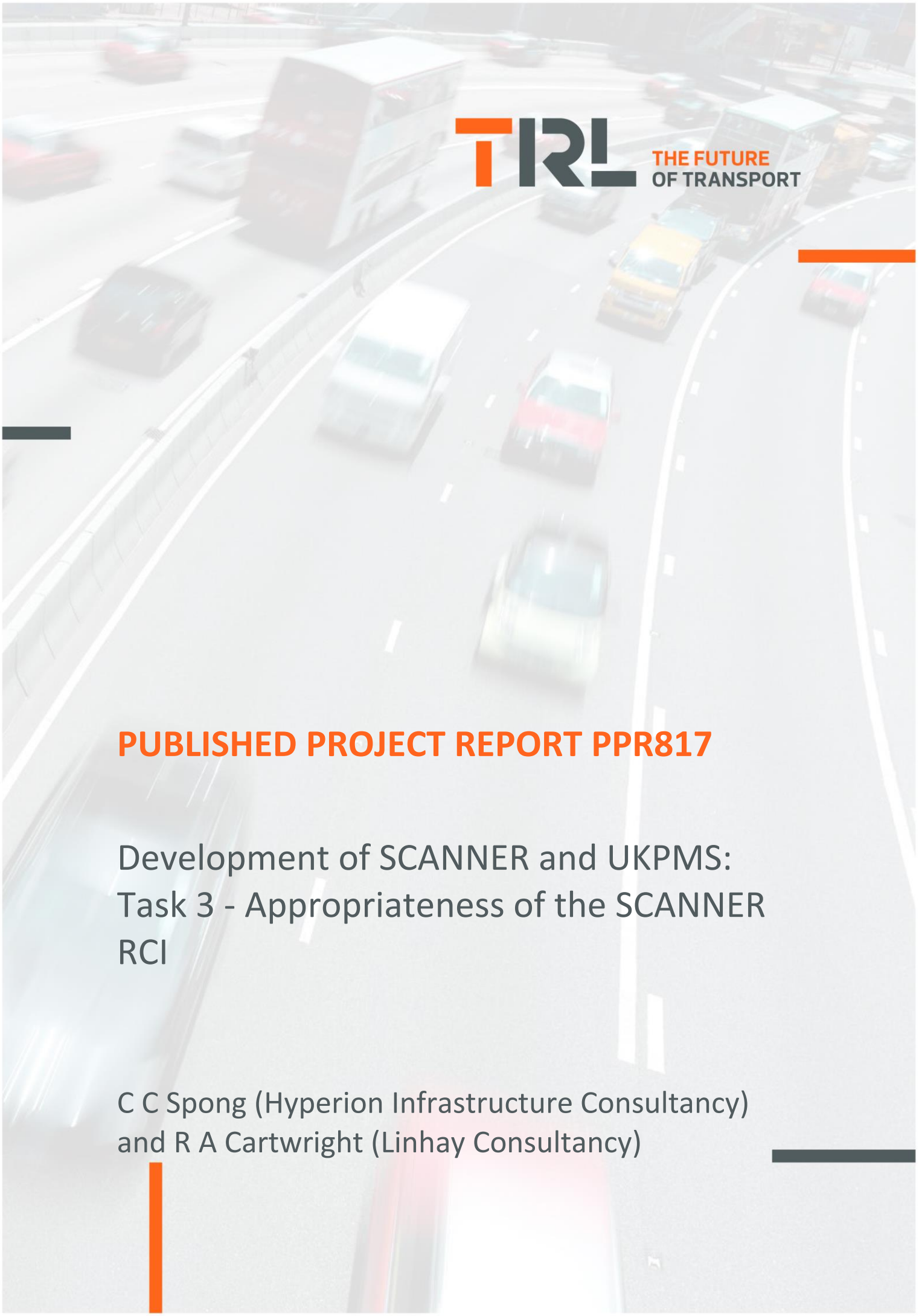

THE FUTURE OF TRANSPORT

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Development of SCANNER and UKPMS: Task 3 - Appropriateness of the SCANNER RCI

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Executive Summary

SCANNER surveys were introduced in 2009 to provide network-wide condition assessment of the local A, B and C road network using survey vehicles that travel at traffic-speed measuring the shape of the road surface using laser sensors, and imaging the surface using digital cameras. The collected data is processed and converted into condition parameters, such as rutting, and delivered in a UKPMS-compliant format to local authorities, for loading into their pavement management systems. The data is used within UKPMS-compliant systems to produce the SCANNER Road Condition Indicator (RCI) that is used for nationally reporting the condition of classified local authority roads throughout the UK. It is also used to identify lengths in need of maintenance or further investigation, and to support scheme identification and prioritisation. In addition, the data supports asset valuation, via the Carriageway Condition Index (CCI), which is a methodology recognised by HAMFIG and CIPFA for use in Whole of Government Accounts (WGA) and for reporting within local authorities' own accounts.

In 2014 a development group led by software developers, survey contractors, the SCANNER auditor, and local authorities (the SCANNER Development Group, SDG) commenced a review of the performance and status of the SCANNER survey, in the light of the experience of local authority data users, SCANNER survey contractors and the SCANNER auditor. The groups identified three key areas where enhancements or modifications to SCANNER were required:

- Consistency: Despite the detailed QA and Accreditation process employed for all SCANNER data there continue to be issues identified with the consistency of SCANNER surveys, in particular in the measurement of cracking. (Task 1)
- SCANNER Condition Parameters: A SCANNER survey reports a wide range of parameters on surface condition. However, there is concern that these are not well used, and that SCANNER does not report all of the defects that authorities regard as important to include in a condition survey. (Task 2)
- Appropriateness of the SCANNER RCI: Does the SCANNER RCI relate well to LHA maintenance decisions, and how LHAs might want to track the effects of maintenance? Could the SCANNER data be better associated with the treatments that are (or would be) undertaken? (Task 3)

The Scottish Road Research Board (SRRB), in collaboration with UK Roads Board, therefore commissioned work to investigate and develop SCANNER surveys in the three key areas identified above, which have been separated into three Tasks. The work described in this report was carried out under Task 3. It has investigated the appropriateness of the SCANNER RCI, with the objective of providing a costed programme for the longer term development of a reporting mechanism that more closely relates SCANNER data to the lengths needing treatment.

An initial desk study has identified that there are significant differences between the RCI, CCI and UKPMS Treatment Rules including the use of specific SCANNER parameters, the way the parameters are weighted and combined, the thresholds where parameters start to contribute, and the lengths over which data is processed. However, it would be necessary

to carry out field studies with real data and engineering input to evaluate the impact of these differences.

A subsequent consultation with local authority practitioners has found that there is a wide range of practices in the use of SCANNER data to support maintenance decision-making, and that there is unlikely to be a single, common solution to improve the RCI. Furthermore, many of the examples of best practice identified make use of existing UKPMS functionality that users in general may not be aware of or may not use for other reasons.

The work concludes that effort should be focussed on making users aware of existing functionality and sharing examples of best practice. Accordingly, a number of 'quick win' improvements are identified that could be implemented quickly at a relatively low cost. An implementation programme has been developed to provide indicative costs for the following improvements within the range £3k to £15k:

- Providing advice on splitting the Amber Band;
- Producing guidance on using the RCI score itself (e.g. for scheme comparison via weighted average);
- Developing a library of local weighting sets (together with guidance for use);
- Capturing and sharing a methodology for developing local weighting sets using local authorities' data;
- Developing a multimedia approach to raising awareness of existing materials (e.g. use of RCI score, information about treatment rules);
- Implementing any new UKPMS Weighting Sets required to support Task 2 of this SCANNER Research Project.

Additionally, a number of longer-term improvement tasks have been identified with the themes of education and awareness, consolidation of previous work, and further analysis to extend the usability of the SCANNER data. An implementation programme has been developed to deliver the improvements, with proposed projects in the range £15k to £100k:

- Developing an overall education strategy for the use of SCANNER data within UKPMS;
- Undertaking further investigations to explore the implications of RCI and CCI differences via a field study with real data and engineering input;
- Finding ways to capture and analyse changes over time at locations and explore how this information could be used (benchmarking, maintenance decisions, valuation);
- Validating existing alternative weighting sets (e.g. Edge, complementary indicators developed by TRL for Scotland etc.);
- Developing treatment rules that use the material/surface type (as stored in UKPMS) when processing SCANNER data. This is likely to involve a calibration exercise with real data;
- Implementing fully any changes arising from Task 2 of this SCANNER Research Project e.g. changes to UKPMS R&P or other national Weighting Sets.

1 Introduction

The SCANNER survey provides network wide condition assessment of the local A, B and C road network using traffic-speed survey devices that collect data on the visual condition and shape of the road surface. The collected data is processed and converted into condition parameters, such as rutting and cracking, and delivered in a UKPMS compliant format to local authorities, for loading into their pavement management systems.

The data is used within UKPMS compliant systems for reporting the condition of classified local authority roads. It is also used to identify lengths in need of maintenance or further investigation, and to support scheme identification and prioritisation. In addition, the data supports asset valuation, via the Carriageway Condition Index (CCI), which is a methodology recognised by HAMFIG and CIPFA for use in Whole of Government Accounts (WGA) and for reporting within local authorities' own accounts.

SCANNER (initially called TTS) was developed from the Highways Agency's TRACS survey of the strategic road network. TRACS was designed for condition measurement on roads that were typically wide and even, and with few extremes of geometry. Therefore development was undertaken to adopt the survey for local roads. A programme of research, supported by the DfT, was carried out between 2003 and 2007 to undertake this development. The primary outcomes were revisions to the data collection requirements to better suit local roads, and the delivery of parameters better focussed on narrower local roads, describing defects such as unevenness and edge deterioration. The research also delivered the definition for the SCANNER Road Condition Indicator (RCI), which estimates the overall condition for each length of the network.

SCANNER surveys are governed under the RCMG, and its sub groups. A working group led by SCANNER contractors and the SCANNER auditor (SCANNER contractor liaison group, SCLG) provides a forum for management and review of the on-going accreditation and QA process. A development group led by software developers, survey contractors, the SCANNER auditor, and local authorities (the SCANNER Development Group, SDG) provides a further forum for the identification of any issues that might be present in SCANNER/UKPMS. In 2014 these groups commenced a review of the performance and status of the SCANNER survey, in the light of the experience of local authority data users, SCANNER survey contractors and the SCANNER auditor. The groups identified a number areas where enhancements or modifications to the SCANNER process were required, in particular the following three key areas.

Optimising the consistency of SCANNER data

As an important survey for both local and national condition assessment a need for consistency and quality control was recognised from the beginning of the SCANNER process. The SCANNER specification requires that all survey devices are accredited, and includes detailed requirements for external independent auditing of the data delivered to Local Highway Authority (LHA) clients. However, even with this process there continue to be issues identified with the consistency of SCANNER surveys. Of the current core data, cracking is the parameter that raises most concern. It is inconsistent across the fleet of SCANNER devices, in that the absolute intensities of cracking reported differ across the fleet and there is inconsistency in the ability of the devices to report cracking at the same locations. Although rutting is more consistent than cracking, concerns were raised over this

measure because issues had been identified with localised bias, noise and inconsistency from device to device (which may be site dependent). This issue is relevant because of the more significant contribution that rutting makes to the SCANNER RCI.

The SCANNER Condition Parameters

The SCANNER survey reports a wide range of parameters including texture, ride quality, rutting, cracking, edge deterioration etc. A number of these were introduced at the conclusion of the 2009 research, but there has been no follow-up work to investigate their capability and relevance. There is also concern that SCANNER does not report all of the defects that authorities regard as important to include in a condition survey. For example, surface defects such as fretting, fatting and, perhaps, potholes. The question has therefore been raised as to whether the current parameter set is appropriate or sufficient to support maintenance operations.

The Appropriateness of the SCANNER RCI.

The review questioned whether the current method of reporting SCANNER data (RCI) matches how LHAs make maintenance decisions or how LHAs might want to track the effects of maintenance. Although the RCI reports the percentage of the network that is estimated to be in poor condition (i.e. in a "red" category), this does not necessarily mean that this is the length that needs treatment, or is the length that will actually receive treatment. This reduces the link between the SCANNER data and the LHA maintenance activities. It has been suggested that more value might be obtained from SCANNER if the data could be better associated with the treatments that are (or would be) undertaken.

Thus the Scottish Road Research Board (SRRB), in collaboration with UK Roads Board, have commissioned work to investigate and develop into the SCANNER survey. The research consists of 3 tasks, relating to the three key areas identified above:

Task 1 - Consistency of SCANNER data

Task 2 - SCANNER Condition Parameters

Task 3 - Appropriateness of the SCANNER RCI

This report describes the work done within Task 3 and the recommendations arising from this work. Tasks 1 and 2 are discussed in a separate report (Benbow et al., 2017).

1.1 Objectives of this task

The purpose of Task 3 has been to investigate the extent to which the current method of reporting condition from SCANNER data (i.e. via the Road Condition Indicator - RCI) matches the approach taken by local highway authorities in selecting locations for maintenance, making maintenance treatment decisions, and tracking the effects of maintenance treatments. The underlying objective is to determine how better value might be obtained from SCANNER if the data could be better associated with local authority maintenance practice. The specific objectives of this task were hence to:

- Undertake a review of the current approach to analysing SCANNER data (RCI), its relationship to other indicators, its strengths and weaknesses, and its application by local authorities (LAs) for local and national road condition assessment.

- Review the current functionality of UKPMS, in particular the treatment rules, to identify how these could be used, in conjunction with SCANNER data (including any new or potentially new parameters identified in Task 2), to develop a SCANNER treatment indicator.
- Review the implications of changing to a "treatment focussed SCANNER RCI" approach on the collection, reporting and use of SCANNER data at the local and national level, and in particular in the context of UKPMS.
- Based on the above reviews, propose a programme for the development of a treatment focussed approach to reporting SCANNER condition data, which should clearly describe the research programme required, the expected costs, timetable and implications for collection and use of SCANNER survey data.

The approach adopted to deliver the task comprised the following steps:

1. Desk-top analysis of RCI, including comparison with other indicators
2. Consult with LAs to understand how they use the RCI, and raw SCANNER data, to make decisions about maintenance
3. Propose improvements to the RCI so that it provides more effective support for decisions about treatments, including potential quick wins as well as a programme of more extensive changes

This report is the final report for this task, and represents Project Deliverable 3b. An initial progress report and early findings were presented to the SCANNER Development Group (SDG) in September 2016, which comprised Project Deliverable 3a (given in Appendix A).

2 Introduction to SCANNER RCI

A SCANNER survey produces a wealth of data. Currently over 40 parameters are collected for every 10m subsection of the carriageway. The challenge has been to extract meaningful management information from this highly technical data source. This challenge was addressed by the SCANNER Road Condition Indicator (RCI), which was originally developed to summarise SCANNER data for national reporting and is now a well-established and consistent way of analysing SCANNER data. For each section of the carriageway network, the RCI calculation combines the SCANNER parameters to give an RCI score; a higher score is indicative of poorer condition. The RCI scores are categorised using a red/amber/green convention so that straightforward summary statistics can be produced for national reporting.

