out how we will manage risks and uncertainties associated with delivering the Government's requirements.

Our Delivery Plan is based on a series of explicit and implicit forecasts and assumptions. These include estimates of customer demand for the network and of the cost of enhancements and renewals, as well as assumptions about the weather and other external events. Clearly there is some level of uncertainty about all of these factors. Moreover given that this is the first time we have planned for a fixed five-year funding settlement, the uncertainties are perhaps greater this time than they will be in future.

In this section we describe:

- Our overall approach to Risk and Uncertainty Management
- Key Internal Risks and Uncertainties
- Key External Risks and Uncertainties
- Sharing of Financial Risk with the Department for Transport.

To ensure continuity in the transition to Highways England we will continue to use the former Highways Agency risk management processes, reviewing and developing these as part of our continuous improvement activity.

9.1 Our overall approach to risk and uncertainty management

This delivery plan explains how we will meet the requirements for the strategic road network as presented by the Government in its RIS.

It is the responsibility of Highways England to manage risk, opportunities and uncertainties in order to meet these requirements.

Our aim is to deliver the outcomes and outputs defined in the RIS. In cases where changes occur we will explain the options we have considered. In some circumstance we will need to demonstrate our proposed solution, taking into account our Shareholder and customer priorities.

We will adopt best practice risk management principles to align with the Companies Act[31] and general public sector requirements.

The former Highways Agency Risk Management Policy & Guidance[32] will be updated over the coming year to align against the Companies Act requirements and best practice principles.

9.2 Key risks and uncertainties – internal

Highways England will regularly review risks and mitigation and escalate issues to the Department for Transport as appropriate. The current risk assessment identifies successful achievement of the delivery plan will require effective mitigation of:

- Operational impact of severe weather, major incidents and clearance times

[31] http://www.legislation.gov.uk/ukpga/2006/46/contents
[32] Highways Agency Risk Management Policy & Guidance dated July 2013

- Resilience risks including supply chain, business continuity, and security issues
- Impact on programmes of severe weather, ground conditions, price inflation, and traffic modelling
- Capacity and capability across Highways England to meet the levels of ambition contained in the RIS and our SBP
- Health and safety of customers, contractors and staff
- Transformation of the culture and ways of working throughout Highways England
- Technical solutions for known environmental constraints
- Gaps in asset information
- Data and information management and dissemination.

We will manage these risks we will manage within our organisation and routinely reported to our Board on the status of these risks and the actions being taken.

9.3 Key risks and uncertainties – external

We have reviewed the key external risks and uncertainties. Below we discuss and explain how we intend to manage these where we can or work with others to mitigate the impact. In these situations we would discuss the implications with the Department for Transport and agree a way forward.

9.3.1 Changes in priorities, requirements or budgets

We recognise that requirements and budgets may change during RP1. We would expect that most changes in costs or outputs would be addressed through the change control process. In exceptional circumstances the Shareholder (see 9.4.1) can use the process set out in the Licence to help resolve the situation.

9.3.2 Macroeconomic factors, including demand risk and inflation risk

We have based our network availability target and our network management approach on reasonable forecasts of traffic growth. These would need to be re-visited if traffic changes significantly.

In our planning we have adopted a set of inflation assumptions that we have agreed with the Department for Transport. In practice, actual inflation may be substantially different (i.e. real prices are higher or lower than the agreed forecast). The Efficiency and Inflation Monitoring Manual will set out how we deal with inflation.

The terms of the Private Finance Initiative (PFI) contracts that we have inherited, have inflation uplifts that are not necessarily linked to our overall SR13 funding. Any significant disparity between our income and the payments due to such PFI contracts would be addressed by the change control process (see 9.4.1).

In the next five years we are planning to deliver a significant increase in enhancements and renewals to achieve the RIS requirements. This will require significant additional supply chain resources to be available, which is a key uncertainty. So far as is practicable we have considered this risk and possible mitigations in our planning.

9.3.3 Aging assets

Our asset base is highly complex including more than 16,000 structures, 21,870 pavement miles, 110,000 technology assets and various major structures such as the Midlands Links, Tinsley and Thelwell Viaducts and Dartford Crossing. Our asset management plans reflect the nature of this critical infrastructure, but the age and rate of deterioration will always be uncertain.

9.3.4 Environmental compliance risk

Legally binding limits for some pollutants are set in EU Directives. The UK and most other Member States are struggling to comply with these in many urban and roadside locations, and there remains a significant risk that our road schemes may be delayed as a result of their air quality impacts. This is because the additional vehicle movements they help facilitate often lead to a worsening of air quality in the immediate vicinity. We will seek to mitigate this, including working with local authorities to support their own initiatives and look for other solutions to improve air quality.

9.4 Sharing of financial risk with the Department for Transport

It has been agreed with the Department for Transport that we should not set aside any specific funds for contingency or strategic risks (other than for inflation) and we have no ability to raise further third party revenue. This means our primary mechanism for dealing with unexpected costs (higher or lower in each year) will be to adjust outputs to compensate through change control. Where there are fundamental changes in circumstance, our Licence provides for a formal variation of the RIS settlement.

The RIS provides a significant opportunity for Highways England to start to develop the strategic road network towards the Strategic Vision, benefitting the economy and customers. However, our agility and flexibility to respond to customer needs and emerging priorities is limited during RP1 due to earlier commitments given for specific schemes. The impact of this will be reviewed regularly throughout RP1 with the aim of agreeing more flexibility for RP2.

9.4.1 Change Control

We are committed to deliver as much as possible within the allocated level of funding. If risks materialise, we will manage this through a transparent change control process with key changes in outputs agreed on a quarterly basis and reported annually in our Annual Report.

Any significant changes in outputs would be discussed with the Highways Monitor and agreed with the Department for Transport.

Successful management of risk or out-performance will allow contingent monies to be released as time progresses. This 'recycling' of risk allowances will also be considered through the change control process such that we will identify suitable additional outputs to match the released funds.

10. People and our Company

10.1 People

The key to successfully delivering our plan over the next five years will be the commitment and capability of our people. That's why we have recently set out our people strategy, which is underpinned by four pillars: Accountable Leadership, Capable Employees, Customer-Focused Delivery and Rewarding Performance.

- Accountable Leadership – We require positive, proactive and engaging leadership at all levels of the organisation. We expect leaders to empower their teams and all employees to take accountability for decisions.
- Capable Employees – We will support and invest in the development of our people using structured career paths, including apprenticeships, and blended learning programmes. We will hire talented individuals to drive growth and innovation at pace.
- Customer-Focused Delivery – We will create a modern working environment that puts our people and customers at the heart of the business. We will support our employees to build stronger, more effective relationships that meet the needs of our customers (both external and internal) and to go the extra mile to help one another.
- Rewarding Performance – We will use robust performance management, including a recognition programme and financial and other rewards, to retain high-performing individuals who offer excellent service to our customers and demonstrate the company values and behaviours.

During RP1, we will anticipate future needs and deploy the right people with the right skills at the right time across the business. We understand that in order to achieve the challenging requirements set out in the RIS and this Delivery Plan, we will need to accelerate the delivery of schemes, as well as grow and improve our asset management capability, all under an increased level of scrutiny

It will require high performance across our organisation to meet the increased volume of business and we will need to develop new ways of working to deliver this agenda. It will also require a significant increase in the size of our workforce, so we anticipate that by early 2016 we will have recruited an additional 600 people.

