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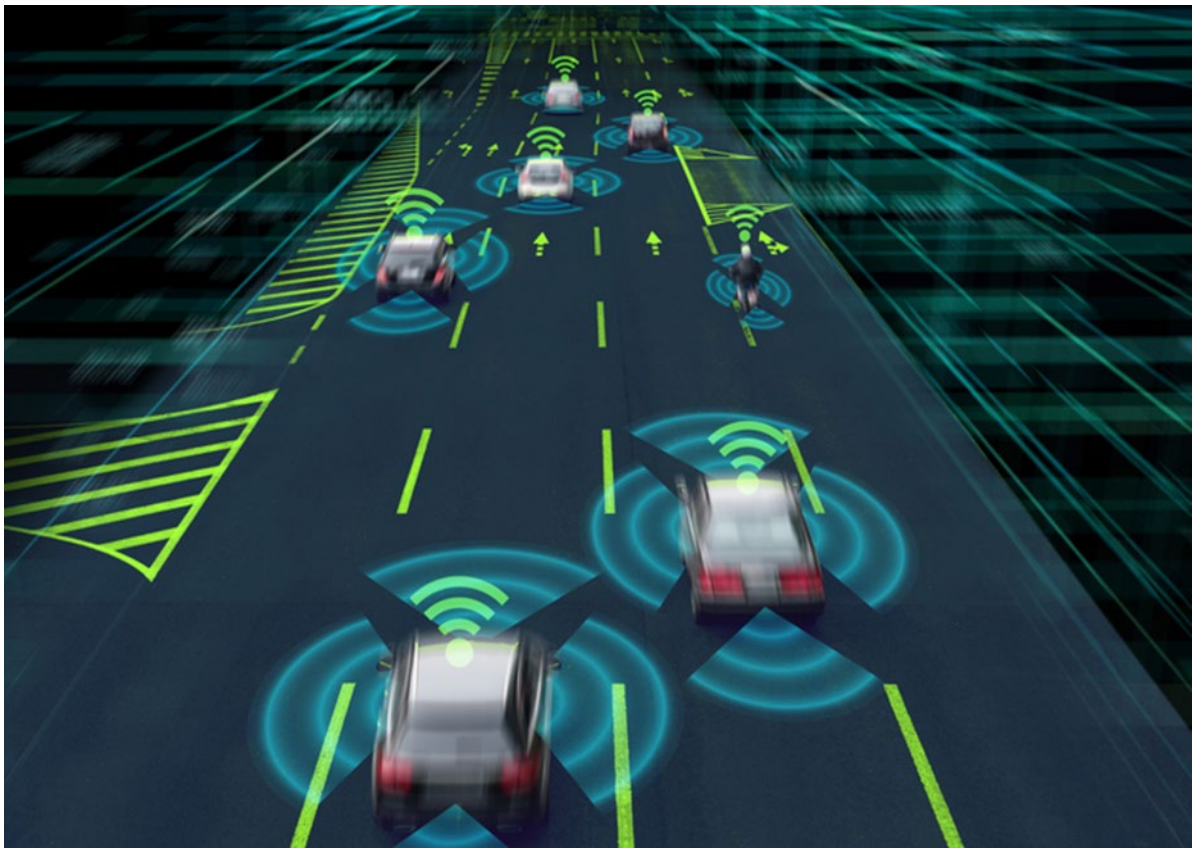

Longer-term implications of Highways England's Road Period 2 delivery

Planning and early delivery of life extension renewals

Final Report

Project Ref: ORR CT 20-09 WS4

Client: Office of Rail and Road

Prepared by Hyperion Infrastructure Consultancy Ltd

Office of Rail and Road

Final Report

ORR CT 20 09 WS4
Longer-term implications of Highways England's Road Period 2 delivery
Workstream 4: Planning and early delivery of life extension renewals

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Executive summary

Project Background

'CT20-09 Longer-term implications of Highways England's road period 2 [RP2] delivery' is a programme of work commissioned by the Office of Rail and Road (ORR) to look at Highways England's planning and direction of travel in a number of areas. The overarching aim is to inform ORR's planning for future monitoring and its advice to the Department for Transport (DfT) for RP3 and beyond, rather than to assess Highways England's performance in RP2.

The programme comprises four workstreams:

WS1 – How Highways England is managing congestion and delay
WS2 – Future technology preparedness
WS3 – Routes to Market review
WS4 - Planning and early delivery of life extension renewals

This report presents the findings and recommendations from **WS4** which considers the progress Highways England has made in in RP2 (2020 to 2025) and the early development of its plans for RP3 (2025 to 2030) for capital programmes - termed Life Extension Renewals (LER) - to replace and/or extend the service life of specific asset classes that were identified for dedicated investment in DfT's Road Investment Strategy 2 (RIS2) (1), i.e.

- Major structures
- Legacy concrete pavements
- Concrete vehicle restraint systems
- Steel vehicle restraint systems

Scoping for the task was undertaken collaboratively with both ORR and Highways England and this identified several lines of enquiry to guide the review:

- The business cases for the LER programmes including consideration of intended outcomes/benefits, and the quality of data used to inform asset need and investment priorities. The review should consider whether these provide a suitable baseline for RIS3.
- The outputs of the ORR's RIS2 Efficiency Review completed in 2020.
- The approach used to evidence programme benefits, efficiencies, constraints, opportunities, and to use the knowledge gained during RP2 to inform the development of plans for RP3 and beyond.
- The procurement and contract approach to deliver programmes including specialist asset supply capacity and capability and efficiency model.
- A comparator review of other organisations with similar asset programmes.

The target outcomes for the task were:

<u>For ORR:</u>

- To provide insight into whether the plans put forward for life extension works in RIS2 can be used as a baseline for the RIS3 programme.
- To identify/clarify the efficiency levers for RIS3.

<u>For Highways England:</u>

- To provide insight into comparator asset programmes for improvement /efficiency and RIS3/4 programme development.

The findings and recommendations have been developed from a review of published literature, evidence provided by Highways England and a comparator study. Hyperion/EAM would like to thank Highways England for its cooperation and access to staff during the study.

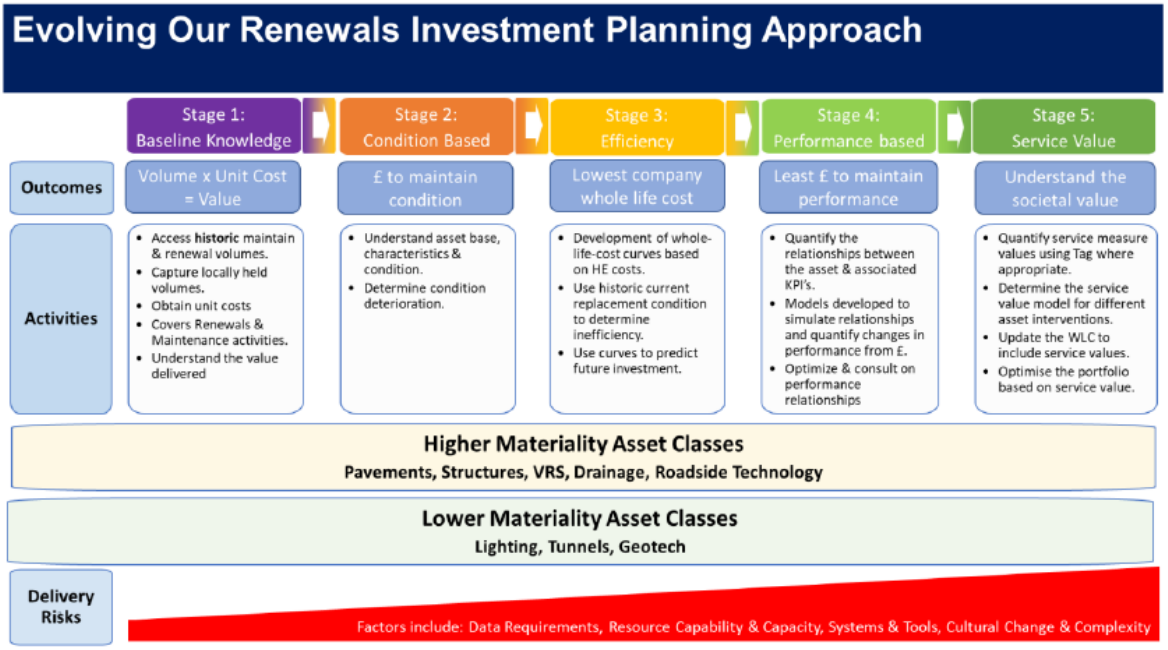
Overall findings

Through its work during RP1, including increasing the knowledge of its assets and learning lessons from renewals projects such as Oldbury Viaduct, Highways England has continued to develop its understanding of investment need for future Road Periods. Specifically, for RP2, a number of asset classes were identified for dedicated programmes of investment in life extension and renewal works (LER), ie:

- Major structures
- Legacy concrete pavements
- Vehicle restraint systems
    - Steel
    - Concrete

It is evident that Highways England undertook a comprehensive process, including using a bottom-up appraisal of asset need against safety and service levels, to develop its outputs, funding requirements and efficiency assumptions for these programmes in RP2. Efficiency assumptions for RP2 vary for each asset class depending on Highways England's consideration of current efficiency/productivity and future improvements in better project management, materials, maintenance techniques and innovation.

Highways England acknowledges its asset management maturity varies between asset classes and has developed an ambition for development of its asset management capability to support business cases for RP3 and beyond.



Highways England long term roadmap to evolving renewals investment planning[1]

[1] Source: *Highways England response to request for information for CT20-09 WS4 20/02/2021*

Highways England has provided outline evidence of its early development of the business case for capitals renewals, including the LER programmes, for RP3. Highways England has provided early estimates of the possible funding requirement but not, at this stage, the ambitions for efficiency. The scale of proposed delivery of LER in RP3 – which translates into an average increase of 234% over RP2 – is ambitious when considered alongside the proposed similar scaling up of capital enhancement delivery over the same period.

Project recommendations

This review has identified several recommendations for ORR to consider both in respect of the advice it provides to DfT during the RIS3 development process, and when developing its monitoring approach in this area for RP3 and beyond. These recommendations are presented below, together with suggested timescales for action:

- RP2, recommendations for ORR for action during RP2;
- dRP3, recommendations for ORR to consider during the RIS3 development process; and
- RP3, recommendations for ORR to consider for RP3.