The original motivation for the development of the RCI was to develop an improved method for national reporting; it was designed to be a transparent, 'user-friendly' measure of the overall condition of the carriageway network based on SCANNER data. After the RCI had been introduced, these positive attributes were recognised by local authority engineers who began to use it to support maintenance decisions. The red/amber/green bandings provide a simple interpretation of the complex underlying data and can be readily visualised using a GIS. This helps local engineers to convey messages about carriageway condition to non-experts. An additional benefit for local authority engineers is that it is relatively easy to adapt the calculation for local purposes by plugging in a different set of processing rules (known as a Weighting Set).

The RCI is implemented in UKPMS for reporting by Local Authorities. However in addition to the RCI, UKPMS systems also provide two other standard ways of processing SCANNER data.

- The first of these, the treatment selection algorithm, pre-dates the RCI. The treatment rules are used to compare the individual SCANNER parameters against defined thresholds in order to indicate if a treatment should be considered. The treatment rules were initially introduced in 2003 and were relatively complex. Furthermore they were implemented via the UKPMS Automatic Pass, a black box within UKPMS, which made them even less transparent. In 2006, the original treatment rules were replaced by a simple set of rules developed by a group of engineers – but as these were still implemented via the Automatic Pass, their underlying simplicity may not have been widely recognised.
- SCANNER data can also be processed to obtain the carriageway condition index (CCI). This algorithm was developed from first principles in 2009 by the Highway Asset Management Financial Information Group (HAMFIG) to provide information about depreciation of the highways asset using SCANNER data. This can then be used for financial reporting. The CCI calculation is different from the RCI calculation but it was possible to implement it in UKPMS within the same processing framework, but using a different Weighting Set (i.e. different thresholds and weightings for the parameters).

Figure 1 below summarises the timeline for the development of different ways of processing SCANNER data in UKPMS systems.

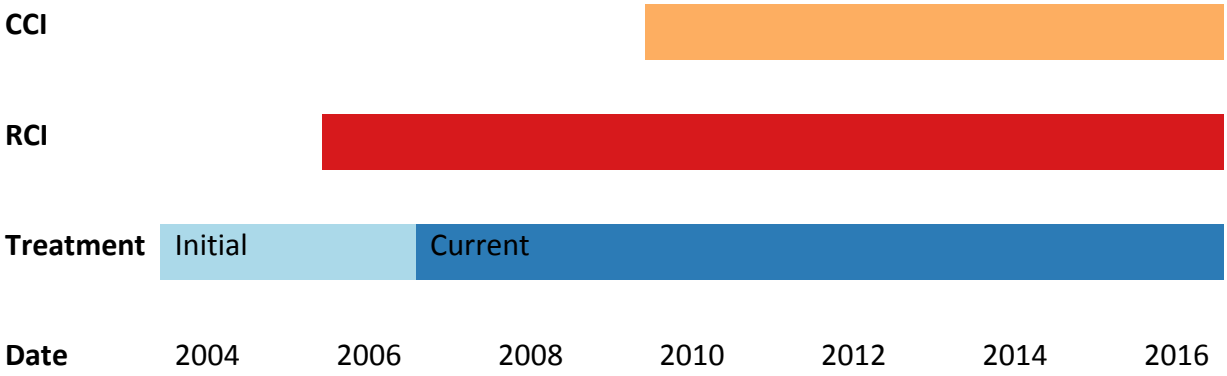

Figure 1: Timeline for ways of processing SCANNER data

As this history shows, the current (simpler) treatment rules were released one year *after* the introduction of RCI processing. It is plausible that many local authorities had already dismissed the treatment rules as overly complicated and opaque and did not revisit this area of UKPMS when the rules were simplified, deciding instead to continue to use the RCI to support maintenance decisions.

Finally, in addition to these standard methods for processing SCANNER data collected across the full width of the carriageway, there is also a weighting set and treatment rules for processing edge data collected during SCANNER surveys. The way in which this edge data is handled is discussed in more detail below in Section 4.

3 Methodology

As described in Section 1, the approach adopted to deliver the task comprised the following steps:

1. Desk-top analysis of RCI, including comparison with other indicators
2. Consultation with local authorities to understand:
    - How they use SCANNER data to make decisions about maintenance including the extent to which they use national UKPMS Treatment Rules, local treatment rules and weighting sets, and/or individual, or subsets of, SCANNER parameters directly; and
    - How they use the RCI itself to make decisions about maintenance, and how it could be improved.

Leading to:

3. Propose improvements to the RCI so that it provides more effective support for decisions about treatments, including potential quick wins as well as a programme of more extensive changes

This section describes the methodology adopted to carry out the desk-top analysis and consultation with local authorities.

3.1 Desk-top analysis of RCI

Based on a review of existing published material, the aim of the desk-top analysis was to understand the RCI calculation and compare this to other SCANNER indicators, in particular the CCI used to calculate depreciation for Whole of Government Accounting (WGA), as well as the existing UKPMS treatment rules for SCANNER data.

In particular, the analysis looked at differences between the following:

- SCANNER parameters included in the indicator
- Thresholds and weightings used for SCANNER parameters
- Processing lengths

The implications of any identified differences were then considered. The results of this analysis are discussed in Section 4.

3.2 User consultation

Using a questionnaire that was developed jointly with Task 2, a two-stage user consultation was undertaken to (i) identify authorities with views and/or experience in the use of the RCI and (ii) to identify a small number of authorities to provide more detailed responses. The full questionnaire is included in Appendix B. However, in summary, the questionnaire included the following eight questions about the use of the RCI:

1. Do you use SCANNER to help you take decisions about maintenance?
2. If you answered YES to Question 1, which of the following do you use (treatments produced by UKPMS, an indicator such as RCI, SCANNER parameters directly, other)?
3. If you answered NO to Question 1, please explain your reasons?

4. Do you use the RCI to help you take decisions about maintenance?
5. Do you use the RCI for any other purposes?
6. Would you like closer links between the RCI and decisions about maintenance?
7. Would you be opposed to any changes being made to the RCI?
8. Do you have any suggestions for improvements to the RCI (e.g. its composition, weightings, etc.)?

Questionnaires were sent to a targeted group of 26 organisations that were reportedly making effective use of SCANNER data to support maintenance decision-making. In order to achieve as wide a coverage as possible, this group included different types of highway authority including private sector service providers, from across the UK.

In total 17 questionnaire responses were received (see Figure 2), of which 11 were from England, four from Scotland, one from Wales and one from Northern Ireland

Responses from England included seven county councils, two unitary authorities, one London borough and one PFI contractor.

Based on the questionnaire responses, more detailed follow-up conversations were held with seven authorities to provide clarification of questionnaire responses and further insight.

The results of the consultation are described in Section 5.

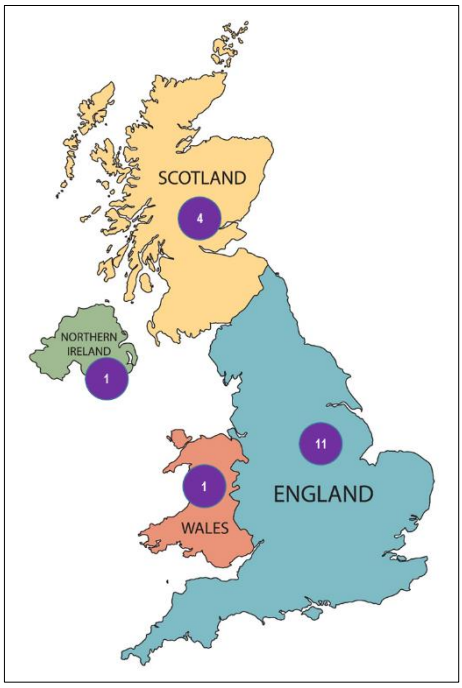

Figure 2: Geographic coverage of questionnaire responses

4 Results of Desktop Analysis

As noted above, the aim of the desktop analysis was to understand the RCI calculation and compare this to other SCANNER indicators, in particular the CCI used to calculate depreciation for Whole of Government Accounting (WGA). Alongside this the existing UKPMS treatment rules for SCANNER data were summarised and any inconsistencies between the RCI and these rules were identified. This section presents a summary of the key findings of the desktop analysis. However, further details are provided in Appendix C.

As described in Section 2 above, the SCANNER RCI was developed independently of the CCI and the treatment rules. Each of these calculations was developed for a different purpose by a different group and at a different time and this resulted in the SCANNER data being combined in different ways. It is therefore not surprising that the RCI, CCI and treatment rules are not fully consistent with each other.

To recap the key points from Section 2:

- The RCI was developed for national reporting and generates a red/amber/green banding of the condition for each 10m subsection of the carriageway network. In this context the red band corresponds to 'plan maintenance soon', the amber band to 'plan investigation soon' and the green band to 'generally good condition'.
- The CCI was developed for financial reporting and is used to give the accumulated depreciation percentage[1] for each 10m subsection of the carriageway network, which is then aggregated for each network group (e.g. rural A roads). The condition (as expressed via the CCI) is used to provide a notional age (using a deterioration curve) and this is converted to depreciation via a straight line.
- The treatment rules were developed to deduce from the condition data whether a treatment is likely to be required. The treatment rules are used to generate treatment lengths (typically a length of carriageway of about 100m) and to suggest indicative treatments for these.

However, despite these differences, these measures all currently use an almost identical small subset of the SCANNER parameters, as listed in Figure 3 below.

SCANNER parameters	RCI	CCI	Treatment Rules
Wheel path rut depth (LLRT, LRRT) mm	✓	✓	✓
Texture depth SMTD (LLTX) mm	✓	✓	✓
Whole carriageway cracking (LTRC) %	✓	✓	✓
10m LPV (LV10) mm^2	✓	✓	×
3m LPV (LV3) mm^2	✓	✓	✓

[1]Depreciation is the systematic allocation of the depreciable amount of an asset over its useful life. The accumulated depreciation percentage is a measure of the extent to which the carriageway has depreciated and is reported as a percentage of full depreciation. It is used in conjunction with other financial information to calculate the depreciated replacement cost for the carriageway.

SCANNER parameters	RCI	CCI	Treatment Rules
Wheel track cracking intensity (LWCL, LWCR) %	×	×	✓

Figure 3: Subset of SCANNER parameters currently used for processing

As this shows, wheel path rut depth, texture depth, whole carriageway cracking and 3m longitudinal profile variance are used in all the calculations. In addition, 10m longitudinal profile variance is used in the RCI and CCI calculations but not in the treatment rules; conversely wheel track cracking intensity is used in the treatment rules but not in the RCI and CCI calculations.

Although the RCI and CCI use the same subset of SCANNER parameters, the parameters are weighted and combined differently for each of these two indicators, which reflects the different purposes of these indices, as discussed above. It is therefore possible, in theory, that a carriageway could have a high RCI and a low CCI value or vice versa. One of the fundamental differences is that thresholds are applied to the defects in the RCI calculation but no thresholds are applied to individual defects in the CCI calculation. For example, any rut depth over 20mm, regardless of how great, contributes 20 to the RCI whereas for the CCI, although a rut depth of 20mm contributes 20, a rut depth of 25mm contributes 25. An empirical study would show to what extent the RCI and CCI differ from each other for a typical real-world network but the theoretical analysis suggests that the two will not necessarily be well correlated.

There are also pronounced differences between the RCI and the treatment rules. Even for the SCANNER parameters which are common to the two calculations, there are different thresholds. For example, whole carriageway cracking begins to contribute to the RCI at 0.15% whereas it does not contribute to the treatment rules until it reaches 1%. It could be argued that this reflects the fact that although cracking is an indicator of deterioration in condition at 0.15%, it does not begin to contribute to decisions about treatments until it becomes more serious. However, there are also examples which cannot be justified so easily. For example, 3m LPV contributes to treatment decisions for all classes of road at 4mm^2, but for the RCI on B, C and unclassified roads the contribution does not begin until a higher level: 5mm^2 (B roads), 7mm^2 (C roads) and 8mm^2 (unclassified roads).

Another more fundamental difference between the RCI and the treatment rules relates to the processing length. The RCI generates a red/amber/green categorisation for each 10m subsection of the carriageway network. In contrast, the treatment rules are applied to treatment lengths (which are typically 100m, but can be defined by the engineer or based on the homogeneity of the data). This difference is a natural consequence of the different purpose of these two calculations.

It is important to note that the RCI and the treatment rules are implemented differently in UKPMS. The RCI is calculated via a UKPMS Weighting Set. This is also the processing method used for the CCI. In contrast the treatment rules are calculated using the UKPMS Automatic Pass. The Automatic Pass is powerful but complex and is perceived in the industry as a 'black box' whereas the Weighting Set method was designed to be user-friendly and transparent. Historically, the Automatic Pass took a very long time to run, particularly for the large data sets typical of SCANNER. Although processing times have improved, this is still a more complex processing method than the Weighting Set method.

These two influences (processing opacity and processing time) could be factors that deter engineers from using the treatment rules despite the fact that the rules themselves are straightforward.

As mentioned above in Section 2, edge data collected during SCANNER surveys can also be processed. For completeness, this was included in the desk top analysis and details are given in Appendix C. This area of processing is entirely separate from the RCI; it uses totally different SCANNER parameters (i.e. those directly relevant to the condition of the edge of the carriageway). An Edge Weighting Set is used to generate an Edge CI, which is divided into red/amber/green bands. Each of these bands is directly associated with an indicative edge treatment (see Figure 16 for more details). There is, therefore, an inbuilt consistency between the Edge CI and the edge treatments. However, this consistency is not a guarantee that the results are meaningful for engineers; the analysis suggests that the Edge CI may be over-reporting the need for treatment.

The desktop analysis provided important background information for the user consultation by identifying (i) what functionality was already available for analysing SCANNER data using the RCI or other functionality in UKPMS and (ii) how these different areas of functionality related to each other. It also provided insights into areas of inconsistency; here a need for further validation was identified in order to assess the practical implications of some of these theoretical findings. In this way, the findings from the desktop analysis have informed the programme of work described below in Sections 6 and 7.

5 Results of User Consultation

As described in Section 3, questionnaires were sent to a targeted group of 26 organisations including highway authorities and a number of private sector service providers. In total, questionnaire responses were received from the following seventeen organisations:

- Bristol City Council
- Carmarthenshire County Council
- Colas (Portsmouth City Council)
- Cornwall County Council
- Cumbria County Council
- Dumfries & Galloway Council
- Essex County Council
- Kier (Northamptonshire County Council)
- LB Kingston
- Leicester City Council
- Norfolk County Council
- North Lanarkshire Council
- DRD Northern Ireland
- Oxfordshire County Council
- SCOTS
- South Lanarkshire Council
- Worcestershire County Council

5.1 Results of initial questionnaire analysis

A detailed analysis of questionnaire responses related to the use of the SCANNER RCI are given in Appendix D and summarised below.

1. All respondents use SCANNER data and the RCI to help make decisions about maintenance in one way or another (but that is why they were selected).
2. In addition to performance reporting and benchmarking, the majority use the RCI to identify areas for further investigation or to validate schemes identified by engineers using other datasets (visual surveys, defects, complaints, local knowledge etc.)
3. Approximately half use the SCANNER parameters – either on their own or in combination with other datasets – to generate treatments or to validate RCI values.
4. Reasons given for not using SCANNER data included concerns about the reliability and coverage of the data (particularly on lower classes of road), unsatisfactory agreement with observed carriageway condition, or a preference for visual inspections.
5. Five use local weighting sets and/or proprietary software tools to generate schemes from either SCANNER data on its own or in combination with other datasets. One also derives a local scheme score based on a combination of SCANNER and visual data. Two split the Amber Band to identify different types of maintenance.
6. Two use the RCI results to support lifecycle planning as well as developing treatment strategies and business cases for capital investment.
7. All but three respondents wanted closer links between the RCI and maintenance decisions and only two were opposed to changes being made to the current RCI – providing the link with historic data isn't lost and the change is effectively managed and communicated.