We will ensure that our people have the right tools for the job and create innovative and inspiring workplace environments that reflect our culture and respond to an increasingly diverse set of workforce requirements. Our Workplace Strategy and associated delivery plan which we will develop and publish by the end December 2015 will set out how we will achieve this over RP1.

Every member of our staff will understand that by holding fast to our vision and values, we will keep the public's trust, remain approachable, dependable and focused on our customers. And that is how we will succeed in delivering the contents of this plan.

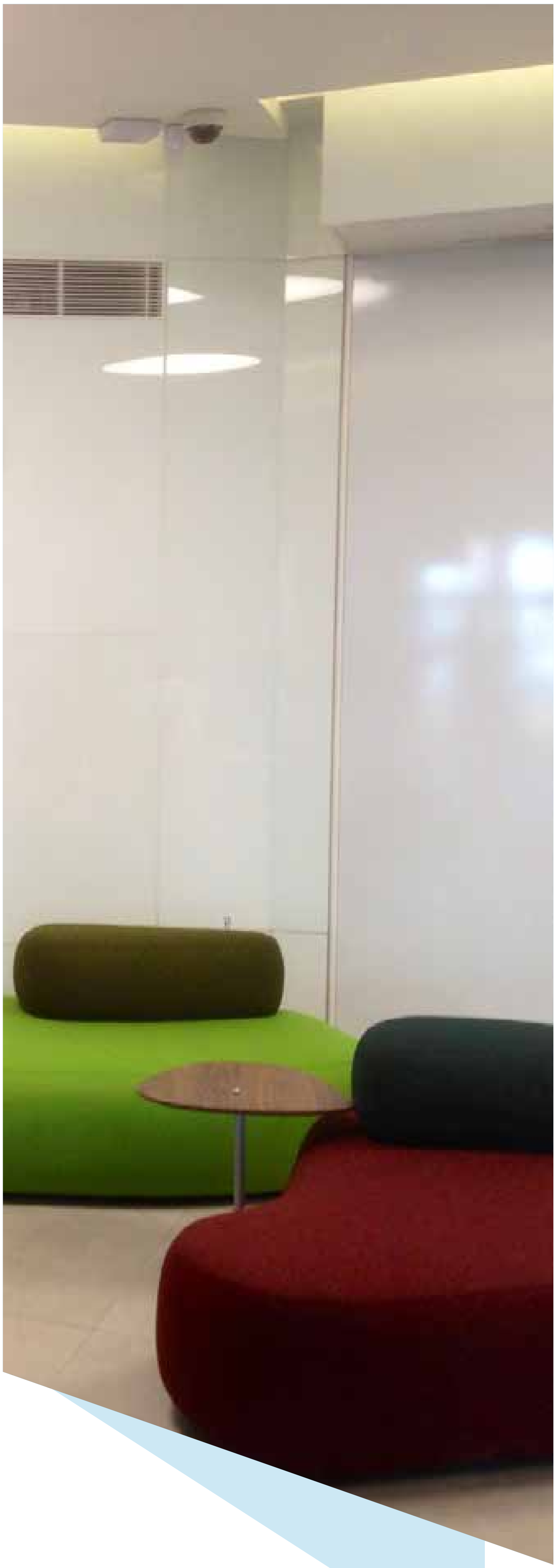
10.2 The company

10.2.1 Vision and values

Our vision for Highways England is to be a confident, energetic, agile and connected organisation, fully realising our people and our partners' potential to benefit our customers.

The values we have adopted are as follows:

- Driven to improve – Building on our professionalism and expertise, we are always striving to improve, delivering a network that meets the needs of our customers
- Leading the way – We have a clear vision for the future of the network. Each of us understands our personal contribution towards it, and we take others with us on the journey



- A trusted friend – We have an open and honest dialogue with each other, as well as our customers, stakeholders and delivery partners
- A responsible custodian – We are custodians of the network, acting with integrity and pride in the long term national interest
- A creative thinker – We find new ways to deliver by embracing difference and innovation, while challenging conventions.

10.2.2 Governance and future planning

As a public owned company Highways England operates in line with required governance including the Corporate Governance Code[32], Treasury Guidance and Managing Public Money[33]. We will ensure that our governance processes are proportionate and support the effective delivery of our business and Licence requirements, whilst ensuring that they also meet the needs of our Shareholder and the Highways Monitor. Further information on the overall framework within which we are required to operate can be found in our Framework Document[33].

This Delivery Plan forms the basis under which our performance and progress in delivering our agreed commitments and outputs will be measured and monitored externally. In terms of reporting and developing our future plans, in consultation with our Shareholder and Highways Monitor, we will report progress annually against our delivery plan. In year progress will be formally reported on a quarterly basis. We will issue an annual report to the Highways Monitor and the Department for Transport, detailing how we are performing against the Delivery Plan and the requirements. We will also produce and publish an annual update to our delivery plan to account for any changes to the way we expect to deliver our plans and outputs.

Looking forward to the next Road Period, and preparing our longer term plans for operation and investment on the network, we will produce our first strategic road network Initial Report by the end of 2016/17. Informed by the outputs of the refreshed route strategies, including asset management plans and route safety assessments, we expect the reports to present options for

[33] https://www.frc.org.uk/Our-Work/Codes-Standards/Corporate-governance/UK-Corporate-Governance-Code.aspx

performance targets, outputs, and investment which can be used to form the basis of the next RIS. Our next five year Strategic Business Plan, along with its associated Delivery Plan, will be developed ready for implementation and delivery during the next Road Period.

10.2.3 Corporate responsibility

Highways England role and remit is mandated by Government, but we have scope to play a more active role now to leverage our position and influence the debate on how to develop a sustainable transport system. Given our contribution to economic development, there is also a need for our voice to be heard in a strategic role in broader transport planning.

We will continue to deliver investment on the strategic road network; demonstrating ethical behavior, by balancing the need of contributing to economic development and improving peoples quality of life.

The Government has a clear requirement on Highways England to develop and implement plans that demonstrate how we aim to support and promote sustainable development. In response we will develop a new Sustainable Development Strategy to sit alongside our core delivery plans and other key strategies. This Strategy will be completed by March 2016, setting out our plans for this Road Period and the longer term.

10.2.4 Public Sector Equality Duty

As a public body, there are four key equality objectives we must and are committed to delivering:

- Encourage our supply chain to take the incremental steps in improving equality outcomes
- Improve our understanding of, and responsiveness to, the needs of protected groups within local communities that are affected by our activities on the strategic road network
- Promote an inclusive culture where the needs of a diverse workforce are valued and promoted
- Successfully encourage talented people from a broad range of backgrounds to join and progress through our business.

Throughout this Road Period we will report annually to Government on how we are delivering against these objectives and the wider Public Sector Equality Duty.

10.3 Other services provided by the company

There are a number of services and areas of responsibility that we will continue to manage on behalf of the Secretary of State for Transport over the course of RP1. These are generally activities we undertake outside our core role as a highways authority, but that we are nonetheless committed to delivering in an effective, efficient and professional manner with the public interest and value for money at its heart. These services are listed below and are set out in Annex C of the Highways England, Framework Document:

- National Salt Reserve
- Abnormal Loads
- Historic Railways Estate
- Technical Requirements
- Dartford Free Flow Charging
- Severn Bridge Crossing Concession
- M6 Toll
- Dartford and Local Authority Pension Scheme.

