

Economic analysis of the second road period

July 2020



Economic analysis of the second road period

July 2020

1

Executive summary

3

Introduction

5

Operations, maintenance and renewals

9

Major capital enhancements

23

Designated funds

27

Annex: Analytical methods to understand the value of the second road period (2020-2025)

Executive summary

Highways England’s Strategic Business Plan (SBP) for the second Road Period (RP2), describes how we will spend £27.4 billion of funding from 2020 to 2025. This investment will enable Highways England to operate, maintain and improve England’s strategic road network (SRN) over the next five years. This will make a significant positive contribution to the millions of people using the SRN and provide benefits to the communities and businesses who live and work alongside the SRN.

This document outlines the results of an array of economic analyses that were undertaken and brought together in defining the value for money (VfM) of Highways England’s work during the RP2. The detailed analytical approach has been set out in *Annex 1: Analytical methods to understand the value of the second road period (2020-2025)*. This document complements the Department for Transport’s RIS2 Analysis Overview¹.

Highways England has a licence commitment to deliver and demonstrate that we deliver VfM. We have undertaken a VfM assessment of the whole SBP, covering all front-line activities. We have worked with the DfT to ensure that analysis is robust and consistent with the HMT Green Book (2018) and the DfT’s Transport Analysis Guidance (TAG).

Our analysis has focussed on the following activities:

- Operational expenditure to support the day to day control of flow and availability of the SRN. Renewals and maintenance to support the delivery of a safe and reliable network
- Major capital enhancements – investment to complete major enhancement schemes started in the first Road Period, and start new enhancements announced in the DfT’s second Road Investment Strategy (RIS2).
- Small scale schemes and projects supporting wider environmental, economic and social objectives through designated funds to address particular issues on the existing road network

We have tailored the analysis to each funding area based on appropriate evidence, and we have developed innovative appraisal techniques to broaden our ability to analyse the impacts of all our activities. This has involved bringing together a variety of analyses such as appraising a package of schemes through our regional traffic models and understanding the impact of delayed maintenance of an asset. Bespoke analysis has been used to understand the value of investment in designated fund schemes, capital renewals and the provision of traffic officers and network management functions.

Overall, the economic analysis of the RP2 SBP demonstrates we are making good use of public money. Our analysis shows that all elements of the SBP generate benefits worth more than their costs, and that the SBP overall is expected to deliver High VfM (VfM), implying over £2 of benefit for every £1 spent on the SRN during RP2.

Our VfM assessment has been shaped by both monetised and non-monetised impacts and has included considerations of uncertainties. Whilst many impacts are expressed in monetary terms, this is not possible for all impacts. These ‘non-monetised’ impacts can be significant, and our VfM process has been designed to ensure that these impacts are taken into consideration in the final VfM judgment.

The breakdown of the VfM rating for each of the major activities is highlighted in the table below:

Major RIS2 activities	VfM assessment
Operations, maintenance and renewals	Very High
Major e nhancements – made up of: Existing commitments carried forward from RIS1 New commitments for RIS2	High
Designated funds	High/ Very High

There are many unknowns and uncertainties involved in our analysis. These include an imperfect understanding of how investment will impact on our performance measures, and the influence of inherently uncertain factors, such as economic growth. Some investments in our portfolio are at an early stage and the precise programme of work is still to be determined.

We have conducted sensitivity testing on some of these uncertain factors to understand the risk of change. For the new enhancements, we have incorporated scenario analysis in the analysis to ensure that robust VfM conclusions can be drawn under a range of different plausible scenarios of the future. Whilst scenarios of this sort can never factor in all uncertainties, we are confident that the key uncertainties have been considered in drawing the VfM judgment for all the major activities in RP2.

Next steps

Throughout the Road Period, we will continue to review the VfM case for investing in schemes and projects as they develop, and further work will be done on the modelling of costs and benefits to ensure that every investment delivers VfM for the tax payer. Major enhancement schemes will be subject to further development and economic analysis as each progress through Highway England’s Project Control Framework. At each stage, the VfM will be reassessed as more information about scope, alternatives and local knowledge become available and more defined.

A benefit management and evaluation exercise will be carried out during and after the completion of each project to ensure the expected objectives and benefit has been realised. This will also measure the level of accuracy associated with estimates of costs and prediction of benefits emerging, and main factors affecting the accuracy. This will help shape how costs and benefits are assessed for similar investments in the future.

¹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/886236/ris2-analysis-overview.pdf

1 Introduction

1.1 Context

In the RIS2 for the RP2 (2020 to 2025), government set out their vision to have a safer, more reliable and greener SRN that uses new technology, supports the country’s economy and is an integrated part of the national transport network. Government’s RIS2 confirms £27.4 billion of funding to help deliver this vision.

Our *SBP*, responds to, and aligns with government’s RIS2. It provides the high-level direction for every part of our company for the RP2, setting the outcomes we will work to deliver and the strategic priorities for our business. Our *SBP* is supported by our *Delivery plan*, which provides the detail of specific funding, activities and projects we will deliver over the five-year period.

1.2 Purpose of this document

Highways England has a Licence commitment to deliver, and demonstrate that we will deliver, VfM. In this document, we outline the results of our economic analyses to define the VfM of our proposed investment portfolio across the RP2, covering all front-line activities.

This document is supported by our detailed analytical approach, set out in *Annex 1: Analytical methods to understand the value of the second road period (2020-2025)*.

1.3 Overview of our analytical approach

To undertake our VfM assessment, we have brought together a variety of analyses. We have used both well-established and new approaches to help us better understand the positive and negative impacts of our activities.

We have, for example, used regional traffic models to appraise our package of major enhancements, and traffic impact assessment models to understand the impact of roadworks due to delayed maintenance of an asset. We have also developed bespoke analysis to understand the value of investment across designated fund schemes, capital renewals and maintenance, as well as across our Traffic Officer Service and network management functions.

All our analysis is consistent with our *VfM framework*, the *HMT Green Book (2018)* and the DfT’s *Transport analysis guidance*. Where our analysis is new, and there is no existing guidance to follow, we have developed and agreed methodologies with the DfT and the relevant experts. We have assured all analyses using our Analytical Assurance Framework, which has ensured that our analysis is compliant, appropriate and fit for purpose.

There are many unknowns and uncertainties involved in our analysis. These include imperfect understanding of how investment will impact on the performance and the influence of factors, such as economic growth. Some investments in our portfolio are at an early stage and the precise programme of work is still to be determined.

All enhancement projects will be followed up by individual business cases for investment, which will be written as more is known about the design, local context, costs and benefits. The analysis contained in those business cases will be subject to significantly less uncertainty and so will be more appropriate for decisions that irreversibly commit funds.

All costs and benefits are reported in their present values and discounted to 2010 prices in line with the DfT’s Transport analysis guidance.

Funding stream	Activities
Operations, maintenance and renewals	<ul style="list-style-type: none"> ■ Operations – helping our customers travel safely and efficiently on one of the most highly-used networks in Europe ■ Maintenance – supporting and maintaining our assets throughout their lifespan, keeping them safe for customers and road workers ■ Capital renewals – keeping our roads and supporting infrastructure in good condition
Enhancements	<ul style="list-style-type: none"> ■ Completing the committed enhancements started in the first road period ■ Starting new enhancements
Designated funds	<ul style="list-style-type: none"> ■ Safety and Congestion Fund ■ Users and Communities Fund ■ Environment and Wellbeing Fund ■ Innovation and Modernisation Fund

Table 1: Funding streams of our investment portfolio for the RP2

2 Operations, maintenance and renewals

Our network is the backbone of the country's economy and integral to our customers' journeys. It carries over four million vehicles every day and moves more freight than all other transport modes put together. Funding for operations, maintenance and renewals is essential to keeping traffic moving safely and reliably every day.

As part of our analysis, we have assessed the baseline for operations, maintenance and renewals. The baseline represents the minimum required to ensure that we fulfil our Licence obligations to maintain our network to a 'safe and serviceable condition' in a way that maximises efficiencies.

Overall, we have found that our proposed investment across operations, maintenance and renewals will reduce capital costs and lessen the impact on road users. The way we operate our network delivers 'Very High' VfM, whilst our planned approach to maintenance and renewals is both 'Very High' and in many cases 'financially positive' VfM, because it leads to an overall reduction in the lifetime costs of keeping the network running.

2.1 Operating our network

We have wide-ranging and comprehensive operational services which help our customers – the public, business users, freight hauliers, local communities and partners – travel safely and efficiently on one of the most highly used networks in Europe. These services include traffic officers on the road, a network of automated real-time information reporting systems and both regional and national control centres.

Our traffic officers patrol our network 24 hours a day, managing incidents safely and quickly. Equally, our control centres operate 24 hours a day, 365 days a year, undertaking real-time traffic management across the country. Our information systems provide customers with traffic data and alternative routes, while our weather stations and winter fleet enable safe journeys in adverse weather.

As part of our economic assessment, we quantified the magnitude of the impacts linked to our operational activities – we focussed the analysis on our front-line services, and in particular our Traffic Officer Service.

In Figure 1, our analysis shows that, when our traffic officers are present on the scene of incidents, delays reduce by 15 minutes on average.

Our benefit cost ratio (BCR) calculations for continuing to operate our Traffic Officer Service across the RP2 have generated a BCR of 4. This represents 'Very High' VfM. Our traffic officers also attend and support vulnerable

customers at breakdowns, clear debris, set signs and reopen closed routes when safe to do so. These non-monetised benefits also contribute positively to our VfM conclusion. Given the significant impact of traffic officers on both safety and reducing delays on the SRN, they will continue to play a vital role over the RP2.

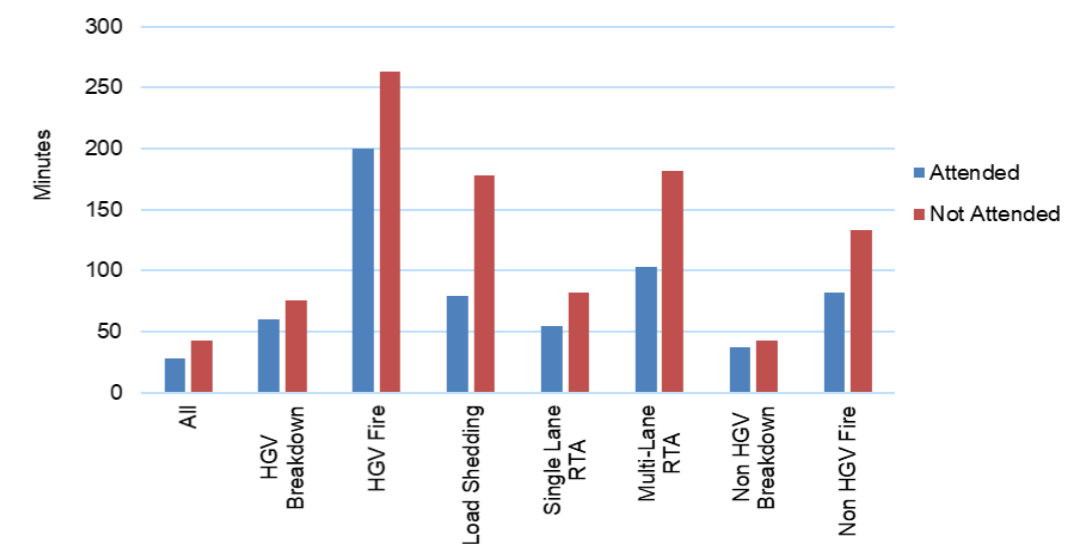


Figure 1: Average delay by incident type, split between incidents attended by traffic officers and those not attended

2.2 Maintenance

Our network consists of many assets, which range from bridges and footpaths to embankments and safety barriers. We support and maintain these assets throughout their lifespan, keeping them safe for customers and road workers. Well-managed maintenance activities reduce the need for major interventions and potentially extend the life of assets. Effective maintenance also prevents problems, such as large vegetation growing on an embankment which cannot support it, reducing the disruption of unplanned works.

Our traffic impact assessment model uses traffic volumes and capacity for each link of the SRN to estimate journey time delays as a result of traffic restrictions. We have used this model to demonstrate the impact of different maintenance routines at a selection of indicative points on our network.

In Figure 2, we provide a case study example which shows the customer impact of delays due to roadworks across three scenarios. These demonstrate the range of approaches to full asset life planning with a constrained budget:

- A – Planned maintenance (driven by asset need and best practice asset management)
- B – Delayed maintenance (still in the RP2, but less frequent)
- C – Postponed maintenance (pushed back to the third road period)

The results show that greater levels of repair would be required where the maintenance has been delayed or postponed. This means that there would be costs to the user from slower and longer journeys as more restrictions are put in place over the course of the intervention. This would cause the capital cost of bringing the road back to a reasonable standard to be much higher in the long run.

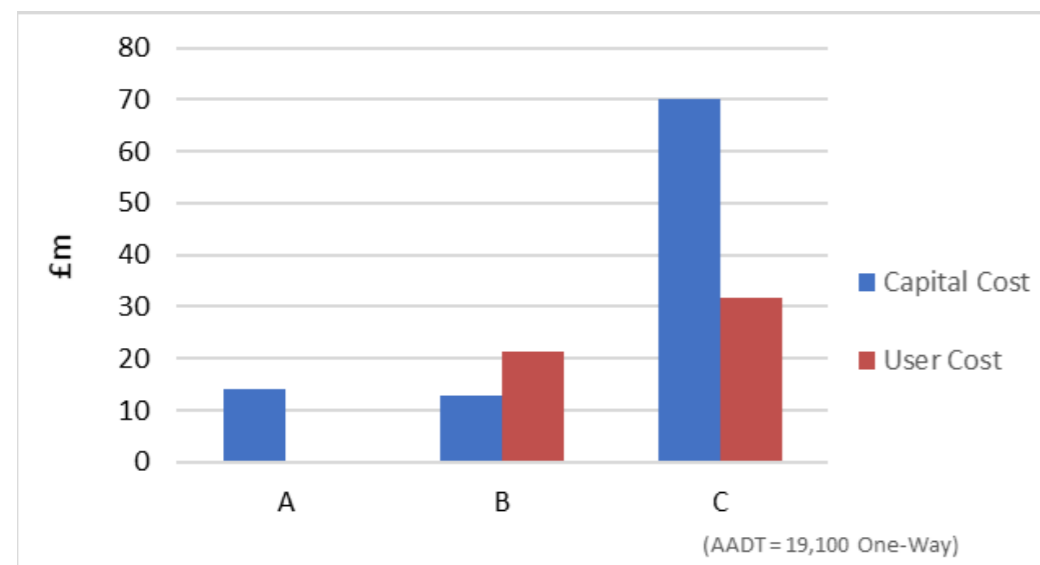


Figure 2: Examples of cost and user impacts from deferred works where assets do not fail

2.3 Capital renewals

To keep traffic flowing smoothly, we need to keep our roads and supporting infrastructure in good condition. Well-planned renewals are essential to safeguard, maintain and modernise our network, much of which dates back to the 1960s and 1970s.