Table 1a – General recommendations

Recommendation for ORR	Timescale
[R1] The robustness of Highways England's assessment of both the scale and timing of investment interventions across its range of asset classes is dependent on the maturity of is asset management approach. Highways England acknowledges that the level of maturity varies between assets and has an ambition to develop its approach to support plans for future road periods. It is, therefore, recommended that ORR establish the current level of asset management maturity across the asset classes to provide assurance that future plans are based on a robust assessment of asset need.	dRP3
[R2] ORR's review of the RIS2 programme highlighted that the efficiency ambitions for the LER programmes are challenging. Highways England is undertaking an operational transformation programme ('OE2025') and has identified several efficiency levers, both general and asset-specific, that contribute to achieving its efficiency target. ORR should continue to assess the delivery of Highways England's RIS2 LER efficiencies against its ambitions and review the evidence from OE2025 to substantiate its RP3 LER efficiency assumptions.	dRP3
[R3] In its RIS2 LER planning Highways England indicated that a further substantial increase in LER renewals may be required in RP3. As part of the RIS3 process, ORR should assess the sustainability of Highways England's emerging RP3 spending plans and efficiency assumptions and request evidence that demonstrates it can practically deliver LER renewals alongside its capital enhancements programme.	dRP3
[R4] Highways England regularly reports LER delivery progress to ORR. The granularity of reporting has improved but does not provide detailed visibility of planned physical renewal locations against actual delivery or a breakdown by regions. During RP2 ORR should request further evidence from Highways England to show which LER schemes it has delivered against those planned in each region to assess whether Highways England is on track to deliver its planned RIS2 programme. This should include evidence of the 'cost per output' of LER in each region to provide a better understanding of Highways England's programming assumptions for RIS3.	RP2

Recommendation for ORR	Timescale
[R5] Highways England has a risk-based approach to develop each LER programme. These include named scheme programmes, such as for legacy concrete pavements and structures, to general non-site-specific programmes with regional decision making such as for VRS. Delivering programmes as planned is a key element of asset management maturity and promotes efficiency through optimising coordination and positively engaging the supply chain. ORR should consider monitoring the degree of change that occurs during Highways England's LER programme delivery and request evidence of planned versus target development of programmed schemes through the 3D process, including justification for programme change and the risk and opportunity impact on planned targets.	RP3

Table 1b –Major Structures renewals recommendations

Recommendation for ORR	Timescale
[R6] To provide greater confidence in the output scores which measure the condition of Highways England's highway structures stock, and as part of its planning for RIS3, ORR should consider introducing/developing performance measures relating to the completeness and quality of structures inspections on an annual basis.	dRP3
[R7] Highways England's investment plan for structures is based on maintaining a certain stock condition target and assumes the use of a particular maintenance strategy – e.g. Do Minimum, Planned Preventative etc. The monitoring of a target condition score is fundamental to assessing need and developing Highways England's structures renewals strategy. Now that Highways England has established and is reporting an average structures target condition score (SCav), ORR should consider advising DfT that a new Key Performance Indicator (KPI) is created to monitor Highways England's target condition for structures.	dRP3
[R8] Highways England is required to monitor and report against Performance Indicator 3.2: Structure asset – inventory and condition. This includes monitoring Average Structural Condition (SCav) and Critical Element Condition (SCcrit). Highways England's strategy for Road Period 2 is based on maintaining a 'steady state' condition against (SCav). ORR should investigate the long-term trends in the condition score relating to (SCcrit) – this would permit a better understanding of the longer-term condition trend of SCcrit and allow ORR to challenge Highways England on the implications of having critical load bearing elements categorised as 'Poor' and what steps are being taken to improve this condition score.	RP2

Table 1c –Legacy concrete pavement renewals recommendations

Recommendation for ORR	Timescale
[R9] It is important to recognise that for concrete pavements the nature of the output delivered, i.e. life extension or reconstruction, is significant; there is benefit in completing reconstruction as soon as possible in terms of whole life cost and disruption. In consequence, while overall output targets may be maintained, deferral of reconstruction in favour of life extension risks eroding the benefits of the programme. Therefore, ORR should explicitly monitor the outputs and outcomes of both reconstruction and life extension works delivered under the programme.	RP3
[R10] It is recognised that life extension works do not remove the need for reconstruction, rather defer the cost, and cause significant disruption. ORR should, therefore, consider the potential benefits and costs of accelerating concrete pavement reconstruction works where feasible considering disruption and coordination with other programmes and taking account of supply chain capacity and resource within Highways England.	dRP3

Table 1d –VRS renewals recommendation

Recommendation for ORR	Timescale
[R11] Highways England operates a risk-based approach to determine VRS needs and a prioritisation process to decide where steel VRS should be retained and where it should be converted to a rigid concrete VRS in central reserves. This is based on factors including asset condition, traffic volumes, network disruption and available funding. It acknowledges that its knowledge of steel VRS condition is less mature than other assets and has plans to improve this knowledge. ORR should undertake specific assessment of the prioritisation process that Highways England uses to determine where not to replace steel with concrete and request evidence of Highways England's condition monitoring programme to enhance this process.	dRP3
[R12] For steel VRS renewals, Highways England's regions are allocated 'ring-fenced' funding to achieve set output targets and they make intelligence-led decisions on how to achieve these – whether to replace stretches of life expired barrier or to adopt a 'find and fix' approach to extend VRS life with smaller discrete barrier sections. The use of 'find and fix' is acknowledged to be a useful whole life cost strategy but the way that these outputs are reported may not provide a holistic assessment of VRS asset residual life. ORR should request evidence from Highways England that assesses the relative value of 'find and fix' in its overall assessment and reporting of VRS residual life, and the long-term implications for managing the VRS asset against a target asset condition.	RP2 and dRP3

1 Introduction

Programme overview

'CT20-09 Longer-term implications of Highways England's road period 2 delivery' is a programme of work commissioned by the Office of Rail and Road (ORR) to look at Highways England's planning and direction of travel in a number of areas. The overarching aim is to inform ORR's planning for future monitoring and its advice to the Department for Transport (DfT) for RP3 and beyond, rather than to assess Highways England's performance in RP2.

The programme comprises four workstreams:

WS1 – How Highways England is managing congestion and delay
WS2 – Future technology preparedness
WS3 – Routes to Market review
WS4 - Planning and early delivery of life extension renewals

This report presents the findings and recommendations from WS4 which is a review of Highways England's planning and early delivery of life extension renewals for:

- Major structures
- Legacy concrete pavements
- Vehicle restraint systems
  - Steel
  - Concrete

Objectives

The outcomes for ORR and Highways England from this task are shown in Table 2 below:

Table 2 – Project Outcomes

Interest	Outcomes
ORR	Insight into whether the plans put forward for life extension works in RIS2, can be used as a baseline for the RIS3 programme. Understand the efficiency levers for RIS3
Highways England	Insight into comparator asset programmes for improvement /efficiency and RIS3/4 programme development.

Approach

An information gathering exercise was undertaken to establish and evidence base for the review. This comprised four elements:

1. Review of publicly available documents and further information provided by Highways England
2. Engagement with internal stakeholders from Highways England
3. Interviews with key external stakeholders
4. Information from a study of other transport infrastructure owners/operators (comparator study)

This information has been assimilated and assessed to identify findings and recommendations that have then been further developed through review and discussion with both ORR and Highways England.

Presentation of report

The following sections of the report present:

2. **Background to the LER programmes**
   Brief overview of the justification, approach and objectives for these asset-specific investment programmes
3. **LER efficiency levers**
   Analysis and assessment of the development of efficiency levers and targets for each of the LER programmes.
4. **Major structures renewals**
   Overview and assessment of Highways England's planning for capitals renewals on major structures including risks for ORR to consider.
5. **Legacy concrete pavement renewals**
   Review of Highways England's objectives and approach for the legacy concrete pavement programme and its early progress in developing its long-term capability for the effective management of this asset together with key findings on the implementation to date.
6. **Vehicle restraint system renewals**
   Review of Highways England's asset management approach for VRS.
7. **Recommendations**
   Concise statement of recommendations for ORR to consider in advising DfT and developing its monitoring regime for the LER programmes for RP2, RP3 and beyond.
8. **References**
   References in the text are shown in parentheses e.g. (1).
9. **Glossary of terms**

2 Background to the LER programmes

Throughout RP1 and in preparation for RP2/RIS2 Highways England has continued to gather and assess information on the SRN, much of which was built in the 1960s and 1970s with the technology and techniques in materials, design and construction in use at the time (1). Deterioration of materials and components due to age, environmental effects and/or increasingly heavy traffic demands, often combined with the maintenance requirements imposed by the original design and/or construction, mean that significant investment, beyond established routine and cyclical maintenance, is required to maintain performance and serviceability. DfT's RIS2 document (which covers the period 2020 to 2025) (1) identifies four particular asset classes where significantly increased investment is deemed timely to address this requirement, pre-empt potential future problems and support a steady level of service in the future (2).

Major Structures

Less than 1%[2] of structures on the SRN are considered to be in poor condition (1), and these have plans in place for action before they become unsafe. However, more extensive renewal works are required to the structures stock to manage a potential peak in investment need arising from structures built in the 1960s-70s requiring significant works within the same timeframe (1). Highways England's programme for RP2 is aimed at safeguarding condition while mitigating disruption (3).

Concrete Pavements

Few significant works have taken place on the concrete roads on the SRN since they were constructed from the 1960s onwards, and many of these roads are now nearing the end of their life (3). Furthermore, this form of construction is poorly perceived by users (1, 4) in terms of ride quality. Strategically, Highways England has determined that reconstruction of these pavements is the preferred option (1, 3, 5) to transform this asset into 'long life' pavement. Given the scale of this task and the associated cost and disruption, this is programmed for delivery over 25 years through a balance of reconstruction and 'holding', i.e. life extension works (2). Full reconstruction is planned to begin in 2021-22; life extension works will be undertaken on existing concrete road surfaces to ensure their ongoing safety for road users pending replacement (3).

Vehicle Restraint Systems: Steel and Concrete

Based on improved asset knowledge and risk-based assessment, safety barriers will require replacement at a faster rate to ensure they remain effective (1). Highways England's planning recognises that a significant proportion of steel VRS assets are approaching end of life and are anticipated to expire within the next decade. Highways England has a risk-based process to determine where to replace steel with concrete VRS in central reserves. The programme of VRS renewals will balance risk with affordability, starting in 2020-2021 and continuing through RP2, RP3 and possibly further ahead (3, 6).

Through these programmes Highways England is looking to develop a longer-term view, assessing requirements for future Road Periods to smooth out peaks in spending while ensuring the network remains safe (3). This approach should also support programming and coordination of works, such as combining renewals activities with operational and maintenance tasks, to minimise disruption and improve value (3, 5). Adopting such long-term strategies to deliver a significant scale of work is expected to yield benefits in terms of efficiency (1).

[2] Based on SCav only i.e. the average score taking into account all the elements of a structure.

3 LER efficiency levers

RIS2 efficiency targets for LER

Highways England defines efficiency in its Efficiency and Inflation Monitoring Manual (EIMM) (7) as *"an improvement in the relationship between inputs and outputs (the final product delivered) or outcomes (the measured impact of the output) achieved*". For RP2, Highways England has an efficiency target[3] of £2.23bn to achieve against its overall post-efficient £25.3bn budget across its capital enhancements, capital renewals and operational functions, i.e. 8.8%. Of this total efficiency target, Life Extension Renewals (LER) together as one programme has an efficiency target of £238m from a post-efficient budget of £1,763m, i.e. 13% and 1.5 times the overall budget efficiency target.

During the RIS2 draft Strategic Business Plan (dSBP) (8) process, Highways England assessed the baseline asset need for each LER asset class necessary to provide an ongoing safe level of service. This was a bottom-up calculation from its regional knowledge of asset condition and understanding of safety and service risks. It then considered the available interventions to manage asset condition at a risk level and set out the appropriate solutions to meet that need. The RP2 efficiency targets for LER were arrived at by Highways England after consideration of the potential productivity improvements that could be achieved during RP2 while delivering its outputs through better project management, materials, maintenance techniques and innovation. These efficiency levers are discussed later in this section.

The calculated values of asset need, baselined to 2017/18, and the efficiency targets for each asset class against the level of post-efficient budgets are shown in Table 3. Although plans for RP3 are yet to be finalised (and will be agreed through the RIS3 development process) the RIS2 dSBP also set out an initial view of the budget requirement for RP3.