11. Collaborative Relationships

The launch of Highways England represents a fresh start and an opportunity both to strengthen relationships with existing stakeholders and work with new ones. We will set out our approach in this area within our external Communications Strategy by December 2015.

11.1 Strengthening existing relationships

We will look to strengthen the relationship we have with the Government, Department for Transport and their representatives and work to provide an effective and trusting environment for other interest groups to achieve the objectives set in the RIS. The clear separation of the Shareholder from the Client function, ensures clarity and transparency in decision making as between Shareholder, policy, regulation and customer interests. To ensure that Highways England does not receive conflicting instructions, the Department for Transport and the Highways Monitor have committed to work together to ensure clarity and consistency in respect of advice, decisions and instructions.

We will continue to provide expert advice to the Secretary of State and other parts of Government on relevant policy areas and technical matters, including in relation to relevant EU activities, where necessary.

We are developing a new approach to engaging with stakeholders and have developed an appropriate account management process. As a result, we will publish an updated account of how we engage with all our stakeholders by the end of December 2015.

In addition, there will be regular progress meetings throughout the year facilitated through the relevant account manager. We will also ensure there are ongoing opportunities to apprise our stakeholders of our work at regular intervals through our Highways England newsletter and topical campaigns.

We will set out the information services we wish to provide to customers and partners in the future. By the end of December 2015 we will publish our Traffic Information Strategy explaining how we will provide better traffic information to customers and show how we will cooperate with others to facilitate the safe and swift movement of traffic. Our aspiration is that by the end of RP1, all our customers will have the excellent quality door-to-door journey information they need to make the right travel choices. This will be available through a variety of channels, making full use of current and emerging technology.

11.1.1 Local authorities

Over the past three years we have developed relationships with more than 120 Local Authorities (and in particular the Traffic Managers of those authorities) by entering into Partnership Agreements. We will further develop those agreements and move towards the new phase agreements from April 2015, working on an incremental basis commencing with the core cities, and covering the whole of the local highways authority community by April 2017.

This phase will see our agreements becoming much more specific in order to secure effective collaboration to strengthen operations and support to local authorities in their planning and management of their own network. The reciprocal use of variable message signs, co-ordinated event plans and, where possible, system-to-system level communications will speed up our response and provide a better and more efficient service for our customers.

By December 2015, we will have completed targeted consultations with Local Enterprise Partnerships.

11.1.2 Emergency services and roadside assistance

We will work with our partners to address a range of issues that impair safe driving, as well as raising awareness of the inherent potential dangers of using the network. We will work closely with police and other emergency services to open roads more quickly after incidents, and work with the Driver and Vehicle Standards Agency[34] and other agencies to reduce the number of poorly-maintained vehicles on the network.

11.1.3 Supply chain

Significant emphasis will be placed on transforming our approach to engaging and communicating with our supply chain to harness the capability of suppliers to deliver efficient and effective services and products. By transforming these key relationships, we will reduce tender assessment baseline for major procurements by 10% and meet the Government's 25% Small and Medium Enterprise spend target by end of March 2016. Our Supply Chain Strategy will highlight how we intend to drive a step change in relationships and growth in capacity and capability. This will be published by the end of September 2015.

Our approach will derive supply chain intelligence from performance management and earned value analysis. We will maintain an appropriate balance between collaboration and commercial tension in order to build excellence, enable delivery and create value. We will also develop commercial intelligence to support informed decision making and create a collaborative shift from cost negotiation to value assurance.

We recognise our responsibility in supporting the supply chain, particularly in how we can develop skills and capability for the longer term. We will carry out an industry review of skills and capability by December 2015 and following this review publish our skills and capability development plan March 2016. We are also championing 'Lean working' e.g. remove waste in process and systems to reduce the proportion of our effort which does not drive customer value.

From the start of this Road Period, increased emphasis will be placed on developing supplier relationships - in particular of tiers 2 and 3 to identify areas where specific action can be taken to improve performance. An approach to measure the maturity of our collaborative relationships with supply chain will be developed by the end of summer 2015. This will lead to the development of new contractual and category management models to support programme delivery.

Having developed a range of delivery models by March 2016, we will commence implementation in April 2016 across the investment portfolio in a way that builds stronger relationships; grows internal and supply chain capability and provides efficient and effective delivery that secures innovation and year on year improvement in quality, safety, cost and value.

11.1.4 Freight

We will consult representatives of the freight transport and road haulage sectors to assist in future network planning, taking into account customer needs across all transport modes and working with others to support sustainable rail freight, for example.

11.1.5 Technology and innovation partnerships

We will work with partners to promote the development of information technology to improve access to information, as well as co-operating with Government and other partners on wider research and development activities. We will publish our Innovation, Technology and Research Strategy by March 2016 with plans for research, development and how we will demonstrate and deploy innovative technology.

[34] https://www.gov.uk/government/organisations/driver-and-vehicle-standards-agency

11.1.6 Working with sustainability and environmental bodies

Through closer working with sustainability and environmental partners, we will reduce pollution and enhance our built, natural, rural and historic environment in order to provide a positive legacy for the future. During RP1, a designated Environment Fund has been set up to help reduce noise and flood risk to our neighbours, and to prevent the loss of biodiversity. Specific attention will be given to improving water quality, protecting SSSIs supporting NIAs. The Fund will support the conversion of operations to low-carbon technology. Our plans will be further refined following the publication of our Sustainable Development and Environmental Strategies in March 2016.

11.1.7 Motorway service operators

We will continue to develop our relationships with the operators of roadside facilities to meet the needs of our customers. Existing legal agreements and processes will be reviewed with the Operators with a view to removing site-specific regulatory provisions that make it difficult for Operators to develop their businesses.

11.1.8 The strategic road network and the delivery of sustainable development

During the first half of RP1 the Stakeholder Advisory Panel will be set up. It will provide expert advice on issues relevant to the operation of the strategic road network, in particular strategic planning and Highways England's role in facilitating economic growth. It will take an overview of these matters with regard to the RIS and SBP, providing additional insight into strategies and opportunities, as well as technical advice and commercial intelligence. The panel should include representatives from Local Government, the Homes and Communities Agency[35], business and planning sectors and other stakeholders, including environmental and safety groups.

11.2 Making the most of new relationships

As part of its long term funding plan for Highways England, the Government has established two new roles. The Highways Monitor will take responsibility for monitoring our performance and efficiency, while Transport Focus, will protect the interests of our customers and others who are affected by the strategic road network. We expect both roles to evolve over time as we, and the industry, learn from experience. Consequently, we will remain flexible in our approach.

11.2.1 The Highways Monitor

The monitoring role (defined in Sections 10 to 13 of the 2015 Infrastructure Act) has been established to place a high level of scrutiny on us. Specifically, the Highways Monitor will monitor how well Highways England is delivering against the Performance Specification, Investment Plan and aspects of our Licence. We explain in the Delivering Performance and Efficiency section of the Delivery Plan how we aim to achieve the planned efficiencies of £1.212bn. We will work collaboratively with the Highways Monitor to develop processes to meet the new reporting requirements and to make necessary improvements to the robustness and coverage of the relevant data sets.

The key benefit of this new relationship is a step change improvement in transparency in the roads sector that will allow us to demonstrate we are doing the right amount of work to maintain and modernise our assets economically, efficiently and effectively.