8. Suggested improvements to the RCI included:
   - Splitting the Amber Band;
   - Reviewing the RCI to ensure that it better meets the maintenance needs for the full range of roads on the network;
   - Looking at merging data longitudinally and transversely to represent more realistic schemes; and
   - Looking at including material/surface type information.

5.2 Results from follow-up interviews

Based on the questionnaire responses, further follow-up conversations were held with seven respondents on one or more of the following topics, which sought to clarify their responses, or examine some of the suggestions from the initial consultation in more detail. The results of these follow-up conversations were as follows:

Topic	Conclusions
Extent and use of local weighting sets[2]	There is evidence that local weighting sets have been successfully developed by several authorities to meet local requirements
Operational use of UKPMS Treatment Rules	The use of UKPMS treatment rules to support maintenance decision making was confirmed by one respondent; there is also evidence of use of proprietary treatment rules by other respondents.
Use of SCANNER RCI to support life cycle planning and asset valuation	The respondent used SCANNER data and in-house tools for life cycle planning and is also experimenting with HMEP LCP toolkit; also evidence from other respondents of use for asset valuation.
Experience of splitting the RCI Amber Band	The application of splitting the Amber RCI band was followed up with one respondent who uses it to discriminate between lengths within the Amber range. Respondent reported that it was easy to do within their UKPMS system.
Use of year-on-year change of RCI score	Followed up with one respondent who displays last year's Red/Amber/Green alongside this year's score to identify sections with worsening condition.

[2] Local Weighting Sets are those not yet part of library of weighting sets available nationally

Topic	Conclusions
Collection and use of SCANNER data on lower category roads	SCANNER data is being collected on unclassified roads by some respondents and local weighting sets are being developed to handle these. Some issues were reported e.g. Junctions affect longitudinal profile variance (LPV) values.
Use of Edge CI	Edge condition is particularly important on narrow roads without kerbs. However, the multiple processing runs that would be needed to use the Edge CI and edge treatment rules as well as the RCI, etc. could be a barrier for some users.
Use of SCANNER data within the entire end-to-end highway maintenance process	SCANNER is used alongside other sources of information as part of the overall 'toolkit' available to authorities. Processes may vary between authorities but ideas could be shared.

The findings of the user consultation were used to identify improvement actions as discussed in Section 6.

6 Recommended Improvements

The objective of Task 3 was to find ways of improving the value of the RCI to local authorities by making a better link between RCI value and maintenance treatments. In support of this objective, an important outcome of the task was to identify improvements to the RCI so that it provides more effective support for decisions about treatments.

However, it was clear from the user consultation that, given the wide range of practices in the use of SCANNER data to support maintenance decision making, there was unlikely to be a single, common solution to improve the RCI that would satisfy the needs of all users.

One of the main findings from the study was that some local authorities were not aware of the full range of options which already exist for interpreting and using SCANNER data. A key issue to address was therefore to find ways to better disseminate information so that the existing use of SCANNER data could be exploited to the full.

The study also highlighted a number of areas where a more extensive investigation could lead to significant improvements to how SCANNER data can be used by local authorities to support local decision making.

The issues identified in the desk-top analysis (Section 4) and user consultation (Section 5) have therefore been categorised as:

- **Dissemination**: A need for training and/or awareness of existing knowledge and functionality, including dissemination of best practice (ways of working already used by some local authorities)
- **Development**: Areas where further development is needed to understand issues more fully in order to propose solutions or where something new needs to be produced. Examples:
    a. Using real-data to explore impact of theoretical desk-study findings.
    b. Development to support Task 2 (i.e. to enable the outputs from this task to be implemented).
    c. Development of an education strategy (as opposed to simple dissemination of existing information).

The suggested improvements to address these issues have been categorised[3] as:

- **Education:** Activities to increase the knowledge of users about existing system functionality
- **Technical**: Enhancements to UKPMS systems to extend their functionality based on existing knowledge
- **Research**: Investigations into the use or meaning of SCANNER data to increase existing knowledge that may lead to enhancements and/or a need for education.

These improvements have been further categorised in terms of their implementation path as either:

[3] It should be noted that some improvements might tick more than one category.

- **Quick wins**: Individual improvement projects requiring a moderate budget (estimated as £15k or less) and that could be fully implemented within 12 months from the current level of industry readiness; and
- **Longer-term improvements**: Individual improvement projects requiring a larger budget (estimated as more than £15k) that will take longer than 12 months to complete and may require an element of research before they can be implemented.

6.1 Dissemination

Based on the above categorisations, the following dissemination issues were identified, along with the proposed improvement actions:

No.	Description of Issue	Where Identified?	Improvement Needed	Improvement Category	Quick Win or Long-term
1	Some users are getting value from splitting the RCI Amber Band; others appear unaware that this is possible	User Consultation	Investigate availability of functionality to split the RCI Amber Band Disseminate good practice	Technical & Education	QW
2	Some users are getting value from using the RCI Score itself; others appear unaware that this is possible	User Consultation	Develop guidance on the use of RCI Score. Disseminate good practice	Education	QW
3	A number of authorities have successfully developed local weightings sets that better meet their local needs. These may be useful to other authorities.	User Consultation	Provide users with access to a library of existing local weighting sets Disseminate good practice	Technical & Education	QW
4	A number of authorities have successfully developed local weightings sets, others may wish to but not know how	User Consultation	Produce guidance on developing local weighting sets Disseminate good practice	Technical & Education	QW

No.	Description of Issue	Where Identified?	Improvement Needed	Improvement Category	Quick Win or Long-term
5	There was a general lack of awareness of existing UKPMS functionality and guidance material related to the use of SCANNER data.	User Consultation	Improve communication and raise awareness	Education	QW

6.2 Development

Based on the above categorisations, the following development issues were identified, along with the proposed improvement actions:

No.	Description of Issue	Where Identified?	Improvement Needed	Improvement Category	Quick Win or Long-term
6	Task 2 of this research project may require a new weighting set to implement	Other[4]	Develop and implement new weighting set	Technical	QW
7	There was a general lack of awareness of UKPMS and SCANNER data.	User Consultation	To draw together the other education projects, develop a sustainable education strategy	Education	LT
8	There are differences in the content and structure of the RCI and CCI that may result in differences between network-level reporting, maintenance decision-making and asset valuation.	Desk-top Analysis	Investigate implications of differences between RCI and CCI for real data	Research	LT
9	Some users were reportedly making use of the change in condition over time as part of their maintenance decision making	User Consultation	Analyse potential to use change in condition at location over time	Research	LT

[4] Improvement actions 6 and 12 would be needed to implement the findings of the other Tasks within this project.

No.	Description of Issue	Where Identified?	Improvement Needed	Improvement Category	Quick Win or Long-term
10	A number of existing weighing sets were identified as part of the study, they should be validated before being more widely distributed	Desk-top Analysis / User Consultation	Validate existing weighting sets, including engineering input	Research	LT
11	Some users reported that material type was important in maintenance decision making and should be included in the UKPMS treatment rules	User Consultation	Investigate the use of material type in UKPMS treatment rules for real data	Research	LT
12	Task 2 of this research project may require wider changes to UKPMS to implement fully	Other	Implement changes arising from SCANNER Research	Technical	LT

6.3 Structure of Implementation Plans

Consideration has been given to the implementation path for each of the recommended improvements identified above. Section 7 includes an outline implementation plan for each improvement that includes:

- A description of the improvement, along with its purpose and benefits
- An implementation plan, including indicative estimates of effort
- Initial costs (i.e. indicative cost to implement improvement)
- Ongoing costs (i.e. indicative ongoing support and/or maintenance costs)
- Risks, Issues and Dependencies, including risks of not implementing the improvement
- Improvement Category, i.e. whether the improvement is categorised as education, technical or research.

It should also be noted that the successful implementation of any improvements would be dependent on effective communication and other dissemination activities and that this should be co-ordinated across all implementation projects.

7 Implementation Plans

7.1 Quick Wins

As discussed in Section 6, the following six 'quick win' improvements were identified:

1. Splitting the RCI Amber Band

Description	Provide advice on splitting the Amber Band into the number of bands required by the authority for their analysis. This approach would be flexible and would not require additional processing via another weighting set.
Purpose	Several authorities reported that they found it useful to split the RCI Amber band in order to identify specific parts of their network. Others expressed a desire to do this but were unsure as to the best way to proceed. It is clear that some UKPMS systems support this type of analysis but it was not obvious if this functionality is provided by all UKPMS systems.
Benefits	This would allow local authorities to obtain more value from their SCANNER data using existing functionality. Fruitful approaches could be shared between local authorities. This would lead to better identification of schemes and hence better targeting of maintenance and ultimately better asset management.
Implementation Plan	Implement via UKPMS Developers 1. Define question (2 x days) 2. Consult with Developers (2 x days) 3. Identify best practice (2 x days) 4. Decide on best implementation route (1 x day) 5. Produce and publish awareness material (3 x days)
Initial Cost	Circa £10k
Ongoing Cost	Nil
Risks, Issues and Dependencies	• If not done, people may miss out on benefits of using RCI for more effective asset management and therefore not get full value from their SCANNER surveys • May impact on scope of UKPMS AHC • Current system functionality
Improvement Category	Technical & Education

2. Guidance on use of RCI Score

Description	Produce guidance on using the RCI score itself (e.g. for scheme comparison via weighted average)
Purpose	Many authorities focus on the red/amber/green categorisation and do not consider drilling down into the data via the RCI score.
Benefits	Using a length-weighted RCI score would provide a way of comparing different maintenance schemes. Other standard statistics (maximum, minimum, median etc.) would also aid with the evaluation of schemes or of the network has a whole. This would lead to better identification of schemes and hence better targeting of maintenance and ultimately better asset management.
Implementation Plan	1. Develop guidance material (5 x days) 2. Publish guidance material (2 x days)
Initial Cost	£5k-10k
Ongoing Cost	Nil
Risks, Issues and Dependencies	• If not done, people may miss out on benefits of using RCI for more effective asset management and therefore not get full value from their SCANNER surveys
Improvement Category	Education

3. Library of local weighting sets

Description	Develop a library of local weighting sets (together with guidance for use)
Purpose	The weighting set approach was designed to allow for local customisation. User consultation has confirmed that some local authorities are indeed using local weighting sets tailored to their network and to suit specific purposes. These weighting sets may be of use to other local authorities with a similar composition and aims.
Benefits	Sharing local weighting sets avoids the duplication of effort which is an inevitable consequence of isolated development. A central library would allow users to share best practice, build on existing expertise and collectively instigate incremental improvements. This would lead to better identification of schemes and hence better targeting of maintenance and ultimately better asset management.
Implementation Plan	1. Liaise with known holders of local weighting sets (3 x days) 2. Identify preferred hosting method (1 x day) 3. Develop guidance on use of each weighting set (3 x days) 4. Develop package for each weighting set (3 x days) 5. Publish weighting sets (1 x day)
Initial Cost	£10k – 15k
Ongoing Activities	1. Adding new weighting sets (3 x days per weighting set – as required) 2. Updating existing weighting sets (1 x day per weighting set)
Ongoing Cost	Circa £3k for any new weighting set (as required) £1k – 2k for any updated weighting set
Risks, Issues and Dependencies	• If existing hosting options are not available – alternative must be developed • Without ongoing commitment could lose momentum • If not done, people may miss out on benefits of more effective asset management and therefore not get full value from their SCANNER surveys • Commercial / IP considerations • Ongoing activities will be ad-hoc – what would be an appropriate funding mechanism? • Dependent on engagement and cooperation from holders of weighting sets
Improvement Category	Technical & Education

4. Methodology for developing local weighting sets

Description	Capture and share methodology for developing local weighting sets using local authorities' data
Purpose	There were reports via the user consultation of a standard methodology for the development of a local weighting set based on local data. This methodology could be used by other local authorities as a shortcut to develop their own local weighting set based on their own data.
Benefits	Sharing the methodology avoids the duplication of effort which is an inevitable consequence of isolated development. This would allow users to share best practice, build on existing expertise and collectively instigate incremental improvements. This would lead to better identification of schemes and hence better targeting of maintenance and ultimately better asset management.
Implementation Plan	1. Liaise with known developer[5] of methodology (2 x days) 2. Produce description of methodology (3 x days) 3. Publish methodology (1 x day)
Initial Cost	Circa £5k
Ongoing Activities	1. Identify, capture and describe new methodologies (6 x days per methodology – as required) 2. Maintain existing methodology (<1 day per year)
Ongoing Cost	Circa £5k for any new methodology <£1k per year
Risks, Issues and Dependencies	• Existing methodology may not be generic • Without ongoing commitment could lose momentum • If not done, people may miss out on benefits of more effective asset management and therefore not get full value from their SCANNER surveys • Commercial / IP considerations • Ongoing activities will be ad-hoc – what would be an appropriate funding mechanism? • Dependent on engagement and cooperation from holders of weighting sets
Improvement Category	Technical & Education

[5] SW England Group

5. Communication and awareness

Description	Develop a multimedia approach to raising awareness of existing materials (e.g. use of RCI score, information about treatment rules) to support the other quick wins
Purpose	To disseminate information in a targeted, accessible and cost-effective way. That is, to ensure the right information reaches the right people, in the right way and at the right time
Benefits	The key benefit of this quick win is that it maximises the benefits of the other quick-wins and longer-term improvements. It therefore consolidates the aims underpinning these other improvements, namely, better identification of schemes, better targeting of maintenance and better asset management.
Implementation Plan	1. Define scope of task (2 x days) 2. Develop initial communication strategy, including potential channels (2 x days) 3. Produce guidance material (2 x days) 4. Deliver communication to raise awareness (4 x days)
Initial Cost	Circa £10k
Ongoing Activities	1. Regularly review strategy (4 x per year) 2. Produce and deliver new guidance and communication (2 x days per deliverable – as required). 3. Ongoing activities would cease if longer term communication tasks is undertaken.
Ongoing Cost	Circa £5k per year Circa £2k for any new deliverable
Risks, Issues and Dependencies	• If not done, other quick wins will fail • Ongoing activities will be critical – what would be an appropriate funding mechanism? • By definition, this is constrained to the extent of existing material • Success will depend on sustained commitment • Success of associated Longer-term Improvement will be dependent on this quick win
Improvement Category	Education

6. Implement new weighting set to support Task 2

Description	Implement new UKPMS Weighting Set to support ride quality recommendations from Task 2 of SCANNER Research Project
Purpose	This will allow the recommendations from Task 2 to be accessed by local authorities via an established mechanism.
Benefits	This is a quick and straightforward way of implementing the benefits of Task 2. This would lead to better identification of schemes and hence better targeting of maintenance and ultimately better asset management.
Implementation Plan	1. Define scope (<1 day) 2. Define parameters (1 day) 3. Create and deliver new series of weighting sets (2 x days)
Initial Cost	Circa £3k
Ongoing Activities	N/a
Ongoing Cost	Nil
Risks, Issues and Dependencies	• If not done, the output of Task 2 will not be able to be implemented • Liaison will be needed with DfT, Scotland, etc. about potential use in national reporting • Dependent on outcome from Task 2 of SCANNER Research Project
Improvement Category	Technical