Table 3 – Asset need value, budget and efficiency targets for LER asset classes

Asset class	Asset need baseline (2017/18) £m	RP2 post-efficient budget £m	RP2 efficiency target £m	Initial view of RP3 budget £m	[1] % RP2 budget to RP2 asset need [2] % RP2 efficiency to RP2 budget [3] % RP3 budget to RP2 budget
Major structures	2,851	922	67	2,842	[1] 32% [2] 7% [3] 308%
Legacy concrete pavements	629	393	104	759	[1] 62% [2] 26% [3] 193%
Concrete VRS	1,254	154	35	97	[1] 12% [2] 23% [3] 62%
Steel VRS	309	294	32	428	[1] 95% [2] 11% [3] 145%
Totals	**5,043**	**1,763**	**238**	**4,126**	**Averages** **[1] 35% [2] 13% [3] 234%**

The table values [1] i.e. '% RP2 budget to RP2 asset need' show a wide range of budget provision in RIS2 to renew the baseline asset need, varying between 12% for concrete VRS to 95% for steel VRS. The evidence we have seen shows that the agreed RP2 budget position recognises that:

[3] These figures can be removed from the final report if sensitive for publication

a) not all asset need can be funded during RP2,
b) the level of agreed funding includes a calculation for technically assured risk, and
c) funding is proportionate as it considers the disruption that renewing all asset need would have on the network.

The last point particularly applies to the installation of concrete VRS in motorway central reserves which requires significant traffic management and road user disruption.

The table values [2] i.e. '% RP2 efficiency to RP2 budget' also show a wide range of efficiency target to budget ratios. These recognise the varying maturity of each asset class and the respective potential efficiencies that could be delivered through productivity improvements. For example, structures efficiency at 7% of budget recognises a mature renewals approach developed over many years which has limited potential to improve upon, whereas legacy concrete pavement renewals at 26% of budget recognises the opportunities to improve efficiencies during the delivery of this new programme through developing and learning from new renewal techniques.

The table values [3] i.e. % RP3 budget to RP2 budget' highlight the proposed ramping up of RP2 budget levels in RP3 to between 145% and 308% for three of the four asset classes but for concrete VRS an increase of 62% over the RP2 funding level. Although these are estimated values and will be refined by Highways England as it develops its RP3 plans, this scale of increase when considered alongside the RP3 capital enhancement programme may pose potential risks in respect of network access, disruption to customers and supply chain capacity. Learning by Highways England from its RP2 delivery to develop a practical and sustainable RP3 LER programme will require ongoing monitoring by ORR during RP2.

Highways England's commentary to support its efficiency assumptions at the RIS2 dSBP stage included the statement *'…For each of the three significant spend areas we believe that there are further opportunities. These opportunities …quickly diminish where the technically assured full intervention needs are supressed by life extending asset management choices…as a result of balancing cost, deliverability and customer impact*'.

In its scrutiny of the RIS2 dSBP, ORR identified the need to carefully monitor the proposed LER programme and efficiency improvements to provide a good understanding of any delivered, and possible future efficiencies and long-term costs of LER works in RP3 and RP4. It concluded:

> *'…We consider that the efficiencies proposed are challenging, however, given the lack of detailed delivery plans ORR will need to ensure that they not achieved (sic) through scope reduction in RIS2…careful monitoring of costs and delivery will be important to ensure that the approach is developed and delivered in a manner which ensures that improved unit rates come from improvements in delivery rather than reductions in scope, and that cost in RIS3 can be assessed and forecast robustly'* (9).

Highways England has committed to providing both primary and secondary evidence during RP2 to demonstrate that RP2 LER efficiencies have been delivered, see Figure 1. For LER, efficiencies are considered embedded, i.e. achieved once Highways England can demonstrate that it has delivered its proposed output targets, as opposed to measured efficiency. For example, achieving renewed lengths (measured in km) of VRS against post-efficient funding. This will form the primary efficiency evidence. Secondary evidence includes providing details of major programme level changes and movement over time on a basket of supporting metrics. This consists of meeting output targets with post efficient funding (primary) and case studies detailing (secondary).

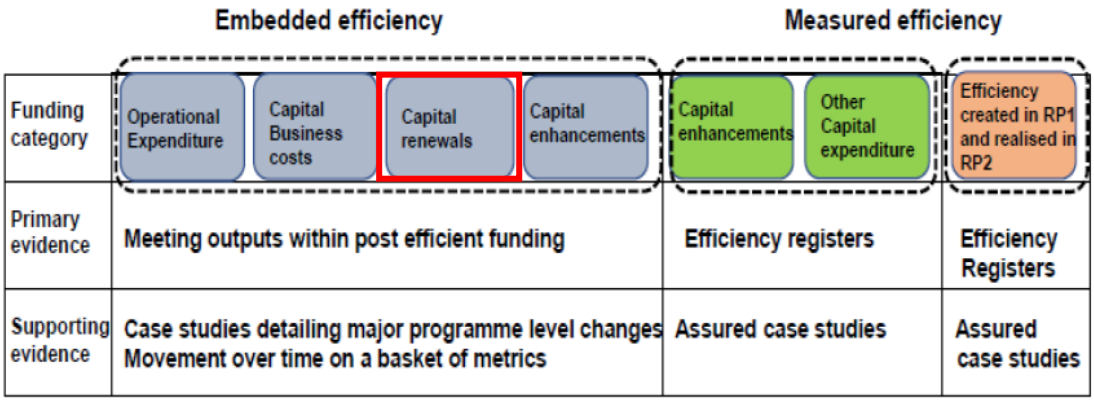


Figure 1 – Highways England's RP2 evidence framework highlighting LER (capital renewals)

RIS2 LER efficiency levers

Highways England has considered a combination of general and asset specific efficiency levers in its RIS2 delivery programme, shown in Table 4. These have been articulated in its RIS2 LER programme development to balance asset need with safety and service risk and take into account current and future availability of renewal intervention processes, materials and solutions.

Table 4 – Highways England's LER efficiency levers

General efficiency levers (applies to all asset classes including LER)	Asset management Procurement and contract management Portfolio and programme management
Asset specific efficiency levers for LER asset classes	Innovative design Innovative construction Innovative materials and material placing techniques such as for legacy concrete pavements Continuous improvement to programmed interventions

Common across all LER asset classes are three efficiency pillars; asset management, procurement and contract management and portfolio and programme management. The ability to derive efficiency from each pillar individually and combine these to make a larger efficiency output is something Highways England is progressing through its ongoing business transformation programmes during RP2; Operational Excellence (OE2025) (10) and the continuing rollout of its Asset Delivery contracts to all regions.

Improving how Highways England procures and manages its suppliers for capital renewals such as LER is the subject of another ORR study, Routes to Market review, which has assessed the evolution of Highways England's contract strategy towards an enterprise environment and the ability to monitor and evaluate the benefits including efficiency from its Asset Delivery contracts. OE2025 also has an 'Intelligent Contracting' transformation theme.

Achieving efficiency through better portfolio and programme management is the first of several ongoing themes in the OE2025 transformation programme shown in Figure 2.

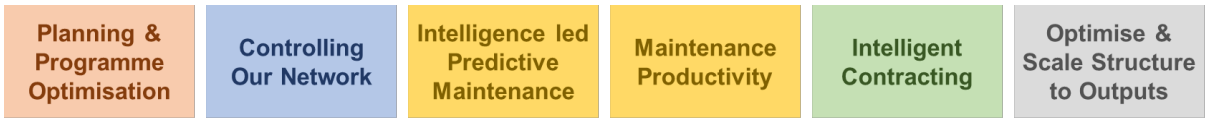


Figure 2 – Highways England's operational excellence programme themes (OE2025)

As well as achieving its RP2 efficiency target, Highways England's ambitions through OE2025 are to deliver its renewal and maintenance outputs, reduce the number of unplanned asset closures and ensure best use of roadspace and improved customer service. A further ambition through OE2025 and to be considered over three to four road periods is for Highways England to understand the societal value of its renewals investment, and to be able to predict future investment efficiency from developing lowest whole life cost using a combination of cost knowledge and replacement condition to determine historic inefficiency.

Major structures specific efficiency levers

Highways England aims to achieve a proportion of its major structures efficiency through developing innovative design initiatives such as standardised design of parapet for renewals (reducing design costs by reducing the time spent on initial design of parapet replacement, and the need for departure from standards by having a standardised solution to the problem) and standardised renewal designs (enabling standard renewal and maintenance procedures to be developed). It also aims to replicate its maintenance procedures across the structures' asset family.

Achieving structures efficiency through continuous improvement initiatives will include its ongoing programmes of thaumasite repair and bridge painting and achieving unit cost reduction through the volume of works and consistency of delivery. It also aims to achieve efficiencies through combining structural works in the same area to minimise traffic disruption and mobilisation and site installation costs.

Legacy concrete pavement specific efficiency levers

Through its development of large-scale programmes of work to renew legacy concrete pavements Highways England aims to achieve efficiencies from a combination of rolling funding, a bespoke specialist procurement framework and proactive management approach aimed at better programming to minimise high levels of disruption to road users.

VRS specific efficiency levers

Highways England's plans to achieve efficiency through innovative design initiatives for VRS include clarifying minimum specification requirements and optimising design. Innovative construction initiatives include greater use of prefabricated components and recycling aggregates on site to construct the VRS barrier foundation. Continuous improvement efficiencies to programmed VRS interventions includes initiatives such as developing better asset knowledge at a national level to identify higher risk assets and the timely operation and rehabilitation of works planning based on the latest deterioration test results (for steel VRS). These will enable repair to be undertaken at the optimum point and reducing intervention costs. Also, better analysis of VRS data to understand effectiveness of specific rehabilitation works methods, materials and parts). Specifically, for concrete VRS renewals developing a national Concrete Barrier Programme to enable improved resource allocation, planning and cross scheme working.

RP2 delivery key findings

It is clear from the evidence we have seen that Highways England undertook a comprehensive process to develop its RP2 capital renewals delivery plans for LER including using a bottom-up appraisal of asset need against safety and service levels to develop its funding requirements outputs and efficiency assumptions. This was presented in the RIS2 dSBP and was subject to scrutiny by ORR. The results of this process have resulted in an ambitious programme of life extension renewals (LER) valued at approximately £1.5bn out of a renewals budget of £4.5bn with an overall efficiency target of £238m.

LER efficiencies in RP2 are considered embedded and will be evidenced by achieving programmed renewal outputs as well as demonstrating appropriate asset stewardship, supported by case studies to demonstrate the achievement of efficiencies and activity-based costing evidence. ORR's review of the RIS2 programme highlighted the need to monitor the proposed LER programme and efficiency improvements during RP2, as the level of efficiency for some LER asset classes is considered challenging, and to ensure that learning informs the refinement of efficiency ambitions in further RIS periods. In particular ORR highlighted two areas for continued monitoring:

- that improved unit rates for capital renewals should come from improvements in delivery rather than reductions in scope, and
- that cost in RIS3 can be assessed and forecast robustly.

LER efficiency assumptions for RP2 vary for each asset class depending on Highways England's consideration of current efficiency / productivity and future forecast improvements in better project management, materials, maintenance techniques and innovation.

Efficiencies vary from 26% for legacy concrete pavements to 8% for structures. Highways England has articulated where it expects these efficiencies to be made by considering generic and asset specific efficiency levers.

RP3 planning key findings

Highways England has provided some outline evidence of its early development of the RIS3 business case for capitals renewals and for the named LER programmes i.e., major structures renewals and legacy concrete renewals. This includes an estimate of funding but not of efficiency. For example, the 25-year concrete pavement forward renewals programme (RP2 to RP6) and risk-based process for major structure renewals (170 structures in RP2 out of a total of 769 structures that require work by RP4) both show funding projections. Highways England acknowledges that the future requirements for VRS are less developed although asset condition and performance knowledge is improving.

Highways England's Operations directorate is developing a process as part of its transformation programme (OE2025) to understand the societal value of its renewals investment as part of the developing RIS3 business case and its better prediction of future investment efficiency using past performance data.