[36] https://www.gov.uk/government/organisations/homes-and-communities-agency

11.2.2 Transport Focus

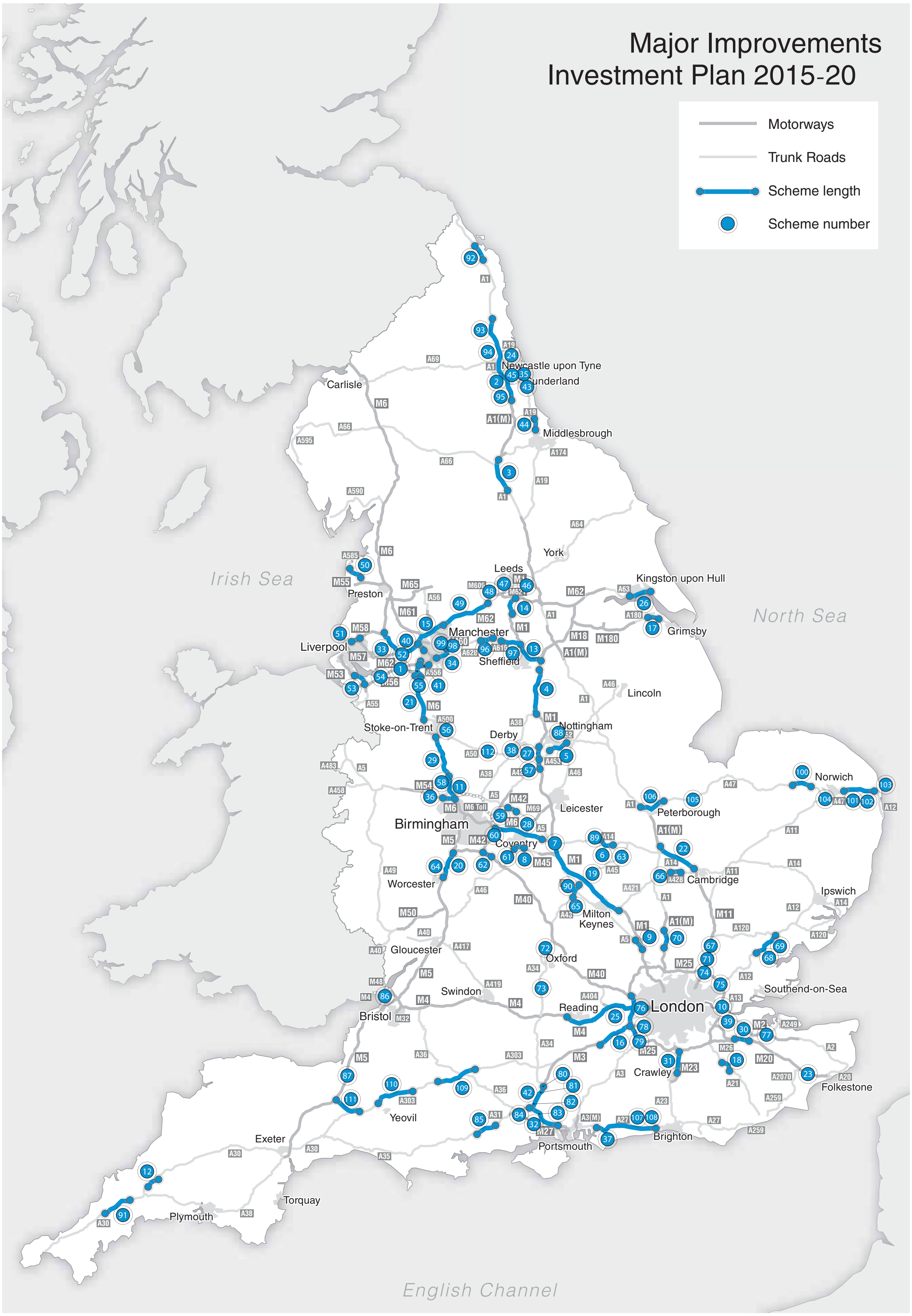
The new road-users' watchdog organisation, Transport Focus has been restructured and renamed through Section 9 of the Infrastructure Act 2015 and will come into existence on March 2015. They will represents the voice of our customers and provide advice independently of central government.
They will represent the views of users of the strategic road network based on research and our customers' concerns and feedback.

As it is a new relationship, we will start by understanding how they work and how they intend to develop their new role. We will then work together to establish the needs and experiences of our customers, through their targeted research and feedback from focus groups and interviews with a range of our customers. By the end of 2017 we will work together to help shape the new independent customer satisfaction measure, it will develop to replace the National Road Users' Satisfaction Survey. This will help us understand our effectiveness in dealing with customer enquiries and improve our understanding of customer needs, their priorities and perceptions about the service we provide.

11.2.3 Customer Panel

A third new relationship for Highways England is with the Customer Panel, a group of customers who are available to clarify customer needs quickly through a variety of research methods, including focus groups and online surveys.
The panel was recently established and is made up of more than 1,000 people; representing our full range of customers and stakeholders who are directly affected by our network. It is also fully representative in terms of region, demographics, user type and network usage.