The case for life extending renewals is predicated on the fact that over time, our road surface and supporting network will deteriorate and will need replacing. We have used a suite of condition deterioration models to determine the condition profiles for each asset type and the longer term spend. This has enabled us to understand how the condition of the assets would change during RP2, which in turn helps determine the volume of work.

We have identified three asset classes which will need an increase in investment over the RP2 and our analysis covers all three of these areas: concrete roads, structures and safety barriers.

Concrete road surface

Many of our concrete road surfaces on the SRN are now approaching the end of their life and will need repairing. Our case for investment over the RP2 is driven by the need for life-extending measures or reconstruction of the concrete surfaces. These long-term measures will help to prevent the need to undertake unplanned maintenance and thus reduce the whole-life cost of this asset.

Renewing bridges and other structure

Some of our largest structures will need significant work over the coming years to counteract the effects of weather and general fatigue. If not renewed in time, these structures will begin to pose safety risks to road users. To minimise these risks without further interventions, restrictions would likely be placed on our network, leading to longer journeys and an increase in cost for traffic.

There would also be an increase in structural failure, which would require more intrusive interventions and/or create safety risks. Such interventions cost more and have a greater impact on road users through lane or road closures, compared to the timelier interventions we have planned for the RP2.

Replacing safety barriers

Large volumes of safety barriers are forecast to expire during the RP2. Without investment, 20% of the network would see its safety barriers degrade to the worst category for safety. It is expected that an investment to renew over 1,000 miles of safety barriers between 2020 and 2025 will ensure that those in poor and very poor condition receive the appropriate intervention.

3 Major capital enhancements

In some locations, there are challenges which cannot be solved through improved operations, maintenance and renewals, or small-scale improvements to the existing network. In these cases, new and improved connections are needed. Major enhancements schemes are a crucial element of our balanced investment portfolio, contributing towards almost all our performance outcomes. Enhancements will reduce journey times, increase reliability and improve connectivity. They will bolster our network’s capacity and resilience and drive economic growth, providing opportunities for people and businesses across the country.

This section summarises analysis and evidence to support our major enhancements proposals, recognising the different stages of their development. We have undertaken all our analysis in line with standard appraisal practice, and with the DfT’s *Transport appraisal guidance*.

The location of all our enhancements are shown in Figure 3. The DfT’s Road Investment Strategy Document² contains a more detailed set of graphics showing each of these schemes.

3.1 Assessing our major enhancements portfolio

In our economic analysis, we have considered the case to: complete the 56 committed enhancements started in the first road period; and start 12 new enhancements. Taken together as an overall enhancements portfolio of 69 schemes, we have analysed both the expected monetised and non-monetised impacts, as well as considering the uncertainty surrounding key inputs of the analysis.

Scheme type	Number of schemes	Total present value benefits	Total present value costs	Net present value	BCR
Junction improvements	25	£4.1bn	£1.8bn	£2.3bn	2.3
Widening	20	£6.7bn	£3.0bn	£3.7bn	2.2
Smart motorway	17	£6.3bn	£2.6bn	£3.7bn	2.4
Bypass ³	7	£9.6bn	£5.8bn	£3.8bn	1.6
Total	69	£26.7bn	£13.2bn	£13.5bn	2.0

Table 2: Summary of BCR for each scheme type in our major enhancements portfolio

²https://www.gov.uk/government/publications/road-investment-strategy-2-ris2-2020-to-2025

³This includes the Lower Thames Crossing scheme

In Table 3 on page 13, we summarise the costs and benefits for the different scheme types. Our modelling has generated an overall BCR of 2.0, meaning that we expect benefit of £2 for

every £1 of cost incurred. Taken together with consideration of non-monetised impacts, this represents “High” VfM.

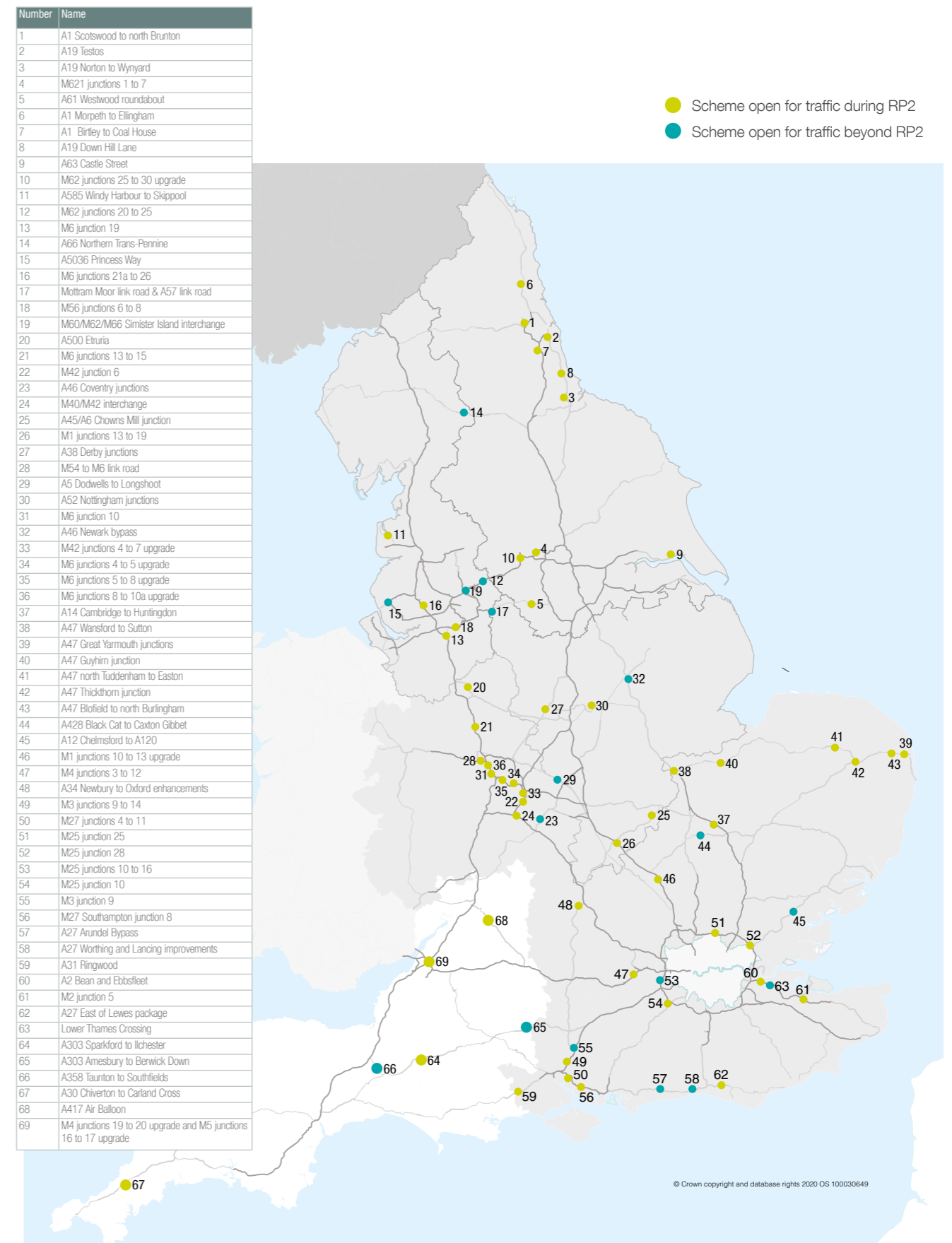


Figure 3: Major enhancements

In Figure 4, we show the scale of the different categories of impacts which have been monetised for all our enhancements in RP2. In this graphic, blue bars indicate positive impacts, whilst red bars indicate negative impacts (including costs).

We expect the development and roll out of our enhancement schemes over the RP2 to deliver about £27 billion of benefits to businesses, commuters and other road users, including productivity boost from agglomeration.

The greatest benefit will be improving travel times and journey reliability because of increased capacity on our network. Freight and business users are heavily dependent on the SRN, and reliable and quicker journeys will improve business productivity. Quicker journeys could also help influence more fundamental decisions in our customers' lives, such as where to live and work, and this may enable wider economic impacts such as employment benefits.

Another significant benefit is the productivity boost from "agglomeration" – a result of better connectivity driven by increased network capacity and reduced travel times and costs. Better connectivity between local economies means that business can connect with potential suppliers, potential customers and other businesses in the same sectors. Bringing businesses closer to each other will enable competition, interaction, knowledge and innovation sharing, and better matching of jobs and skills – fostering productivity and boosting economic growth.

The analysis also looks at negative impacts from our work, sometimes called "disbenefits", and finds these to be modest compared to the benefits. Non-business users can expect to spend more on fuel and other running costs as

more people travel, sometimes further and at higher speeds. This offsets a small proportion of the time saving benefits to those users, but they remain significant beneficiaries overall. Using more fuel also leads to increases in greenhouse gas emissions (GHGs) which, whilst modest in the context of overall benefits from our work, represent an important negative impact that Highways England is working hard to reduce.

On a technical note, our GHG calculations use a standard government tool which does not currently take account of the expected uptake of electric and other ultra-low emission vehicles (ULEVs). The Department for Transport's most recent projections of demand for road transport suggest that as much as 45% of cars in England may be electric by 2050 in their "current policy projection". Our true GHG impacts are therefore likely to be around 35% lower than we have calculated.

This analysis is focussed on the GHGs from our enhancement programme. The Strategic Business Plan also includes wider commitments around reducing Highways England's own carbon emissions and that of our supply chain, building on our environment and sustainability strategy, and the projects we may carry out through Designated funds. Whilst GHG increases from our enhancement programme reflect to a great extent the choices made by road users over their future vehicles, these other initiatives provide opportunities for Highways England to reduce GHGs, and facilitate greener choices by our users, where ever we can.

Sections 3.2 and 3.3 give a breakdown of the monetised and non-monetised impacts of our committed schemes to be completed in RP2 and the new enhancements respectively.

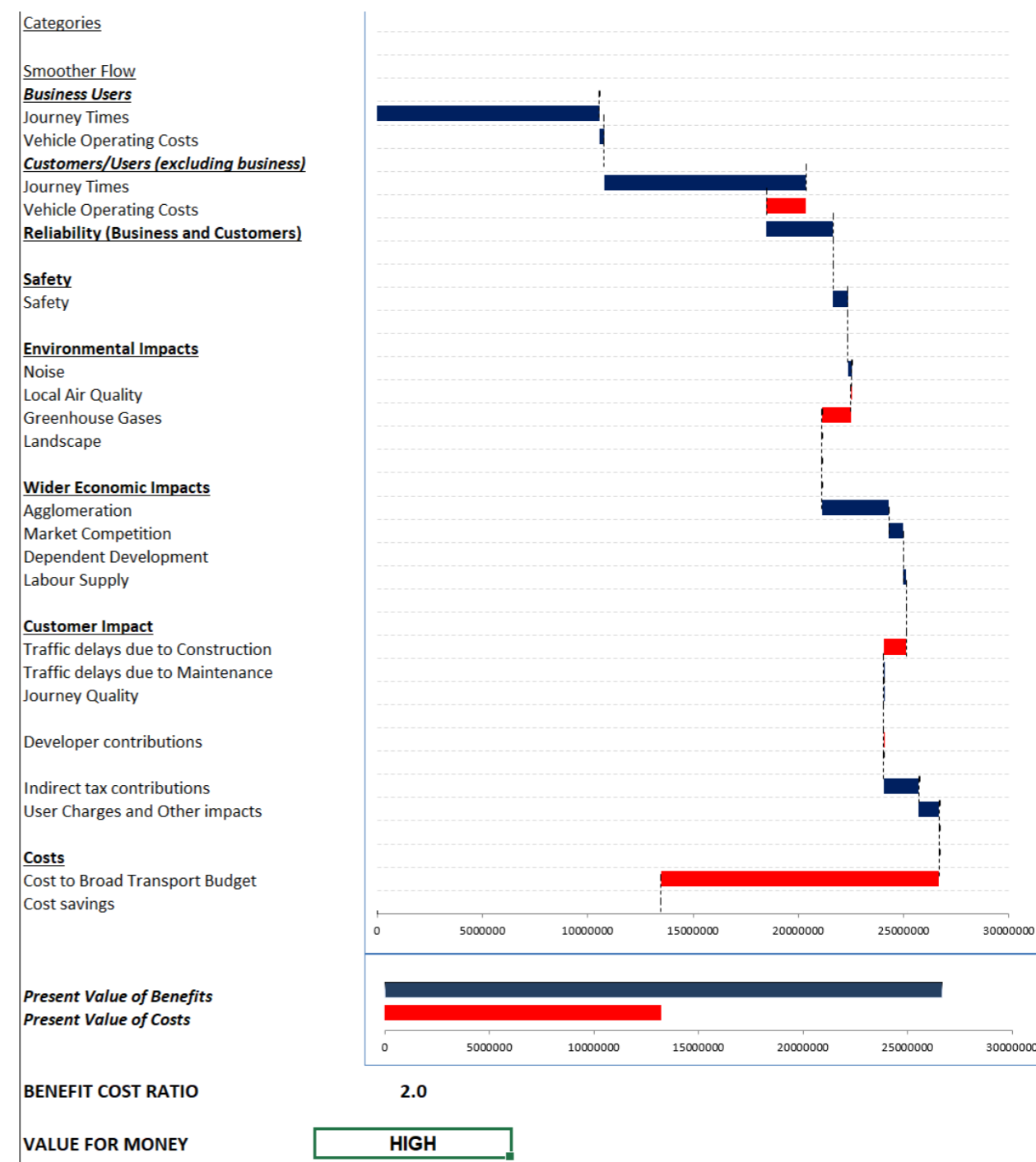


Figure 4: Total monetised impacts of the major enhancements portfolio

3.2 Assessing our committed enhancements started in the first road period

We have 56 committed major enhancements schemes for the RP2. These schemes are rolling programmes which, due to their scale and complexity, will form a significant volume of work early in the RP2. Although they are at different stages of development in our Project Control Framework⁴, these schemes are advanced in terms of ongoing economic analysis of impacts.