The scale of delivery of LER in RIS3 at an average of 234% over and above RIS2 is ambitious and is likely to create network constraints when considered alongside the proposed similar scaling up of capital enhancement delivery over the same period.

4 Major structures renewals

Highways England structures portfolio is regarded as highly diverse in terms of the complexity and size of its structures assets.

Many of the bridge structures in Highways England's portfolio were built at broadly the same time, with 42% of all structures built in the 1960's and 70's, of which 66% were built from reinforced concrete. If left to deteriorate beyond an acceptable condition, there is the possibility of a reduction of network availability if restrictions such as weight restrictions and/or lane and speed restrictions are required to safeguard the structure and the travelling public.

It is vital that these structures are well managed, well maintained and eventually their replacement planned when life expired, in order to provide a predictable investment profile and minimise disruption.

Highways England's Life Extension Renewals (LER) objectives and strategy

In terms of Major Structures within the Life Extension Renewals programme for RP2, Highways England's objectives are straightforward. At the end of RP2 the three main priorities are (12) to:

1. Safeguard condition i.e. maintain 'Steady State'.
2. Undertake renewals on 249 of the 769 locations identified as requiring significant intervention after the Oldbury Viaduct (Reference Case study on Page 21 of this report).
3. Use RP2 to better develop the understanding of asset need and required interventions.

Demonstration of 'Steady State' Condition by the end of RP2

To demonstrate 'steady state' it is essential to understand what 'steady state' is measured against i.e. what is the baseline condition? Without establishing a baseline condition it is not possible for Highways England to demonstrate whether it has met its condition objective at the end of RP2. In Highways England's Capital Renewals draft SBP for Structures (Annex 1) (11), the Structures Investment Toolkit (SIT) was used to model a 'Do Minimum Strategy' scenario with the aim of maintaining a safe network condition and target network condition score of 84.1 ± 2. This target is referred to as SCav structures condition (average score for structures elements).

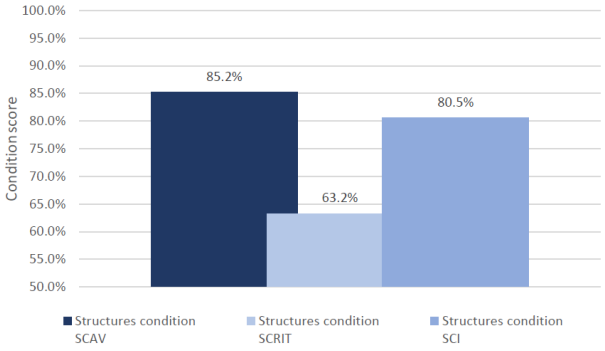
In Highways England's 5 Year Delivery Plan 2020-2025 (3), a single Performance Indicator (PI 3.2) measures the stock condition of Highways England's structures assets. There are two scores which inform PI 3.2, one takes account of all the elements of a structure from paint systems and superstructure drainage to primary girders and columns, known as SCav (see above). The other scores the condition of very high importance load bearing elements such as primary deck elements, half-joints, piers/columns etc. This known as SCcrit structures critical. There is a further 'supporting indicator' - the Structural Condition Index (SCI) – which is the percentage (%) of structures rated as 'Good' in the subjective opinion/view of the Inspector.

The PI is further explained in the Asset Class Strategy (ACS) for Structures (12) Section 3.2. - Asset Performance measures for RP2 - where it describes PI 3.2 as directly related to how effectively Highways England is maintaining the condition of all its highway structures. As PI 3.2 measures the condition score for the structures stock, this report concludes that Highways England has two main priorities in RP2 – to maintain structures in a steady state condition and to develop a better understanding of future structure need. PI 3.2 should therefore be reviewed against the following findings:

1) The scores for PI 3.2 are output figures and therefore only as good as the quality of the input data used to calculate the scores. The input data for PI 3.2 is mainly obtained from the inspection process. Highways England has indicated that it is already working on alternative or additional performance metrics. It is recommended that ORR work closely with Highways England on this matter and consider measuring the inspection process more closely and consider introducing more robust performance measures which target the completeness of inspection reports uploaded onto IAM-IS annually and the results of the quality audits for inspections. The rationale behind this finding is that if there is confidence in the completeness and quality of the input condition data from the inspection process, there will be a high degree of confidence in the output average and critical condition scores at a stock level. This will also improve confidence in the accuracy of any baseline condition and steady state assumptions.
2) The scores for PI 3.2, comprising SCav, SCcrit and SCI, are published quarterly in the Highways England Quarterly Operations, Maintenance and Renewals (OMR) report (13), the latest values from Q3 published in February 2021 are provided below in Figure 3. It is also understood that more detailed information is provided on the structures condition on an annual basis.

Performance Indicators

PI 3.2: Structure Condition



Structure condition is reported annually, next due end March 2021. Chart shows the April 2020 position.

An informal check on the condition metrics data in early December showed a slight increase in Average score and slight reduction in Critical score (85.3 and 63.1 respectively).

Investigation for potential alternative or additional performance metrics for structures is underway and has moved from concept stage to feasibility stage.

Figure 3 – Structures Condition as reported on OMR 20/21 Q3 (13)
Note – the National Bridge Condition Index bandings are shown inset.

Structure Condition Index Key	
Very Good	>=90 & <=100
Good	>=80 & <90
Fair	>=65 & <80
Poor	>=40 & <65
Very Poor	>=0 & <40

Figure 3 shows that SCav and SCI are both in the 'Good' category with SCI marginally above 80%. SCcrit at 63.2% has fallen below 'Fair' and marginally into the 'Poor' category. The inference of the SCcrit score is that a significant number of the critical load bearing elements in the stock of Highways England's structures such as bearings, primary members, half joints etc. may be in a 'Poor' condition. It should be made clear at this point that this statement should in no way be interpreted as there are structures on the network that pose a risk to the public. Highways England has consistently indicated that they are aware of their high-risk structures and mitigation measures are in place ensure public safety. It does however raise the question of whether there should more focus on SCcrit and possibly a target condition set for SCcrit as well as SCav. Furthermore, as well as an objective for 'steady state', should there be a target condition for SCcrit from 'Poor' into the 'Fair' condition category? It is recommended ORR work with Highways England to understand what the long-term condition trend of SCcrit has been; is SCcrit currently in continuous decline, steady state or on an upward

trajectory? What impact will the current investment strategy developed using the SIT and the LER programme have on SCcrit and has that been assessed?

Historic data on bridge condition trends maybe available from the WSP report *State of Bridge Infrastructure* (14) and the draft SBP for Structures (11). One further observation is that the SCcrit score, in terms of evidencing the need for future structure LER funding, is more convincing than the SCav condition scores, yet there seems to be far less reporting on SCcrit or understanding of the impact Highways England's strategy will have on this metric.

3) As part of PI 3.2, Highways England has set themselves a Steady State target condition score (SCav) of 84.1 ± 2 and this has been used to determine investment need up to RIS 7. We have not found evidence of a similar target for SCcrit and we recommend that ORR considers advising the DfT of the need for a similar target condition score for SCcrit to recognise the importance of monitoring critical load bearing elements within the structures stock. This depends on any outcome of ORR's further investigations of SCcrit as recommended in 2) above. We also recommend that, due to the importance attached by Highways England to safeguard the condition of its structures at the end of RP2 and beyond, ORR considers elevating PI 3.2 to a KPI in the next RIS.

Having complete and accurate data on structures condition is seen as fundamental to the entire Highways England strategy for the LER programme for structures and this is recognised by Highways England in the Asset Class Strategy (ACS) document for structures (12). Highways England states that the asset information and the '*accuracy and completeness of the data is crucial to the effective and efficient management of the assets, if wholesale inaccuracies or a significant backlog of inspections develops, erroneous condition scores will result which in turn would result in inappropriate results from decision support tools and errors in the stock condition reporting.*

The need for confidence in the completeness and accuracy of the data in IAM-IS, Highways England's asset data base for structures, is considered to be of the highest importance as this information is pivotal in terms of not only establishing the long term condition trends of structures assets at individual asset and stock levels, but also for informing other strategies such as identifying asset need, prioritising and setting programmes of work as well as scenario testing and condition monitoring to ensure the right intervention at the right time approach.

Having high quality asset and condition data will also help to make better Whole of Life decisions for assets as well as providing greater confidence in Performance Measures and effectively managing risks.

Use of asset information to develop a better understanding of asset need and required interventions by the end of RP2

In the Highways England Final Strategic Business Plan 2020-2025 (Section 3) (5), Highways England has stated its intention to take a planned longer-term view in the way they manage asset renewals.

The structures renewal programme in RP2 is primarily based on the evaluation and prioritisation of defect information gathered from the inspection programme (Principal and General Inspections).

The long-term Highways England Management Strategy ambition for structures assets (12) is that, by 2050, the public will benefit from a road network where Highways England's structures asset is managed in a way that:

- Implements a long-term plan to renew ageing asset across multiple road periods
- Is not compromised by competing priorities within the business

- Embeds consistent governance measures for all high-risk elements to mitigate risk of catastrophic failure
- Properly manages assets handed back from Design, Build, Finance and Operate Areas (DBFOs)
- Reflects increases in traffic and patterns of demand
- Accounts for challenges brought about by climate change
- Enables assets to be maintained or renewed with minimum disruption.

For Highways England's long-term management strategy ambition for structures to be realised, Highways England plans to develop a better understanding of asset need which will allow them to make better decisions, including:

- ***Linking strategic planning and service delivery*** – i.e. translate strategic objectives into pragmatic, practical advice and communicate asset needs, approaches and objectives to the wider business.
- ***Right intervention at the right time*** – i.e. identify and deliver efficient and timely interventions for the structures asset. To achieve this, they will:
  - Develop Agile, the new decision support tool (DST) being rolled out to replace SIT.
  - Improve Highways England's approach to renewals programme prioritisation, and implement a consistent approach across the regions.
  - Introduce asset management plans for the major structures assets.
- ***Making better whole life decisions*** – Highways England intends to balance affordability with long term planning, recognising the challenges of delivering sustainable service now and in the future by improving asset data collection and having a more consistent approach across the areas and develop a replacement for SIT which will model deterioration of the structures asset to model whole life cost options.
- ***Using our asset knowledge to manage risk*** – Improved asset information will allow Highways England to better evaluate the risks to make informed decisions.

In addition to identifying asset need through the Principal and General Inspection process and using that data to feed into decisions on predicted asset condition, asset risk and timely interventions etc. Highways England has also identified over 700 locations where significant renewals may be required, largely because of the learning from the Oldbury viaduct scheme.

The case study for Oldbury Viaduct has been extracted from DfT's RIS2 Document (1) and is provided below. The main issue with Oldbury relates to the failure of the deck waterproofing which went undetected leading to a deterioration of the concrete deck, the full extent of which did not become apparent until the scheme had started, and the road surfacing removed. The extent of the defects led to a significant overrun in terms of programme and costs and led to the identification of more than 700 structures on the network which could potentially present similar issues to Oldbury.

Case study – Oldbury Viaduct

The M5 Oldbury Viaduct sits at the heart of Birmingham's road network. In 2013, routine pothole filling found unexpected damage to the underlying deck, the structure on which the road itself rests. More than forty years of salt water had seen chlorides percolating into the underlying concrete, meaning that it became much more vulnerable to decay. This meant that this part of the M5 was experiencing potholes at a much higher rate than expected, and also meant that the structure was less able to deal with heavy loads than had been thought.