7.2 Longer-term Improvements

As discussed in Section 6, the following six longer-term improvements were identified:

7. Develop an Education Strategy

Description	Develop an education strategy for use of SCANNER data within UKPMS
Purpose	This is linked to quick-win 5 (Communication and awareness) but is more extensive and moves beyond communication and awareness to a full-blown education strategy. The purpose of the strategy will be to develop local authority confidence and expertise in the use of SCANNER data. It is envisaged that delivery is likely to be via high-quality multimedia education materials so that the courses are inclusive and accessible regardless of location, time constraints or other local limitations.
Benefits	This will enable full use to be made of SCANNER data by developing confidence and expertise throughout the industry. It will also provide a platform for new developments to be disseminated in the future. The education strategy is a vital ingredient in helping the industry to gain the greatest benefit from other improvements to asset management by ensuring that they reach as wide an audience as possible and are implemented to maximum effect.
Implementation Plan	1. Define scope of task (3 x days) 2. Develop ongoing education strategy, including potential multi-media channels (15 x days) 3. Produce education framework (dependent on previous steps) 4. Deliver training materials to initiate approach (dependent on previous steps)
Initial Cost	£15k – 20k to produce strategy Subsequent costs dependent on strategy
Ongoing Activities	Ongoing implementation of strategy
Ongoing Cost	Costs dependent on strategy

Risks, Issues and Dependencies	• If not done, authorities will continue to under-utilise SCANNER data within UKPMS and skills gap will widen • Other risks may be identified within strategy • Ownership and governance of education strategy must be clearly defined • Ongoing activities will be critical – what would be an appropriate funding mechanism? • Success will depend on sustained commitment • Could be developed to build on and will ultimately replace relevant quick win
Improvement Category	Education

8. Investigate implications of differences between RCI and CCI

Description	Further investigation to explore implications of RCI and CCI differences via a field study with real data and engineering input.
Purpose	The desktop study identified theoretical differences between the RCI and CCI. The purpose of this longer-term improvement would be to find out (via real data and engineering input) which of these differences are significant from a practical perspective.
Benefits	A deeper understanding of how the differences are manifested in real data is a pre-requisite for further practical guidance to support the interpretation and ongoing development of these two indicators. This project reduces the risks associated with a lack of understanding of the practical implications of the differences between the RCI and the CCI. It will support better asset management by helping practitioners to better understand which indicator to use in which circumstances.
Implementation Plan	1. Define scope of task (2 x days) 2. Develop methodology and identify data sources, sites, etc. (15 x days) 3. Undertake field study (20 x days) 4. Analysis of results (20 x days) 5. Produce report (15 x days)
Initial Cost	£70 - 80k
Ongoing Activities	N/a
Ongoing Cost	Nil
Risks, Issues and Dependencies	• Project will require input from representative authorities and data sets • Findings may have implications for national reporting and financial reporting • Cooperation and resources from local authorities
Improvement Category	Research

9. Analyse change in condition at location over time

Description	Find ways to capture and analyse change over time at locations and explore how this information could be used (benchmarking, maintenance decisions, valuation).
Purpose	This project aims to provide a way of tracking the change in condition over time at a particular location, and of understanding the opportunities and limitations of such information.
Benefits	This project would add an important dimension to asset management. It would enable existing deterioration models to be validated more readily and extensively and would promote further development of these. It would also allow the timing of maintenance treatments to be more accurately targeted e.g. by identifying parts of the network which are deteriorating rapidly versus those parts where the condition is more stable. It would allow for more accurate and consistent monitoring of new treatments and techniques. All these advances would lead to better asset management.
Implementation Plan	1. Define scope of task (3 x days) 2. Develop methodology and identify data sources, sites, etc. (20 x days) 3. Undertake research and collect data (30 x days) 4. Analysis of results (30 x days) 5. Produce report (15 x days)
Initial Cost	£90k - 100k
Ongoing Activities	N/a
Ongoing Cost	Nil
Risks, Issues and Dependencies	• Project will require input from representative authorities with accurate data sets over a sustained period of time • Findings may have wide ranging applications • Cooperation and resources from local authorities, survey contractors and other data suppliers
Improvement Category	Research

10. Validate existing weighting sets

Description	Validation of weighting sets (e.g. Edge, complementary indicators developed by TRL for Scotland etc.)
Purpose	Various alternative weighting sets were uncovered during the desktop study and user consultation. Some of these offered promising lines of development but had not yet been validated using real data. The purpose of this task is to validate these weighting sets to provide a greater understanding of their performance in the real-world before disseminating them more widely.
Benefits	Various existing weighting sets could be disseminated more widely in the industry once there is a greater understanding of their performance in a practical context. An additional benefit is that such an understanding could lead to refinements to these weighting sets or to the development of new weighting sets to meet new challenges. This would lead to better identification of schemes and hence better targeting of maintenance and ultimately better asset management.
Implementation Plan	1. Define scope of task (2 x days) 2. Develop methodology and identify data sources, sites, etc. (15 x days) 3. Undertake field study (20 x days) 4. Analysis of results (20 x days) 5. Produce report (15 x days)
Initial Cost	£70k – 80k
Ongoing Activities	N/a
Ongoing Cost	Nil
Risks, Issues and Dependencies	• Project will require input from representative authorities with accurate data sets • Findings may have implications for national reporting and valuation • Cooperation and resources from local authorities
Improvement Category	Research

11. Investigate use of material type in treatment rules

Description	Develop treatment rules which use the material/surface type (as stored in UKPMS) when processing SCANNER data. This is likely to involve a calibration exercise with real data.
Purpose	Currently SCANNER data is processed independently of material type. However, UKPMS stores material type and this could be combined with the SCANNER data to provide a more nuanced interpretation of the parameters. The purpose of this project is to explore this area so as to find the key relationships between SCANNER data and material type and identify how these might best be used in practice.
Benefits	This will allow SCANNER data to be interpreted more reliably across different material types and will therefore lead to improvements in how SCANNER data can be used to support maintenance decisions. It may also provide insights and data to support further development of the SCANNER survey. This would lead to better identification of schemes and hence better targeting of maintenance and ultimately better asset management.
Implementation Plan	1. Define scope of task (2 x days) 2. Develop methodology and identify data sources, sites, etc. (15 x days) 3. Undertake field study (20 x days) 4. Analysis of results (20 x days) 5. Produce report (15 x days)
Initial Cost	£70k - 80k
Ongoing Activities	N/a
Ongoing Cost	Nil
Risks, Issues and Dependencies	• Project will require input from a representative authority with accurate data sets • Findings may have wide ranging applications • Cooperation and resources from a local authority • Availability of accurate and current inventory data
Improvement Category	Research

12. Implement changes arising from SCANNER Research

Description	Full implementation of changes arising from Task 2 recommendations for ride quality e.g. changes to UKPMS R&P or other national Weighting Sets
Purpose	This will allow the recommendations from Task 2 to be utilised fully by local authorities across all parts of UKPMS via an established mechanism.
Benefits	This project follows on from Quick Win 6 (Implement new weighting set to support Task 2). The benefit of this longer-term improvement is that it implements the findings from Task 2 fully into UKPMS. Without this task the gap between the RCI and other uses of SCANNER data (e.g. CCI and treatment rules) will become wider.
Implementation Plan	1. Define scope (2 x days) 2. Liaise with national stakeholders (DfT, CIPFA, etc.) (5 x days) 3. Define parameters (e.g. new treatment rules) (10 x days) 4. Create and deliver new UKPMS Rules and Parameters and Weighting Sets (10 x days) 5. Update documentation (10 x days)
Initial Cost	£35k - 40k
Ongoing Activities	N/a
Ongoing Cost	Nil
Risks, Issues and Dependencies	• If not done, the output of Task 2 will not be able to be fully implemented • If not done and Quick Win 6 is done, the existing gap between RCI and other uses of SCANNER data will widen • Liaison will be needed with national stakeholders about impact of changes • Will impact on the AHC • Dependent on outcome from Task 2 of SCANNER Research Project • Dependent on Quick Win 6 • Link to research task investigating differences between RCI and CCI (Longer-term Improvement 8)
Improvement Category	Technical

7.3 Summary of Costs

The table below summarises the initial costs for each of the improvements identified and indicates whether or not ongoing costs are expected:

No.	Title	Quick Win or Long-term	Initial Cost (£k)	Ongoing cost?
1	Splitting the RCI Amber Band	QW	10	No
2	Guidance on use of RCI Score	QW	10	No
3	Library of local weighting sets	QW	15	Yes
4	Methodology for developing local weighting sets	QW	5	Yes
5	Communication and awareness	QW	10	Yes
6	Implement new weighting set to support Task 2	QW	3	No
7	Develop an education strategy	LT	20	Yes
8	Investigate implications of differences between RCI and CCI	LT	80	No
9	Analyse change in condition at location over time	LT	100	No
10	Validate existing weighting sets	LT	80	No
11	Investigate use of material type in treatment rules	LT	80	No
12	Implement changes arising from SCANNER Research	LT	40	No

8 Conclusions and Recommendations

The aim of this task was to investigate the appropriateness of the SCANNER RCI with the longer term objective of providing a development programme (with costs) for a reporting mechanism that more closely relates SCANNER data to the lengths needing treatments.

1. A desk study examined differences between the RCI (developed for national condition reporting), CCI (developed for financial reporting), and UKPMS Treatment Rules (developed to provide indicative treatments) and found that:
    - Although the RCI and CCI both use the same small subset of SCANNER parameters, they are weighted and combined differently meaning that, in theory, a carriageway could have a high RCI score and a low CCI score, or vice versa.
    - There are some differences between the SCANNER parameters used by the RCI and UKPMS treatment rules as well as differences in the thresholds where parameters start to contribute. There are also differences in the lengths over which data is processed; the RCI generates a score for each 10m length whereas UKPMS treatments are generated for each 'treatment length' which is typically 100m.
    - It would be necessary to carry out field studies with real data and engineering input to evaluate the impact of these differences.
2. Results from a consultation on the use of SCANNER RCI from 17 local authorities believed to be using SCANNER data and the RCI to help make decisions about maintenance found that:
    - In addition to performance reporting and benchmarking, the majority use the RCI to identify areas for further investigation or to validate schemes identified by engineers using other datasets;
    - Approximately half use the SCANNER parameters – either on their own or in combination with other datasets – to generate treatments or to validate RCI values;
    - Reasons given for not using SCANNER data included concerns about the reliability and coverage of the data – particularly on lower classes of road, unsatisfactory agreement with observed carriageway condition, or a preference for visual inspections;
    - Five use local weighting sets and/or proprietary software tools to generate schemes from either SCANNER data on its own or in combination with other datasets. One also derives a local scheme score based on a combination of SCANNER and visual data. Two split the Amber Band to identify different types of maintenance;
    - Two use the RCI results to support lifecycle planning as well as developing treatment strategies and business cases for capital investment; and
    - All but three respondents wanted closer links between the RCI and maintenance decisions and only two were opposed to changes being made to the current RCI – providing the link with historic data isn't lost and the change is effectively managed and communicated.
3. Given the wide range of practices in the use of SCANNER data to support maintenance decision making, it was clear that there was unlikely to be a single, common solution to

improve the RCI. Furthermore, many of the examples of best practice identified made use of existing UKPMS functionality that users in general may not be aware of or may not use for other reasons.

4. It was therefore recommended that effort should be focussed on making users aware of existing functionality and sharing examples of best practice. In particular, this should include splitting the Amber RCI Band and, more generally, using the RCI score itself, and encouraging the development and use of local weighting sets. Other potential areas requiring further investigation were the use of change in RCI score at a particular location over time and the use of material type within the UKPMS treatment rules.
5. On the basis of this analysis, it was recommended that the following 'quick win' improvements should be implemented:
   - Providing advice on splitting the Amber Band;
   - Producing guidance on using the RCI score itself (e.g. for scheme comparison via weighted average);
   - Developing a library of local weighting sets (together with guidance for use);
   - Capturing and sharing a methodology for developing local weighting sets using local authorities' data;
   - Developing a multimedia approach to raising awareness of existing materials (e.g. use of RCI score, information about treatment rules); and
   - Implementing any new UKPMS Weighting Sets required to support Task 2 of this SCANNER Research Project.

   These quick win improvements could be implemented within 12-months for a total up-front cost of less than £55k, and would quickly enable users to get more value from the SCANNER data and make better maintenance decisions. Alternatively any of the individual tasks could be implemented in isolation and would still deliver benefits.
6. It was also recommended that the following, longer term improvement tasks would provide benefits:
   - Developing an overall education strategy for the use of SCANNER data within UKPMS;
   - Undertaking further investigations to explore the implications of RCI and CCI differences via a field study with real data and engineering input;
   - Finding ways to capture and analyse changes over time at locations and explore how this information could be used (benchmarking, maintenance decisions, valuation);
   - Validating existing alternative weighting sets (e.g. Edge, complementary indicators developed by TRL for Scotland etc.);
   - Developing treatment rules that use the material/surface type (as stored in UKPMS) when processing SCANNER data. This is likely to involve a calibration exercise with real data; and
   - Implementing fully any changes arising from Task 2 of this SCANNER Research Project e.g. changes to UKPMS R&P or other national Weighting Sets.

These longer-term improvements would require two to three years to implement for a total up-front cost of approximately £400k, but would lead to significant enhancements in the SCANNER RCI as well as providing a sustainable longer-term solution to maintain the knowledge base amongst users. Alternatively any of the individual tasks could be implemented in isolation and would still deliver benefits.