Scheme-specific transport models have been used to quantify and value the changes in road capacity on journey times, greenhouse gas emissions, air quality and, where appropriate, the reliability of our network and wider economic impacts.

Table 3 summarises the costs and benefits which have been monetised for the 56 schemes. The results indicate that the BCR for the package of schemes is 2.2. This means we expect the benefit to be worth £2.2 for every £1 spent, and once all non-monetised impacts have been considered, these schemes represent ‘High’ VfM. Most of these schemes are at an advanced stage of development and we expect this rating to remain stable.

In addition to the monetised impacts, we also systematically assessed the non-monetised impacts of each of the schemes. The scale of these non-monetised impacts has been used in the VfM judgment of the package.

Scheme type	Number of schemes	Total present value benefits	Total present value costs	Net present value	BCR
Junction improvements	24	£3.8bn	£1.7bn	£2.2bn	2.3
Widening	17	£5.3bn	£2.3bn	£3.1bn	2.4
Smart motorway	10	£6.1bn	£2.5bn	£3.6bn	2.4
Bypass	5	£4.7bn	£2.5bn	£2.2bn	1.9
Total	56	£20.0bn	£9.0bn	£11.0bn	2.2

Table 3: Summary of BCR for each scheme type in our committed enhancements

Figure 5 shows a summary of the assessment of non-monetised impacts. The chart shows that about 20% of schemes is expected to have moderate to large adverse impacts on landscape, historic environment and biodiversity, but a majority of schemes are expected to have none or a neutral effect on these non-monetised impacts. A significant number of schemes are expected to improve journey quality, severance, physical activity and security for road users. We never stop looking for ways to improve schemes to maximise benefits and avoid or mitigate adverse impacts, so further scheme development may see this picture change.

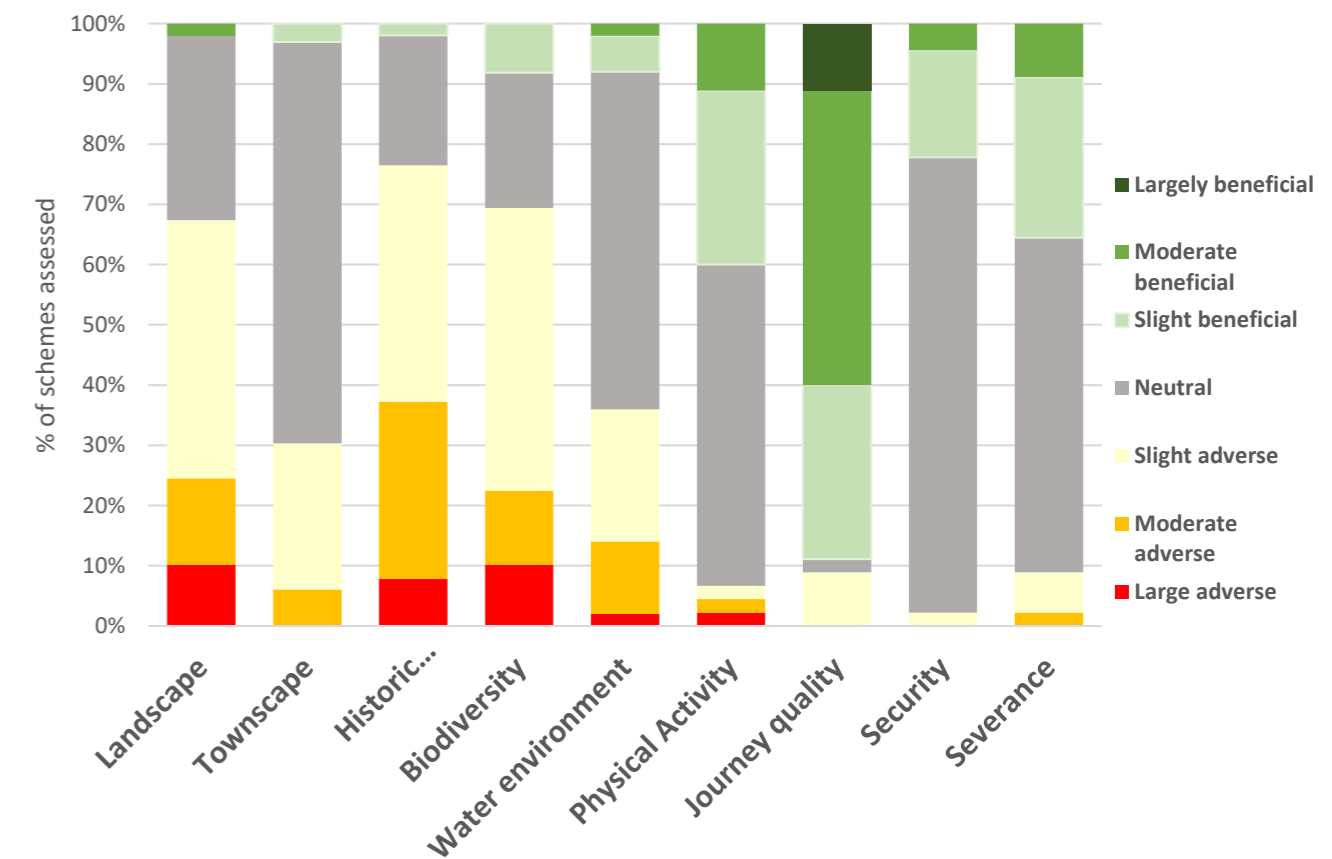


Figure 5: Assessment of non-monetised impacts of committed schemes

⁴The Project Control Framework Handbook http://assets.highwaysengland.co.uk/roads/road-projects/A46+Coventry+Junctions+Upgrade/Proofs+of+evidence/J.01+PROJECT+CONTROL+FRAMEWORK+HANDBOOK++V4-NOVEMBER+2018_.pdf

3.3 Assessing our new major enhancements schemes

We will deliver 12 new enhancement schemes across the country. These schemes as outlined in the strategic business plan are:

- M62 junctions 25-30 ALR Retrofit
- A66 Trans-Pennine
- M60 Simister Island
- A46 Newark Northern Bypass
- M42 junctions 4 to 7 ALR*
- M6 junctions 4 to 5 ALR*
- M6 junctions 5 to 8 ALR*
- M6 junctions 8 to 10 ALR*
- M1 junctions 10 to 13 ALR Retrofit*
- Lower Thames Crossing
- A417 Air Balloon
- M4/M5 ALR

Overall, we expect the roll out of these new schemes across the RP2 to deliver an additional 6.7 billion of benefit over the lifetime of the schemes. It will provide a BCR of 1.6, this equates to a net benefit worth £1.6 for each £1 invested; and once all non-monetised impacts have been considered too, these schemes represent 'Medium' VfM.

Our VfM assessment of our new enhancements package for the RP2 is based on the monetised and non-monetised impacts, as well as consideration of all sources of risk and uncertainty associated with the new enhancements portfolio. Our approach to analyse these schemes are proportionate to reflect the early stages of scheme development.

3.3.1 Monetised impacts

We have used traffic modelling and other tools to value impacts, such as the changes in road capacity on journey times, greenhouse gas emissions, air quality, noise and safety. We have expressed these impacts in monetary terms, using evidence and established appraisal guidance. The results are summarised in the table 4 below:

Total present value cost	£4.2bn
Total present value benefit	£6.7bn
Net Present Value (£)	£2.4bn
BCR	1.6

Table 4: Summary results of new enhancements

The sections below outline the key results for travel time savings, wider economy, safety and the environment (noise, air quality and carbon)

Travel time

Most of the user benefits come from reduction in travel times. Travel time savings is a suitable metric to proxy for number of different benefits that our enhancements will provide: reducing the amount of time spent on travel enables transport users to spend the time they have more productively or more enjoyably. For example, leisure users have more time to spend enjoying their destinations, commuters can choose whether to use the extra time for work or leisure, and businesses have more time for productive work.

The travel time savings experienced by drivers, relative to the expected future travel times without our enhancements schemes, will vary according to the nature of the journey being taken, the route taken and the time of day. For instance, significant improvements will be seen in travel times between Kent and areas

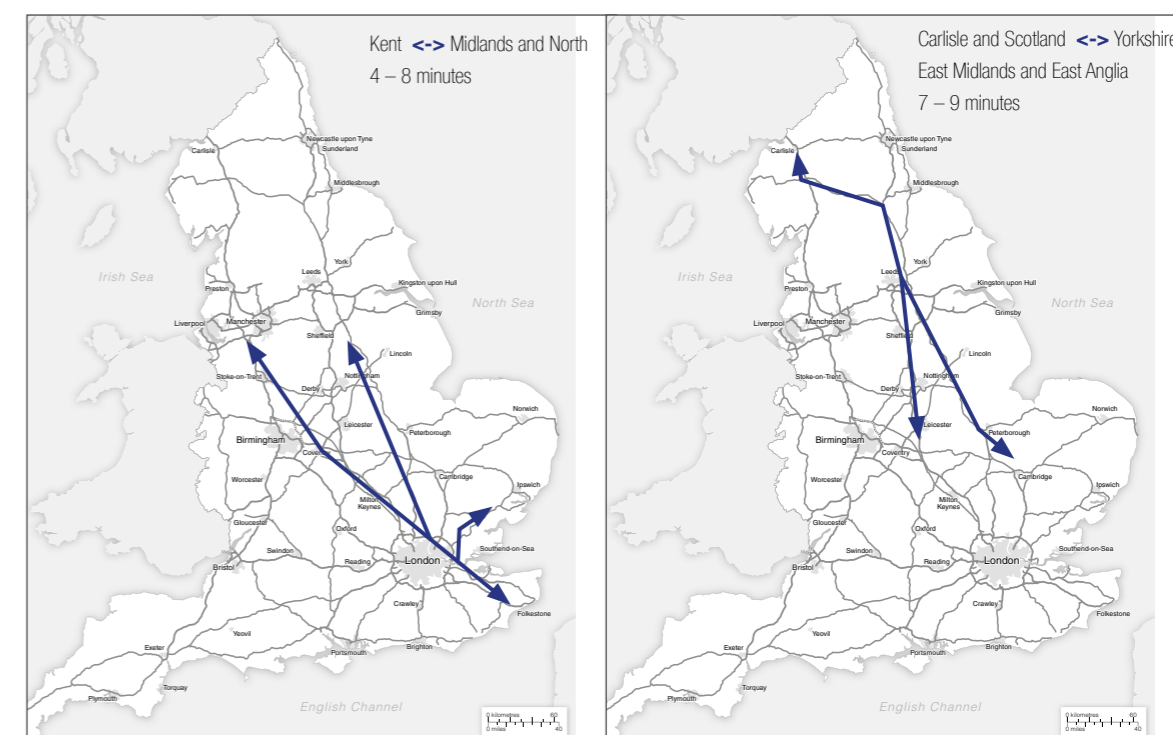


Figure 6: Map of indicative travel time savings due to new enhancements schemes

north of the Thames due to our Lower Thames Crossing scheme. This will be most noticeable in movements to/from East Anglia due to the shortening of the route with the more easterly crossing point. Our improvement of the A66 is also expected to improve movements to/from north-west England (and also Scotland) and north-east England. Indicative time savings are illustrated in figure 6.

Road users who live in local authority districts near to the schemes are likely to experience the greatest level of benefits per head, compared to those living further away. Our analysis shows that this is more distinct in areas close to the Lower Thames Crossing and districts within the northern regions.

The main economic benefit is travel time savings to business users, especially from our schemes that increase capacity and reliability on routes with high freight movements for SRN-dependent businesses. Freight and business users are heavily reliant on the SRN. The SRN carries over two-thirds of freight, whilst nine

out of ten businesses are located within ten miles of the SRN. Reduced travel time because of improved connectivity means that these businesses can connect with potential suppliers enabling them for example, to access lower cost input, connect with potential customers further afield and connect with a wider pool of talent in the labour market. On the other hand, reduced transport costs mean that individuals can enter the labour market and access a wider range of jobs as a result of reduced and cheaper commuting journeys. People can also connect with leisure and retail opportunities, helping to increase the competitiveness of local businesses.

Through this mechanism, travel time savings for business users can drive increases in business productivity and employment, resulting in increased economic output. Increases in productivity and competitiveness will increase the Gross Value Added (GVA) of the local economy.

*The impacts of these scheme have not been modelled as there are insufficient information available on scheme definition. It is expected that they won't make significant impact on the VfM judgment of the portfolio

Wider economy

Time savings for business users translate directly into improvements in GVA, but they are not the only impacts on the ‘measured’ economy. There are other wider economic impacts that are potentially additional to all the benefits that accrue directly to users, and benefit the economy as a whole. These impacts can be interpreted as spill over effects from our enhancement investments to other sectors and to the overall economy.

Our analysis reveals that wider economic impacts are the largest source of benefits after journey time savings. Wider economic impacts reflect the agglomeration and productivity benefits for businesses and the labour market that come from improved connectivity.

Wider economic impacts from improved journey times

The benefits of improved journey times are, over time, transferred into the wider economy.

Improved connectivity facilitates getting workers into concentrated and productive centres of activity. Improved connectivity brings businesses closer together with productivity advantages from locating in close proximity. Businesses may become more specialised, have access to a large and pooled labour market. This creates positive benefits for other businesses, an effect called ‘agglomeration’. Better connectivity will increase agglomeration benefits.

Improved productivity as a result of agglomeration is estimated to deliver £1.5 billion of benefits to the wider economy, in addition to the £4.6 billion productivity boost from faster and cheaper business trips discussed above.