The damage within the structure had been invisible, but once it was found the scale of the problem became clear. Emergency measures were taken to prop the viaduct up, to ensure there was no risk to the public. Work then began to prepare for one of the largest programmes of structural maintenance ever undertaken on a UK motorway.

Highways England has implemented a comprehensive programme to repair the soffits, decks and deck ends, and to renew the waterproofing whose failure had caused the original problem. Bridge joints were replaced and the pavement resurfaced; and the opportunity was also taken to upgrade vehicle restraint systems, lighting and drainage.

There was no prospect of closing the M5 while this work was done. To enable both the local and motorway network to continue to function, a contraflow system was put in place, with all traffic using either the north or southbound carriageway at a time across two narrow lanes in each direction with a 30mph speed restriction.

The final cost of the work is expected to be over £180 million, making the scheme the largest concrete repair project ever undertaken in the UK.

Highways England's Renewals and Investment Strategy for RP2, RP3 and beyond

Highways England's structures renewals strategy is described in detail in the draft Capital Renewals Strategic Business Plan document (2). This document describes (in section 2.5) where the current and future risks are with respect to structures, these are summarised below:

- Increasing age profile leading to the requirement for significant deterioration.
- Accelerated deterioration in structures built in the 60's and 70's when concrete construction techniques and materials were less well understood.
- Hidden defects in concrete decks beneath the road surfacing (as witnessed at Oldbury)
- Serviceability reductions leading to more weight restrictions, propping, lane and speed restrictions and substandard parapets.
- Appropriate funding settlements which will allow proactive planning of works programmes which balances intervention needs whilst minimising road user disruption.

Highways England's general approach to developing the LER programme is based on a bottom-up approach using:

- The defect results from the routine inspection regime (PI's and GI's) supplemented by scheme specific special/monitoring inspections.
- Prioritisation procedures to assess and rank defects.

- Secondary information such as increases in pothole repairs on bridges which could be indicative of underlying problems on concrete bridge decks.

Using this approach Highways England has developed a programme of renewals and preventative works which meet the 'right intervention at the right time' aspiration to achieve optimum whole life costs. This approach has been used for the development of Highways England's strategy for RP2.

Highways England's approach to evaluating the need for significant structural renewals uses the SIT to model different asset management scenarios or strategies whilst maintaining a certain asset condition. The SIT tool provides the global overview of Highways England's future structure needs based on visible inspection data and therefore has its limitations with respect to hidden components such as the buried surface of the deck and the ends of the deck beneath expansion joints. Non-visible areas rely more on local knowledge gained from activities such as pothole repairs and resurfacing repair contracts, as well as special inspections and studies. Local knowledge is key to identifying the 249 major renewals schemes not readily identifiable from the routine inspection programmes.

The SIT produces costs for meeting the set asset management criteria e.g. Do Minimum against the desired condition target. Due to limitations with the SIT not being able to assess needs for individual assets effectively, Highways England has engaged regional engineers to identify locations where significant interventions are potentially required. The needs at these renewal locations have been peer reviewed to develop a consistent maintenance programme for RP2 and an indicative programme of work to be undertaken in later RIS periods.

This exercise identified a long list of 769 renewals interventions with individual indicative costs. Each intervention is risk scored 1 to 5 with risk level 5 representing the highest risk, shown in Table 5. The 1 to 5 ranking has been developed by Highways England and considers the risks to safety and functionality (or serviceability) if work is not carried out in RP2. For example if specific work cannot be carried out in RP2 and in the opinion of Highways England it is considered this would then result in a high risk to safety and availability of the network, then the highest risk score of 5 has been applied.

The spread of interventions for the 769 structures/locations shows that Highways England intends to complete most of the targeted renewals in RP2, RP3 and RP4 with the highest risk interventions (Levels 4 and 5) carried out in RP2. This high-level programme however assumes that there is little slippage from RP2 to RP3, if significant slippage does occur then the risk profile categories may change.

Table 5 – Number of structures in each risk category from preliminary assessment of renewals requirements

Level of Risk if work not done in RP2-	No. Structures	Required date of work to maintain safety
1	61	RIS4+
2	170	RIS3
3	289	RIS2 but could be deferred to RIS3
4	149	RIS2 (years 3-5)
5	100	RIS2 (years 1-2)

The breakdown of cost by road period and value is as shown in Table 6 below.

Table 6 – Preliminary assignment of significant structures renewals costs by period

Required date of work to maintain safety	Renewals <£10M	Renewals >=£10M	Total
RIS2	£456.5m	£801.9m	£1,258.4m
RIS2 (but could be deferred to RIS3)	£625.1m	£927.9m	£1,553.0m
RIS3	£230.6m	£352.2m	£582.8m
RIS4+	£75.7m	£830.5m	£906.2m

The development of the renewals programme is heavily reliant on the Structures Investment Toolkit (SIT). The SIT is used to assist in the scenario planning of renewals interventions across the entire structures asset stock. Its use is described in detail in Annex 1 of the Structures section of the draft Capital Renewals Strategic Business Plan (12). For the RIS2 business plan for structures, a model was created in the SIT that would achieve following three objectives:

1. Maintain the end condition at the start and end of each RIS period up to the end of RIS6; this was assumed to be a Network condition of 84.1 ± 2.1;
2. Maintain a safe and serviceable condition for Highways England structures Assets; and
3. Provide an accurate estimate of the level of funding required to ensure average network condition is maintained.

The model created had to adopt a hybrid approach of planned 'do minimum' (a strategy that maintains the safety of elements on a structure) and a planned 'preventative approach' (to maintain condition level through to the end of RIS6). To achieve a sustainable level of funding over future RIS periods it was agreed to average the required funding to avoid peaks and troughs.

The following rule set was applied to achieve such an output:

- For the rest of RP1: maintain a do minimum strategy (this means once the element condition goes above an Element Condition Score (ECS) of 4 it gets repaired) with unlimited budget, this is with the aim of keeping all structures in a safe condition up to the start of RP2.
- For RP2: Do minimum strategy with the aim of maintaining safe network condition and maintain a target network condition of 84.1 ± 2
- RP3: Planned preventative strategy with a target network condition of 84.1 ± 2 (the reason for the change of strategy is that it is impossible to maintain the target condition on a do minimum strategy for RP3.
- RIS 4: Do minimum strategy (aim to maintain safety) and a target network condition of 84.1 ± 2
- RIS 5: Planned preventative strategy with a target network condition of 84.1 by the end of RIS5 (Reason for the change in strategy to maintain the condition target)
- RIS 6: Planned preventative strategy with a target network condition of 84.1 ± 2
- RIS 7: Planned preventative strategy with a target network condition of 84.1 ± 2

The above effectively sets out Highways England's asset strategy up to RIS7. The target condition score SCav is 84.1 ± 2 up to RIS7 however over that period the maintenance strategy changes from a 'Do minimum' strategy in RP1 to the end of RIS4 except in RP3 where a Planned preventative strategy is put forward because it is impossible to maintain the target condition of 84.1 ± 2 on a Do minimum strategy for RP3.

From RIS 5 to end of RIS 7 the modelling indicates the target condition can be maintained using a Planned Preventative maintenance strategy.

Risks to Highways England's Renewals and Investment Strategy for RP2, RP3 and beyond

In addition to the recommendations in this section of the report, in respect of major structures, several risks have been identified which may impact the effective delivery of Highways England's Road Investment Strategy for RP2 and RP3, and possibly beyond RP3**.** The purpose of highlighting these risks is to raise awareness with ORR and provide an opportunity for ORR to seek assurances from Highways England that for these risks there are appropriate mitigation measures in place.

1) Highways England's asset data on structures is stored in IAM-IS, which has only recently replaced the Structures Management Information System (SMIS). Highways England has confirmed that it is expected it will take some time to gain confidence in the robustness and accuracy of the data in IAM-IS, including the data migrated to the new system from SMIS. The migration and 'bedding in' of IAM-IS is seen as a risk and something ORR should seek a better understanding of including the transfer of data from SMIS to IAM-IS and embedment of Highways England's new working practices. Furthermore, in 5.1.1 of the ACS for Structures (12) – Cyclic Structures (CapEX) maintenance - it is stated that the SIT has been retired and a new improved Decision Tool is being developed, but there is no indication when this will be or how long it will take to be fully operational. Both the SIT and IAM-IS are critical tools in Highways England's renewals strategy. It is recommended that ORR seek assurance that the replacement for SIT and the change over from SMIS to IAM-IS will not adversely impact on the structures asset management strategy, renewals programme development and investment decisions.

2) The Oldbury Viaduct case study highlighted problems with so called 'hidden defects' to the concrete deck immediately beneath the road surfacing and waterproofing layer. Whilst Highways England is clearly tackling this problem and putting measures and resources in place, it is recommended that ORR continue to seek assurance from Highways England that the issue of 'hidden defects' is firmly in hand to mitigate the risk of a similar Oldbury Viaduct scenario.

3) Handback of DBFO structures could present a risk if structures are handed back in a condition which is below the target condition set as part of Highways England's asset management strategy of 'Do Minimum' and 'Planned preventative' for a SCav target condition of 84.1 ± 2. In the Highways England Final Strategic Business Plan 2020-2025, Highways England has identified the need to properly manage assets handed back from DBFOs. The condition of the DBFO structures is outside the remit of this report and therefore the predicted condition of the DBFO structures at handover is not known. It is recommended that ORR with Highways England continue to monitor structures condition of the DBFO structures to understand what impact these structures have on Highways England's renewals programme and strategies in advance of their handover to Highways England.

Comparator study

The purpose of the comparator study undertaken as part of this review was to identify any areas of good practice that may be useful for Highways England, DfT and/or ORR to consider. Those examples that emerged that are relevant to Major Structures renewals are highlighted below.

M25 DBFO

M25 has 11 years valuable experience of investigating and monitoring its structures stock which could provide useful information to HE for structures renewals on prevalent forms of defectiveness/deterioration as well as innovation on solution options. M25 is keen to engage and share with wider HE, regions etc and knowledge sharing between the DBFO and HE could be improved.

Transport for London (TfL)

TfL monetise risks using the VfM function in Bridgestation. Bridgestation has built in costs for certain risk criteria such as engineering difficulty, structures over the railway, traffic volumes, length of diversion routes.

TfL carry out 'Special Inspections' at the end of schemes which improve the condition of their structure. They do not wait until the next General Inspection or in some cases the next Principal Inspection for some elements of a bridge to update condition. This ensures they are always working with the most up to date condition information.

TfL are keen to have a closer dialogue with HE to share learning.

Transport Scotland (TS)

TS have adapted their Bridge Condition Indicators (BCI's) to cover post tensioned structures. TS have also developed their own bespoke systems called PEARL and IRIS (their SMS system) which considers cyclic inspections outside the normal PI and GI inspections. Some special inspections are carried out by TS at more regular intervals.

ORR Rail Division

Because the age of Network Rail's structures stock is much older than HE's a lot of work has been on managing assets to end of life, especially insights to cover the relationship between performance parameters and asset remaining life and in later stages of asset life to support a greater appreciation of changing risk. It is considered that HE might benefit from engaging with Network Rail to share best practice on how to manage end of life structures.

5 Legacy concrete pavement renewals

Legacy concrete pavements

The 'legacy concrete pavements' on the SRN are defined as those constructed from pavement quality concrete (PQC) with up to 50mm of asphalt surfacing. The majority of these pavements are of jointed construction, comprising individual slabs of fixed dimension with mechanisms to transfer loading between them. Jointed PQC construction, while durable if well-constructed and maintained, is no longer permitted as an option for new build on the SRN primarily due to its whole life maintenance requirement (cost and disruption) and customer perception of ride quality and noise. Much of the legacy concrete pavement stock on the SRN is ageing and, as end-of-life deterioration of these pavements can be rapid, significant renewals are now required. Strategically, Highways England has determined that reconstruction of these pavements is the preferred option (1, 3, 5) to transform this asset into 'long life' pavement by the end of RP6 (2).