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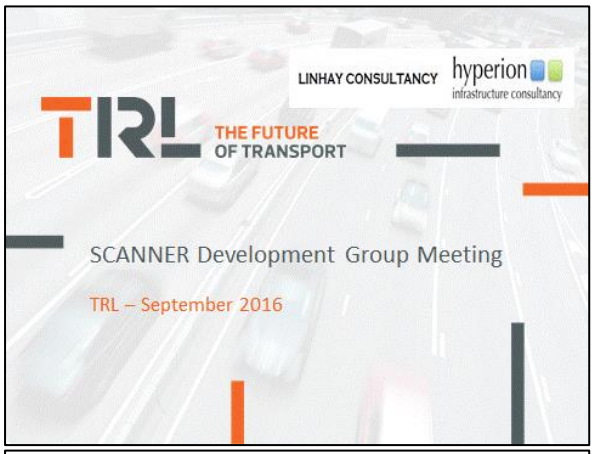
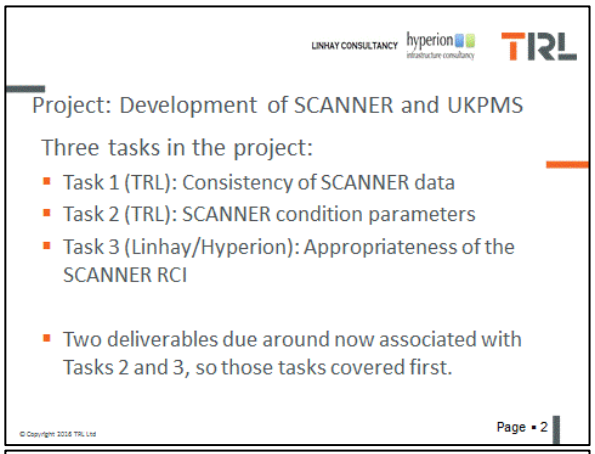
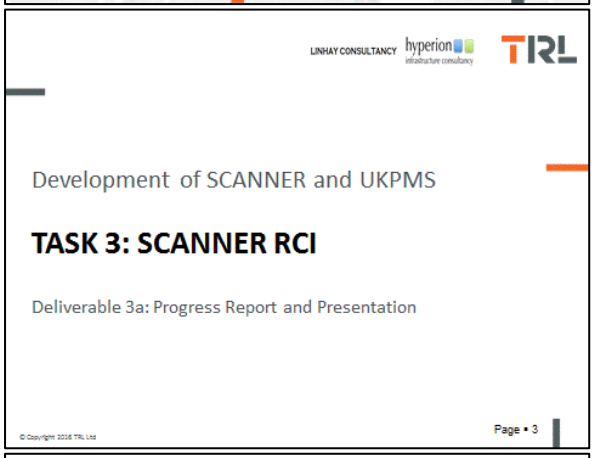
Watson, P., Wright, A. & McRobbie, S. (2006). Edge deterioration on local roads, PPR084. Crowthorne: TRL Ltd.

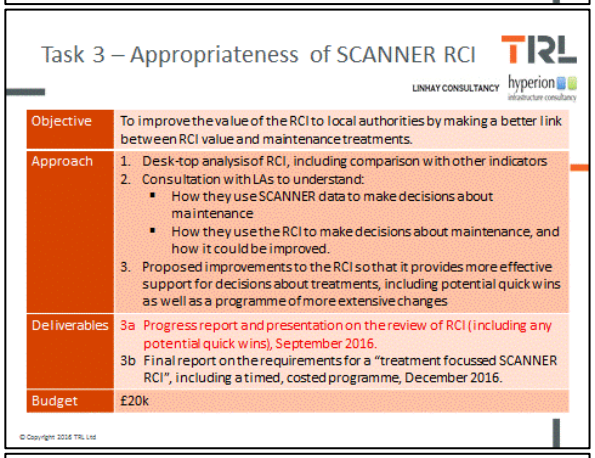
Appendix A Interim Deliverable

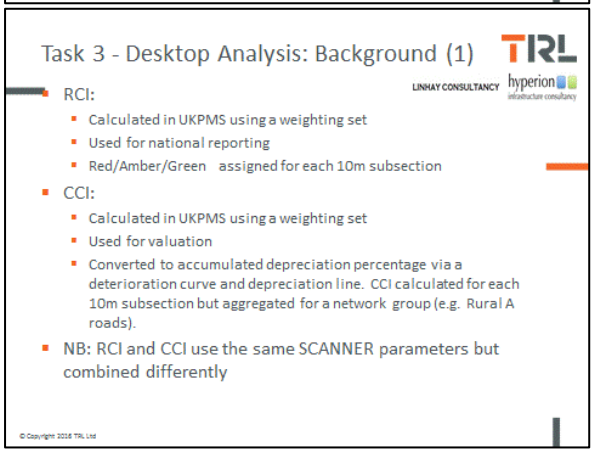
The Interim Deliverable (Deliverable 3a: progress report and presentation) was delivered to the SCANNER Development Group at its meeting on 22nd September 2016. The progress report comprised the slides reproduced below:

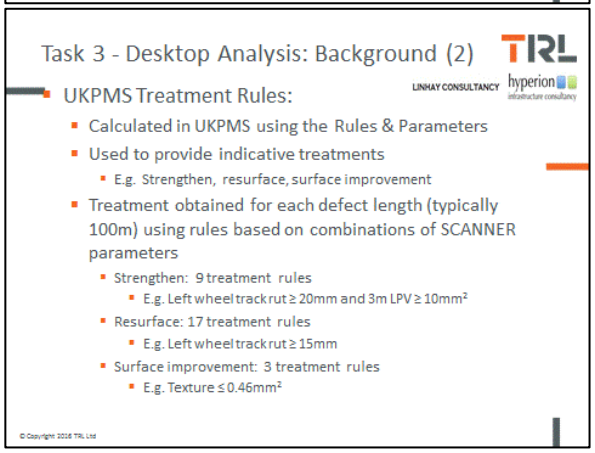












Task 3 - Results from Desktop Analysis

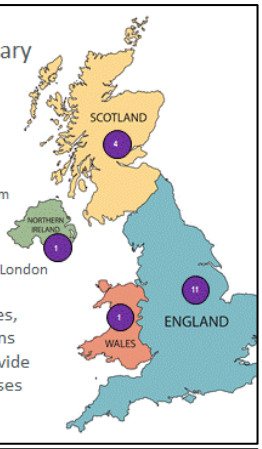
- A comparison of RCI with other indicators concluded that the RCI, CCI and main UKPMS treatment rules are inconsistent with each other

Wheel track cracking	Used in treatment rules, not in RCI or CCI
10m LPV	Contributes to RCI and CCI but not treatment rules
Parameter thresholds	Threshold at which parameters contribute differs between RCI and treatment rules
Processing length	Treatment rules apply to 100m lengths (typically), RCI calculated for each 10m subsection
Comparison of RCI vs CCI	Use same parameters but weighted and combined differently

- Edge Treatments in UKPMS are based on the Edge CI so the two measures are consistent but not necessarily appropriate.

Task 3 - Consultation Summary

- 17 questionnaire responses were received (out of 26), of which:
  - 11 from England, 4 from Scotland, 1 from Wales, 1 from Northern Ireland
- Responses from England included:
  - 7 x counties, 2 x unitary authorities, 1 x London Borough and 1 x PFI Contract
- Based on the questionnaire responses, more detailed follow-up conversations were held with 7 x authorities to provide clarification of questionnaire responses and further insight



Task 3 - Analysis of Consultation Responses (1)

1. All respondents use SCANNER data and the RCI to help make decisions about maintenance in one way or another (but that is why they were selected)
2. In addition to performance reporting and benchmarking, the majority use the RCI to identify areas for further investigation or to validate schemes identified by engineers using other datasets (visual surveys, defects, complaints, local knowledge etc.)
3. Approximately half use the SCANNER parameters – either on their own or in combination with other datasets – to generate treatments or to validate RCI values
4. Reasons given for not using SCANNER data included concerns about the reliability and coverage of the data – particularly on lower classes of road, unsatisfactory agreement with observed carriageway condition, or a preference for visual inspections

Task 3 - Analysis of Consultation Responses (2)

5. Five use local weighting sets and/or proprietary software tools to generate schemes from either SCANNER data on its own or in combination with other datasets. One also derives a local scheme score based on a combination of SCANNER and visual data. Two split the Amber Band to identify different types of maintenance
6. Two use the RCI results to support lifecycle planning as well as developing treatment strategies and business cases for capital investment
7. All but three respondents wanted closer links between the RCI and maintenance decisions and only two were opposed to changes being made to the current RCI – providing the link with historic data isn't lost and the change is effectively managed and communicated
8. Suggested improvements included:
   - Splitting the Amber Band;
   - Reviewing the RCI to ensure that it better meets the maintenance needs for the full range of roads on the network;
   - Looking at merging data longitudinally and transversely to represent more realistic schemes; and
   - Looking at including material/surface type information.

Task 3 - Further Follow-up (1)

- Further follow-up conversations with seven respondents on one or more of the following topics sought to clarify responses or examine some of the suggestions from the initial consultation in more detail

Topic	Conclusions
Use of local weighting sets *i.e. those not yet part of library of weighting sets available nationally*	Evidence that local weighting sets have been successfully developed by several authorities to meet local requirements
UKPMS Treatment Rules	Use of UKPMS treatment rules followed up with one respondent; also evidence of use of proprietary treatment rules by other respondents.
Life cycle planning & valuation	Respondent used SCANNER data for in-house tools for life cycle planning and is also experimenting with HMEP LCP toolkit; also evidence from other respondents of use for valuation.
Split Amber Band	Splitting the Amber category followed up with one respondent. Used to discriminate between lengths within the Amber range. Respondent reported that it was easy to do within their UKPMS.

Task 3 - Further Follow-up (2)

- Further follow-up conversations (continued)

Topic	Conclusions
Year-on-year change	Followed up with one respondent who displays last year's Red/Amber/Green alongside this year's
Lower category roads	SCANNER data is being collected on unclassified roads by some respondents and local weighting sets are being developed to handle these. Some issues e.g. Junctions affect LPV
Edge CI	Edge is particularly important on narrow roads without kerbs. Multiple processing is a barrier to using Edge CI and edge treatment rules
Entire end-to-end process	SCANNER is used alongside other sources of information as part of the 'toolkit'. Processes vary but ideas could be shared.

Task 3 - Potential Quick Wins

- Based on the desktop analysis, consultation and follow-up, a number of potential, pragmatic quick wins have been identified to deliver practical benefits

1. Provide advice on splitting the amber band (and guidance on using the RCI score itself e.g. for scheme comparison via weighted average)
2. Develop a library of local weighting sets (together with guidance for use) and methodology for developing local weighting sets using own data
3. Develop a multimedia approach to raising awareness (e.g. use of RCI score, use of treatment rules)
4. Implement new Weighting Set to support Task 2 (if needed)

Task 3 – Longer-term developments (1)

- Potential longer-term developments include:

1. Plans for education (using modern multimedia approaches i.e. not traditional classroom or manual-reading learning).
2. Further investigation to explore implications of RCI and CCI differences via a field study with real data and engineering input.
3. Finding ways to capture and analyse change over time at locations and explore how this information could be used (benchmarking, maintenance decisions, valuation).

Task 3 – Longer-term developments (2)

- Potential longer-term developments (continued):

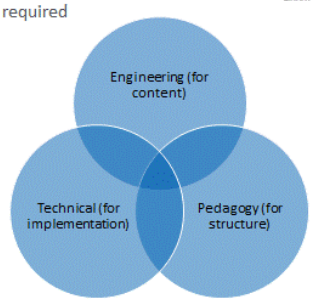
4. Validation of weighting sets (e.g. Edge, complementary indicators developed by TRL for Scotland, local weighting sets etc.)
5. Develop treatment rules which use the material/surface type (as stored in UKPMS) when processing SCANNER data. This is likely to involve a calibration exercise with real data.
6. Implementation of changes arising from Task 2 (or possibly even Task 1) e.g. changes to UKPMS R&P or Weighting Sets

Task 3 – Multimedia Education

- E-learning, blended learning, distance learning
- Examples: FutureLearn, OpenLearn and HMRC
- Teaching methods: Lecture, discussion, Q&A, assignments etc
- Resources: Videos, written text, audio, slides, www links, podcasts, interactive exercises, blogs, forums and wikis
- Delivered via MOOCs, webinars, online tutorials, discussion forums (peer-to-peer learning & assessment), self-evaluation tasks
- Benefits: Inclusive, flexible (when & where), scale can be large or small, can be cheaper than traditional training.

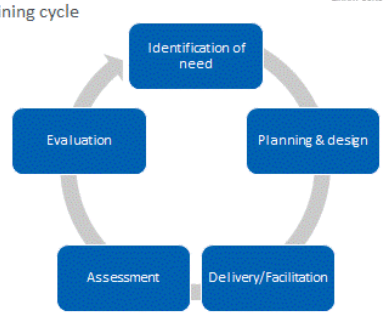
Task 3 – Multimedia Education

- Expertise required



Task 3 – Multimedia Education

- Training cycle



Task 3 - Risks

- Will there be IP constraints on sharing Weighting Sets developed commercially?
- There is a need for multi-processing to get the most from the data (which has implications for time, effort, resources). Innovation needed?
- How will quick-wins and longer-term developments be implemented? What is funding mechanism?

Task 3 – Remaining Work

- To prepare the final report

Deadline for comments (if any) by steering group on quick wins and longer-term developments identified above:
End of October

Task 3 – Conclusions

- RCI appears to be broadly suitable as a benchmarking tool and as a first sift but other weighting sets are more useful for particular situations (especially lower use roads); there is no single multi-purpose weighting set that can do everything for everyone
- Authorities need education and guidance on what is already possible (e.g. using the RCI score itself, splitting the Amber Band, developing local weighting sets, using treatment rules)
- There are limitations when using SCANNER on unclassified network, but there is a clear demand for this. It's possible that improvements here could inform improvements to classified network (i.e. bottom up versus top down from trunk roads).

Appendix B Questionnaire

Development of SCANNER condition surveys

Consultation March 2016

B.1 The Development of SCANNER condition surveys consultation

The SCANNER survey on the local road network provides network wide condition assessment of the local A, B and C road network using survey devices that travel at traffic-speed measuring the shape of the road surface using laser sensors, and imaging the surface using digital cameras. The collected data is processed and converted into condition parameters, such as rutting, and delivered in a UKPMS compliant format to local authorities, for loading into their pavement management systems. The data is used within UKPMS compliant systems for the reporting of the SCANNER Road Condition Indicator (RCI) and the associated Highways Condition Index (HCI) figures for classified local authority roads in England and for the PIs used in Scotland, Wales and Northern Ireland. It is also used within these systems to identify lengths in need of maintenance or further investigation, to support scheme identification and prioritisation and to support asset valuation via the delivery of the Carriageway Condition Index (CCI), which is recognised by HAMFIG and CIPFA as an appropriate measure and methodology for use in Whole of Government Accounts (WGA).

In January 2015 the UKRLG commissioned TRL, supported by the Linhay and Hyperion consultancies, to undertake work to develop the SCANNER survey. One of the key objectives of this project is to determine how SCANNER could be improved to better meet the needs of local highway authorities in two areas:

- **The parameters delivered by SCANNER**. The SCANNER survey reports a wide range of condition parameters, covering road texture, ride quality, rutting, cracking and edge deterioration. Some of these were developed in research undertaken several years ago are not well used by authorities, or included in the SCANNER Road Condition Indicator (RCI). So, are the current parameters well used? Could any be rationalised, or removed? Are any measures missing?
- **The SCANNER Road Condition Indicator (RCI)**. Does the current method of reporting SCANNER data match how local highway authorities make maintenance decisions (or track the effects of maintenance undertaken)? Perhaps if this could be improved a stronger link could be developed between SCANNER data and maintenance activities.

To investigate these questions we are undertaking a consultation on the SCANNER survey and the data it provides, which will focus on these two areas.

B.2 Consultation on the SCANNER Parameters

See the following table

Section B.2.1: Use of the parameters

We would like to better understand the use of the current core and enhanced SCANNER parameters and wish to seek views on the use, coverage, reliability, practicality, value and applications of these.