Wider economic impacts from expanding choices over where to live and work

Improved connectivity provides households with choices over places to live where they can access employment and services. It provides firms with choices over places to locate where they can access customers, suppliers, and workers, and it provides developers with choices over where to provide new homes and workplaces.

We are developing a greater understanding of how our enhancements schemes will influence these choices of households, firms, and developers, and what impact this has in different parts of the country in terms of employment, population, and economic output. As part of this, we have invested in our economy model – a land use transport interaction model that simulates the choices of households, firms, and developers. We have applied this model to test the impact upon total employment across the new enhancement schemes.

Figure 7 shows our model's forecasts of employment change by 2041 in our East and South-East operational regions in response to the Lower Thames Crossing. The East/South-East region of England is estimated to gain an additional 4,800 jobs – across these regions that again is likely to be more locally significant. The increases in employment are concentrated in proximity to the crossing in northern Kent and southern Essex, with further increases in eastern Kent. Some of the increases displace employment from Greater London and parts of south-eastern England. It does not mean that there will be a fall in employment these areas; all parts of the country show employment growth over the period we have assessed.

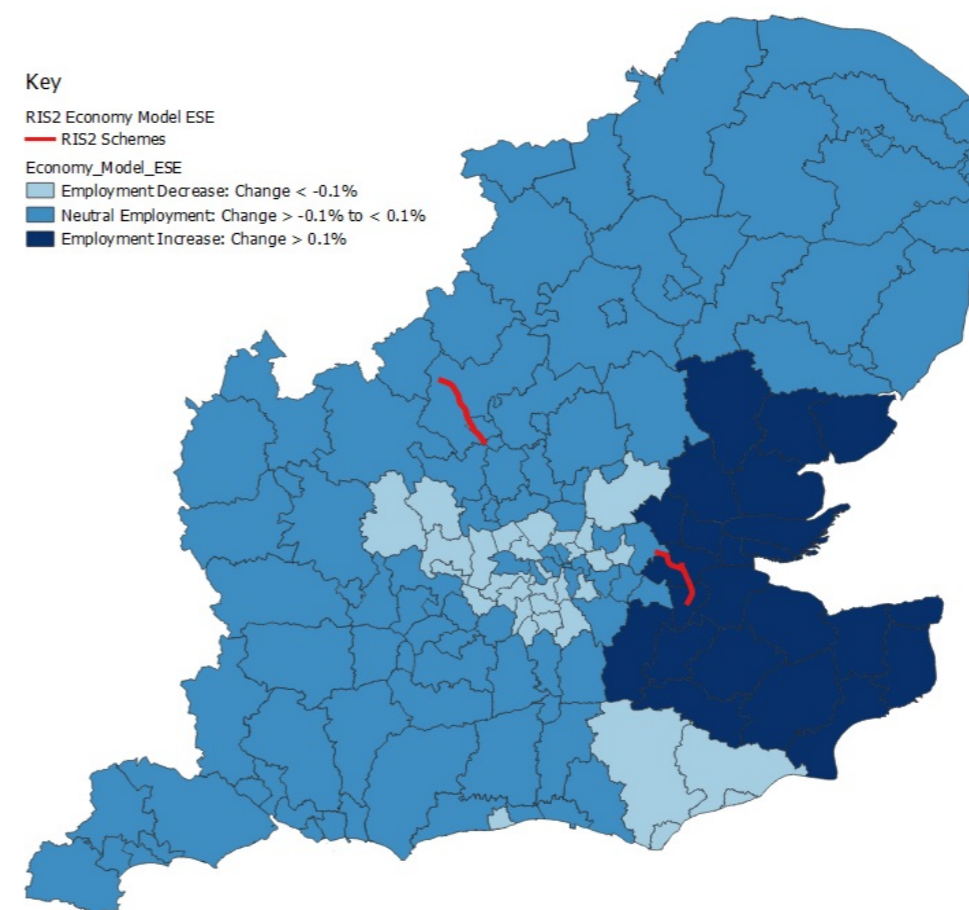


Figure 7: Forecasts of employment change by 2041 in Highways England's East and South-East Operational Regions in response to the Lower Thames Crossing. The map shows the Lower Thames Crossing and the M1 junction 10 to 13 ALR scheme in red.

The enhancement portfolio is forecasted to boost national productivity by around £20 per job across the whole economy (+0.02%), or £4.6 billion in total. This primarily represents productivity benefits from faster and quicker journeys ('business user benefits') and benefits from bringing households and businesses closer together.

At a local level, the portfolio is likely to generate significant employment benefits as people and jobs re-locate. This relocation may be driven by perceived improvements in quality of life such as lower housing costs or (for businesses) lower production costs. Where jobs relocate away from existing centres of economic activity, some of the predicted agglomeration spill-overs may be lost in favour of less tangible benefits, but they are benefits nonetheless.

Safety

We expect to deliver safety improvements through our new enhancements schemes by increasing capacity to enable freeflowing journeys. This may also help to improve incident-related journey time reliability. Overall, these improvements are expected to reduce over 50 fatal injuries on our network.

Environment

The environmental impacts we have expressed in monetised terms are: noise, air quality and greenhouse gas emissions (GHG). The monetised impacts of noise are significantly smaller than those of greenhouse gases and air quality.

The appraisal results from our transport models show that, as a result of investment in these major enhancements, there will be air quality and greenhouse gas emissions associated with increased economic and traffic growth. For air quality, the monetary value is estimated as £5.4 million over the appraisal period⁶. We are working to improve air quality by working with government and the industry to encourage the expansion of electric car charging points. We will also support the government's *Air quality plan*, ensuring our network is compliant with NO₂ limits in the shortest possible time.

The new enhancements to be completed during RP2 can be expected to increase GHG emissions with a monetary equivalent of £46.8 million by 2040 if there is no significant switch towards ultra-low emission vehicles before this date. The Department for Transport has recently published forecasts showing that current policies and market trends are expected to lead to a shift towards electric vehicles, and our preliminary work to take account of this suggests current methods overstate the GHG impacts by around 35%.

3.3.2 Non-monetised impacts

While our appraisal process expresses some impacts in monetary terms, this is not possible for all impacts. Non-monetised impacts can be significant, and our VfM process has been designed to take the expected scale of these into consideration, before any judgement can be reached on overall VfM.

Overall, we expect some non-monetised impacts to have a large beneficial impact, and others to have a large adverse impact. On balance, our systematic assessment suggests the effect of these non-monetised impacts will be broadly neutral, and that the BCR based upon the monetised impacts is a good gauge of overall VfM. Moreover, there are opportunities to ensure that the non-monetised benefits are maximised, and the non-monetised dis-benefits are avoided or mitigated.

We have assessed non-monetised impacts in the following areas:

- Environment
- Resilience

Environment

We have developed a series of analytical tools to assess risk on the environment across eight areas:

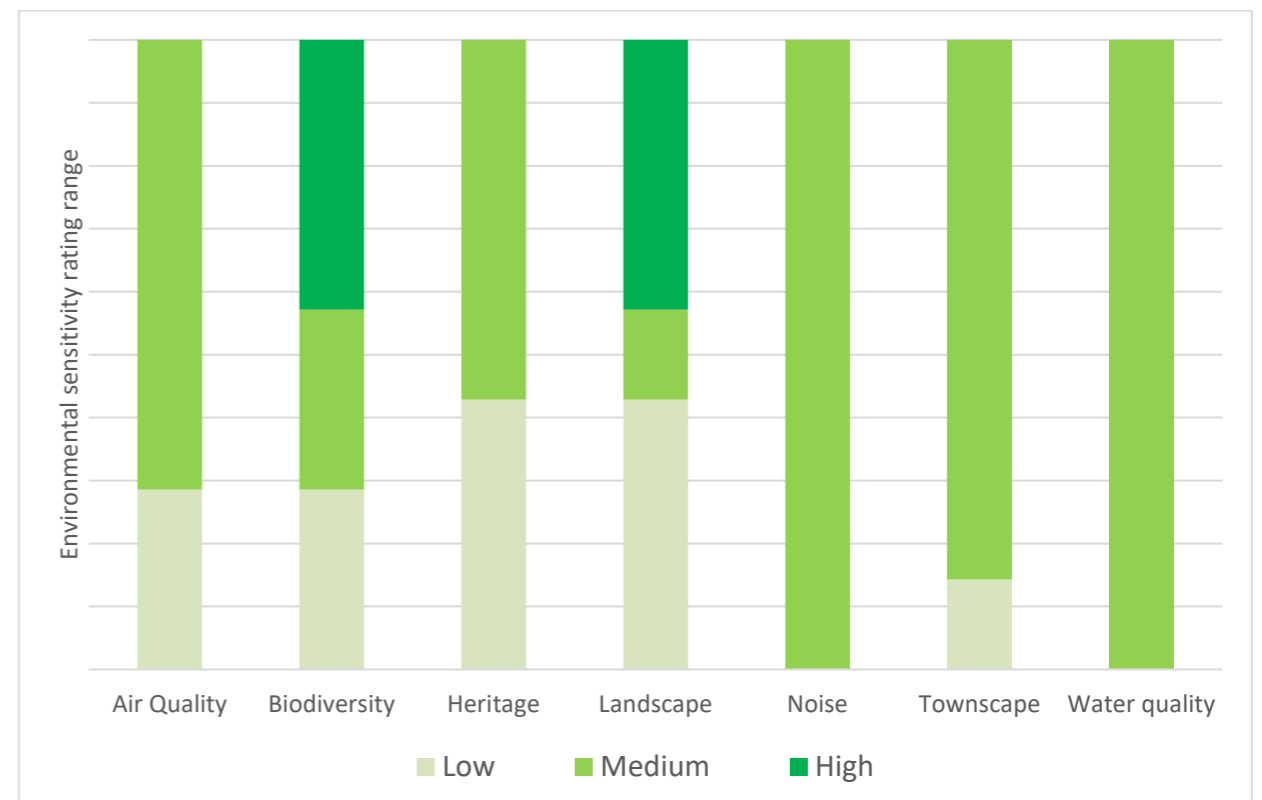
Core environment (monetised)	Natural environment (qualitative)
<ul style="list-style-type: none"> ■ Greenhouse gasses ■ Air quality ■ Noise 	<ul style="list-style-type: none"> ■ Landscape ■ Townscape ■ Biodiversity ■ Heritage ■ Water quality

At an early stage of analysis, we used a qualitative tool to identify the likely risk of major enhancements affecting a designated or environmentally sensitive area. We rated each of these areas based on the potential significance of the implications of the environmental sensitivity on: cost; design (both constraints and opportunities); delivery of the scheme; and opportunities for investments to deliver better environmental outcomes.

To understand the full potential environmental outcomes, we have identified potential environmentally sensitive sites within the proximity of the schemes to help us avoid, protect or enhance these during the on-

going design process. Some schemes, such as Lower Thames Crossing, have already announced their preferred route and so focus on mitigation. Other schemes, at an early stage of development, have identified potential routes and will be able to consider avoidance or improvement measures as part of the scheme design.

Each investment has been assigned an environmental sensitivity rating of High, Medium or Low taking into account the proximity and importance of designated or environmentally sensitive areas. For each environmental impact, the range of the environmental sensitivity ratings are summarised in Figure 8.



- High: environmental constraints that cannot be addressed using established and readily deliverable design solutions or mitigation thereby posing a risk to the programme (timeline) for a project, its budget and/or delivery
- Medium: environmental constraints that, whilst potentially significant, can likely be resolved / mitigated with potential implications for programme and budget
- Low: environmental constraints that are likely be resolved / mitigated within programme and budget

Figure 8: Summary of environmental sensitivity in habitat or areas close to proposed scheme

⁶This monetary value of air quality and GHG does not include the results of the 2 smart motorway (SM) schemes as they have not yet been assessed. These smart motorway schemes have been included in response to the SM stocktake and so have been subject to less quantitative analysis than the schemes announced in the RIS. They will however be subject to an appropriate appraisal before an irreversible commitment is made to them.

Our assessment also considers the potential risks to the programme (the time to design and deliver), cost and deliverability of a scheme. These are not final assessments; instead they give a sense of scale as to what would need to be considered in the route planning, and help to inform the overall VfM assessment.

Resilience

Our enhancements schemes are likely to provide a large benefit around increasing the resilience of our network. For example, Lower Thames Crossing will provide an alternative route for SRN users when routes such as the Dartford Crossing are closed. Schemes such as A66 Trans-Pennine will provide an alternative route for travelling east-west in the north of the country. Currently the A66 faces reliability issues as it is susceptible to road closures due to bad weather or incidents involving HGVs, therefore A66 dualling is expected to improve journey reliability.

Where schemes are further ahead in their development, we have estimated reliability impacts in accordance with the DfT's *Transport analysis guidance*.

3.3.3 Accounting for uncertainties and future demand scenarios

There will always be uncertainties in analysis of this form, because scheme designs change as they are developed, and because we are forecasting many years into the future. These factors have been taken into consideration in drawing up the VfM judgment of our new major enhancements.

Schemes at early stages of development

For some schemes in our portfolio, such as Lower Thames Crossing, a preferred route has been announced. In contrast, other schemes are at an early stage of development. As these latter schemes progress through the development process, costs and benefits

may reduce or increase. For example, scope and route decisions could change as new information becomes available and this may impact on scheme costs.

The use of more scheme-specific models will take better account of local traffic conditions. It is uncertain how this will impact the VfM of schemes and it will need to be considered as schemes develop, although we anticipate that the addition of more details should generally lead to more benefits being identifiable.

Changes in the core assumptions of our analysis

Throughout our economic analyses, we have based our results on a core scenario (also called 'Reference case') which uses current growth forecasts. However, there are several factors – such as population growth, car ownership, changes in income levels and GDP – which could change the pattern of demand for travel. This could ultimately lead to changes in the core assumptions of our analysis, such as traffic growth forecasts.

In September 2018, the DfT published the latest set of forecasts of growth in road traffic – known as *Road traffic forecast 2018*. These forecasts were presented as seven different scenarios that reflect the uncertainty in the key drivers of road traffic demand. The key drivers of demand used to define the scenarios are changes in population growth, GDP, fuel costs, migration, trip rates and a shift to zero emission vehicles.