There is approximately 1,000 lane km[4] of legacy concrete pavement (2), which is a relatively small proportion of the approximately 36,000 lane km total pavement asset – including existing Design, Build, Finance & Operate (DBFO) commissions – on the SRN (15). Prior to developing the business case for RP2 there had been little investment in renewals of concrete pavements over a sustained period and, hence, there was relatively little stock of experience or expertise in how to evaluate or repair these pavements. In addition, knowledge of this asset had deteriorated since the principal inspection method, involving manual surveys to detect signs of distress, was suspended due to safety constraints (automated traffic-speed surveys as used for asphalt pavements have not yet developed to the same level of robustness for concrete pavements).

Development of asset management approach

Highways England has recognised that longer term improvement in the management of the concrete pavement asset would require improved asset knowledge, tools to support planning and both skills and capability across the industry to develop and deliver effective solutions. It is evident that significant investment and progress has been made in addressing these requirements and establishing a robust system to support asset management and programme development for concrete pavements. This includes:

- Development of a data collection regime to provide the necessary data on asset inventory and condition.
    - Highways England has introduced centrally coordinated surveys to *'more consistently and accurately understand the condition of concrete pavements'*. The first cycle of these surveys is at or nearing completion and this will both refine the inventory record for concrete pavements and support detailed development and prioritisation of the schemes being considered for delivery in the later years of Road Period 2. Further cycles of the survey are planned during RP2 to inform both the RIS3 case, and the early design for RP3 schemes. (2, 16).
- Establishment of a Centre of Excellence (CoE) resourced from Operations and Safety Engineering and Standards (SES) directorates, and external specialists where appropriate, to support programme development and delivery and collaborate with industry and academia in developing solutions and techniques to improve performance and/or value. In addition to the national survey (above) the CoE is leading or supporting:
    - Early design activity for RP2
    - Initiation of work to develop a deterioration model for concrete pavements to support improved programme development and investment planning through better strategic assessment of need and timing of interventions.

[4] This figure is subject to refinement through network survey and does not include current DBFOs. The national concrete pavement survey will be extended to DBFO from 2021/22.

- Development of a facility for trialling materials and techniques including recycling.
- Development of resources and skills including the Concrete Pavement Maintenance Manual, training material and programmes.
- Development of a cost model (cost and carbon) for evaluation and optimisation of solutions for legacy concrete pavements.

Programme development

The assessment of investment need for concrete pavements in preparation for RP2 was developed 'bottom up' from existing inventory (15, 16) and assessment of available condition information (15). In the process of development of Highways England's dSBP for RP2 this investment need was profiled over 25 years, balancing reconstruction and 'holding' (life extension works) (2), to manage both the capital outlay and network disruption for the scale of works required.

It was recognised that there was a degree of uncertainty in the programme arising from the initial state of knowledge of the asset and its performance characteristics (2, 16) and the fact that the extent of works required will generally only be accurately determined through the detailed investigation and development of individual schemes. It is noted that the programme for RP2 was 'back end loaded' to:

- Allow the programme approach to be developed.
- Allow efficient and innovative solutions to be developed and implemented.

While profiling the programme over 25 years to manage cost and disruption requires a combination of reconstruction and life extension works Highways England recognises that:

- Life extension works do not remove the need for reconstruction, but defer the cost,
- Both reconstruction and life extension works on the legacy concrete pavement cause significant disruption for road users, continuing to *'operate with end of life assets is both a poor asset management decision, (cost) and highly challenging to road users (safety & disruption)*' (2).

Accordingly, any opportunity to accelerate the reconstruction programme would be beneficial in reducing the extent of life extension works. Currently Highways England aims to commit schemes to the programme in order of *"transformation (i.e. reconstruction), innovation and life extension*" (12) to support this. As the knowledge and modelling of the concrete pavement asset improve certainty of need and planning, thus optimisation of coordination with other asset renewals, Highways England will plan to accelerate the programme to reduce the overall need for life extension works and hence lessen long-term disruption. This may impact the level of investment required and/or require movement of funds between asset classes (2, 16) in future Roads Periods.

The benefits from the work to improve the management of the concrete pavement asset, e.g. the implementation of a consistent national survey and improved performance modelling will, together with accumulating experience of delivery from RP2, be used to inform and refine the case for RIS3 and beyond. It is possible that the handover of existing DBFO commissions from RP3 onwards will add to the legacy concrete pavement stock to be considered in the longer-term programme.

Programme delivery

The legacy concrete programme delivery will be through bespoke national contracts for the three principal elements of the programme:

- Design (award has recently been made)
- Life extension works (award imminent)
- Reconstruction works (award imminent)

These are to be 4-year duration contracts, i.e., to cover delivery during the remainder of RP2 and design/preparation for early stages of RP3.

The model for development and delivery of the legacy concrete roads programme is based on a national programme office, supported by the CoE, to identify and develop named individual schemes for delivery through Operations directorate in the Regions with Regional Operations Directors accountable for delivery. Highways England has established a dedicated governance framework (Figure 4) for the legacy concrete pavements programme (17).

The framework sets out terms of reference for the key elements, i.e.

- Programme Steering Group
- National Design Authority
- Programme Management Office
- National Delivery Review
- Centre of Excellence
- Regional Delivery Leadership

and addresses processes for:

- Governance & Reporting
- Risk & Issue Management
- Information Management
- Change Control

Change to the programme, due to delay in Major Projects schemes with consequences in network access for renewals, has seen Highways England's output target for 2020/21 increase from 12 lane km to 40-50 lane km. Only life extension works will be undertaken in 2020/21; the first reconstruction scheme is planned for summer of 2021/22.

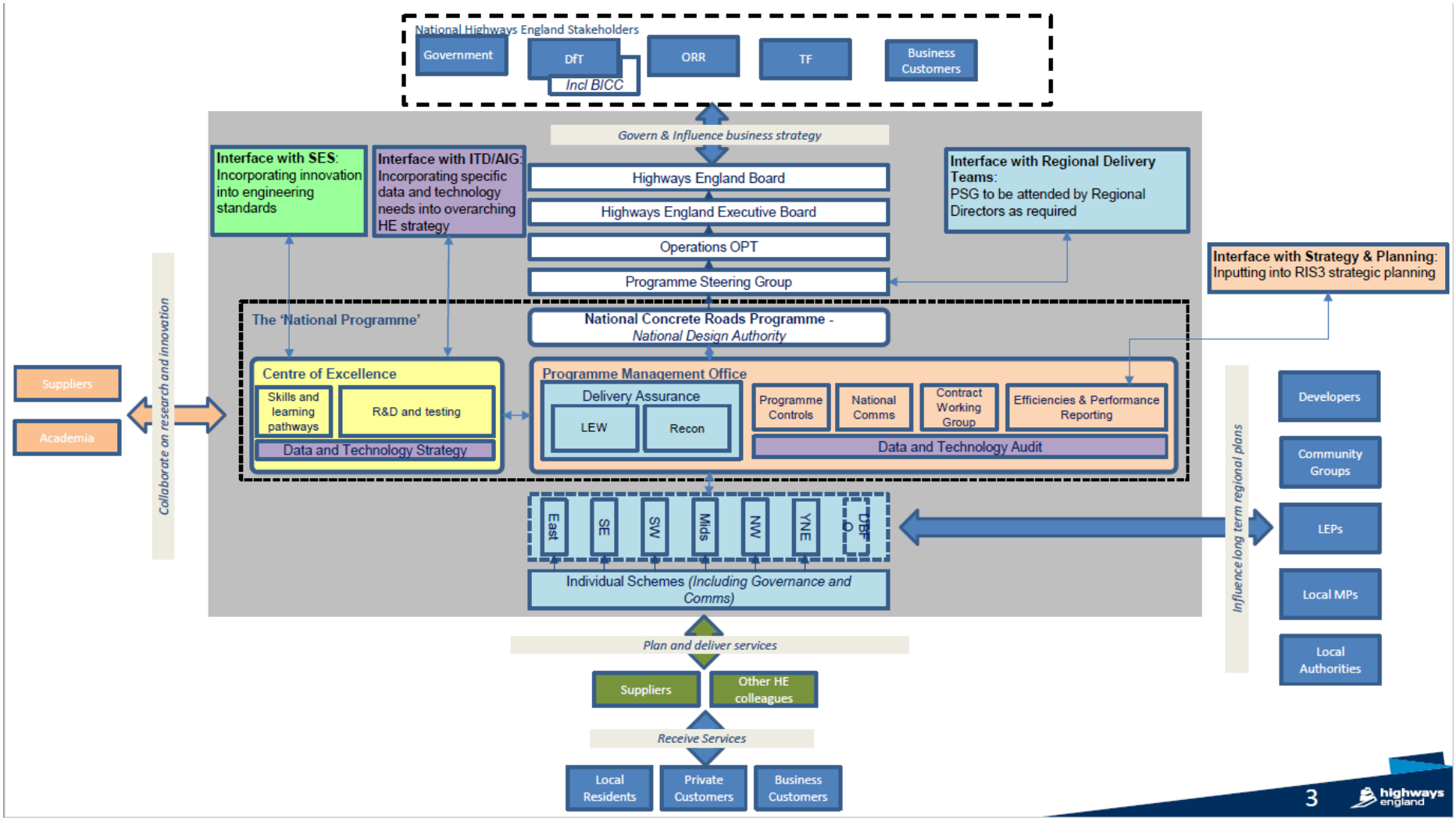


Figure 4 – Governance framework for legacy concrete pavements programme

Legacy concrete pavements renewals key findings

It is recognised that life extension works do not remove the need for reconstruction, rather defer the cost, and cause significant disruption. Future acceleration of reconstruction would, therefore, be beneficial where feasible considering cost, disruption and coordination with other programmes.

It is evident that Highways England has made significant investment and progress in developing its asset management approach for concrete pavements:

- It has established a Centre of Excellence to build skills and capability and support programme development and delivery.
- It has rolled out a new national survey programme to obtain current and consistent data on concrete pavements across the SRN.
- It is developing modelling capability and tools to support better planning of interventions on concrete pavements.

This early progress should help to build knowledge and develop innovative solutions to achieve the efficiency ambitions assumed for RP2.

The planned length of the legacy concrete pavement programme, i.e., 25 years, provides the opportunity both to develop new techniques and accumulate knowledge from implementation which should, as the approach matures, improve confidence in programming and evaluation of investment requirements.

In turn, more robust programming and certainty of works should yield efficiency from stability of planning, optimising coordination with other work programmes as well as encouraging supply chain engagement and investment. ORR's recent supply chain readiness update (18) has shown that certainty of programming is essential for commitment from the supply chain, and this is particularly important where Highways England may be looking to the supply chain to invest in particular skills and resources to deliver asset-specific programmes efficiently and effectively.

Comparator case study M25 DBFO

The purpose of the comparator study undertaken as part of this review was to identify any areas of good practice that may be useful for Highways England, DfT and/or ORR to consider. While it is recognised that Highways England SES technical specialists maintain good liaison with the M25 DBFO aspects of practice for concrete pavements merit highlighting here.

M25 DBFO has placed great emphasis on customer perception in determining intervention investments. In the case of concrete pavements this entailed trialling a range of treatment solutions and gathering customer feedback, in which surface noise has been an key factor and will influence the choice of treatment for the renewals programme. This is of relevance for Highways England given its Customer imperative and commitment to introduce a customer-centric ride quality metric during RP2.