The following table presents the current list of SCANNER parameters. Could you provide a view on these parameters, using the following as a guide:

- ***Current use**: Please describe whether and how you use this parameter currently e.g. to calculate a condition index, to identify or prioritise maintenance need on the network. State how often you use the parameter: e.g. frequent use, moderate use, little/no use.*
- ***Views**: Please give your views on this parameter, and your understanding of it, in engineering terms. Is it useful/valuable to you in managing the asset? Could it be more useful if improved in some way and what might this improvement be? Alternatively, you may feel that this is of little use. If so, why?*
- ***Importance rating**: If you were to consider this parameter in terms of its value to you in asset management, how would you score it in the range 1-5 (where 1 is very important and 5 is not important at all)? Please give reasons for your rating where appropriate.*

Parameter	Core/ Enhanced (C/E)	My current use of this parameter	My views on this parameter	Importance rating (1-5), and reason
Road Roughness / shape				
3m LPV (nearside, offside)	C			
10m LPV (nearside, offside)	C			
Enhanced 3m LPV (nearside, offside)	E			
Enhanced 10m LPV (nearside, offside)	E			
Bump Measure (nearside, offside)	E			
Geometry (gradient, crossfall, curvature)	C			
Rutting and transverse unevenness				
Rut Depths (nearside, offside)	C			
Cleaned Rut Depths (nearside, offside)	E			
Transverse variance	E			
Transverse unevenness (ADFD)	E			

Texture Parameters				
Texture (SMTD)	C			
Texture (MPD)	C			
RMST Texture depth in the nearside, centre and offside	E			
RMST Variance (nearside, centre, offside	E			
Texture Variability (RMST 5th Percentile, 95th Percentile, Variance)	E			
Surface Deterioration Parameters				
Cracking (whole carriageway)	C			
Wheel Track Cracking (nearside, offside)	C			
Edge of carriageway cracking	C			
Other Visible Defect	C			
Transverse/reflection cracking	E			
Surface Deterioration	E			
Edge Deterioration Parameters				
Edge roughness	E			
Edge steps (at two levels)	E			
Edge coverage	E			

Section B.2.2: The enhanced parameters for rutting and variance *These are parameters that are a direct replacement for the current parameters* • *Enhanced LPV vs Moving Average LPV* • *Cleaned rutting vs Rutting*	
Do you use these enhanced parameters? If not, please tell us why not	
If you do use them, please tell us: Which do you use Why – e.g. have you noted any benefits through applying these parameters in comparison with the originals?	
Section B.2.3: Additional needs for SCANNER parameters *In this section we are seeking views on measures/parameters that are missing from SCANNER*	
Considering the list of parameters given above, what gaps do you see in the SCANNER data? E.g. defects on your road network, which you consider to be important, that SCANNER does not assess? Please list these and describe how you might use this information if SCANNER could be developed to provide this.	

B.3 Consultation on the SCANNER RCI

The aim of this section is to help us understand the extent to which authorities use the RCI, or use SCANNER parameters in another way, to inform maintenance decisions.

Using this information the SCANNER development project aims to consider how the RCI could be improved to provide more effective support for decisions about treatments.

Section B.3.1: Use of SCANNER data in maintenance decisions. *In this section we are examining how current use is made of the SCANNER in maintenance decisions*	
Q1. Do you use SCANNER data to help you take decisions about maintenance?	Yes / No
Q2. If you answered *Yes* to Q1, which of the following do you use?	
Treatments produced by UKPMS using the national treatment rules (i.e. UKPMS Rules & Parameters)	Yes/No *if Yes, please provide more detail*
An indicator (e.g. RCI, CCI, Edge CI or a locally-designed CI)	Yes/No *if Yes, please provide more detail*
SCANNER parameters directly	Yes/No *if Yes, please provide more detail*
Other	Yes/No *if Yes, please provide more detail*

Q3. If you answered *No* to Q1, please explain your reasons	
SCANNER parameters don't give the type of information needed to make decisions about maintenance	Yes/No *if Yes, please provide more detail*
SCANNER parameters are appropriate, but aren't collected reliably enough	Yes/No *if Yes, please provide more detail*
SCANNER parameters are not combined together in the right way in the UKPMS treatment rules and indicators	Yes/No *if Yes, please provide more detail*
We have other methods which are satisfactory	Yes/No *if Yes, please provide more detail*
Other	Yes/No *if Yes, please provide more detail*

Section B.3.2: Use of SCANNER RCI. *In this section we are examining how current use is made of the SCANNER RCI, and views on how it may be improved or better linked to maintenance decisions*	
Q4. Do you use the RCI to help you take decisions about maintenance? **Note: RCI is used in the calculation of national indicators such as 130-01 and 130-02 (England), SRMCS PI (Scotland), THS/012 (Wales). The RCI categorises lengths as red/amber/green.**	Yes/No *if Yes, please provide more detail*
Q5. Do you use the RCI for any other purposes?	Yes/No *if Yes, please provide more detail*
Q6. Would you like closer links between the RCI and decisions about maintenance?	Yes/No *please explain your answer*
Q7. Would you be opposed to any changes being made to the RCI?	Yes/No *please explain your answer*
Q8. Do you have any suggestions for improvements to the RCI (e.g. its composition, weightings, etc.)?	Yes/No *please provide more detail*

B.4 Background Information - What are the SCANNER Parameters and RCI?

SCANNER was developed from the Highways Agency's TRACS survey of the strategic road network. As TRACS was focussed fully on the measurement of roads that were well designed, typically wide, even and with few extremes of geometry, there was a need to undertake development of the survey to adopt it for local roads. A programme of research supported by the DfT was carried out between 2003 and 2007 to undertake this development. The primary outcomes of this work were revisions to the data collection requirements to better suit local roads and the delivery of parameters more focussed on narrower local roads, describing defects such as unevenness and edge deterioration. These have been applied, unchanged, since 2009 for network level SCANNER surveys.

There is a coordinate parameter (which consists of 3 attributes, X, Y, Z), used to locationally reference the data to the network, and 40 further parameters delivered by the SCANNER survey. These are listed in the following table, along with whether they were introduced in, or before, 2009.

All SCANNER parameters are reported at intervals of approximately 10m.

UKPMS code	**SCANNER survey parameter**	**Introduced**
LCRV	(Radius of) Curvature	<2009
LFAL	Crossfall	<2009
LGRD	Gradient	<2009
LV3	3m moving average LPV (left / nearside)	<2009
LL03	3m enhanced LPV (nearside)	2009
LV10	10m moving average LPV (nearside)	<2009
LL10	10m enhanced LPV (nearside)	2009
LLBI	Bump intensity (nearside)	2009
LR03	3m enhanced LPV (offside)	2009
LR10	10m enhanced LPV (offside)	2009
LRBI	Bump intensity (offside)	2009
LLRT	Nearside wheel path rut depth	<2009
LLRD	Nearside rut depth from cleaned profile	2009
LRRT	Offside wheel path rut depth	<2009
LRRD	Offside rut depth from cleaned profile	2009
LTAD	Absolute deviation of 1st derivative of transverse profile	2009
LTRV	Transverse variance	2009
LEDR	Edge roughness	2009
LES1	Road edge step L1 (between 20 and 50mm step down)	2009
LES2	Road edge step L2 (greater than 50mm step down)	2009
LEDC	Edge coverage	2009
LLTX	Nearside Wheel Path Average Texture depth (SMTD)	<2009

UKPMS code	SCANNER survey parameter	Introduced
LLTD	Nearside Wheel Path Average Texture depth (MPD)	<2009
LLTM	Nearside Wheel Path Mean RMST Texture depth	2009
LLTV	Nearside Wheel Path RMST Variance	2009
LCTM	Centre Mean RMST Texture depth	2009
LCTV	Centre RMST Variance	2009
LRTM	Offside Wheel Path Mean RMST Texture depth	2009
LRTV	Offside Wheel Path RMST Variance	2009
LT05	Overall Texture Variability – RMST 5th Percentile Value	2009
LT95	Overall Texture Variability – RMST 95th Percentile Value	2009
LTVV	Overall Texture Variability – RMST Variance	2009
LTRC	Cracking (whole carriageway)	<2009
LWCL	Nearside Wheel Track Cracking Intensity	<2009
LWCR	Offside Wheel Track Cracking Intensity	<2009
LECR	Edge of carriageway cracking	<2009
LOVD	Other Visible Defect	<2009
LRCR	Transverse/reflection cracking	<2009
LSUR	Surface Deterioration Parameter	<2009
LSPD	Survey speed	<2009

The measurements used to calculate these parameters and the pavement features that they describe are given in the following sub-sections.

B.4.1 Road Roughness / Shape

The longitudinal profile is the shape of the road in the direction of travel. SCANNER measures longitudinal profile in both the nearside and offside wheel paths. **Longitudinal profile variance (LPV)** is a measure of how much the road undulates. This is reported over 2 scales: 3m LPV and 10m LPV, where 3m LPV reports the undulation of the road due to features of less than 3m in length and 10m LPV reports undulation due to features of less than 10m in length. There is an **enhanced** version of these parameters which was developed to reduce the influence of road geometry on the reported roughness.

In addition to the general ride quality measures provided by LPV, SCANNER also reports the **Bump Measure** in the two wheelpaths, which indicates the presence of short features that cause discomfort to the users through bumping or jolting.

SCANNER also measures the **geometry**, reported as the gradient, the cross-fall and the radius of curvature of the road.

B.4.2 Rutting and Transverse unevenness

The transverse profile is the shape of the road perpendicular to the direction of travel. The SCANNER measurements of the transverse profile are analysed to produce the parameters of rutting, transverse profile unevenness and edge condition.

Rut depth determined from SCANNER surveys corresponds to a measurement made with a 2m straight edge and wedge and average rut depths in the left (or nearside) and right (or offside) wheel paths are provided. There is an **enhanced** version of rutting which was developed to reduce the influence of the road edge on the reported rutting.

SCANNER also reports **Transverse Profile Unevenness**, which can be used to quantify how much the slope of the transverse profile changes from point to point across the carriageway. **Transverse Variance** is a measure of the difference in the roughness (transversally) between the two halves of the measurement width.

B.4.3 Texture

Texture can be separated into two groups – single line and multiple line texture.

The **SMTD** and **MPD** parameters are calculated from texture, measured in a single line in the nearside wheelpath, and can be used to provide an indication of the high-speed skidding resistance.

Multiple line texture measurements from between 3 and 40 lines across the carriageway width, including the nearside and offside wheel paths, and the line midway between them, are used to calculate nine **RMST** parameters:

- The variation of texture in the nearside wheel path (Mean RMST and Variance)
- The variation of texture in the centre of the road (Mean RMST and Variance)
- The variation of texture in the offside wheel path (Mean RMST and Variance)
- Overall Texture Variability - RMST 5th Percentile Value, 95th Percentile Value and Variance.

B.4.4 Surface Deterioration

SCANNER measures cracking on the surface of the pavement, which is reported as the location of each crack identified in the form of a crack map. The cracks are analysed to produce the three derived SCANNER cracking parameters:

- **Whole carriageway cracking**, obtained by overlaying the crack map with a grid covering the whole survey width, and summing up the areas of the grid squares containing cracks.
- **Wheel track cracking** intensity is reported over the two tracks, each of width 0.8m, centred on the wheel paths.
- **Transverse/reflective cracking** is a measure that attempts to indicate if the cracking is mainly transverse. Cracking that occupies a short length along the road but a large width across the road results in higher values of this parameter.
- **Surface Deterioration** is a measure that attempts to indicate if the cracking is short and "spread out", as might be the case if the defects look like fretting that has begun the develop into crack-like features.

B.4.5 Edge Deterioration

SCANNER uses the measured transverse profile to estimate the extent and severity of the deterioration of the road edge, which is reported as three parameters:

Edge Roughness reports the roughness within a half metre wide strip adjacent to the road edge.

Edge steps (L1 and L2) assess the height of the stepping present within the transverse profile adjacent to the identified road edge with LS1 being the percentage of reporting length with small step down at the road edge (20 to 50mm) and LS2 the percentage with large step down (greater than 50mm).

The Edge Coverage indicates the percentage of the reporting length where the profiles have been measured over the edge of the road. Where the value is low less confidence should be placed, in particular, on the measure of edge stepping.

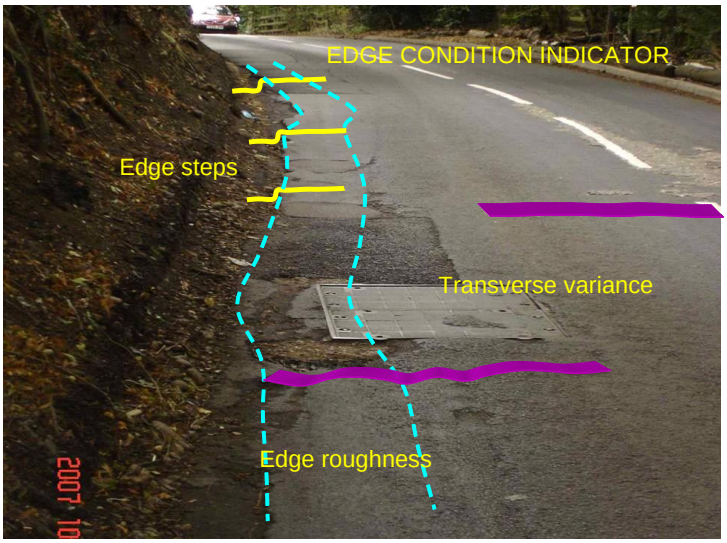


Illustration of the components of the edge condition indicator

B.4.6 The SCANNER RCI

The primary aim of the SCANNER RCI, since 2005/06, has been to process SCANNER data to produce performance indicators. Currently the performance indicators produced using the RCI are the data topics 130-01 and 130-02 for the England Single Data List, the SRMCS PI for Scotland, THS/011 and THS/012 for Wales and a performance indicator for DRD Northern Ireland. Note that SCANNER data is also used for calculating depreciation but this is via a different calculation (referred to as the CCI).

The RCI is based on the following SCANNER parameters:

- LLRT: Nearside wheel path rut depth
- LRRT: Offside wheel path rut depth
- LLTX: Nearside Wheel Path Average Texture depth (SMTD)
- LTRC: Cracking (whole carriageway)
- LV10: 10m moving average LPV (nearside)
- LV3: 3m moving average LPV (left / nearside)

These parameters are weighted using a straight line between upper and lower thresholds which vary by road classification (and for texture, the thresholds also vary by rural/urban categorisation) and are combined to give an overall score for each subsection. Each subsection is then categorised as Red, Amber or Green based on this score.

Appendix C Details of Desktop Study

C.1 Introduction

The aim of the desktop study is to understand the RCI calculation and compare this to other SCANNER indicators, in particular the CCI used to calculate depreciation for Whole of Government Accounting (WGA). Alongside this the existing UKPMS treatment rules for SCANNER data have been summarised and any inconsistencies between the RCI and these rules identified.

An introduction to the SCANNER RCI is given in Section 0 of the main report and the results of the desktop study are given in Section 4. This Appendix gives details of the desktop study.

This desktop study contains:

- **Background** information about how SCANNER data are processed in UKPMS;
- **Summary Analysis** of the main factors which drive the various indicators and treatment rules;
- **Implications** of the differences between the various indicators and treatment rules; and
- **SCANNER Treatment Rules** for the main SCANNER treatments and for the edge treatments.

C.2 Background

UKPMS contains two approaches to processing SCANNER data; Automatic Pass processing and Weighting Set processing.

C.2.1 Automatic Pass processing

This type of processing was part of UKPMS from the outset. It allows all types of condition data (including SCANNER) to be processed to produce treatment suggestions. For each Automatic Pass run, the user can choose whether to fix the treatment lengths (e.g. 100m); to process the data using variable lengths (to form consistent lengths); or to use user-defined lengths.