We undertook a scenario analysis to assess and understand how our VfM conclusion will change under these seven outcomes. This provides a strategic view of the key uncertainties that might impact on future road traffic and support the delivery of a business plan that is resilient to these uncertainties.

Figure 9 visualises the impact that different demand scenarios would have on the VfM of our new major enhancements package. It shows that it is likely to deliver 'Medium' VfM under a range of different future traffic demand scenarios, with BCR ranges between 1.40 (low case) and 1.88 (upper case).

High carbon sensitivity

Our analysis of the monetary value of carbon has been based on the central non-traded carbon values in the DfT's GHG Workbook⁷ but our findings are similar when much higher values of carbon are used.

Applying government's high carbon value would reduce the BCR to 1.54, down from 1.57 in the central case; even with a much greater weight placed on climate change, the new major enhancements portfolio would deliver medium VfM.

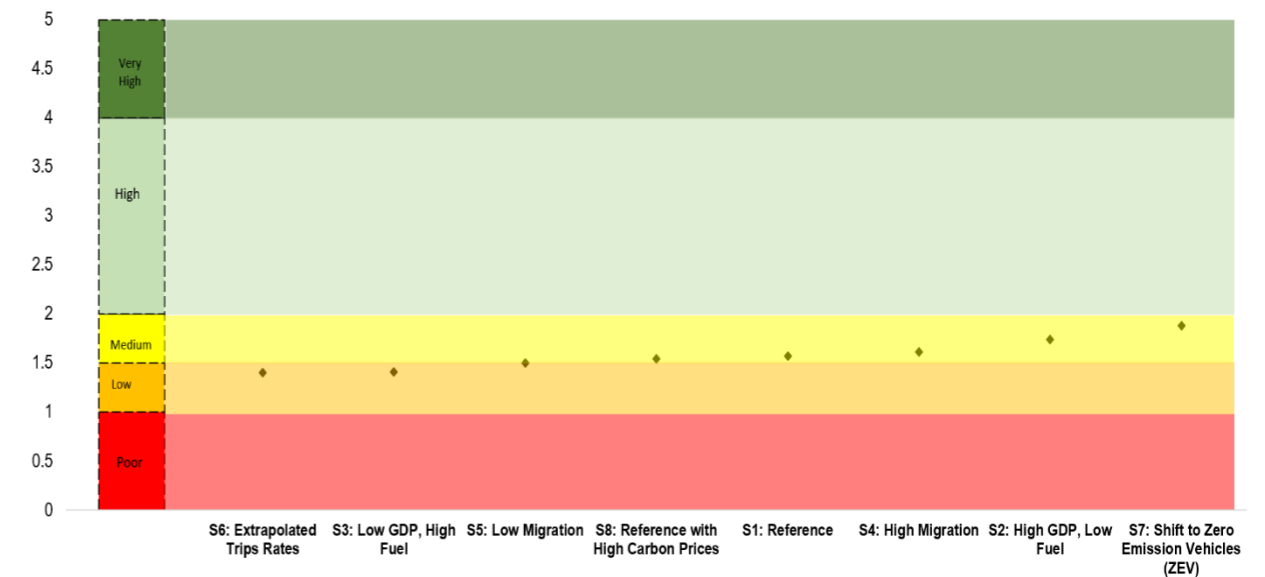


Figure 9: BCR and VfM category for each demand scenario

⁷<https://www.gov.uk/government/publications/tag-environmental-impacts-worksheets>

4 Designated funds

We introduced designated funds in 2015 to help us deliver activities beyond the traditional focus of road investment. We wanted to go above and beyond to improve lives, as well as protect the environment, support the nation's economy and increase accessibility. Importantly, they have enabled us to build relationships and work in partnership with other specialist organisations, such as Sustrans, the National Trust, the Environment Agency, the Canal and River Trust and Wildlife Trusts.

Over the RP2, we will invest through the following four funds:

- Safety and Congestion Fund
- Users and Communities Fund
- Environment and Wellbeing Fund
- Innovation and Modernisation Fund

Our plans do not explicitly identify the specific projects under each fund, allowing us to be flexible in how the money is spent. This will maximise efficiency, especially given the range of factors which might affect the optimal allocation of spending. These could include contributions towards our strategic aims, VfM and deliverability considerations.

In addition to the measurable benefits that the funds are expected to deliver, the individual spending areas will support the delivery of a range of strategic agendas and a number of government policies and objectives. For example, the government has set a target to bring all greenhouse gas emissions to a net zero by 2050, compared with the previous target of at least 80% below 1990 levels. Designated

funds have the potential to contribute towards this, for example, by supporting the development of innovative solutions to reduce vehicle carbon emissions. Our designated fund schemes will also contribute to delivering the commitments in the *Noise policy statement for England* by effective management of noise on the network.

4.1 Safety and Congestion Fund

This designated fund will help us deliver interventions to improve safety on high-risk roads, accident-cluster locations and potential suicide-cluster areas. It will also help to deal with congestion issues in local areas and support economic development.

We have assessed the VfM of this fund based on evidence from the impact of past spending on similar schemes, namely: Local Network Management Scheme programme; the Pinch Point programme; and the Congestion Relief Fund. Overall, this funding represents 'Very High' VfM.

4.2 Users and Communities Fund and Environment and Wellbeing Fund

Our Users and Communities Fund will be used to make the SRN safer and more accessible for everyone's journey, regardless of how they are travelling – including walkers, cyclists and horse riders. Our Environment and Wellbeing Fund will deliver interventions that promote wider environmental outcomes and wellbeing. We want our roads to work more harmoniously with the communities that live alongside them, and the built, natural and historic environments that surround them.

We have based our VfM assessment of these two funds on evidence of similar projects delivered in the first road period, weighted based on initial funding allocations. There is evaluation evidence for the three areas already delivered in the first road period: flooding and water quality; carbon reduction measures; and cycling.

The available evaluation evidence includes projects which are comparable to only 20% of this fund's scope, and that those projects have historically delivered an average BCR of 7.3. The remaining 80% of the funding (approx. £540 million), for which evidence is not available, would need to generate £402 million of additional benefits for the funds overall to represent 'High' VfM. As Highways England's processes seek to ensure no individual project is value-destroying (BCR less than 1), overall, we believe the designated funds will represent 'High - Very High' VfM. This is outlined in Table 6.

The non-monetised impacts are also likely to be positive. This includes significant impacts, such as reducing severance from introducing new road crossings or footbridges and reducing delays for motorists by creating wider lanes of segregated cycling facilities.

RIS2 Fund	Categories of investments	BCR	VfM
Safety and Congestion	Safety	21.0	Very High
	Congestion	16.0	Very High
Total			Very High

Table 5: Weighted-average benefit-cost ratios for the Safety and Congestion Fund

RIS2 Fund	Categories of investments	Average BCR from 20% funding	VfM
Environment & Wellbeing	Carbon	2.0	High
	Flooding and Water Quality	13.7	Very High
Users and Communities	Cycling	1.8	Medium
Weighted average		7.3	High

Table 6: Estimated BCR for designated funds

4.3 Innovation and Modernisation Fund

We will use this fund to explore the full range of opportunities presented by innovation and modernisation. This will include delivering projects which support the take up of connected and autonomous vehicles, and projects which use data and technology to increase speed and quality of our design and construction.

The nature of this fund is such that past VfM is not indicative of the future. We, therefore, have not assessed the VfM at this stage. We are committed to ensuring that all proposals in this area have a realistic prospect of delivering VfM.



Annex: Analytical methods to understand the value of the RP2 (2020-2025)

1 Introduction

1.1 Purpose of this document

This document sets out the appraisal, analysis and assurance approach which we have used to determine the VfM of our investment plan for the RP2.

In this document we explain the approach – our analytical platform – we have used to meet these requirements, describe our suite of analytical tools and how we have used these. We also introduce the framework we have applied to assure our analysis.

Our analytical tools have enabled a step change in the strength of the evidence base we have available to underpin our investment decisions. In particular, our suite of models have allowed us to analyse how the balance of different types of interventions (e.g. major enhancements and operational activities) would generate value for the country. We have better understood the link between inputs and outputs, and in turn the link to outcomes for the RP2.

1.2 Objectives of our analysis

Through our analysis, our aim was to provide comprehensive decision support for investment planning activities, with a view to:

- improving the VfM of the investment through our advice and demonstrating the VfM of the programme that was ultimately adopted
- informing the proposed balance of spend between options for operations, maintenance, enhancement and other expenditures
- forming a better understanding of the potential impact of the programme on the performance of the SRN in meeting our customer objectives to inform the performance specification in the Delivery Plan
- providing a foundation of robust assurance to give us more certainty on the benefits that our investment programme can deliver over the RP2

To achieve this, our ambition was to:

- articulate the current performance of the SRN and project its future performance both with, and without, additional interventions
- link inputs, such as our assets, to our outputs and in turn to outcomes that affect our customers, for distinct areas of investment
- assess the impacts of the investment portfolio, relative to the baseline, in terms of both strategic outcomes and VfM
- develop, test and assure metrics for monitoring and reporting performance across the RP2

2. Our analytical platform

2.1 Overview

Highways England is responsible for operating, maintaining, renewing and improving the SRN. We have developed a suite of models and tools to analyse our spending across these core activities– which we refer to jointly as the ‘analytical platform’.

We present this analytical platform in Figures 1 and 2, highlighting:

- the analytical tools we have developed within each key area of expenditure
- the key links between tools in different types of expenditure to generate investment proposals that are internally consistent
- how we link our evidence and analytical activities to performance