Trialling of concrete rejuvenation techniques which may aid life extension could be of interest to Highways England's Centre of Excellence.

6 Vehicle restraint system renewals

VRS background and RP2 renewal context

Highways England has approximately 12,800km of VRS comprising of three main types: steel wire, steel section and concrete. For the purposes of this project and the LER programme steel wire and steel section VRS are grouped together. Approximately 2,300km of the total VRS length is on roads managed by DBFOs, which are not part of the LER programme and therefore outside the scope of this study. Steel barrier is the most used in all SRN locations and is required to have a minimum design life of 20 years although recent Highways England analysis shows that it can have a longer operational life. Concrete barriers provide the highest containment (safety) benefit and have a minimum design life of 50 years. They are installed on motorways and some dual carriageway central reserves, in line with Highways England's policy where traffic flows are greater than 25,000 vehicles per day, to reduce the risk of crossover incidents and on the verge to protect vehicles from collision with roadside features and assets such as structures. Approximately 60% of all VRS is in motorway and trunk road central reserves. The total gross replacement cost for the VRS asset is valued at £1.5bn at 2017/18 prices, which assumes a like for like replacement with no upgrading of steel to concrete.

In its dSBP submission (2) Highways England stated that '…As much of the VRS was installed during the motorway construction boom in the 1960's and 1970's, based on condition data from inspections and our understanding of deterioration mechanisms, we have been able to determine that a large proportion of the steel VRS is forecast to expire during the second road period (RP2). We need to renew the VRS asset so that they can provide their important safety function…However we recognise the available funds in RP2 will not enable the replacement of all life expired steel VRS in the central reserve with concrete in accordance with current standards'. The Delivery Plan also stated '…The RIS2 funding settlement for the VRS asset class will not be sufficient to address all needs on the network, particularly given the anticipated volume of renewals needed'.

Highways England's current RIS2 delivery plans and evidence requirements for VRS LER (13) compared with the Delivery Plan published in 2020 are shown in Table 7.

Table 7 – VRS LER RP2 funding, outputs and evidence commitments

LER Programme	*Current RP2 total*		Comparison with Delivery Plan and evidence requirements
	Quantity	*Value*	
Concrete VRS	80 lane kms (50 lane miles)	£143m	Quantity same as Delivery Plan.
Steel VRS	1540 lane kms (962.5 lane miles)	£260m	Quantity slightly greater than Delivery Plan (957 miles)
Totals	1,620 lane kms	£403m	Total value (steel & concrete) less than RIS2 £450m and dSBP £447m

VRS asset management approach

In its dSBP submission Highways England outlined a risk-based 'bottom-up' approach based on known and estimated condition and degradation modelling to determine VRS asset need from a combination of location and safety factors and the incremental cost benefit of VRS interventions

against available funds. From this approach a technically acceptable level of risk was calculated. The dSBP also outlined Highways England's residual life modelling approach including an understanding of how steel galvanising corrodes linearly and validating this with specialist inspections. This suggests that steel VRS can last an average of between 40 to 50 years, i.e. twice its minimum design life, depending on its location and exposure to environmental corrosion factors such as road de-icing or proximity to the sea, and accumulation of rainwater. The dSBP also highlighted the important interdependencies for both steel and concrete VRS with '…geotechnical assets which provide the sound foundation for the VRS to provide its safety critical function, and…drainage which often requires upgrading in the median where the VRS is changed from steel to concrete'.

Although Highways England's Delivery Plan states that its long-term policy is the upgrade of old steel safety barriers with concrete barriers in motorway and trunk road central reserves which require a higher level of containment, both the Asset Class Strategy for VRS and our discussions with the M25 DBFO indicate that this policy is under consideration due to affordability and further evaluation of cost-benefit. This is because while concrete barriers provide a longer lifespan and require less maintenance and therefore disruption to road users during operation, they are expensive and disruptive to install. The evidence we have seen from the dSBP submission (2) and engagement with Highways England shows that a risk-based decision process was used based on a calculated benefit cost ratio (BCR) against marginal safety improvement to decide which locations to install concrete barrier and which to defer. This has resulted in a 25-year phased renewal plan to replace steel with concrete with the deferred locations receiving either 5, 10 or 15-year renewal interventions, see Figure 5.

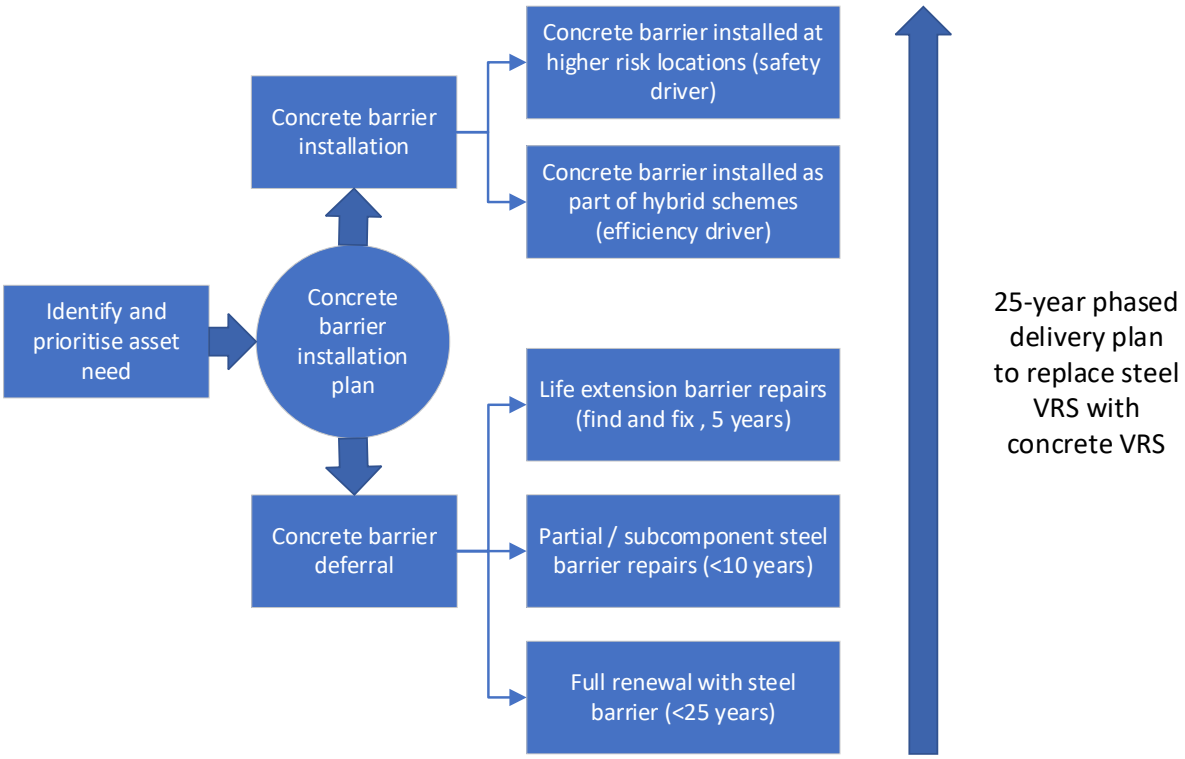


Figure 5 – RIS2 VRS risk-based renewal approach and long-term renewal strategy

Highways England also uses a risk-based site ranking tool to determine whether to install concrete barrier and prioritises these sites based on several factors including current steel barrier condition, location and traffic flows, accident history, road worker safety and installation costs. This provides a consistent scoring method and ensures that funding and installation of concrete barrier is prioritised at the higher risk locations.

The Asset Class Strategy for VRS sets out the approach, current position and challenges for management of the VRS asset. Overall, it appears that the asset management approach for VRS is less mature when compared to other assets, and this is recognised by Highways England as requiring improvement, specifically in condition knowledge as a large volume of VRS renewals is predicted over RP2/RP3 and in future road periods. Highways England suggests that the current assumed knowledge of asset condition may not be a mature/stable baseline for planning for RP3 and beyond '…The completeness and quality of condition data varies significantly, and this creates a challenge in our ability to create a consistently applied national view of the asset need and forward programme of renewals'.

In its dSBP and confirmed in our engagement, Highways England stated that the inspection of steel barrier has to date been largely subjective because inspection of central reserve steel barrier, which accounts for approximately half of all barrier, is difficult to achieve from the road verge and therefore must wait until periodic re-tensioning occurs usually every 2-3 years. '… Now that the asset is, en masse, moving to life expiry the completeness and quality of condition data which varies significantly creates a challenge in our ability to create a consistently applied national view of the asset need and forward programme of renewal. During RP2 we propose to explore new inspection methods to enhance our knowledge'.

Highways England also reported that '…the completeness and quality of condition data varies significantly, and this creates a challenge in our ability to create a consistently applied national view of the asset need and forward programme of renewals. Asset record information for much of the VRS asset, such as as-built drawings, product information and manufacturer's instructions are limited or non-existent'.

As part of our engagement with external comparators, the M25 reported that is has observed early deterioration in some vertical concrete barrier (VCB) which may need repairs/replacement before the end of the DBFO contract. While the expected service life of concrete barrier is 50 years, some lengths may not achieve this. Deterioration of VCB is being monitored and modelled based on visual inspection of the number of cracks and crack widths. The contract is also considering an enhanced inspection and assessment approach as inspection of the central reserve from the hard shoulder is onerous both in terms of access and risk.

VRS Programme delivery

Highways England reported that the RIS2 VRS LER programme does not have named renewal locations against each year of RP2 but that each region is allocated 'ring-fenced' funding over the 5-year period based on an assessment of asset need. Each region also has a certain amount of discretion with how to achieve its RIS2 outputs for both new concrete barrier and renewal of steel with steel barrier.

For steel with steel replacement, the region makes a risk-based decision whether to replace stretches of life expired barrier or to replace smaller discrete barrier section lengths under a 'find and fix' strategy. The assessment process also considers available funding. A region we engaged with reported that 'find and fix' can amount to 25% of all steel barrier outputs. It is considered as a

finding that the whole life implications and regional consistency of a 'find and fix' approach within the overall asset management strategy for VRS requires further understanding by ORR. The Highways England Regional Operations Director is ultimately accountable for the delivery of regional outputs including how to programme VRS with other network renewals and capacity enhancements to maximise asset life and minimise network disruption.

Where the regional operations teams decide that the implementation of VRS renewals need to be deferred, Highways England stated that measures will be put in place to manage the risk of accelerated asset deterioration towards end of life, and possible non-performance in the event of road traffic collisions. Highways England reported that they will consider the legal obligations and potential liabilities if a VRS asset were to fail to perform on impact – for example by ensuring adequate risk mitigation measures are introduced.

Highways England's current RIS2 Year 1 forecast delivery outputs for VRS LER (13) compared with the Delivery Plan are shown in Table 8. These show Highways England is forecast to be ahead of schedule for both steel and concrete renewals by the end of March 2021.

Table 8 – VRS LER Year 1 forecast outputs and comparison with Delivery Plan

LER Programme	*Forecast RP2 Year 1 total*[5]	Comparison with Delivery Plan Year 1 totals
	Quantity	
Concrete VRS	14 lane km	Quantity greater than Delivery Plan (4 lane km)
Steel VRS	195 lane km	Quantity greater than Delivery Plan (143 lane km)
Totals	209 lane km	Quantity greater than Delivery Plan (147 lane km)

The current in-year delivery of concrete VRS is primarily by one region, Yorkshire and the North East, and although Highways England is overall ahead of target across all regions it is not clear if the forecast delivery for each region is the same as that planned at the commencement of Year 1 and is being tracked for variance by the national programme lead.