Automatic Pass processing is powerful but complex and is perceived in the industry as a 'black box'. Historically, the Automatic Pass took a very long time to run, particularly for the large data sets typical of SCANNER. Although processing times have improved, this is still a complex processing method.

The main treatments produced when SCANNER data are processed are Strengthen, Resurface and Surface Improvement. The rules to trigger these treatments are described in Cartwright (2007) and are comparatively straightforward. However, because these treatment rules were implemented in UKPMS *after* the introduction of the RCI and as a replacement for the previous more complex treatment rules, it is plausible that local authority engineers had already dismissed the treatment rules as overly complicated and

did not revisit this area of UKPMS, preferring instead to use the RCI to support maintenance decisions.

In conjunction with these treatments, SCANNER edge parameters are also processed to add various edge treatments to the main treatments. These treatments are described in unpublished work by Cartwright & Gallagher (2009).

The treatments generated when SCANNER data are processed in UKPMS are discussed in more detail below and are listed in full in C.5.

C.2.2 Weighting Set processing

This type of processing was developed from the work of Cartwright & Pickett (2004) and was designed to be user-friendly and transparent. It is described in Technical Note 49 and was added to UKPMS in 2005 via the Annual Health Check (AHC) process. The processing is controlled by weighting sets. There are currently several different national weighting sets, each of which processes the data in a different way for different purposes:

- *Road Condition Indicator*: There are three weighting sets used for the RCI for national reporting as shown in Figure 4 below. These are based on work by TRL and published as PPR238 (McRobbie, 2007) and PPR199 (McRobbie et al., 2007). They have subsequently undergone further refinement; the weightings currently used for the RCI are the revised values given in the SCANNER User Guide and Specification Volume 3 (2011)

	National PI				
RCI Weighting Set	*England*	*Scotland*	*Wales*	*Northern Ireland*	**Road Class**
WSPrinv0201	130-01		THS/011 & THS/012	SCANNER Survey PI	A
WSBCv0202	130-02				B & C
WSAllClassesv0202		SRMCS PI			A, B, C & U

Figure 4: RCI weighting sets

  The WSAllClasses weighting set used by Scotland contains the same weightings as the WSPrin (A roads) and WSBC (B & C roads) weighting sets but also includes weightings for the unclassified network.

- *Carriageway Condition Index*: The CCI is defined in a single weighting set, WSCCIv0102, and is described in Technical Note 46 – Part 1. The CCI was developed by the Highway Asset Management Financial Information Group (HAMFIG) to enable depreciation to be calculated.

- *Edge Condition Indicator*: The weighting set used for edge data is WSEdgev0101. The weightings were developed by TRL (Watson et al., 2006)

The relationships between these weighting sets and the treatment rules are discussed in more detail below.

In addition to these national weighting sets, work has also been carried out by TRL in Scotland to develop complementary indicators for use with the RCI (McRobbie et al., 2011).

This work is a promising avenue for further investigation but the authors acknowledged that 'testing of the models has been hampered by the lack of useable reference data' (p44). The report contained the following caveat.

> The limited amount of testing done on specific sites was encouraging, but more work is required to properly validate the performance and confirm that the correct parameter thresholds and weightings have been selected (McRobbie et al., 2011: 44).

C.3 Summary Analysis

C.3.1 SCANNER parameters used in the calculations

Figure 5 below compares the SCANNER parameters used in the RCI and CCI weighting sets with those used for the main treatment selection[6] (via the UKPMS Automatic Pass). Note that only a very small subset of the full set of SCANNER parameters is currently used for any of these purposes.

SCANNER parameters	RCI	CCI	Treatment Rules
Wheel path rut depth (LLRT, LRRT) mm	✓	✓	✓
Texture depth SMTD (LLTX)[7] mm	✓	✓	✓
Whole carriageway cracking (LTRC) %	✓	✓	✓
10m LPV (LV10) mm^2	✓	✓	×
3m LPV (LV3) mm^2	✓	✓	✓
Wheel track cracking intensity (LWCL, LWCR) %	×	×	✓

Figure 5: Comparison of SCANNER parameters used for weighting sets and treatment selection

As this table shows, the RCI and CCI weighting sets use the same small subset of SCANNER parameters but weighted and combined in a different way. It is therefore possible, in theory, that a carriageway could have a high RCI and a low CCI value or vice versa. This theme is explored further below when the RCI and CCI calculations have been explained in more detail.

Figure 6 below compares the SCANNER parameters used in the Edge weighting set with those used for the selection of edge treatments (via the UKPMS Automatic Pass).

[6] The term main treatment selection is used as shorthand for treatments other than edge treatments.

[7] The treatment rules also include two additional parameters (LCTX and LRTX) but these parameters are no longer collected.

SCANNER parameters	Edge CI	Treatments
Edge roughness (LEDR)	✓	✓
Edge step level 1 (LES1)	✓	✓
Edge step level 2 (LES2)	✓	✓
Transverse variance (LTRV)	✓	✓

Figure 6: Comparison of SCANNER parameters used for edge weighting sets and treatment selection

The SCANNER edge treatments are based on the Edge CI and so the same subset of SCANNER parameters weighted in the same way are used for both.

C.3.1.1 Missing parameters

The RCI, CCI and treatments are calculated even if some parameters are missing; any missing parameters are assumed to have a zero contribution. However, when summarising the RCI values to calculate the indicators for England (130-01, 130-02) Wales (THS/012) and Northern Ireland any subsections with missing parameters are excluded from the report. Subsections with missing parameters are still included in the SCRMS PI report and (via the CCI) they still contribute to the calculation of accumulated depreciation.

C.3.2 Thresholds and weightings used for SCANNER parameters

C.3.2.1 Road condition Indicator (RCI)

The tables below summarise the RCI weighting sets. In Figure 7 the upper and lower threshold are given. Below the lower threshold the parameter score is zero; above the upper threshold the score is 100; linear interpolation is used between the two thresholds. Note that for the texture depth parameter there are two sets of thresholds for A roads: Rural (R) and Urban (U).

SCANNER parameters	Road Classification			
	A	B	C	U
Wheel path rut depth (LLRT, LRRT) mm	10 to 20			
Texture depth SMTD (LLTX) mm	0.4 to 0.7 (R) 0.3 to 0.6 (U)	0.3 to 0.6		
Whole carriageway cracking (LTRC) %	0.15 to 2.00			
10m LPV (LV10) mm^2	21 to 56	27 to 71	35 to 93	41 to 110
3m LPV (LV3) mm^2	4 to 10	5 to 13	7 to 17	8 to 20

Figure 7: RCI thresholds for each road class

In Figure 8 the reliability and importance factors are given. These multiply the parameter score and thereby reduce the maximum contribution each parameter can make to the overall subsection value. The only differentiation between road classes is for texture depth

where the importance factor is higher for A & B class roads than for C & U class roads, and higher for rural roads than for urban roads.

SCANNER parameters	Reliability	Importance			
	All road classes	A	B	C	U
Wheel path rut depth (LLRT, LRRT) mm	1.00			1.00	
Texture depth SMTD (LLTX) mm	1.00		0.75 (R) 0.50 (U)		0.50 (R) 0.30 (U)
Whole carriageway cracking (LTRC) %	0.60			1.00	
10m LPV (LV10) mm^2	1.00			0.60	
3m LPV (LV3) mm^2	1.00			0.80	

Figure 8: RCI reliability and importance factors for each road class

The same thresholds for the red, amber and green categories are used by all the RCI weighting sets (WSPrin, WSBC and WSAllClasses) and are given in Figure 9 below.

RAG	RCI
Red	≥100
Amber	100>RCI≥40
Green	<40

Figure 9: RAG thresholds for RCI weighting sets

C.3.2.2 Carriageway condition index (CCI)

For SCANNER data, the CCI is defined as follows:

CCI = Max (LLRT, LRRT) + LV3 + (0.1 * LV10) + (10 * LTRC) – (2.5 * LLTX)

When the CCI is used to calculate depreciation it is constrained to lie between 0 and 100 (i.e. values which are less than zero are set to zero and values which are greater than 100 are set to 100).

In order to make use of the Weighting Set processing algorithm, this formula for the CCI is replicated within a weighting set, WSCCIv0102.

The CCI is also defined for visual survey data (DVI and CVI) so that these data sources can be used for financial reporting. For CVI and DVI data the CCI is obtained via Automatic Pass processing.

C.3.2.3 Main treatment rules

The main treatment rules for SCANNER data are listed in full in C.5, but in Figure 10 the key threshold values for each parameter are given. Note that the treatment rules as currently configured are independent of road classification.

SCANNER parameters	Key parameter values
Wheel path rut depth (LLRT, LRRT) mm	20mm, 15mm, 11mm
Texture depth SMTD (LLTX) mm	0.45mm
Whole carriageway cracking (LTRC) %	4%, 1.34%, 1%
3m LPV (LV3) mm^2	10mm^2, 4mm^2
Wheel track cracking intensity (LWCL, LWCR) %	4%, 1%

Figure 10: Key parameter values for treatment selection

C.3.2.4 Edge CI and Edge treatment rules

The Edge CI and the Edge treatment rules are closely aligned. The definition of the Edge CI is given in C.5.2; it is used to trigger treatments as described below in Figure 11.

Edge condition indicator	RAG	Treatment
ECI >30	Red	Edge Reconstruct
30 ≥ ECI ≥ 10	Amber	Edge reconstruct part depth
10 > ECI > 0	Non-zero green	Edge Patch
ECI = 0	Green	No treatment

Figure 11: Treatments triggered by Edge CI

The Edge treatments are added to the main treatment rules i.e. it is possible to trigger a main treatment and an edge treatment. However, the edge patch treatment is not invoked if the main treatment is strengthen, resurface or surface improvement (i.e. the only main treatment with which it is combined is resurface (WT patch)). The edge treatments can also be suggested in isolation (i.e. not accompanied by a main treatment).

C.3.3 Processing lengths

The treatment lengths produced via the Automatic Pass are controlled by the user at the time the pass is run; it is possible to process the data using fixed lengths (typically 100m); variable lengths (which aim to give consistent treatment lengths) or user-defined lengths. In contrast results from Weighting Set processing are given for each subsection (typically 10m in length).

For the Automatic Pass the rated parameters are merged into treatment lengths and then used collectively to select a treatment; for Weighting Set processing, the weighted parameters are combined to give a red/amber/green value. Because the processes involved are non-linear, merging the Weighting Set results over longer lengths after the end of processing would not be consistent with the way the treatments are currently derived via the Automatic Pass process.

C.4 Implications of the differences between the RCI and other results

C.4.1 RCI, CCI and Main Treatment Rules

The RCI, CCI and main treatment rules are not consistent with each other.

C.4.1.1 Wheel track cracking

The main treatment rules make use of wheel track cracking data (LWCL and LWCR) to trigger a WT patch treatment and this SCANNER parameter also contributes when determining a need for strengthening or resurfacing treatments. However this parameter is not used in the RCI or CCI. So, the RCI could be zero in locations where a WT patch treatment has been suggested. Likewise the RCI could be lower than expected in locations where strengthening or resurfacing treatments have been suggested if wheel track cracking data is contributing to these treatment suggestions.

C.4.1.2 10m Longitudinal Profile Variance

The 10m longitudinal profile variance (LV10) contributes to both the RCI and the CCI, but not to the treatment rules. In the RCI it is capped at 60 so in isolation it could at most cause a subsection to be Amber. Moreover, in combination with other parameters its contribution could tip a subsection from Green to Amber or from Amber to Red.

C.4.1.3 Thresholds defining the parameter contribution

The table below summarises the value at which the parameter begins to contribute to the RCI or to the main treatments. The final column of the table indicates the impact of the difference in the threshold; if there are values of the parameter which would contribute to the RCI but not to the treatment rules then the column contains 'RCI' and conversely if there could be a contribution to the treatment rules at levels where there is no contribution to the RCI the column contains 'Treat'. So, for example, a rut depth of 10.5mm would contribute to the RCI but not to treatments. Note that for texture a low value indicates a worse condition than a high value.

SCANNER parameters	RCI	Treat	Impact
Wheel path rut depth (LLRT, LRRT) mm	10	11	RCI
Texture depth SMTD (LLTX)[8] mm	0.6 to 0.7[9]	1.0	Treat
Whole carriageway cracking (LTRC) %	0.15	1	RCI
10m LPV (LV10) mm^2	21 to 41[10]	×	RCI
3m LPV (LV3) mm^2	4 to 8[11]	4	Treat
Wheel track cracking intensity (LWCL, LWCR) %	×	1	Treat

Figure 12: Comparison of thresholds at which parameter begins to contribute

[8] The treatment rules also include LCTX and LRTX but these parameters are no longer collected.

[9] Threshold depends on road class and R/U

[10] Threshold depends on road class

[11] Threshold depends on road class

The table below summarises the value at which the parameter makes its maximum contribution to the RCI or to the main treatments. That is, even if the parameter is greater than this value there will be no further impact. As for the previous table the final column gives the potential impact of the difference in the threshold.

SCANNER parameters	RCI	Treat	Impact
Wheel path rut depth (LLRT, LRRT) mm	20	20	None
Texture depth SMTD (LLTX) mm	0.3 to 0.4[12]	0.45	RCI
Whole carriageway cracking (LTRC) %	2	4	Treat
10m LPV (LV10) mm^2	56 to 110[13]	×	RCI
3m LPV (LV3) mm^2	10 to 20[14]	10	RCI
Wheel track cracking intensity (LWCL, LWCR) %	×	4	Treat

Figure 13: Comparison of thresholds at which maximum contribution occurs

C.4.1.4 Impact of processing length

The treatment rules are applied to lengths of 100m (typically) whereas the RCI is calculated for each 10m subsection. The SCANNER parameters values used for the treatment rules are therefore averaged and so are less likely to be as extreme as the RCI values.

If the condition of the network is very variable from subsection to subsection then there may be a significant percentage of the network in the RCI Red category but comparatively few treatments suggested. This could be mitigated to some extent by lowering the thresholds for treatments as compared with those for the RCI. For texture and 3m LPV the treatment thresholds are already at the lower end of the range; but for rutting and for whole carriageway cracking the treatment thresholds are typically more onerous than the RCI ones.

However, if the condition of the network is reasonably homogeneous along a treatment length, then lower thresholds for treatments could result in a treatment being suggested despite relatively low RCI values.

An empirical study using real-world data would help to analyse the implications of this difference between the RCI and the treatment rules for a typical network, and may be able to suggest a compromise for thresholds in order to achieve reasonable consistency between the RCI and treatment rules.

C.4.1.5 Comparison of RCI and CCI calculations

Although the RCI and the CCI use the same subset of parameters, they are weighted and combined differently for each of these two indicators. It is therefore possible, in theory,

[12] Threshold depends on road class and R/U

[13] Threshold depends on road class

[14] Threshold depends on road class

that a carriageway could have a high RCI and a low CCI value or vice versa. In particular, the way in which texture is handled is very different; a road with poor texture may have a high RCI but this will only have a marginal effect on the CCI. An empirical study would show to what extent the RCI and CCI differ from each other for a typical real-world network but the theoretical analysis suggests that the two will not be well correlated.