Annex A – Enhancement Projects

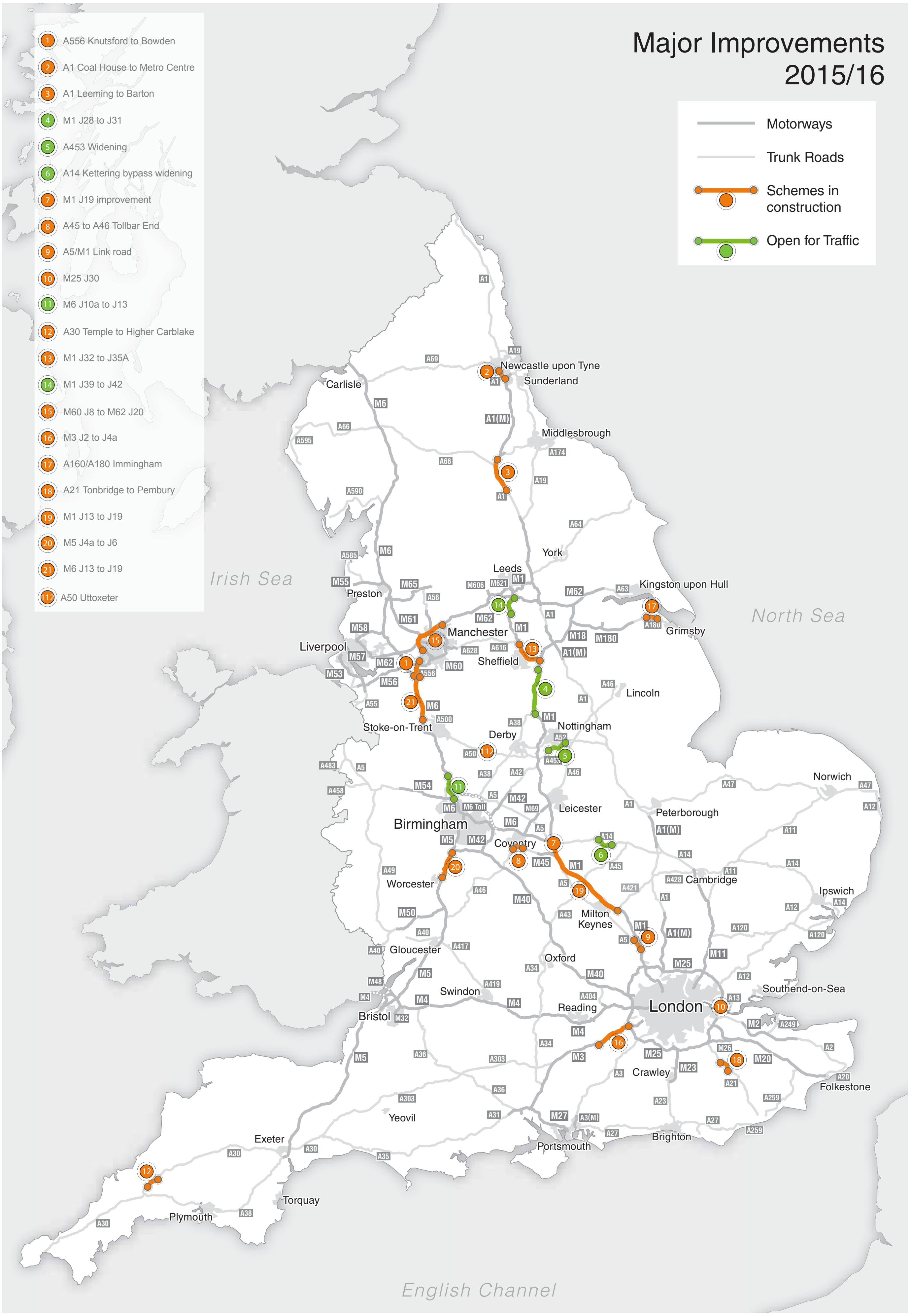


Major Improvements Investment Plan

Scheme Schedule 2015-20

Number on Map	Schemes already in construction
1	A556 Knutsford to Bowdon
2	A1 Coal House to Metro Centre
3	A1 Leeming to Barton
4	M1 Junctions 28-31
5	A453 Widening
6	A14 Kettering bypass widening
7	M1 Junction 19 improvement
8	A45-A46 Tollbar End
9	A5/M1 J11a Link
10	M25 Junction 30
11	M6 Junctions 10a-13
12	A30 Temple to Carblake[1]
13	M1 Junctions 32-35A
14	M1 Junctions 39-42
15	M60 Junction 8 to M62 Junction 20: Smart Motorway
16	M3 Junctions 2-4A
Number on Map	**Schemes announced in June 2013 and due to start construction by end 2019/20**
17	A160/A180 Immingham
18	A21 Tonbridge to Pembury
19	M1 Junctions 13-19
20	M5 Junctions 4A-6
21	M6 Junctions 16-19
22	A14 Cambridge to Huntingdon
23	M20 Junction 10a
24	A19/A1058 Coast Road
25	M4 Junctions 3-12
26	A63 Castle Street
27	M1 Junctions 24-25
28	M6 Junctions 2-4
29	M6 Junctions 13-15
30	M20 Junctions 3-5
31	M23 Junctions 8-10
32	M27 Junctions 4-11
33	M6 Junctions 21A-26
34	M60 Junctions 24-27 & J1-4
35	A19 Testos
36	M54 to M6 / M6 toll
37	A27 Chichester Bypass
38	A38 Derby Junctions
39	A2 Bean & Ebbsfleet
40	M62 Junctions 10-12
41	M56 Junctions 6-8
42	M3 Junctions 9-14
Number on Map	**Schemes announced in December 2014 and due to start construction by end 2019/20**
43	A19 Down Hill Lane junction improvement
44	A19 Norton to Wynyard
45	A1 & A19 Technology enhancements
46	M1 Junction 45 Improvement
47	M621 Junctions 1-7 improvements
48	M62/M606 Chain Bar
49	M62 Junctions 20-25
50	A585 Windy Harbour - Skippool
51	A5036 Princess Way - Access to Port of Liverpool
52	M6 Junction 22 upgrade
53	M53 Junctions 5-11
54	M56 new Junction 11A
55	M6 Junction 19 Improvements
56	A500 Etruria widening
57	M1 Junctions 23A-24
58	M6 Junction 10 improvement
59	A5 Dodwells to Longshoot widening
60	M42 Junction 6
61	A46 Coventry junction upgrades
62	M40/M42 interchange Smart Motorways
63	A45/A6 Chowns Mill junction improvement
64	M5 Junctions 5, 6 & 7 junction upgrades
65	A43 Abthorpe Junction
66	A428 Black Cat to Caxton Gibbet
67	M11 Junctions 8 to 14 - technology upgrade
68	A12 Chelmsford to A120 widening
69	A12 whole-route technology upgrade
70	A1(M) Junctions 6-8 Smart Motorway
71	M11 Junction 7 junction upgrade
72	A34 Oxford Junctions
73	A34 Technology enhancements
74	M25 Junction 25 improvement
75	M25 Junction 28 improvement
76	M4 Heathrow slip road
77	M2 Junction 5 improvements
78	M25 Junctions 10-16
79	M25 Junction 10/A3 Wisley interchange
80	M3 Junction 9 improvement
81	M3 Junction 10-11 improved sliproads
82	M3 Junctions 12-14 improved sliproads
83	M27 Southampton Junctions
84	M271 / A35 Redbridge roundabout upgrade
85	A31 Ringwood
86	M49 Avonmouth Junction
87	M5 Bridgwater Junctions
88	A52 Nottingham junctions
89	A14 Junction 10a
90	A5 Towcester Relief Road
91	A30 Chiverton to Carland Cross
Number on Map	**Schemes identified following the outcomes from the six feasibility studies**
92	A1 North of Ellingham
93	A1 Morpeth to Ellingham dualling
94	A1 Scotswood to North Brunton
95	A1 Birtley to Coal House widening
96	A628 Climbing Lanes
97	A61 Dualling
98	Mottram Moor link road
99	A57(T) to A57 Link Road
100	A47 North Tuddenham to Easton
101	A47 Blofield to North Burlingham dualling
102	A47 Acle Straight
103	A47 & A12 junction enhancements
104	A47/A11 Thickthorn Junction
105	A47 Guyhirn Junction
106	A47 Wansford to Sutton
107	A27 Arundel Bypass
108	A27 Worthing and Lancing improvements
109	A303 Amesbury to Berwick Down
110	A303 Sparkford - Ilchester dualling
111	A358 Taunton to Southfields
Number on Map	**Schemes contributing to investment with local authorities**
112	A50 Uttoxeter

[1]*Scheme is being delivered by Cornwall County Council and is partly funded by Highways England.*



Major Improvements 2015/16
1 A556 Knutsford to Bowden
2 A1 Coal House to Metro Centre
3 A1 Leeming to Barton
4 M1 J28 to J31
5 A453 Widening
6 A14 Kettering bypass widening
7 M1 J19 improvement
8 A45 to A46 Tollbar End
9 A5/M1 Link road
10 M25 J30
11 M6 J10a to J13
12 A30 Temple to Higher Carblake
13 M1 J32 to J35A
14 M1 J39 to J42
15 M60 J8 to M62 J20
16 M3 J2 to J4a
17 A160/A180 Immingham
18 A21 Tonbridge to Pembury
19 M1 J13 to J19
20 M5 J4a to J6
21 M6 J13 to J19
112 A50 Uttoxeter
Motorways
Trunk Roads
Schemes in construction
Open for Traffic
Irish Sea
North Sea
English Channel
Newcastle upon Tyne
Sunderland
Carlisle
Middlesbrough
York
Leeds
Preston
Kingston upon Hull
Grimsby
Manchester
Liverpool
Sheffield
Lincoln
Stoke-on-Trent
Derby
Nottingham
Norwich
Leicester
Peterborough
Birmingham
Coventry
Worcester
Cambridge
Ipswich
Milton Keynes
Gloucester
Oxford
Swindon
Reading
London
Southend-on-Sea
Bristol
Crawley
Folkestone
Yeovil
Portsmouth
Brighton
Exeter
Torquay
Plymouth