Although DBFO assets are not considered in the LER programme, the dSBP (2) noted that '*…VRS renewals on DBFO routes are not part of this investment plan, but…eight of the 11 DBFO's will expire and handback assets to Highways England control in RP3*' (3). It is assumed that the management of these assets will be subject to the same design standards but not necessarily the same asset management approach and handover criteria.

Through our engagement with Highways England and VRS suppliers, the delivery programme and cost of VRS renewals can vary significantly depending on the knowledge of ground conditions and whether it is a discrete VRS scheme (with proportionately higher traffic management costs) or installed at the end of a capacity enhancement scheme with multiple assets and one of the last assets to be installed. An observation from the supply chain that we engaged with suggests that a significant proportion of VRS schemes can exceed their forecast cost due to overrun from preceding site activities and a constrained uncertain window to install VRS.

[5] Highways England OMR Q3 2020-21 Report

VRS renewals key findings

Highways England has an ambitious plan to renew both steel and upgrade to concrete barrier during RP2 and is already forecast to better its Year 1 outputs, although it is not clear if the forecast in-year delivery by region is the same as that planned. The dSBP submission, and confirmed through our engagement, outlines a logical risk-based approach to manage and upgrade the existing VRS asset over a 25-year period based on condition knowledge, safety and location factors and degradation modelling. However, modelling assumptions are based on the maturity of Highways England's asset condition knowledge. The RIS2 position is to replace a proportion of the life expired central reserve steel VRS with concrete based on the safety case at each location and prioritised using a risk-based ranking tool, and where the safety benefits of installing concrete VRS are low, to replace steel with steel.

Highways England acknowledges that the condition assessment of over half of its VRS steel asset is subjective as it has had to rely on periodic inspection every 2-3 years. It is planning to explore new inspection methods during RP2 to enhance its condition knowledge as it develops its plans for RIS3 although it has not set any targets for improved data quality. It will be important to achieve any improved knowledge of VRS condition prior to developing the RIS3 dSBP.

Highways England's Delivery Plan provides ring-fenced funding to each region with flexibility given to each region to achieve outputs based on the risk-based approach, including 'find and fix'. This is likely to mean that annual renewal targets have the potential to change significantly each year in RP2. Achieving RP2 renewal targets will require each region to optimise its forward programming of VRS renewals with other asset renewal schemes and capacity enhancement schemes to ensure appropriate levels of network access and certainty of forward programming for VRS installers. Our engagement with a sample of regions confirmed the range of options used to manage VRS LER where concrete barrier has been deferred through risk-assessment, including 'find and fix' of up to 25% of renewals, as one of three options to extend asset life. The implications of this multi-solution approach on Highways England's overall VRS asset management strategy assumptions should be understood further by ORR.

The cost and timescale to deliver VRS can vary significantly depending on whether it is installed as a discrete renewal or as part of a multi-asset renewal or capacity enhancement scheme. Although each Highways England region is responsible for delivering the overall RIS2 programme of VRS renewals, these factors may produce uncertainty in the profiling of RP2 delivery targets and the knowledge used to develop RIS3 plans, i.e. the profiling of outputs within a proposed funding envelope.

Although DBFOs contributes a small proportion of the overall VRS asset, the profiling of VRS asset condition and asset management plans for RP3 needs to consider the handback of DBFO assets to operational regions over the next 10 years and the potential variance in management approach which could introduce uncertainty in risk and cost profiling.

7 Recommendations

This review has identified a number of recommendations for ORR to consider in both advising DfT and developing its monitoring regime in this area for RP3 and beyond to assure the robustness of LER investment planning and deliverability of programmes. These recommendations are presented below, together with suggested timescales for action:

- RP2, recommendations for ORR for RP2 monitoring;
- dRP3, recommendations for ORR to consider for RIS3 / RP3 monitoring development; and
- RP3, recommendations for ORR to consider for RP3 monitoring.

Table 9a – General recommendations

Recommendation for ORR	Timescale
[R1] The robustness of Highways England's assessment of both the scale and timing of investment interventions across its range of asset classes is dependent on the maturity of is asset management approach. Highways England acknowledges that the level of maturity varies between assets and has an ambition to develop its approach to support plans for future road periods. It is, therefore, recommended that ORR establish the current level of asset management maturity across the asset classes to provide assurance that future plans are based on a robust assessment of asset need.	dRP3
[R2] ORR's review of the RIS2 programme highlighted that the efficiency ambitions for the LER programmes are challenging. Highways England is undertaking an operational transformation programme ('OE2025') and has identified several efficiency levers, both general and asset-specific, that contribute to achieving its efficiency target. ORR should continue to assess the delivery of Highways England's RIS2 LER efficiencies against its ambitions and review the evidence from OE2025 to substantiate its RP3 LER efficiency assumptions.	dRP3
[R3] In its RIS2 LER planning Highways England indicated that **a further substantial increase in LER renewals may be required in RP3**. As part of the RIS3 process, ORR should assess the sustainability of Highways England's emerging RP3 spending plans and efficiency assumptions and request evidence that demonstrates it can practically deliver LER renewals alongside its capital enhancements programme.	dRP3
[R4] Highways England regularly reports LER delivery progress to ORR. The granularity of reporting has improved but does not provide detailed visibility of planned physical renewal locations against actual delivery or a breakdown by regions. During RP2 ORR should request further evidence from Highways England to show which LER schemes it has delivered against those planned in each region to assess whether Highways England is on track to deliver its planned RIS2 programme. This should include evidence of the 'cost per output' of LER in each region to provide a better understanding of Highways England's programming assumptions for RIS3.	RP2
[R5] Highways England has a risk-based approach to develop each LER programme. These include named scheme programmes, such as for legacy concrete pavements and structures, to general non-site-specific programmes with regional decision making such as for VRS. Delivering programmes as planned is a key element of asset management maturity and promotes efficiency through optimising coordination and positively engaging the supply chain. ORR should consider monitoring the degree of change that occurs during Highways England's LER programme delivery and request evidence of planned versus target development of programmed schemes through the 3D process, including justification for programme change and the risk and opportunity impact on planned targets.	RP3

Table 9b –Major Structures renewals recommendations

Recommendation for ORR	Timescale
[R6] To provide greater confidence in the output scores which measure the condition of Highways England's highway structures stock, and as part of its planning for RIS3, ORR should consider introducing/developing performance measures relating to the completeness and quality of structures inspections on an annual basis.	dRP3
[R7] Highways England's investment plan for structures is based on maintaining a certain stock condition target and assumes the use of a particular maintenance strategy – e.g. Do Minimum, Planned Preventative etc. The monitoring of a target condition score is fundamental to assessing need and developing Highways England's structures renewals strategy. Now that Highways England has established and is reporting an average structures target condition score (SCav), ORR should consider advising DfT that a new Key Performance Indicator (KPI) is created to monitor Highways England's target condition for structures.	dRP3
[R8] Highways England is required to monitor and report against Performance Indicator 3.2: Structure asset – inventory and condition. This includes monitoring Average Structural Condition (SCav) and Critical element condition (SCcrit). Highways England's strategy for Road Period 2 is based on maintaining a 'steady state' condition against (SCav). ORR should investigate the long-term trends in the condition score relating to (SCcrit) – this would permit a better understanding of the longer-term condition trend of SCcrit and allow ORR to challenge Highways England on the implications of having critical load bearing elements categorised as 'Poor' and what steps are being taken to improve this condition score.	RP2

Table 9c –Legacy concrete pavement renewals recommendations

Recommendation for ORR	Timescale
[R9] It is important to recognise that for concrete pavements the nature of the output delivered, i.e. life extension or reconstruction, is significant; there is benefit in completing reconstruction as soon as possible in terms of whole life cost and disruption. In consequence, while overall output targets may be maintained, deferral of reconstruction in favour of life extension risks eroding the benefits of the programme. Therefore, ORR should explicitly monitor the outputs and outcomes of both reconstruction and life extension works delivered under the programme.	RP3
[R10] It is recognised that life extension works do not remove the need for reconstruction, rather defer the cost, and cause significant disruption. ORR should, therefore, consider the potential benefits and costs of accelerating concrete pavement reconstruction works where feasible considering disruption and coordination with other programmes and taking account of supply chain capacity and resource within Highways England.	dRP3

Table 9d –VRS renewals recommendation

Recommendation for ORR	Timescale
[R11] Highways England operates a risk-based approach to determine VRS needs and a prioritisation process to decide where steel VRS should be retained and where it should be converted to a rigid concrete VRS in central reserves. This is based on factors including asset condition, traffic volumes, network disruption and available funding. It acknowledges that its knowledge of steel VRS condition is less mature than other assets and has plans to improve this knowledge. ORR should undertake specific assessment of the prioritisation process that Highways England uses to determine where not to replace steel with concrete and request evidence of Highways England's condition monitoring programme to enhance this process.	dRP3
[R12] For steel VRS renewals, Highways England's regions are allocated 'ring-fenced' funding to achieve set output targets and they make intelligence-led decisions on how to achieve these – whether to replace stretches of life expired barrier or to adopt a 'find and fix' approach to extend VRS life with smaller discrete barrier sections. The use of 'find and fix' is acknowledged to be a useful whole life cost strategy but the way that these outputs are reported may not provide a holistic assessment of VRS asset residual life. ORR should request evidence from Highways England that assesses the relative value of 'find and fix' in its overall assessment and reporting of VRS residual life, and the long-term implications for managing the VRS asset against a target asset condition.	RP2 and dRP3

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9 Glossary of terms

ACS	Asset class strategy
ADEPT	Association of Directors of Environment, Economy, Planning & Transport
AFI	Association of Fencing Industries
APTR	All Purpose Trunk Road
BASt	Bundesanstalt für Straßenwesen
BCR	Benefit Cost Ratio
BEIS	Department for Business, Energy & Industrial Strategy
BMVI	Bundesministerium für Verkehr und digitale Infrastruktur
CECA	Civil Engineering Contractors Association
CEDR	Conference of European Directors of Roads
CtC	Connecting the Country: Planning for the long term
dSBP	Draft Strategic Business Plan
DBFO	Design, Build, Finance & Operate
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DoT	Department of Transportation (US)
DP	Delivery Plan
DST	Decision support tool
ECS	Element Condition Score
EIMM	Efficiency and Inflation Monitoring Manual
GI	General inspection
HE	Highways England
HGV	Heavy Goods Vehicle
IAM-IS	Integrated Asset Management Information System
KPI	Key Performance Indicator
LA	Local Authority
LER	Life extension renewal
LGA	Local Government Association
MPA	Mineral Products Association
O&M	Operation & Maintenance
OE2025	Operational Excellence transformation programme
OMR	Operations, maintenance and renewals
ORR	Office of Rail and Road
PI	Performance Indicator
PI	Principal Inspection
PQC	Pavement Quality Concrete
PS	Performance Specification
RACI	Responsible, Accountable, Consulted, Informed
RIS	Road Investment Strategy
RP	Roads Period
S&P	(Highways England) Strategy and Planning directorate
SBP	Strategic Business Plan
SCav	Structures Condition (average score for structures elements)
SCcrit	Structures Condition (critical score for structures elements)
SES	(Highways England) Safety, Engineering & standards directorate

SIT	Structures Investment Tool
SMIS	Structures Management Information System
SRN	Strategic Road Network
TfL	Transport for London
TO	Traffic Officer
TS	Transport Scotland
VCB	Vertical Concrete Barrier
VRS	Vehicle restraint system