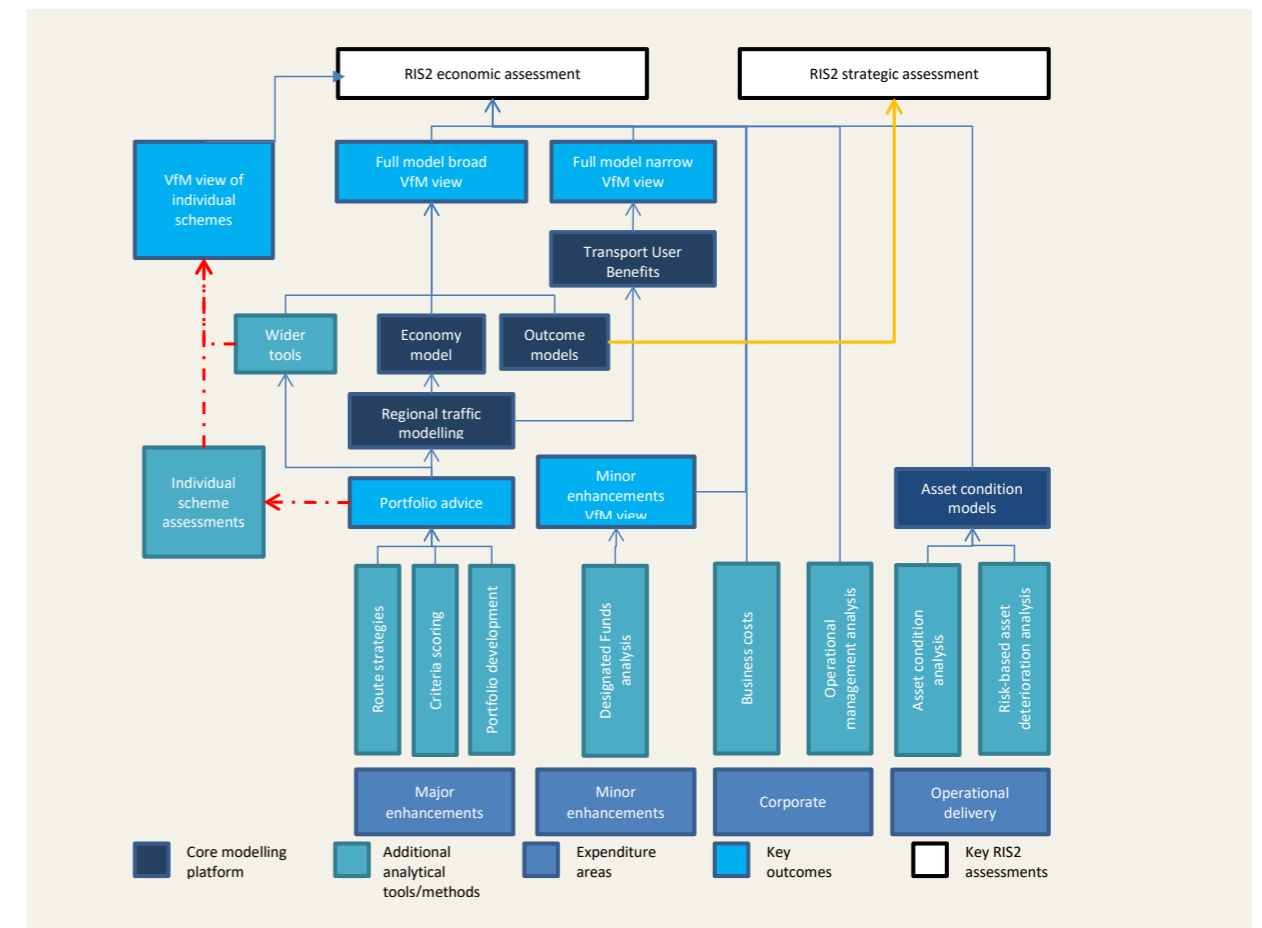


Figure 1: Map of the economic/strategic branch of the analytical platform

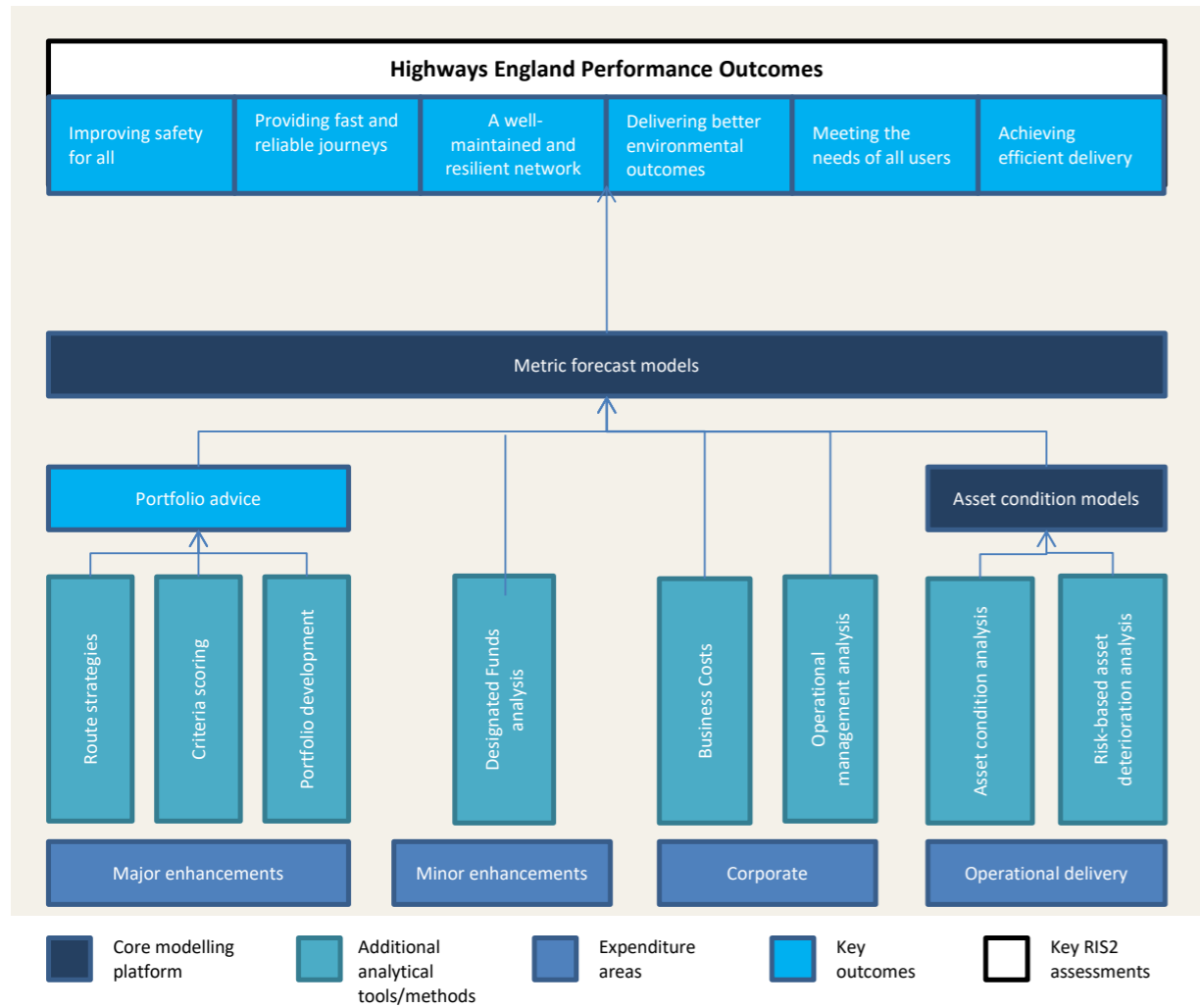


Figure 2: Map of the performance branch of the analytical platform

We have developed our core modelling suite to create a consistent and structured approach to appraising all major investments under consideration, split across three funding segments:

- Operations, maintenance and renewals
- Major enhancements
- Designated funds

2.2 Methods

We use a series of analytical activities to provide decision makers with the quality evidence they need. Our models, and their methodologies, underpin the outputs from our analytical platform. These models span each funding segment in their inputs, outputs and influence.

This section provides high-level descriptions of the models, broken down by:

- asset condition data
- traffic models
- outcome models
- cost data
- economy model
- distributional impacts

2.2.1 Asset condition data

Our assets are split into nine asset classes, shown in Figure 3. Each of these plays a vital role in the smooth running of the SRN, with key interdependencies. For example, safety barriers support drainage, lighting, structures and technology. We have developed an appraisal tool for each asset type to identify the desired level of renewals required. Two of the more complex tools cover road surfaces and structures and are discussed below.



Figure 3: Nine asset classes

2.2.2 Road surfaces

Our road surfaces are also known as ‘pavement’. Our pavement investment tool (PIT) uses mapping to help plan investments across our road surface assets, based on a specific lifecycle renewal modelling capability. It has pre-determined road resurfacing treatment rules that have been agreed in consultation with our Safety, Engineering & Standards division, and validated independently.

PIT predicts the future condition of road surface per subsection length by taking the current condition and applying a deterioration model. Condition data is taken from our pavement management system and analysed by PIT into specific 100 metre subsections. Each subsection is scored from ‘very poor’ to ‘very good’. PIT then divides the SRN into asset groups, where lengths within each asset group are behaving and deteriorating

homogeneously. By doing this, PIT use future condition parameters, such as surface material, to produce deterioration curves and forecast deterioration.

Overall, PIT gives us a rich picture of how much renewal activity to undertake, where to do it and at what points in the future to consider it.

2.2.3 Structures

Our asset portfolio comprises approximately 21,000 structures. Our structures investment tool (SIT) enables lifecycle planning and investment prioritisation.

SIT provides an understanding of the impact of alternative funding scenarios on the condition of our structures. Structure asset condition is updated from the structures management information system, which records visual inspections of assets and sub-assets. SIT combines asset condition data with deterioration rates, from industry experts, to produce element condition scores to form intervention cases. These cases are forecasted and prioritised based on element condition, element importance and structure importance.

2.2.4 Other assets

While the other assets that form our SRN still require complex procedures to inform future needs, they do not require an approach similar to road surfaces or structures.

Where detailed asset data, trends or history do not exist, we have used existing risk-based models. This has informed the investment need to keep assets in a safe and serviceable standard. In general, as shown in Figure 4, this is calculated on price and quantity, with the given minimum ‘need’ identified by the *Design manual for roads and bridges*, as well as technical expertise.

After bringing the need and cost elements together, there is an ‘efficiency loop’ to make sure that funds deliver the best VfM. This includes nearby assets requiring similar attention, procurement and assessing the bigger picture. Figure 4 explains this process.

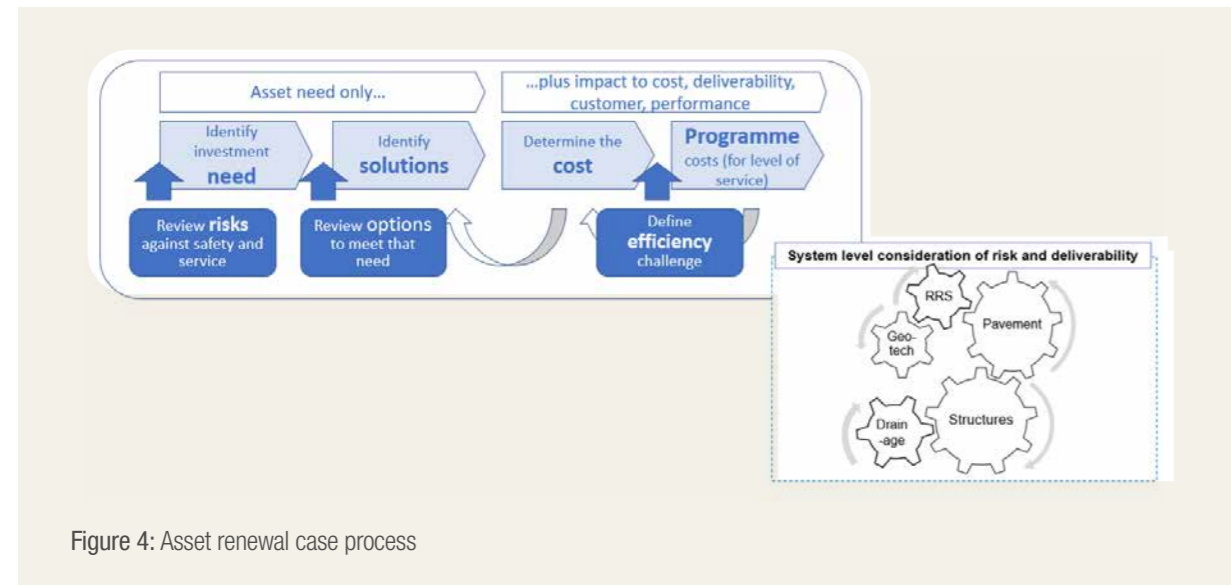


Figure 4: Asset renewal case process

2.2.5 Regional traffic models

We use traffic models to forecast how traffic flows and vehicle speeds change over time following infrastructure investment and other drivers of traffic growth and behaviour. This is primarily used to look at investments in major enhancements. We have built five regional traffic models which, together, cover all of the SRN in England, along with other A roads and B roads (see Figure 5).

The data underpinning traffic models has traditionally been sourced from roadside interview surveys on a sample of locations. For our regional traffic models, we instead draw upon a data set including mobile phone and GPS data, allowing us to capture – more accurately than ever before – user demands on our network. Our models also incorporate a simple rail model, enabling us to include the impact of rail within our assessments.

We have used these regional traffic models in the development of our investment portfolio for the RP2. They have provided us with an early indication of the potential opportunity from tackling current and future challenges in over 100 different locations on the SRN. Our models have also given us the opportunity to assess alternative proposals in a more robust and timely manner than previously possible and analyse the possible interactions between different road schemes.

Our models calculate the change in benefits (e.g. journey time savings, vehicle maintenance costs and fuel costs) that we expect to be realised by road enhancements. This is described in more detail below. In many instances, journey time savings generate a large proportion of the total benefits we expect to be created. It is clear, however, that this reflects just one of many potential impacts

that might result from a road enhancement. For example, a scheme might open up land for commercial development or encourage domestic productivity or expose more individuals to noise or to potentially harmful emissions. The remaining elements of the major

enhancements analytical platform allow us to formulate a broader view of VfM that effectively captures a wider range of impact categories and allows us to develop a more holistic assessment.

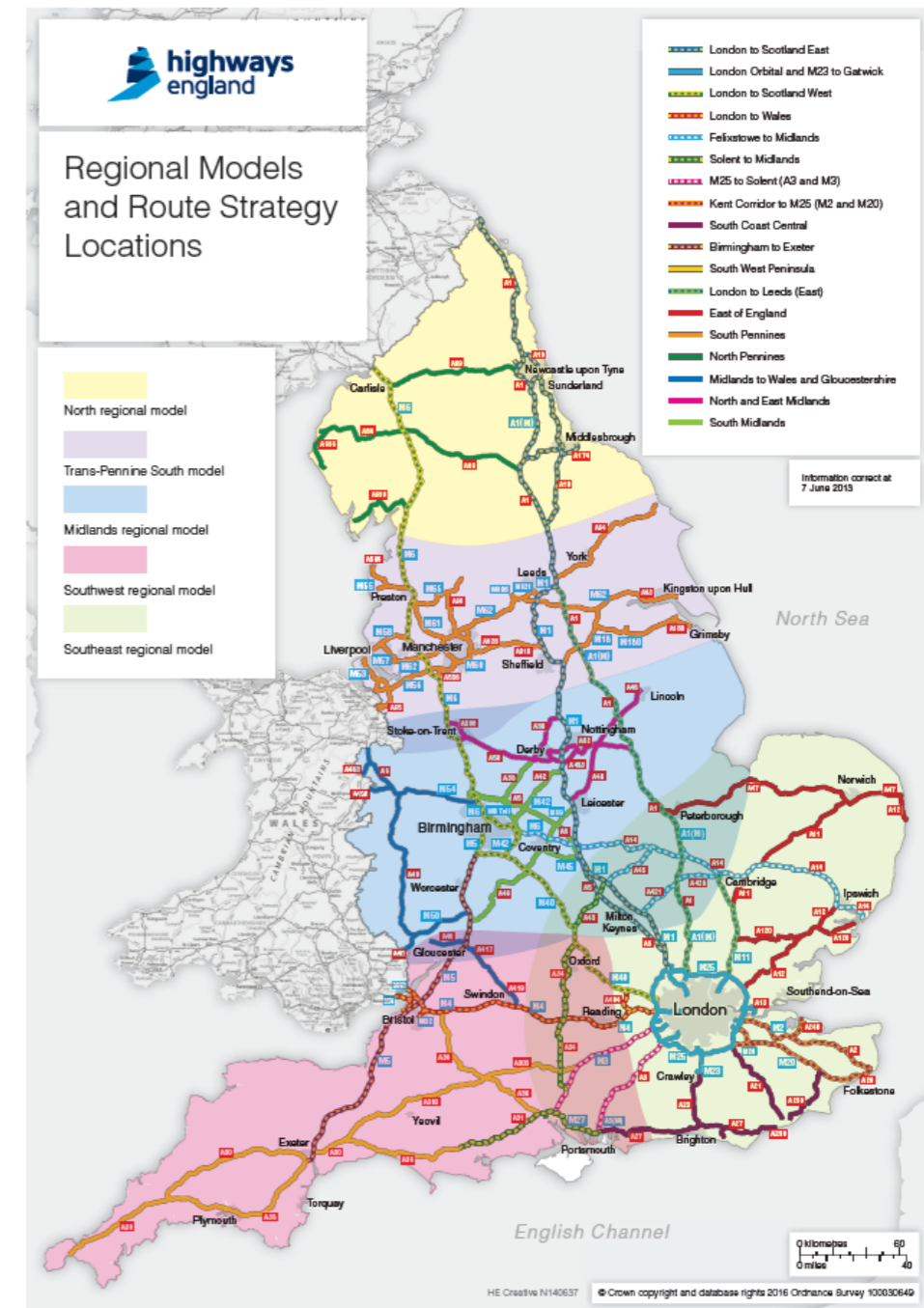


Figure 5: Illustrative map of our regional traffic models

2.2.6 Benefits appraisal

We have used the transport users benefit appraisal (TUBA) tool to undertake the economic appraisal for our proposed major enhancements portfolio. TUBA is a standard tool developed to undertake the economic appraisal of transport schemes in accordance with the Department for Transport's (DfT) cost benefit analysis guidance.

TUBA takes trip, time, distance and charge matrices from model outputs disaggregated by vehicle type and travel purpose. To realise the economic value of an intervention, we also input the other costs associated with do-minimum and do-something scenarios. TUBA then calculates the user benefits in time, vehicle operating costs and charge, the operator and government revenues, and the scheme costs – discounted to the present value year. This is summarised in a series of tables showing the economic efficiency of the transport system, known as TEE tables.