Major Improvements Progress to End 2019/20

1 A556 Knutsford to Bowden
2 A1 Coal House to Metro Centre
3 A1 Leeming to Barton
4 M1 J28 to J31
5 A453 Widening
6 A14 Kettering bypass widening
7 M1 J19 improvement
8 A45 to A46 Tollbar End
9 A5/M1 Link road
10 M25 J30
11 M6 J10a to J13
12 A30 Temple to Higher Carblake
13 M1 J32 to J35A
14 M1 J39 to J42
15 M60 J8 to M62 J20
16 M3 J2 to J4a
17 A160/A180 Immingham
18 A21 Tonbridge to Pembury
19 M1 J13 to J19
20 M5 J4a to J6
21 M6 J16 to J19
22 A14 Cambridge to Huntingdon
23 M20 J10a
24 A19/A1058 Coast Road
25 M4 J3 to J12
26 A63 Castle Street
27 M1 J24 to J25
28 M6 J2 to J4
29 M6 J13 to J15
30 M20 J3 to J5
31 M23 J8 to J10
32 M27 J4 to J11
33 M6 J21a to J26
34 M60 J24 to J27 and J1 to J4
35 A19 Testos
36 M54 to M6/M6 Toll
37 A27 Chichester
38 A38 Derby Junctions
39 A2 Bean & Ebbsfleet
40 M62 J10 to J12
41 M56 J6 to J8
42 M3 J9 to J14
43 A19 Down Hill Lane junction improvement
44 A19 Norton to Wynyard
45 A1 & A19 Technology enhancements
46 M1 J45 improvement
47 M621 J1 to J7 improvements
48 M62/M606 Chain Bar
49 M62 J20 to J25
50 A585 Windy Harbour - Skippool
51 A5036 Princess Way - Access to Port of Liverpool
52 M6 J22 upgrade
53 M53 J5 to J11
54 M56 new J11A
55 M6 J19
56 A500 Etruria widening
57 M1 J23A to J24
58 M6 J10
59 A5 Dodwells to Longshoot widening
60 M42 J6
61 A46 Coventry junction upgrades
62 M40/M42 interchange Smart Motorways
63 A45/A6 Chowns Mill
64 M5 J5, J6 and J7
65 A43 Abthorpe junction
66 A428 Black Cat to Caxton Gibbet
67 M11 J8 to J14
68 A12 Chelmsford to A120 widening
69 A12 whole-route technology upgrade
70 A1(M) J6 to J8 Smart Motorway
71 M11 J7 upgrade
72 A34 Oxford junctions
73 A34 Technology enhancements
74 M25 J25 improvement
75 M25 J28 improvement
76 M4 Heathrow slip road
77 M2 J5 improvements
78 M25 J10 to J16
79 M25 J10/A3 Wisley interchange
80 M3 J9 improvement
81 M3 J10 to J11 improved sliproads
82 M3 J12 to J14 improved sliproads
83 M27 Southampton junctions
84 M271 / A35 Redbridge roundabout upgrade
85 A31 Ringwood
86 M49 Avonmouth junction
87 M5 Bridgwater junctions
88 A52 Nottingham junctions
89 A14 J10a
90 A5 Towcester Relief Road
91 A30 Chiverton to Carland Cross
92 A1 North of Ellingham
93 A1 Morpeth to Ellingham Dualling
94 A1 Scotswood to North Brunton
95 A1 Birtley to Coal House widening
96 A628 Climbing Lanes
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108 A27 Worthing and Lancing improvements
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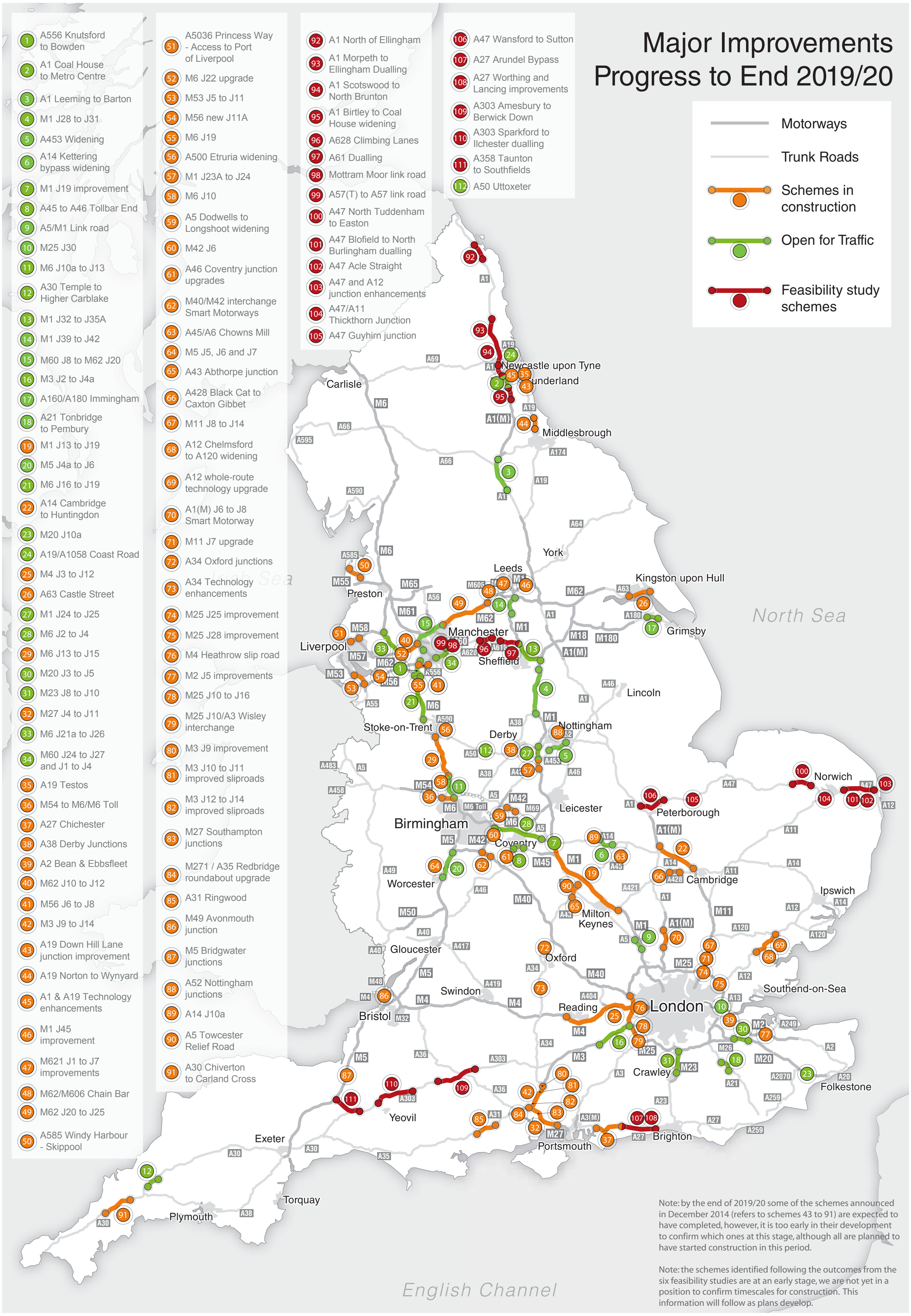
110 A303 Sparkford to Ilchester dualling
111 A358 Taunton to Southfields
112 A50 Uttoxeter



Note: by the end of 2019/20 some of the schemes announced in December 2014 (refers to schemes 43 to 91) are expected to have completed, however, it is too early in their development to confirm which ones at this stage, although all are planned to have started construction in this period.