C.4.1.6 Comparison of Edge CI and Edge Treatments

An Edge Weighting Set is used to generate an Edge CI which is divided into red/amber/green bands. Each of these bands is associated with an indicative edge treatment. There is, therefore, an inbuilt consistency between the Edge CI and the edge treatments. However, this consistency is not a guarantee that the results are meaningful for engineers; the analysis and some limited real-world feedback suggest that treatments may be invoked at too low a level.

C.5 SCANNER treatment rules

C.5.1 Main Treatment Rules

The main treatment rules for SCANNER data were introduced in RP6.02 (2006) and have been unchanged since then. Each row is considered in turn and once the conditions in a row are all satisfied, that treatment is suggested and no further rows are tested. So, for example, the first rule is:

If LLRT ≥ 20mm and LV3 ≥ 10mm^2 then strengthen is suggested.

The rules for surface improvement treatment are based on a surface condition index (TTSSU) which is a combination of LTRC and LLTX. It is therefore difficult to express this rule using the tabular format below.

Treatment	**LLRT (mm)**	**LRRT (mm)**	**LV3 (mm^2)**	**LTRC (%)**	**LWCL (%)**	**LWCR (%)**	**LLTX (mm)**
	≥	**≥**	**≥**	**≥**	**≥**	**≥**	**≤**
Strengthen	20		10				
		20	10				
	20			4			
		20		4			
	20				4		
		20				4	
			10	4			
			10		4		
			10			4	
Resurface	15						
		15					
			10				

Treatment	LLRT (mm) ≥	LRRT (mm) ≥	LV3 (mm^2) ≥	LTRC (%) ≥	LWCL (%) ≥	LWCR (%) ≥	LLTX (mm) ≤
				4			
	11		4				
		11	4				
	11			1			
		11		1			
	11				1		
		11			1		
	11					1	
		11				1	
			4	1			
			4		1		
			4			1	
Resurface/Patch WT					4		
						4	
Surface Improvement				1.34			
							0.45
	If 1.00 ≤ LTRC < 1.34 and 0.45 < LLTX ≤1, then the rule to trigger surface improvement is: (30 x LTRC) – (92.31 x LLTX) ≥ -11.4						

Figure 14: Main treatment rules for SCANNER data in UKPMS

A more detailed explanation of the main treatment rules is given in document 112v0102 (Cartwright, 2007).

C.5.2 Edge Treatment Rules

The Edge CI and the Edge treatment rules are closely aligned. The Edge CI is defined as:

$$\text{ECI} = 0.30y_{LEDR} + 0.15y_{LTRV} + 0.25y_{LES1} + 0.30y_{LES2}$$

where

y_{LEDR} is the rated value for LEDR

y_{LTRV} is the rated value for LTRV

y_{LES1} is the rated value for LES1

y_{LES2} is the rated value for LES2

The ratings are obtained from a simple two point rating curve, with values below T_{lower} rated at 0 and values above T_{upper} rated at 100. Between T_{lower} and T_{upper} linear interpolation is used, as for other rating curves:

	T_{lower}	T_{upper}
LEDR	0.035	0.161
LTRV	7.24	71.08
LES1	0.0	5.0
LES2	0.0	0.1

Figure 15: Rating of edge parameters

Note that for LES2 any non-zero parameter is rated at 100.

The Edge CI is used to trigger treatments as shown in Figure 16:

Edge condition indicator	RAG	Treatment
ECI >30	Red	Edge Reconstruct
30 ≥ ECI ≥ 10	Amber	Edge reconstruct part depth
10 > ECI > 0	Non-zero green	Edge Patch
ECI = 0	Green	No treatment

Figure 16: Treatments triggered by Edge CI

The Edge treatments are added to the main treatment rules i.e. it is possible to trigger a main treatment and an edge treatment. However, the edge patch treatment is only suggested in conjunction with resurface (WT patch) (i.e. it is not invoked if the main treatment is strengthen, resurface or surface improvement). The edge treatments can also be suggested in isolation (i.e. not accompanied by a main treatment).

Appendix D Details of User Consultation

D.1 Introduction

Questionnaires were sent to a targeted group of 26 organisations including highway authorities and a number of private sector service providers. This was not intended to be a representative survey; instead it was a way of identifying authorities with 'something to say' and to identify a small number of authorities to provide detailed case studies. The questionnaire included questions related to Tasks 2 and 3. The paper summarises the responses related to Task 3 and suggests next steps.

D.2 Questionnaire Responses

In total, questionnaire responses were received from the following seventeen organisations:

- Bristol City Council
- Carmarthenshire County Council
- Colas (Portsmouth City Council)
- Cornwall County Council
- Cumbria County Council
- Dumfries & Galloway Council
- Essex County Council
- Kier (Northamptonshire County Council)
- LB Kingston
- Leicester City Council
- Norfolk County Council
- North Lanarkshire Council
- DRD Northern Ireland
- Oxfordshire County Council
- SCOTS
- South Lanarkshire Council
- Worcestershire County Council

D.3 Analysis of Responses

The questionnaire included eight questions relating to Task 3. This section analyses the responses.

Question 1. Do you use SCANNER to help you take decisions about maintenance?

All respondents answered YES to Question 1.

Question 2. If you answered YES to Question 1, which of the following do you use?

Treatments produced by UKPMS using the national treatment rules

- Carmarthenshire and Essex use prioritised treatments based on SCANNER data prior to validation on site
- Cumbria use NI130, processed to 10m and prioritised as a first sift of the data
- Oxfordshire use national treatment rules for DRC estimates and financial modelling
- All other responses were NO

An indicator (e.g. RCI, CCI, Edge CI or locally-designed CI)

12 of the respondents use the RCI to support maintenance decision making. Of these:

- Six use the RCI to identify areas for further investigation or to validate schemes identified by inspectors
- Bristol, Carmarthenshire, Cornwall, Essex, and South Lanarkshire all reportedly use locally developed Weighting Sets either for particular categories of road or to remove specific defects from the calculation (e.g. LPV)
- Norfolk derive a local scheme score based on a combination of SCANNER and visual data
- Dumfries & Galloway use WDM Scheme Manager to derive schemes
- Other respondents were either non-specific, or used the RCI for internal/external performance reporting

SCANNER parameters directly

Eight of the respondents reported that they use SCANNER parameters directly to support maintenance decisions but the responses were mixed:

- Cornwall use texture and LPV to validate areas with a high RCI
- The scheme prioritisation process employed by Carmarthenshire and Essex uses individual parameters to identify treatment options and overall priorities
- Colas (Portsmouth) use two of the parameters to identify and monitor potential safety defects – as per the PFI contract
- Leicester overlay parameters with the results from internal engineering inspections

- Norfolk uses the parameters in some cases but also look at 10m summary values
- DRDNI use the parameters for asset valuation
- Worcestershire occasionally use rutting

Other

Only four of the respondents reported that they use other data to help take maintenance decisions:

- Kier (Northants) use information about defect hot-spots, complaints from the public and councillors, etc.
- South Lanarkshire base treatments on the results of visual surveys plus available funding
- Carmarthenshire use SCANNER measured geometry to identify low-points for drainage and high-points for winter gritting analysis
- Norfolk use a mixture of data that includes SCANNER parameters

Question 3. If you answered NO to Question 1, please explain your reasons[15] ?

SCANNER parameters don't give the type of information needed to make decisions about maintenance

Four of the respondents felt that this was a reason why their use of SCANNER parameters was limited:

- Worcestershire felt that the data produces too many false negatives
- Cumbria reported that in some cases the parameters don't reflect carriageway condition
- LB Kingston prefer to use DVI as the defects collected better align with maintenance decisions and are easier for engineers to understand and relate to
- Leicester felt that a combined rating for all subsections would be more useful

SCANNER parameters are appropriate but aren't collected reliably enough

Only one respondent reported that reliably of data collection was a reason why their use of SCANNER parameters was limited:

- Worcestershire felt that neither cracking nor edge deterioration was reliable enough and also felt that survey coverage on C-Roads was inadequate for operational purposes.

SCANNER parameters are not combined in the right way in the UKPMS treatment rules and indicators

[15] Although all respondents answered YES to Question 1, i.e. that they used SCANNER to help take decisions about maintenance, a number chose to provide responses to Question 3 to express their views on the limitations of SCANNER data. Other respondents may share these views but have simply skipped this section.

Only two respondents reported that the combination of SCANNER parameters was a reason why their use of SCANNER parameters was limited:

- LB Kingston prefer to use DVI data to produce an overall condition indicator and develop a work programme
- Worcestershire felt it was more important to address the limitations of SCANNER before looking at the UKPMS rules and parameters

We have other methods which are satisfactory

Four of the respondents reported that they preferred to use other methods to make maintenance decisions:

- Worcestershire felt that their in-house visual survey team was more reliable and therefore used visual data in conjunction with machine surveys
- Leicester used an internal engineering assessment to firm-up condition data and to generate treatment programmes in line with asset management policies
- Cumbria generally use SCANNER parameters augmented with local knowledge and backed up by a site investigation
- LB Kingston prefer to use DVI data to produce an overall condition indicator and develop a work programme

Other

No respondents had any other reasons for not using SCANNER data to help take maintenance decisions.

Question 4. Do you use the RCI to help you take decisions about maintenance?

All but three of the 17 respondents reported that they did use the RCI to help take decisions about maintenance. Of the respondents who answered YES to Question 4:

- Six used the RCI to either identify areas for further investigation or to validate inspector selected schemes. Of these, Carmarthenshire and Essex also use the RCI within WDM Scheme Manager to identify potential schemes
- Kier (Northants) use the RCI score to identify schemes, splitting the Amber category into two bands (Low Amber = Preventative Maintenance, High Amber + Red = Resurfacing/Reconstruction)
- Oxfordshire use the RCI to weight scores for schemes identified through claims, defects and local knowledge, and then prioritised through visual condition scores, hierarchy and value for money. The RCI is split so that a higher weighting is given to High Amber (60 – 100) compared with Red, Low Amber and Green.
- Worcestershire use the RCI alongside other datasets (CVI, defects, SCRIM, accidents, claims, public enquiries, etc.). South Lanarkshire also use the RCI in conjunction with visual survey data
- In Northern Ireland, the average RCI score over 50m is a factor in assessing and prioritising schemes.

- Leicester and LB Kingston use the RCI at a network level for reporting performance and for justifying a business case, however Leicester also use the RCI at a 10m subsection level to identify changes year-on-year following maintenance
- Cornwall, Carmarthenshire, Essex and Northern Ireland all expressed a view that the RCI was more appropriate on higher category roads.

Question 5. Do you use the RCI for any other purposes?

11 of the respondents reportedly use the RCI for purposes other than supporting maintenance decision making. Of the respondents that answered YES to Question 5:

- Seven use the RCI for Government performance reporting, internal performance monitoring or benchmarking against other authorities
- Cornwall use the RCI to defend decisions not to carry out treatments
- Dumfries & Galloway use the RCI to verify schemes identified by local engineers
- SCOTS use the RCI within their cost projection tools to calculate backlog and standstill budgets as well as benchmarking condition trends.
- Carmarthenshire and Essex use the network length in each band within the HMEP and in-house models for lifecycle planning. Outputs of the models are used to produce treatment strategies and business cases for capital investment, as well as HAMP reporting valuation reports.

Question 6. Would you like closer links between the RCI and decisions about maintenance?

All but three of the respondents said that they would like closer links between the RCI and maintenance decisions. Of the respondents that answered YES to Question 6:

- Three expressed concern about the accuracy, reliability and timeliness of the data
- Norfolk felt that there needed to be a more practical approach
- Carmarthenshire and Essex felt it could be used to facilitate better informed maintenance strategies and accurate investment predictions. They also wanted improved links with surface deterioration
- Cumbria felt that maintenance decisions should impact more directly on the RCI
- LB Kingston thought that a bespoke RCI was needed for authorities to ensure that it reflects defects that matter most to them

Of those respondents who answered NO to Question 6:

- Cornwall felt that there was still a need for engineering judgement and that the RCI was just a tool like Deflectograph and SCRIM
- Northern Ireland felt that the RCI was useful as part of an overall strategy but was an insufficiently accurate indicator of maintenance need to be given more weight.

Question 7. Would you be opposed to any changes being made to the RCI?

Only two of the respondents were opposed to any changes being made to the RCI. Of the respondents that answered NO to Question 7:

- Five felt that the RCI needed to be improved
- Five expressed the view that the change would need to be carefully managed so that authorities could still compare with historic results and that it continued to meet Government reporting requirements. Management of this change would need to include clear communication.
- Norfolk reported that they would like to see a secondary figure/result that sits alongside the current RCI (e.g. a second maintenance indicator)

Of the respondents who answered YES to Question 7:

- Kier (Northants) felt that there needed to be consistency and comparability year-on-year
- North Lanarkshire expressed the need to retain value in historical data.

Question 8. Do you have any suggestions for improvements to the RCI (e.g. its composition, weightings, etc.)?

All but five of the respondents answered YES to Question 8:

- Two respondents suggested splitting the Amber Band; Kier (Northants) suggested 2-bands, Cornwall suggested 3-bands
- Five respondents felt that the RCI needed to be made more appropriate to the maintenance needs for the full range of roads on the network (including unclassified roads, rural roads); Cornwall suggested that an indicator based on hierarchy rather than class would be better
- Worcestershire felt that the RCI should include edge defects and should be based on a variable longitudinal/transverse merge method to generate more realistic scheme lengths. They also questioned the efficiency of the need to carry out repeat processing with different weighting sets for different indicators
- Leicester felt that RAG is useful as is a total aggregated link for a treatment
- Norfolk felt that the RCI should be linked to surface type / material
- LB Kingston wanted to ensure that data collection is repeatable and reproducible over time

D.4 Conclusions

1. All respondents use SCANNER data and the RCI to help make decisions about maintenance in one way or another
2. In addition to performance reporting and benchmarking, the majority use the RCI to identify areas for further investigation or to validate schemes identified by engineers using other datasets (visual surveys, defects, complaints, local knowledge etc.)

3. Approximately half use the SCANNER parameters – either on their own or in combination with other datasets – to generate treatments or to validate RCI values
4. Reasons given for not using SCANNER data included concerns about the reliability and coverage of the data – particularly on lower classes of road, unsatisfactory agreement with observed carriageway condition, or a preference for visual inspections
5. Bristol, Carmarthenshire, Cornwall, Essex and South Lanarkshire all use local weighting sets and/or proprietary software tools to generate schemes from either SCANNER data on its own or in combination with other datasets. Norfolk also derive a local scheme score based on a combination of SCANNER and visual data. Kier (Northants) and Oxfordshire split the Amber Band to identify preventative versus reactive maintenance
6. Carmarthenshire and Essex use the RCI results to support lifecycle planning as well as developing treatment strategies and business cases for capital investment
7. All but three respondents wanted closer links between the RCI and maintenance decisions and only two were opposed to changes being made to the current RCI – providing the link with historic data isn't lost and the change is effectively managed and communicated
8. The suggested improvements included: splitting the Amber Band; reviewing the RCI to ensure that it better meets the maintenance needs for the full range of roads on the network; looking at merging data longitudinally and transversely to represent more realistic schemes and look at including material/surface type information.

Development of SCANNER and UKPMS: Task 3 - Appropriateness of the SCANNER RCI

Other titles from this subject area

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