As well as delivering faster journeys, we want our customers to trust that their journey will be consistent each day. This is why we believe it is important to capture the change in reliability; many of our new schemes focus on achieving this as a core aim for customers. We estimate reliability using guidance from the DfT's *Transport analysis guidance*, which states that reliability is a function of journey time savings, given the likelihood of the scheme delivering greater reliability.

We know quick and reliable journeys are key to supporting our business customers and supporting economic growth. While we already capture the journey time savings to businesses, we also consider the wider benefits to businesses that a fall in travel costs can induce. For example, if we reduce the time it takes to travel a key freight route, this will save fuel and labour costs which could be reinvested by the company to increase how much it produces.

Our economic assessment tool uses information about the significance of the local economy and its reliance on our road network to assess a scheme's likely economic growth impacts. In the very earliest stages of scheme development, we used this tool to proxy whether a specific new scheme is likely to increase economic activity. If the scheme satisfies this, we estimated an increase in output in imperfectly competitive markets as a function of business user benefits, in line with the DfT's *Transport analysis guidance*.

Our schemes also play a role in supporting business growth by bringing them closer to their supply chain and customers. This is known as 'agglomeration' and comes about in the form of greater productivity from businesses when they are closer to each other, their labour pool and customers. Again in the very early stages, we used our economic assessment tool to judge whether schemes are likely to contribute towards economic growth. If a scheme satisfied this, we estimated the change in productivity as a function of total user benefits and the likelihood to contribute towards economic growth – in line with the DfT's *Transport analysis guidance*.

Land Use Transport Interaction/ Economy Modelling

We have also developed an economy model, which we used to estimate wider economic impacts for our largest schemes – individually, and for the final portfolio of new major enhancements. This is a national land use transport interaction model (LUTI), known as the Highways England economy model.

Our economy model is designed to assess some of the key push-and-pull factors affecting people and businesses' location choices and how they respond to changes in accessibility. It produces estimates for

changes in economic activity, such as GDP and employment, and how those effects are distributed geographically. Our model captures some of the key mechanisms by which road improvements impact the economy, as set out in our 2016 publication, *The road to growth*. This includes raising productivity through agglomeration benefits.

Our economy model covers the entirety of Great Britain, which allows us to assess the cumulative impact of road investments. It takes inputs from our regional traffic models and builds on previous land use transport interaction models – developed for projects such as the Transpennine Tunnel Study, High Speed 2 and Crossrail 2. We used our model alongside conventional methods to appraise wider economic impacts, as set out in the DfT's *Transport analysis guidance*.

2.2.7 Outcome models

In our *Analytical methods*, published in 2018, we mentioned our intention to develop outcome models. These were later developed into key performance indicator (KPI) forecast metrics, as described in Section 4.

2.2.8 Distributional impacts

We undertook a distributional impact analysis of user benefits and affordability impacts, using outputs from our regional traffic models – in line with the DfT's *Transport analysis guidance*.

Simplified, we show how benefits and disbenefits are distributed between different income groups of the population. We also examined how benefits are distributed between different geographical areas, adjusting for differences in the population.

For areas of the country where noise, air quality, accidents and severance impacts could potentially be significant, we further examined the sociodemographic make-up of the population. We undertook this in relation to the

specific social groups which are identified in the DfT's *Transport analysis guidance* as more likely to be adversely affected by these impacts.

3. Forming our portfolio assessment

3.1 Overview

We have used our analysis to make an overall assessment of the impact of our investment programme for the RP2, as well as demonstrate how these proposals could have a positive impact for the country. Our analysis has appraised VfM (the economic assessment) as well as projecting the potential impact on a range of performance outcomes (the strategic assessment).

In the following pages, we establish how we have reached the minimum activities required, known as the counterfactual, and then layered on analysis around further investment across three areas:

- Capital maintenance, operations and renewals
- Major enhancements
- Designated funds

3.2 Capital maintenance and renewals

3.2.1 Overview

We have developed a set of analytical tools to inform the economic and strategic assessment of our operational activities in the RP2. These tools have allowed us to more accurately forecast future minimum asset renewal needs to allow decision makers to make more informed decisions and keep our network in a safe and serviceable standard over future road periods. This minimum level was calibrated to take account of our proposed major enhancements portfolio.

3.2.2 Establishing the counterfactual

Our network is made up of a large number of complex assets and, as such, requires extensive attention to run safely and smoothly. Through our capital renewals activities, we will ensure every asset is:

- In safe, stable condition
- Able to fulfil its intended safety purpose
- Managed and maintained to minimise risk
- Managed and maintained to optimise environmental performance.

With an agreed funding level, we have used our asset condition models to prioritise and split out investment in our assets over the RP2. The outputs from our models were then subject to efficiency review.

3.3 Major enhancements

3.3.1 Overview

We used our tools to support decision making in the RP2, including on the shape and size of the major enhancements portfolio and the appropriate balance between different types of activity. This involved real-time support to decision makers, followed by more detailed analysis through the full application of our analytical platform (see Figure 6). Following such an approach allowed for iteration of our analysis as the evidence base developed and new considerations emerged.

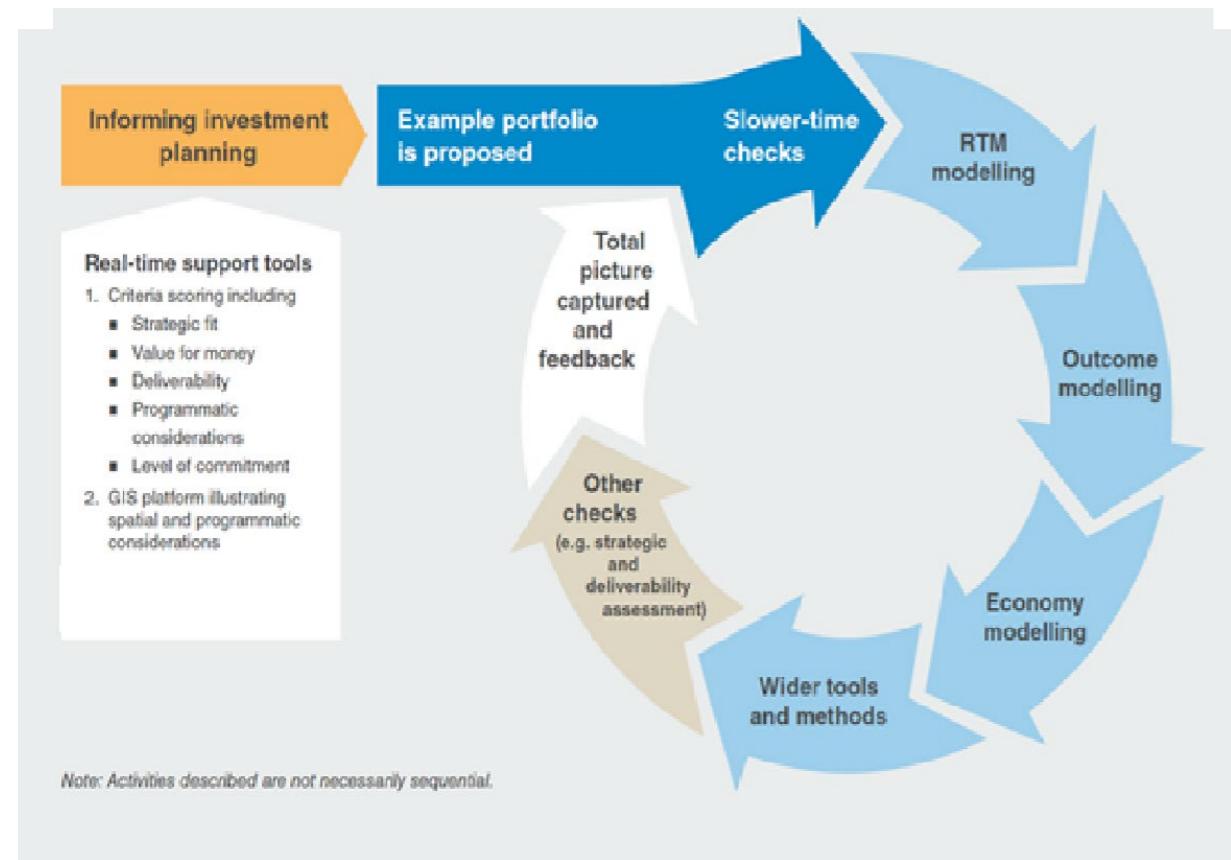


Figure 6: Analytical Platform lifecycle

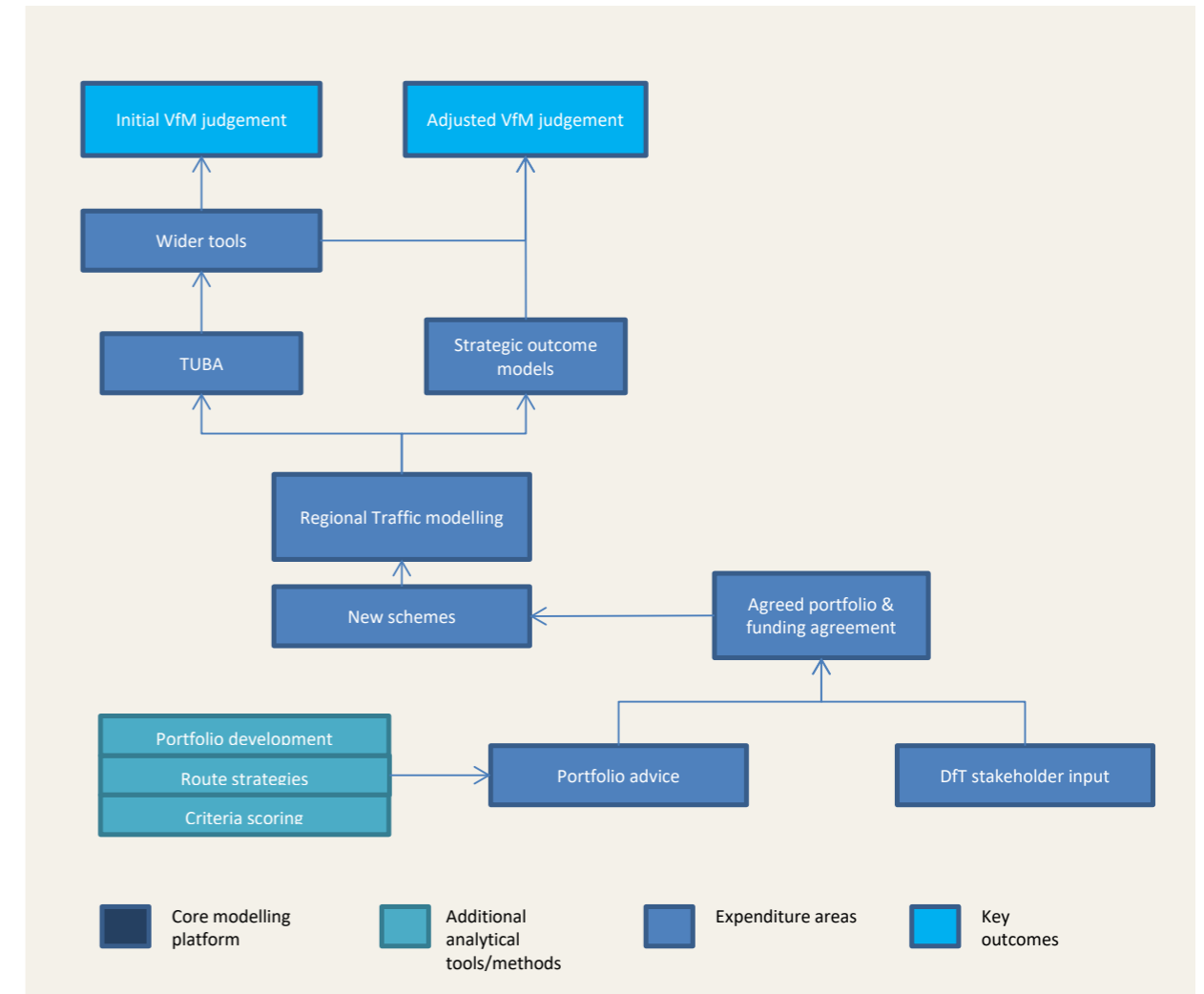


Figure 7: Forming a VfM judgement for major enhancements

3.3.2 Establishing the counterfactual

To create a case for further investment in major enhancements, we first had to establish a baseline position – the counterfactual – from which we would measure all work over and above this. In this area, the counterfactual consists of the committed schemes from the first road period, based on the following criteria – schemes that were:

- in construction
- committed, and previously announced, prior to RIS2
- committed, and new, to RIS1

From a VfM point of view, we included counterfactual schemes in the baseline of the following models:

- Regional traffic models
- TUBA
- All outcome models
- Economy model

This allowed us to more accurately estimate the impact of new enhancements, by making sure that new benefits were not duplicated by already committed schemes.

3.3.3 Appraising new major enhancement schemes

For the new enhancement proposals, our regional traffic models allowed us to provide a monetised estimate for the change in user benefits, using TUBA. However, user benefits – such as journey time savings – reflect only a portion of the potential total benefits that might result from a scheme.

A scheme, for example, might open up land for commercial development, encourage domestic productivity or enable greater international connectivity. A scheme might also realise significant disbenefits, such as delays in construction and maintenance, spur greater carbon emissions or expose more individuals to noise pollution.

We therefore complemented an important but narrow view of VfM with a broader view, incorporating an early assessment of some of these wider impacts. Our approach was proportional to the stage of government’s road investment strategy process. As this process advanced, we matured our economic appraisal, ensuring we fully captured each impact as well as the full range of impacts. For example, we conducted more programmatic appraisal as

our proposals for the RP2 developed, enabling us to understand any significant interactions between different schemes.

3.4 Designated funds

Interventions through designated funds can significantly improve safety, congestion and environmental outcomes for a large number of road users and neighbouring communities. A well-designed cycle path separated from the main road by hedgerow, for example, can alleviate localised congestion, help improve air quality by capturing some of the more harmful exhaust gasses before they reach the cycle path, and improve biodiversity.