Note: the schemes identified following the outcomes from the six feasibility studies are at an early stage, we are not yet in a position to confirm timescales for construction. This information will follow as plans develop.

Annex B – KPI's and PI's

Performance Specification				Delivery Plan		
Topic		Measure	KPI target	Highways England Output	Delivery Date	Section number
Making the network safer	KPI	The number of KSIs on the SRN	Ongoing reduction of at least 40% by end of 2020 against 2005-09 average baseline	Annual report of the number of KSIs, to fall to no more than 1,393 by December 2020	End of December 2020	4.1.0
	PI	Incident numbers and contributory factors for motorways	N/A	Annual report	Annually	4.1.1
	PI	Casualty numbers and contributory factors for APTRs	N/A	Annual report	Annually	4.1.1
	PI	IRAP based road safety investigators, developed in conjunction with the Department, to feed into subsequent Route Strategies	N/A	Develop and test	Developed by March 2018	4.1.1
Improving user satisfaction	KPI	The % of NRUSS respondents who are Very or Fairly Satisfied	90% by end March 2017 and then maintain or improve it	Annual report	90% by end March 2018	2.5.1
	PI	Suite of indicators to provide additional information about the performance of factors that influence user satisfaction	N/A	% of respondents who are Very or Fairly Satisfied with Journey Times information & signs, Management of Roadworks, Feeling Safe, Upkeep	Ongoing reporting	5.1.3/5.1.4/5.1.5
	Requirement	Demonstrate what activities have been undertaken, and how effective they have been, to maintain and improve user satisfaction	N/A	Develop measures, such as new performance measure that drives the right behaviours to minimise the impact of incident realated congestion	Develop during 2015	5.1.5
	Requirement	Support Transport focus as it develops replacements for the NRUSS	N/A	Provide support to Transport Focus	Ongoing throughout 2015	5.1.5
Supporting the smooth flow of traffic	KPI	Network Availability: % of the SRN available to traffic	Maximise lane availability so it does not fall below 97% in any one year	Achieve at least 97% lane availability	Each year of RP1	5.1.0
	KPI	Incident Management: % of motorway incidents cleared within 1 hour	At least 85% of all motorway incidents cleared within 1 hour	Achieve at least 85% clearance within 1 hour	Achieve in 2015/16 and maintain throughout RP1	5.1.2
	PI	Suite of PIs to illustrate the impact of the activities undertaken by the company and the influence of other external factors, on traffic flow. This should include, at a minimum, reliability of journey times	N/A	Develop a 'Delay in Roadworks' indicator	Develop during 2015	3.0
	Requirement	Report annually on how the Company has minimised inconvenience to road users through roadworks over the previous year	N/A	Develop a new performance measure that drives the right behaviours in order to minimise the impact of incident related congestion	Develop during 2015	5.1.3
	Requirement	Demonstrate that it is working effectively with its partners to imorove incident response	N/A	Develop a new performance measure that drives the right behaviours in order to minimise the impact of of incident related congestion	Develop during 2015	5.1.2

KPI PI Requirement

This table set out Highways England's planned activities in response to the KPIs, PIs and requirements as specified by the Government in the Road Investment Strategy, and references their section location.

Performance Specification				Delivery Plan		
Topic		Measure	KPI target	Highways England Output	Delivery Date	Section number
Encouraging economic growth	KPI	Average Delay (time lost per vehicle)	No target	Annual report from a new baseline calculated in 2015 (using a HATRIS based reference network)	Ongoing reporting	3.0
	PI	Suite of PIs to help demonstrate and evaluate what activities have been taken to support the economy. These should, at a minimum include metrics on: Being an active and responsive part of the planning system	N/A	99% of formal planning applications responded by Highways England within 21 days	Each year during RP1	3.2
	PI	Suite of PIs to help demonstrate and evaluate what activities have been taken to support the economy. These should, at a minimum include metrics on: Supporting the business, and freight and logistics sectors	N/A	Report average delay(time lost per vehicle per mile) on Gateway Routes to represent service experience for importers and exporters and international travellers. Baseline will be revised in 2015 (using a HATRIS based reference network)	Annual report	3.2
	PI	Suite of PIs to help demonstrate and evaluate what activities have been taken to support the economy. These should, at a minimum include metrics on: Helping the government support small and medium sized enterprises	N/A	Meet government 25% SME spend target through the supply chain	Annual report	3.2/11.1.3
	Requirement	Report on average delay	N/A	Annual report from a new baseline calcaulated in 2015 (using a HATRIS based reference network)	Ongoing reporting	3.0
	Requirement	Actively support the Construction 2025 goals	N/A	Report support on an annual basis	Report in Q4 of each year	3.0
	Requirement	Deliver the Roads Academy programme across the industry	N/A	Report numbers of cohorts each year and rate of graduate success	Annual Report	10.1.0
	Requirement	Develop an approach to innovation, technology, and research and agree an implementation plan by 31 March 2016	N/A	Produce innovation, technology and research strategy	By 31st March	3.1.6,8.3,11.1.5
	Requirement	Through Route Strategies identify constraints to economic growth that the performance of teh SRN could help to alleviate and identify how futire delivery and investment plans might address them	N/A	Route Strategies	Drafts complete and submitted to DfT by 31 Marchg	3.2

KPI PI Requirement

Performance Specification				Delivery Plan		
Topic		Measure	KPI target	Highways England Output	Delivery Date	Section number
Delivery better environmental outcomes	KPI	Noise: Number of Noise Important Areas mitigated	At least 1,150 Noise Important Areas over RP1	1,150 Noise Important Areas mitigated	By 31st March 2020	6.1.1
	KPI	Biodiversity: Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan	Publish Biodiversity Action Plan by 30 June 2015 & report annually against the Plan to reduce net biodiversity loss on ongoing annual basis	Biodiversity Action Plan (BAP) to include method for demonstrating impact on biodiversity, and subsequent reporting progress against this plan	Publish BAP by 30 June 2015, report progress annually	6.1.4
	PI	Suite of PIs to provide additional information about environmental performance. These should, at a minimum, include: - Air Quality;	N/A	Undertake 10 Air Quality Pilot Studies to test the feasibility of 'Air Quality Intervention Measures'	Complete all 10 studies by 31 March 2018	6.1.2
	PI	Suite of PIs to provide additional information about environmental performance.'- Carbon dioxide, and other greenhouse gas emissions for the Company and its supply chain that occur as they carry out work on the SRN.	N/A	Monitor carbon dioxide equivalents in tonnes associated with the company's activities, and separately activities associated with the supply chain	Report annually	6.13
	Requirement	Demonstrate what activities have been undertaken, and how effective they have been, to improve environmental outcomes	N/A	Produce a programme and monitor progress against it	Programme by 31 March 2016, then annually report progress	6.0
	Requirement	Develop metrics covering broader environmental performance. These should include: - a new or improved biodiversity metric	N/A	Produce a programme, collect data to develop biodiversity baseline and monitor against it; by the end of RP1, develop and a biodiversity metric.	Programme by 31 March 2016, annual progress reports, new 'env capital' metric by 31 March 2020	6.1.4
	Requirement	Develop metrics covering broader environmental performance. These should include: - carbon dioxide, and other greenhouse gas emissions arising from the use of the network.	N/A	Produce a programme, collect data to develop baseline and monitor against it; by the end of RP1, develop a network carbon metric.	Programme by 31 March 2016, annual progress reports, new network carbon metric by 31 March 2020	6.1.3
Helping Cyclists, walkers, and other vulnerable users	KPI	The number of new and upgraded crossings	No target set	Annual report	Ongoing	7.0
	PI	Suite of PIs to demonstrate the safety of the SRN for cyclists, walkers, and other vulnerable users	N/A	Monitor number of casualties for cyclists, pedestrians, motorcyclists and equestrians	Report annually	7.2
	Requirement	Report annually on the number of new and upgraded crossings	N/A	Annual report	Ongoing	7.2
	Requirement	Develop new indicators which demonstrate improved facilities for cyclists, walkers, and other vulnerable users	N/A	Each year define the Annual Cycling Programme to include improved cycling facilities	Annual report	7.2
	Requirement	Report on how it is delivering against the Public Sector Equality Duty	N/A	Annual report		10.1.4

KPI PI Requirement

Performance Specification				Delivery Plan		
Topic		Measure	KPI target	Highways England Output	Delivery Date	Section number
Achieving real efficiency	KPI	Cost savings: savings on capital expenditure	At least £1.212 billion over RP1	Savings monitored regularly throughout RP1	Ongoing	8.0
	KPI	Delivery Plan progress: progress of work, relative to forecasts set out in the Delivery Plan, and annual updates to the Plan, and expectations at the start of RP1	Meet or exceed expectations	Annual updates of Delivery Plan	Ongoing	2.6
	PI	Suite of PIs to demonstrate that the portfolio is being developed and the Investment Plan delivered in a timely and efficient manner. These should include the progress of major schemes and programmes in construction through reporting CPI and SPI for schemes at Project Control Framework Stage 5 and beyond	N/A	Reporting CPI and SPI and progress of the major improvements programme	Ongoing	3.1
	Requirement	Demonstrate on an annual basis how efficiencies have been achieved	N/A	Annual report of capital efficiencies achieved	Ongoing	8.0
Keeping the Network in good condition	KPI	% of pavement asset that does not require further investigation for possible maintenance	To be maintained at 95% or above	Measure reports at least 95% each year of RP1	Ongoing	4.2.1
	PI	Suite of PIs to provide additional information on the asset condition of the SRN as a whole	N/A	Develop new condition indicators	Pavements and Structures - agreed by 31 March 2017 and validated by 31 March 2019; Technology, Drainage and Geotechnical Works - agreed by 31 March 2018 and validated by 31 March 2020	4.2.2
	Requirement	Produce an implementation plan, by 31 March 2016, to show how the Company will improve asset information quality over RP1.	N/A	Produce implementation Plan	By 31 March 2016	4.2.2
	Requirement	Develop new condition indicators for: • Pavements and Structures for agreement by 31 March 2017 and complete validation for these by 31 March 2019. • Technology, Drainage and Geotechnical Works for agreement by 31 March 2018 and complete validation for these by 31 March 2020.	N/A	Develop new condition indicators	Pavements and Structures - agreed by 31 March 2017 and validated by 31 March 2019; Technology, Drainage and Geotechnical Works - agreed by 31 March 2018 and validated by 31 March 2020	4.2.2

KPI PI Requirement

Annex C – Funding table

£m	2015/16	2016/17	2017/18	2018/19	2019/20	Period 1
Capital						
Modernise/Enhance						
SR10 & SR13 Schemes	1,012	892	1,088	1,174	1,226	5,392
RIS Schemes	14	80	177	322	578	1,171
Feasibility Studies	3	12	48	67	191	321
Major Projects Pipeline Schemes	10	15	29	36	44	134
Air Quality	0	10	15	25	25	75
Cycling, Safety & Integration	18	32	40	42	43	175
Environment	6	40	60	61	58	225
Innovation Fund	1	10	32	37	40	120
Supporting Growth Schemes	0	10	20	25	25	80
Sub Total	**1,064**	**1,101**	**1,509**	**1,789**	**2,230**	**7,693**
Maintain/Renew						
Renewals	718	726	732	738	744	3,658
Total Capital	**1,782**	**1,827**	**2,241**	**2,527**	**2,974**	**11,351**
Resource/Operational						
Operate the Network						
Operations	229					
PFI Contracts	413					
Maintenance & Renewals	261	262	263	271	268	1,325
Sub Total	**903**					
Support	130					
Protocols	39					
Total Resource/Operational	**1,072**					

Operational expenditure

The resource budget for 2015/16 was set in the 2013 Spending Round. As an exception the Government also agreed future budgets for resource maintenance and renewals spending up to 2020/21, reflecting the importance of taking sound maintenance decisions in line with good asset management principles. The remaining resource funding from 2016/17 will be agreed in the usual way at the next Spending Review.

Annex D – Glossary

AONB	Area of Outstanding Natural Beauty
Category Management	The strategic management and procurement of product groups.
CHARM	Common Highways Agency Rijkswaterstaat Model
CLEAR	Collision, Lead, Evaluate, Act, Re-open
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EPA 90	Environmental Protection Act 1990
EuroRAP 3	European Road Assessment Programme
HGV	Heavy Goods Vehicle
HS2	High Speed 2
IAMIS	Integrated Asset Management Information System
ICF	Investment Control Framework
ISO55000	International Standards for Asset Management
JESIP	Joint Emergency Services Interoperability Programme
Key Performance Indicator (KPI)	A key metric used to define and measure progress toward organisational objectives.
KSI	Killed or seriously injured
LED	Light Emitting Diode
LGV	Large Goods Vehicle
NIA	Nature Improvement Areas
ORR	Office of Rail Regulation (also known as the Highways Monitor)
Pavement	Road Surface
PCF	Project Control Framework
PFI	Private Finance Initiative
Performance Indicator (PI)	A metric used to define and measure progress toward organisational objectives.
RIS	Road Investment Strategy
RP	Road Period
RP1	Road Period 1
RP2	Road Period 2
RPB	Regional Programme Boards
SR10	Spending Review 10
SR13	Spending Round 13
SSSI	Sites of Special Scientific Interest
Tier 2 and Tier 3 Suppliers	Subcontracted Suppliers
Transport Focus	A ‘Watchdog’ responsible for gathering the views of Strategic Road Network users and using them to shape policy and decision-making.
TSS	Traffic Systems and Signing
ULEV	Ultra-Low Emission Vehicles

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