As part of our funding for the RP2, we have ringfenced funds for specific activities through four designated funds that will address issues beyond the traditional focus of road investment:

We have assessed the VfM of our proposed designated funds, using evidence from the first road period funds and the expectation that similar benefits may be delivered by future schemes.

Safety and Congestion	Users and Communities	Environment and Wellbeing	Innovation and Modernisation
To address safety, congestion and economic development (jobs and housing) issues, striking the right balance to achieve network performance strategic outcomes and fulfilling existing commitments.	To help us understand our customer’s evolving expectations and improve the service provided to all users. This fund will support engagement with stakeholders and the collection of actionable insight to deliver improvements on and off our network, across six themes.	The purpose of the Environment and Wellbeing fund is to support environmental and community wellbeing outcomes across the SRN.	The purpose of the Innovation and Modernisation fund is to exploit the potential that innovation holds to transform our roads, by supporting the development of new technologies and working practices and assist with enabling wider roll-out once concepts are proven.

4. Measuring our performance over the RP2

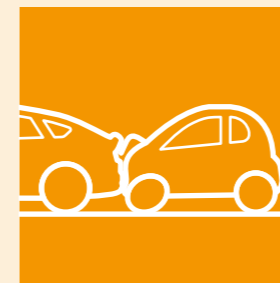
4.1 Overview

Alongside the economic and strategic assessment part of our analytical platform, we also forecast, target and measure our performance over the RP2. Our performance will be determined using a number of KPIs, and we have developed a series of bespoke metric forecast models as a contribution to the evidence base that will inform target setting.

We will also be monitored against a further set of performance indicators (PIs). Further information on these PIs is included in the performance annex of the Delivery Plan.

4.2 KPIs

The table below shows how analysis informed our KPIs.



Improving Safety for all

Road User Safety

Safety is our overarching priority at Highways England, which is why we had a commitment to reduce the number of killed and seriously injured casualties, by 40% over RP1 (2015-2020). To inform our target for RP2, we used

our existing safety outcome model, which forecasts and measures the outright number of casualties on the SRN and the rate of casualties per hundred million vehicle miles travelled on the SRN, for a given portfolio of enhancement schemes.



Providing Fast and reliable journeys

Average Delay

As demand for the SRN grows, there will inevitably be increased delay. By measuring average delay on the network, we can identify how the trend of average delay is linked to traffic growth. We forecasted this with our existing strategic delay outcome model, which gives average delay by total delay (difference between observed speed and speed limit) divided by total vehicle miles travelled, presented as delay seconds per vehicle per mile.

Network availability

Roadworks are one of our customers’ biggest frustrations on the SRN and something that is very much in our control, over the length, timing and magnitude of works. We will aim to minimise lane closures as far as is possible.

Incident clearance

Clearing incidents safely and efficiently is an activity that is within Highways England’s control. The metric in RP2 will now have 24-hour coverage, and an increased target from RP1, to continue to drive advancements in incident clearance performance.



A well maintained and resilient network

Pavement condition

The pavement (road surface) is our main and most prized asset, with over 36,000 lane kms, stretching from Penzance to the Scottish Borders. This is why we are committed to

keeping the asset in “good” condition over the next and future road periods. We have a pavement investment tool (PIT), which is a sophisticated decision support tool that efficiently and proactively highlights where investment may be needed.



Delivering better environmental outcomes

Biodiversity gains/losses across the SRN

We acknowledge that our work has the potential to be damaging to the environment. This is why we are committed to having no net loss of biodiversity across all our activities by the end of RP2. We have developed a biodiversity metric forecast model which measures and forecasts our impact on the amount and quality of biodiversity lost or gained. A biodiversity metric can help our major enhancement and capital renewal programmes build in clear biodiversity plans into their projects from the very start.

Noise affected households

Another negative product of the SRN is the impact of noise from vehicles, primarily tyre noise, on nearby houses. We recognise that road noise can have a profoundly negative effect on people's mental wellbeing, which can have a significant cost to the economy. In RP2 we will measure the number of households in Noise Important Areas mitigated.

This metric will encourage us to intervene with noise mitigating activities such as low noise surfacing, noise barriers and insulating households.

Air Quality links in exceedance

There are negative air quality impacts from vehicles using the SRN, and in some locations these levels breach legal limits. For those links where the DfT agree that exceedance can be impacted through Highways England activities, we will deliver mitigations which reduce air quality issues such that the links become compliant.

Corporate Carbon

We aim to reduce carbon emissions across all our activities and from Year 2 of RP2 we will have a KPI targeting our corporate carbon emissions. We will also continue to meet the expectations of the Greening Government Commitments.



Meeting the needs of all users

Meeting our customers' needs is at the centre of everything we do, although we acknowledge that every customer has different needs, which is why Transport Focus conducts the Strategic Road User Survey (SRUS). This allows us to understand the percentage of customers that are satisfied with our performance.

Roadworks information timeliness and accuracy

We understand the frustrations that customers have when encountering roadworks on their journey but in most cases, these works are for the long-term benefit of all road users. What we can do to dampen this frustration is to be transparent and keep our customers well informed, in good time about roadworks disruption.



Achieving efficient delivery

Capital and operational savings

Achieving greater efficiency is important because it will help drive up the value we offer to the tax payer. If we identify further

efficiencies during RP2, we will be able to record the additional efficiencies against the metric target. In this way, we are incentivised to strive for continual improvement

Performance on one metric can also impact on other metrics. Figure 9 illustrates the interdependencies between different KPIs

Improvement in this metric (horizontal) affects the vertical metric's performance:	Safety	Average delay	Availability	Incident clearance	Pavement	Biodiversity	Noise	Air quality	Corporate carbon	Road user satisfaction	Roadworks information	Efficiency
Safety												
Average delay												
Availability												
Incident clearance												
Pavement												
Biodiversity												
Noise												
Air quality												
Corporate carbon												
Road user satisfaction												
Roadworks information												
Efficiency												

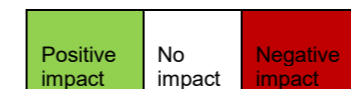


Figure 8: KPI dependency matrix

The level of assigned funding to each area of spend can have an influence on metric performance. If funding is reduced for the Traffic Officer Service (under business costs), for example, then there will be fewer resources to clear incidents and, as a result, incident clearance time would increase.

In Figure 9, we provide a logic map showing the impact of a change in funding on the performance of our KPIs. The effect of increased spend is over the RP2, unless otherwise stated. The figure shows that increased spending on major enhancements

has a negative effect on delay in works over the RP2, but will have a net positive effect on average delay as users will benefit over subsequent road periods. Major enhancements have a neutral impact on biodiversity and noise because we are committed to offsetting the impacts we have on the environment, for example through relocating trees and building noise mitigation structures.

It is also important to acknowledge that these links between funding and performance outcome areas involve a ‘feedback loop’ to inform setting targets for our KPIs.

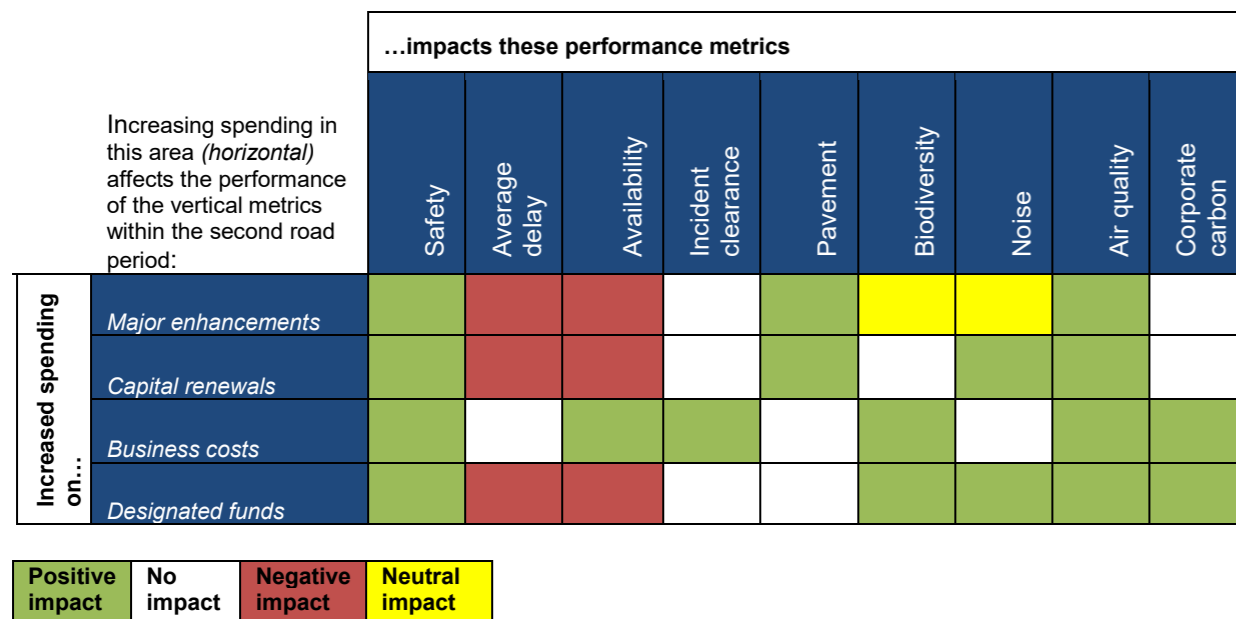


Figure 9: Funding to KPI dependency matrix

5. Ensuring consistency in our overall assessment

While we do not yet have fully automated consistency in our assessment through automatically linked models, we are still able to take a thorough approach to ensuring consistency in our proposals. We have used a number of mechanisms, including:

- soft-linking models, where feasible and appropriate
- ensuring all expenditure is traceable
- mapping the relationships between inputs, outputs and outcomes so each element of our analytical platform can be traced back to a consistent set of value drivers
- deploying a consistent approach to strategic-level cost estimation
- tracking cross-cutting analytical assumptions and coordinating these centrally
- articulating appraisals in the same way and calculating impacts consistently – in line with our own *Appraisal manual* and the DfT’s *Transport analysis guidance*
- applying the Analytical Assurance Framework in a consistent way (see Section 6)

While the evidence available to conduct our appraisals is at an early-stage, our assessments have consistently captured the key interactions within our cost base, such as capturing the operational implications of enhancement spending. They have also consistently capture the key interactions across impact areas, for example how enhancement and operational interventions might impact on overall safety performance.

6. Providing analytical assurance

Since Highways England was formed in 2015, we have worked hard to strengthen our in-house analytical capability. We take analytical assurance seriously; the degree of autonomy we receive from the DfT means that our reputation stands or falls on the quality of the evidence behind our decisions.

Our Licence specifies that we need to have “in place robust internal arrangements to achieve, and to demonstrate how [we have] achieved, value-for-money”. This obligation requires us to make informed decisions based on robust and clearly communicated expectations of benefits, costs and risks. Analytic failure can have consequences for effective operations and use of taxpayers’ funds.

As such, we have developed an analytic assurance framework to provide a robust internal arrangement to assure the specification, production and use of analysis throughout our company. This framework builds on existing good practice and resources and develops a structure of mutual responsibility between those delivering, reviewing and using analysis. This helps ensure that analysis, and outputs, meet our evidential and quality requirements.

Our framework identifies the required analytical processes, risks and materials, providing a common foundation for project leaders, analysts and assurers. Through the framework, we:


- define the analytical requirements for each area of analysis
- prepare and assure analytical plans for each area of analysis
- apply a ‘four lines of defence’ approach to assuring analysis (see Figure 10), based on the likelihood and materiality of analytic failure
- assure the key analytical products (see Figure 10)

What are the Four Lines of Defence?

The Lines of Defence are not mutually exclusive; i.e. a scheme requiring the third line of defence also requires lines one and two.

The Lines are:

1. **Operational Management** – peer and management review within the project and programme;
2. **Executive Overview** – management review from the responsible officers for the task, project and/or programme;
3. **Internal Assurance** – independent technical specialists from within Highways England; and
4. **External Assurance** – independent technical specialists or quality assurance functions (such as the National Audit Office or Office of Road & Rail) from outside Highways England.



Analytical Assurance Statement: 3rd Line of Defence

Appropriateness Amber	Compliance Green	Uncertainty Red	Fit for purpose Amber
---------------------------------	----------------------------	---------------------------	---------------------------------

<u>Role</u>	<u>Name</u>	<u>Role</u>	<u>Name</u>
Project Lead	John Smythe	Senior Model Owner	Joanne Smith
Analysis Owner	Jo Smith	Assurer	Joe Smitt
Analytic Lead	J.Smithee, JS Consultants		

This model, whilst not intended for this purpose, is reasonably appropriate to underpin this decision, although a customised model would avoid the weakness of using a national set of growth forecasts for this local region. Overall the analysis suggests that a road scheme is likely to provide a better alternative than a rail intervention.

Figure 10: Example excerpts from our analytical assurance framework

© Crown copyright 2020.

You may re-use this information (not including logos) free of charge in any format or medium, under the terms of the Open Government Licence. To view this licence:

visit www.nationalarchives.gov.uk/doc/open-government-licence/

write to the **Information Policy Team, The National Archives, Kew, London TW9 4DU**, or email psi@nationalarchives.gsi.gov.uk.

Mapping (where present): © Crown copyright and database rights 2020 OS 100030649. You are permitted to use this data solely to enable you to respond to, or interact with, the organisation that provided you with the data. You are not permitted to copy, sub-licence, distribute or sell any of this data to third parties in any form.

This document is also available on our website at www.highwaysengland.co.uk

For an accessible version of this publication please call **0300 123 5000** and we will help you.

If you have any enquiries about this publication email info@highwaysengland.co.uk or call **0300 123 5000***. Please quote the Highways England publications code **PRxxx/xx**.

Highways England creative job number GFD20_0072

*Calls to 03 numbers cost no more than a national rate call to an 01 or 02 number and must count towards any inclusive minutes in the same way as 01 and 02 calls.

These rules apply to calls from any type of line including mobile, BT, other fixed line or payphone. Calls may be recorded or monitored.

Printed on paper from well-managed forests and other controlled sources when issued directly by Highways England.

Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ

Highways England Company Limited registered in England and Wales number 09346363